EXPLORING THE USE OF EVOLUTIONARY PRINCIPLES IN EARLY CHILDHOOD MONTESSORI EDUCATION

A THESIS

SUBMITTED TO THE DEPARTMENT OF PSYCHOLOGY

OF THE STATE UNIVERSITY OF NEW YORK AT NEW PALTZ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF SCIENCE IN PSYCHOLOGICAL SCIENCE

By

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August, 2024

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ACKNOWLEDGEMENTS

This thesis represents my deepest commitment to higher education and the pursuit of knowledge, signifying both years of cultivating my journey in psychological science whilst also launching my career as a Montessori educator. I am profoundly grateful to my mentor and professors for the opportunities they have provided, which have continuously challenged me to think critically and grow. Special thanks to Dr. Glenn Geher, Dr. Matthew Wice, Kathryn Gruskin, and Julie Planke for their invaluable insight and ongoing guidance – Your support is greatly appreciated, and I thank you all. To my graduate and CGMS (Center for Guided Montessori Studies) cohorts, who have been my pillars of support, sources of inspiration and life-long friends: I thank you all from the bottom of heart! I couldn't have done it without you. My family and friends, whose encouragement has been unwavering through numerous life challenges, has been instrumental in helping me finish this thesis. K.T Korngold my boss, mentor and friend, your dedication and influence in the Montessori community has been the cornerstone of my research and personal growth as a Montessorian; I am grateful for your role in introducing me to this cherished community. And to my beloved, fur babies Gus and Penny, your purrs and cuddles have brought me immense comfort and deserve recognition; I love you forever, furballs. Lastly, to my partner: your love, encouragement and unconditional support has helped me believe in myself and realize that I have the potential to achieve whatever I put my mind to. I am proud to be your partner and share this life with you.

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Abstract

This study explores the evolutionary relevance of early childhood Montessori education by examining whether Montessori schools offer a more adaptive learning environment compared to traditional preschools. By surveying a sample of parents (n = 106), with over 85% of participants identifying as female and the average age of their children being 50 months, from both Montessori and traditional preschools, this research assesses children's abilities across several developmental domains while also considering the evolutionary principles underlying the classroom environments. To account for confounding variables, such as socioeconomic status, educational level, and race, the study included relatively matched samples to ensure comparability between the groups. Results suggest that Montessori preschoolers experience more evolutionary-friendly class environments, as well as scoring higher on practical life skills. Correlational analyses revealed statistically significant relationships between the evolutionary relevance variable and certain developmental outcomes measures (See Table 2). This finding potentially supports the idea that Montessori education aligns more closely with evolutionary adaptive principles than traditional methods. Montessori environments may better support children's innate developmental learning processes. The findings offer important implications for future research, particularly for understanding how to design educational approaches that better align with evolutionary principles to enhance children's developmental outcomes.

Keywords: Evolutionary educational psychology, Montessori education, Prepared environment, Work, Traditional education

Exploring the use of Evolutionary Principles in Early Childhood Montessori Education

For decades, developmental psychologists have long been interested in studying education and human development from infancy through adolescence and adulthood. Psychologists explore various aspects such as learning processes, cognitive development, individual differences, effective teaching methods, classroom dynamics, and the impact of educational interventions (Lerner, 2006). Additionally, in recent years, there has been a trend toward increased enrollment of children in early childhood education programs in the United States (National Center for Education Statistics, 2024). As per the NCES, as of January 2022, the overall school enrollment rates increased for both 3 to 4 years old's from about 40 to 70%-, and 5-years old's from 79 to 84%. American children also spend significantly more hours in school compared to global peers and devote most of their time to educational programs such as preschool, elementary, and kindergarten according to the Organization for Economic Cooperation and Development (Hess, 2023). The purpose of these programs is to provide children with early learning experiences and opportunities to engage in prosocial activities and participate in academic readiness. In the United States, preschool programs vary widely, ranging from traditional daycare centers to specialized educational environments. Among these diverse options, Montessori education has become a popular choice for many families rather than traditional public schooling (Manner, 2006).

The Montessori philosophy is rooted in self-directed educational practices and hands-on learning experiences with natural materials and tools. This individualized approach emphasizes the differences in instruction and learning through a more holistic developmental lens. The Montessori perspective, established by Maria Montessori in the early 1900's, has garnered attention for its approach to fostering independence, agency, and critical thinking skills in young children. Montessori educators are highly qualified, holding additional certifications in the Montessori method apart from traditional education training to work in this specialized learning environment effectively. Consequently, Montessori programs can have higher tuition rates due to the cost of employing highly trained guides who are specialists in Montessori education and play a crucial role in facilitating individualized learning for each child. As a result, Montessori programs have gained popularity, particularly among families with great access to financial means and social capital, which are known to influence educational outcomes significantly (Debs, 2016). Hence, further scientific study of the Montessori approach is necessary to evaluate its effectiveness across various child outcomes and overall developmental impact.

Despite the diversity in educational programs offered by various preschool programs, the overarching emphasis is placed on academics, extracurricular activities, and longer school days, thus resulting in children spending less time at home than previous generations. Factors such as additional learning activities, participation in after-school programs, and longer commutes to and from school can also contribute to children having less leisure time for exploration during the week. In addition, some children enrolled in early education programs are as young as four months old. As a result, children from Western cultures, like the United States, spend significantly less time learning from family and kin. Therefore, researchers and educators must shift their focus toward studying preschool education as it is often the precedent for modern elementary education programs.

Learning through an Evolutionary lens

One perspective in the behavioral sciences that may shed much-needed light on modern educational systems can be found in the evolutionary perspective (Geary, 2012). An evolutionary perspective on behavior suggests we can gain important insights by stepping back and examining how traits and behaviors may have evolved over time in response to selective pressures. This theoretical perspective can explain why certain behaviors exist and persist in modern humans. In other words, we can think about behaviors and social institutions, such as education, by applying evolutionary principles.

Evolutionary educational psychology is a relatively new concept that strives to combine evolutionary and educational psychology principles to understand how evolution has shaped how humans learn and develop (Muller, 2010). Researchers also explore how evolutionary pressures and adaptations influence cognitive processes, social behaviors, and educational practices (Bjorklund, 2022). Evolutionary psychologists suggest that academic pedagogies consider evolutionary theory, educational adaptations due to our ancestral history, and the origins of our evolved learning processes for optimal learning (Gruskin & Geher, 2018). According to Gruskin and Geher, evolutionary-rooted pedagogy includes features of curriculum that are thought to match ancestrally based ways of learning during childhood. Such features include self-directed learning, mixed age groups, valuing student play, and imagination. Schools incorporating these principles provide children with an education that aligns more closely with their evolved educational practices. Though researchers have spent time studying the importance of evolutionary-informed education for grades K-12, even less research has focused on preschool programs and curriculums. Therefore, studying preschool education from an evolutionary standpoint holds even more significant potential for enhancing our understanding of early childhood development and improving educational systems.

Hunter-Gatherer Education

To explore ways early childhood education can benefit from an evolutionary perspective, we must understand how our ancestors have evolved to learn. According to Bowlby (1969), the ancestorial environment of a species is referred to as the environment of evolutionary adaptiveness (EEA). Life in the EEA provided physical exercise and exposed individuals to various experiences and challenges that facilitated learning. For most of human evolutionary history, our hunter-gatherer ancestors gained knowledge through actively engaging with their natural environment. Individuals foraged for food, hunted animals, and migrated in search of resources. Children in the EEA also acquire knowledge through observation, imitation, and play within their social groups (Geher (2014). According to David Geary (2016), This form of learning involves mastering “folk domains”, which are essential skills for survival and reproduction, categorized into biological, psychological, and physical domains. These skills were learned without explicit training and were critical for passing on genetic traits. In his research, Geary distinguishes between biologically primary knowledge, which includes basic survival skills, and biologically secondary knowledge, which involves more complex concepts like reading and mathematics. However, moving from a biological understanding of learning to a focus on cultural transmission reveals how human evolution has shaped our methods of learning exchange, enabling us to build upon and refine the knowledge accumulated by previous generations (Sweller, 2008).

Cultural Transmission of Knowledge

From an evolutionary perspective, cultural transmission involves passing cultural information, such as attitudes, behaviors, and beliefs, from one generation to the next. Researchers Gangestad et al. (2006) propose that cultural information may be transmitted through multiple lenses and filters shaped by natural selection, which adapt to environmental and social changes. Other researchers like Boyer (2000) argue that evolutionary psychologists must consider how cognitive predispositions to cultural material affect their representation in following generations.

With children acquiring primary knowledge through observation, imitation, and community participation, it is important to highlight that cultural transmission is a fundamental aspect of human social development and learning (Mesoudi, 2016). For example, young children acquire language, social norms, and basic skills by interacting with kin, peers, and community members (Rogoff, 2007). Teachers play a pivotal role in the cultural transmission process by using language and interactions to transmit academic content and social norms (Gelman & Roberts, 2017). The quality of the teacher-child relationships significantly impacts children's academic readiness and social development, with positive relationships linked to overall better outcomes partly due to children's behavior and peer exclusion, which is seen to mediate the impact of negative teacher-child relationships (Pianta & Stuhlman, 2019; Palermo et al. 2007). Educators are also referred to as acting in "in loco parentis", which is a Latin term meaning "in place of parents" (Dwards, 1971). Thus, teachers act similarly to alloparents, emphasizing the importance of viewing them from an evolutionary perspective.

From Alloparenting to Contemporary Learning

To fully grasp the significance of alloparenting, it is essential to understand how this cooperative parenting style enhances the children's survival while strengthening social bonds within the community (Hrdy, 2009). In hunter-gatherer societies, alloparenting functioned as a cornerstone of communal child-rearing practices, fostering socialization and educational development among children (Emmott & Page, 2019). The alloparenting approach, where individuals other than biological parents assist in child-rearing, helped reduce costs for biological parents, allowing for more efficient resource allocation (Geher, 2014). Evolutionary psychology has recently shifted toward the idea that parenting is a cooperative process and acknowledges that mothers require assistance from others to successfully rear their children (Sear, 2016). Preschool teachers provide essential care and education outside the home, typically in a classroom setting (Brandl et. al., 2023). While teachers and educators have long served as alloparents, providing guidance and care akin to that of the extended family, as mentioned above, the traditional education system often falls short of aligning with our evolved needs and learning preferences, highlighting the significant evolutionary mismatch in modern education.

Evolutionary Mismatch within Traditional Education

Evolutionary psychologist have often criticized traditional education systems for their misalignment with the evolved needs and practices of humans (Gruskin & Geher, 2018). The concept pertains to the issue of “Evolutionary Mismatch,” which refers to the idea that many aspects of modern environments, including education settings, may be mismatched with the environments in which our cognitive, social, and emotional traits have evolved (Geher, 2014). The following sections discuss ways in which traditional education might be considered a result of evolutionary mismatch.

Traditional Classroom vs. The Natural Environment

The evolutionary mismatch theory suggests that children in traditional education systems may face challenges due to discrepancies between our evolved learning traits and modern educational environments. Human cognition evolved in dynamic, movement-rich environments where learning was carried out through exploration/experimentation and hands-on social interactions. However, in traditional classrooms, movement and physical activity are often restricted and limited with rows of tables or desks (Bjorklund & Bering, 2002). For preschoolers, the bright colors and manufactured plastic toys designed to engage can be overstimulating and contrast with more muted, natural environments our ancestors' experiences. Further, constant exposure to bright colors and patterns can distract young children and may impact their ability to focus and process information. Thus, the discrepancies highlighted between the traditional classroom designs and evolved learning preferences point toward noticeable mismatches in our modern educational systems.

Teacher-driven Instruction vs. Self-directed learning

Traditional classrooms are another common mismatch with evolved learning preferences, as they emphasize teacher-driven instruction versus self-directed learning (Gruskin & Geher, 2018). In contemporary education, the teacher often controls the lesson and presents material in a one-size-fits-all approach. This method of instruction is delivered in a structured, top-down manner, with the teacher typically controlling the pace, content, and delivery of lessons while students primarily passively receive information. This approach contrasts with the learning environments our cognition evolved for, where children learn by exploring their innate interests. Additionally, teachers in traditional education often lack the intimate, nurturing involvement characteristics of alloparents, which can lead to more distant and formal relationships with their students. Unlike contemporary alloparents such as nannies and babysitters who provide emotional and practical support in a personalized manner, conventional teachers may struggle to offer the same level of individual attention and care to students due to large class sizes and rigid standardized curricula. That said, the teacher-led model often inhibits children's ability to explore topics of personal interest, make choices about their learning processes, and actively engage with materials. As a result, this can negatively impact overall development and self-esteem and reduce intrinsic motivation in children.

Emphasis on Academic Knowledge vs. Play/Exploration Encouragement

As mentioned above, the heavy emphasis placed on standardized curriculum can be seen as a form of evolutionary mismatch, given that it diverts from the natural learning processes that shaped human development. Unlike our ancestors, who learned through experimental play and real-world exploration, modern education prioritizes memorization and formal instruction, which can lead to disengagement and diminished motivation for learning (Bjorklund, 2022). Play, a fundamental mechanism for learning, mirrors real-life experiences and fosters critical thinking, cooperation, and resilience within a safe context. (Geary, 2016). Play mimics real-life scenarios and challenges, allowing children to practice critical thinking, cooperation, and resilience in a self-directed manner (Gray, 2019). Imagination can be considered the heart of more complex thinking, and children practice this kind of thinking regularly through play. Researchers believe that play helps people develop the ability to think creatively and consider ideas beyond their immediate environment (Gray, 2013). Sudbury schools, for example, exemplify a more evolutionary aligned educational approach by allowing children to engage in self-directed learning and play, thus promoting exploration and creativity in ways that traditional schools often overlook (Gray, 2011). With their rigid structures, traditional schools often neglect the benefits of play and imagination, limiting opportunities for creative expression and child-centered learning. Consequently, play-based learning in modern education reflects an evolutionary mismatch, as it fails to align with the play-driven methods essential for children's cognitive, social, and emotional development.

A Montessori Approach toward Evolved Preschool Education

As discussed, early childhood education plays a large role in shaping children's overall development laying the foundation for life-long learning and success. Within the context of educational philosophies, Montessori education has captured the attention of parents, educators, and researchers for its wholesome approach to fostering development through child-centered, hands-on learning experiences. Developed by Maria Montessori herself in the early 20th century, the Montessori pedagogy emphasizes self-directed exploration, individualized lessons, and a thoughtfully prepared environment that supports children's innate curiosity and independence (Montessori, 1967). The prepared environment refers to a thoughtfully arranged and purposeful learning space where everything is organized and intentional. The furniture is lightweight and child-size, and the learning materials are designed to be easily handled by children. Everything in the environment is arranged to be accessible and encourage independence. In Montessori classrooms, children engage in daily activities that directly connect with fundamental domains of human understanding, living organisms, artifacts, social groups, and natural phenomena. According to researchers Geary (2016) and Gray (2019), play is integral to development, serving adaptive functions by allowing children to practice survival skills and problem-solving in contexts that mirror real-life scenarios. Montessori's approach resonates with these evolutionary perspectives of education by integrating play and exploration into its educational framework, reflecting an understanding of human development that values cultural and biological diversity.

Work Play from a Montessori Perspective

"Work" in the Montessori environment is a pivotal and life-changing concept. During her practice, Maria Montessori witnessed that children possess a natural drive to learn and explore their surroundings. She believes that when children are given enough freedom to choose activities within a carefully prepared environment, their "work" becomes a profound and fulfilling form of play (Montessori, 1967). According to Maria Montessori, "Play is the work of the child." Contrary to traditional education, where work and play are often viewed as different activities, Montessori education blends the two, allowing children to engage in purposeful activities that captivate their intrinsic interests while also supporting development. Prior studies have shown that children are more likely to engage deeply with their learning when participating in meaningful activities (Lillard, 2017).

The purpose of "Work" is simply about the process of learning rather than completing tasks or achieving certain outcomes. The materials are designed to be self-correcting, motivating children to experiment, make discoveries, and gain confidence through their efforts. This autonomous work is fundamental for developing concentration, independence, and an appreciation for learning. Montessori believed that when children participate in work that resonates with their developmental stages and interests, they experience a deep sense of satisfaction and joy, fostering a lifelong passion for exploration and knowledge (Montessori, 1995). Montessori teachers are certified as guides who observe and organize a learning environment rather that deliver information, emphasizing individual paths to master through hands-on materials that promote independent exploration and self-correction (Lillard, 2017). The educators are referred to as "guides" rather than "teachers" because they establish a prepared environment where children can explore their own interests autonomously. Montessori guides are exceptionally qualified professionals who support children by offering lessons and demonstrations when needed, acting as a resource rather than directing their learning.

Nurturing Altruism: The Promotion of Social-Emotional Skills

Montessori philosophy is notable for its dedication to nurturing altruism by integrating social-emotional skills. Maria Montessori's principles prioritize children's growth, emphasizing academic abilities and cultivating qualities like empathy, compassion, and a strong sense of communal responsibility. Evolutionary psychologists suggest that altruism has adaptive roots that benefit individuals and the community (Wilson, 2016). In Montessori environments, activities that promote altruism, such as cooperative play and community service projects (setting the table), align with the evolutionary perspective by fostering advantageous skills (e.g., cooperation, empathy, and social cohesion).

The classroom, referred to as “The Children’s’ House,” is designed to teach children responsibility through acts that benefit their peers, such as returning materials and cleaning up after one another. Robinson and Curry (2005) also suggest that altruism is demonstrated through acts like volunteering and kindness. To foster altruistic behaviors in children, educators must first teach them about altruism, help them understand others’ feelings, and guide them in developing personal values and helping skills. Teachers play a role in this process, using the classroom to promote moral development and encourage students to become responsible, contributing members of society (Robinson & Curry, 2005). Mixed-age settings further support altruistic behaviors by allowing older children to assist younger ones in their work. Studies show that smaller teacher-to-student ratios and teacher modeling foster prosocial behaviors and effective classroom management (Long, 2017). Overall, Montessori education meets academic goals and helps children develop social-emotional skills that enhance their well-being and that of their communities, reflecting the evolutionary mechanisms for survival and success (Trivers, 1971).

The Outdoor Curriculum

A core aspect of the Montessori philosophy is incorporating nature into the curriculum. Maria Montessori perceived the outside environment as an extension of the classroom. When children “work” outside, they use all of their senses to discover resources, enhance their scientific curiosity, and nurture their creativity. The Children’s House outdoor spaces should offer rich opportunities to see, touch, hear, smell, and taste. Depending on the classroom, children might be sweeping the sidewalks, watering plants, washing windows, filling bird feeders, digging in the sand, sorting leaves and acorns, collecting rocks, etc. In her book *From Childhood to Adolescence,* Maria Montessori emphasizes the irreplaceable value of direct interaction with nature, writing, “There is no description, no image in any book that is capable of replacing the sight of real trees, and all the life to be found around them, in a real forest. Something emanates from those trees which speak to the soul, something no book; no museum can give.” Through this, Montessori highlights the importance of incorporating nature into the curriculum, suggesting that real-life experiences with the natural world offer profound and unique benefits that cannot be replicated through books or museums (Montessori, 1973).

Activities like gardening, exploring natural elements, and outdoor tasks like sweeping and sorting leaves provide practical learning experiences and promote physical activity, independence, and confidence (P. Lillard, 1996). Research supports that outdoor learning significantly benefits early childhood development and well-being (Johnson, 2012). This approach to outdoor education is not only inherently evolutionary friendly but enhances learning and well-being while fostering a natural love for the environment, reflecting how our ancestors adapted and thrived in their surroundings.

Adaptation to the Environment

Montessori philosophy guides children toward essential skills such as math, reading, and language. However, Montessori goes beyond the basics to prepare students for future success in various aspects of life. The Montessori approach to education emphasizes academic learning and important life skills with a strong focus on adaptability (Kramer, 2017). Unlike traditional classrooms, the Montessori approach involves a dynamic curriculum that evolves with each student's progress, encouraging continuous adaptation (Cole, 2020). A key aspect of adaptability is the ability to work in diverse environments, as children cannot always control the space around them.

Contrary to traditional public schools, relying on a single, unchanged classroom is unrealistic. Montessori environments foster adaptability by exposing students to various situations and encouraging independent and group work. Maria Montessori highlighted the importance of creating an adaptable environment for effective learning, stating that children need many experiences to grow and adapt effectively (Montessori, 2012). As a result, the children learn how to adapt to new situations by learning to interact with students outside their direct age group. Therefore, Montessori education effectively fosters adaptability, helping children thrive in various environments and work well with diverse people, ultimately preparing them to better manage future challenges with greater ease and resilience.

Practical Life Skills

Contrary to traditional education, Montessori programs differ significantly in their approach to practical life instruction. In many conventional education settings, the focus is primarily on academic subjects and standardized testing with less emphasis on teaching children essential life skills they can use in everyday life. Montessori education, however, strongly emphasizes practical life skills by integrating them into the daily classroom routine (Bagby et al. 2012). Montessori environments include activities such as pouring liquids, sorting objects, and cleaning, designed to assist children with their motor skills, concentration, and sense of responsibility (Bettmann, 2000). Though these skills might appear straightforward to adults, they can mark crucial developmental milestones for children (Woods, 2000). Studies, such as one conducted by Elcombe (2017), have shown that these activities enhance fine motor skills, supporting the inclusion of these materials in the curriculum. Montessori's approach also aims to cultivate normalization, a state of psychological health characterized by concentration and independence through practical life tasks like walking the line and practicing silence (Lillard, 2011). This approach aligns well with the evolutionary approach to education, which suggests that children have an innate drive to engage in meaningful, purposeful activities that mimic the tasks of adults in their community.

Scaffolded Learning

The Montessori approach is designed as a progressive learning system where skills are developed gradually through diverse activities and experiences. In Montessori education, scaffolding learning is intricately connected to sensitive periods, specific times in a child's development when they are particularly receptive to certain types of learning. According to Maria Montessori (1967), sensitive periods are a window of opportunity when children have an intense urge to learn and master skills. These periods are characterized by an increased sensitivity to certain stimuli, which makes the child more receptive to acquiring a new skill. By carefully observing each child and tailoring interventions to their sensitive periods, educators can offer just the right amount of challenge and support. For example, during a sensitive period for writing, children begin with tasks that strengthen their hand muscles, refine their grip/grasp, and gradually progress from large chalkboards to line paper as skills mature (Lillard, 2017). Research shows that Montessori education enhances academic achievement, social understanding, and executive function, helping to bridge achievement gaps between different income groups and support varying levels of executive function (Lillard et. al., 2017). The scaffolded approach ensures that learning builds on previous skills by providing targeted assistance to help children overcome difficulties and build confidence. Support is provided initially and gradually withdrawn as proficiency is attained, like removing scaffolding from a completed structure. Importantly, this aligns with Peter Gray's ideas on scaffolding education, highlighting the support and guidance provided by more knowledgeable individuals (teachers and peers) to help younger children accomplish tasks they cannot complete independently (Gray & Feldman 2004). In Montessori classrooms, older children can be observed unconsciously scaffolding the younger children into genuine social play.

A Broad-Stroke Comparison of Montessori versus Traditional Preschool in the United States

Montessori classrooms blend structured work with exploratory play, enabling children to select activities and collaborate with peers of varying ages autonomously. This approach promotes adaptability and altruism, contrasting sharply with the rigid standardized curricula and teacher-led instruction typical of traditional education. Research shows that Montessori education often outperforms traditional methods in academic and nonacademic outcomes, including language, executive function, and creative skills (Randolph et al., 2023). Other studies also found that 4-5 year old's who received Montessori education developed a deeper understanding of geometric shapes compared to peers in traditional preschool settings (Öngören & Turcan, 2009). Notably, another study found that Montessori students demonstrated superior readiness in reading, math, and social skills, also producing more creative writing compared to their traditional school peers (Lillard 2006). Based on the work of Gruskin and Geher (2018), many of the facets of Montessori learning seem to map onto learning that would have been typical under ancestral conditions. For instance, the emphasis on self-directed learning, hands-on sensorial exploration, mixed-age classrooms, and a focus on real-world learning contexts. These facets reveal the unique alignment between Montessori philosophy and evolutionary principles.

The Present Study

Understanding how our ancestors evolved to learn in the EEA, holds the potential to offer educators, policymakers, and developmental researcher's valuable tools and insights for improving traditional education systems. Integrating evolutionary principles into educational philosophies represents a manageable and viable shift in teaching approaches that have been shown to predict student achievement.

The present study was designed to investigate the integration of evolutionary principles in Montessori preschool education. Montessori education is hypothesized to align more closely with an evolutionarily informed take on education compared to traditional preschool methodologies, thereby inherently mitigating the prevalent disparities within traditional educational systems. To think about the best ways to educate offspring and prepare them for success in adulthood, utilizing Montessori theory helps address the current gaps within traditional education. The goal herein is to highlight the evolutionary relevance embedded within Montessori pedagogy and advocate for the claim that Montessori theory is inherently rooted in evolutionary principles. Thus, potentially serving as a catalyst for reform within contemporary educational paradigms.

Controlling for pertinent child demographic factors, this study examined the following hypotheses. Specifically, individuals with greater access to resources and social capital are more likely to enroll their children in Montessori schools, which could influence children's developmental outcomes (Debs, 2016). Controlling for these demographic factors, the fundamental predictions of the study are as follows:

Hypothesis 1: Children attending Montessori preschools will experience more evolutionarily aligned classroom environments than traditional preschool children.

Hypothesis 2: Montessori preschool children will show overall higher rates of academic success based on developmental milestones than traditional preschool children.

Hypothesis 2a*:* Montessori preschool children are predicted to score higher on gross motor skill development than traditional preschool children.

Hypothesis 2b*:* Montessori preschool children are predicted to score higher on fine motor skill development than traditional preschool children.

Hypothesis 2c*:* Montessori preschool children are predicted to score higher in cognitive development than traditional preschool children.

Hypothesis 2d*:* Montessori preschool children are predicted to score higher on social-emotional development than traditional school children.

Hypothesis 2e*:* Montessori preschool children are predicted to score higher on attention and concentration than traditional preschool children.

Hypothesis 3: Montessori preschool children are predicted to score higher on practical life skills than traditional preschool children.

Hypothesis 4: Montessori preschool children are predicted to score higher on adjustment and school enjoyment than traditional preschool children.

Method

An online survey was administered using Qualtrics software. Participants comprising English-speaking parents aged 18 years or older with children between the ages of three and five attending either Montessori or Traditional style preschools. The survey was distributed to a sample of parents (n = *106*), with over 85% of parents identifying as female in both groups and the average age of their children being 50 months. For demographic information, see “Table 1.” Recruitment of parents was carried out through social media platforms, distributing flyers to local preschools in Westchester County, NY, and the snowballing method. Informed consent was obtained from all participants prior to their involvement in the study and the study was approved by the university’s human research ethics board.

Procedures and Materials

Participants in this study began by answering standard demographic questions for both them and their children. Next, participants were asked to report whether their child was enrolled in Traditional preschool or Montessori preschool. Parents were then asked to report on their children's classroom environment using a 5-point scale ranging from 1 *(Never)* to 5 *(Always),* with options including Rarely, Sometimes, and Often. Parents in both groups were administered all questions in the same order, and the survey took roughly 15-20 minutes to complete. Additionally, the internal reliability of these items, as indicated by a Cronbach's alpha of 0.56, shows moderate variability in how well they measure evolutionary relevance within the preschool environment. This section of the study included 13 distinct items selected to assess evolutionary relevance within the classroom setting, drawing from prior research on education in hunter-gatherer education (See Appendix 1). Variables were coded bidirectionally. For instance, higher scores on variables such as students having autonomy in deciding whether to participate in circle time or selecting their own lessons signify a stronger association with learning patterns in our ancestral history. Instead, variables such as participating in structured play or engaging in teacher-led activities indicate a lesser connection to the evolutionary history of our species.

The following portion of the survey asked parents to share their own insights and understandings and rate their children's academic progress across several developmental milestones. These ratings were captured on specific Likert-scale measures (see Appendix 2), ranging from 1 (*Never*) to 5 (*Always*), with additional options considering of Rarely, *Sometimes*, and *Often*.

Participants were given scales created by the researcher to measure children's cognitive (14 items), socio-emotional (16 items), motor skills (25 items) and language abilities (20-items). Each scale was devised specifically for preschool children ages 3 to 5 years, drawing upon cognitive milestones outlined by the CDC. Specific items were selected to create the developmental scale, focusing on key abilities relevant to children ages 3 to 5 years old. These items were carefully pulled from the CDC to assess critical milestones and skills appropriate for this age range, ensuring that the scales effectively captured the developmental progress and abilities of early childhood children. The scales demonstrated high internal reliability: (α=.855) for cognitive, (α=.877) for socio-emotional, (α=.910) for motor skills, and (α=.936) for language. These scales aimed to comprehensively assess a spectrum of cognitive abilities pertinent to this age group. The CDC's research on child health and development contributes valuable insights into factors influencing child development, such as environmental exposures and community-level interventions. The CDC instrument is essential in aiding the promotion of optimal child development and well-being.

A practical life scale (9 items) was developed for the purpose of this study to assess children's skillfulness in everyday tasks. These skills encompass activities such as self-care routines, chores, and basic problem-solving tasks that are foundational to children's independence and social functioning. This scale demonstrated high internal reliability, with a Cronbach's alpha coefficient of .851. Previous research has found that these skills have been used to improve self-regulation abilities for children ages 4-5 years (Hasibuan, 2024). Utilizing a scale that measures practical life skills in psychological research not only provides a nuanced understanding of children's developmental capabilities but also offers insights into the factors that influence development and well-being.

Attention and concentration scale (7 items) was developed to evaluate children age 3-5 years ability to focus and sustain attention. These skills encompass the capacity to maintain focus on tasks, resist distractions, and shift attention when necessary. With a Cronbach's alpha coefficient of .870, this scale also demonstrates high internal reliability. Research has predicted these skills improve cognitive abilities and academic performance later in adulthood, thus highlighting the significance of attention/concentration skills (McClelland et al., 2013). By assessing these skills, researchers can better understand factors that influence attentional control and concentration abilities, thereby informing educational practices and interventions.

The school enjoyment/adjustment scale (16-items) designed by the research to assess children's adaptation and happiness within school environments demonstrated high internal reliability with a Cronbach's alpha of .936. Drawing on items adapted from Morgan's (2014) Children's Happiness Scale, this measure specifically addresses the developmental contexts of preschool-aged children, encompassing aspects such as social interactions, emotional regulation, and overall enjoyment during the preschool day. The research found that positive preschool experiences are related to social skills, cognitive development, and overall well-being in young children (Herry et al.).

Results

Evidence of Matched Samples

Characteristics of parents and children were compared between Montessori (N = 49) and Traditional (N = 57) preschools. Descriptive data and statistical tests are presented in Table 1. Results indicate no significant differences in gender, education, and race between parents and children in both preschool conditions. Furthermore, no significant differences were found in age and income, thus establishing general equivalence between the two groups. These efforts in sample-matching enhance the internal validity of the preschool type's effects by reducing the impact of potential confounding variables.

Table 1.
Descriptive Statistics of Parents and Child Demographics

	M-PrK		T-PrK		χ^2	*df*	*p*
	n	%	*n*	%			
Parent Characteristics							
Sample size	49		57				
Gender:					3.63	1	.57
Male	5	10.2%	1	1.8%			
Female	43	87.8%	56	98.2%			
Parents Race:					1.92	3	.59
Caucasian	40	81.6%	50	87.3%			
African American	1	1.8%	1	1.8%			
Asian	5	10.2%	2	5.5%			
Mixed	1	2.0%	1	1.8%			
Parent Education:					1.67	2	.43
High School/Associates	5	8.9%	9	11.4%			
Bachelor's	23	41.1%	24	30.4%		4	
Graduate (or higher)	28	50%	46	58.3%		4	
Child Characteristics							
Sample size	49		57				
Gender:					1.31	1	.25
Male	23	46.9%	32	56.1%			
Female	26	53.1%	23	40.4%			
Child Race:					1.44	3	.49

Caucasian	36	73.5%	45	78.9%			
African American	1	2%	0	0%			
Asian	3	6.1%	1	1.8%			
Mixed	8	16.3%	9	15.8%			
	M	*SD*	*M*	*SD*	*t*	*df*	*p*
Parent's Annual Household Income	218,389	118,518	200,868	106,194	-.097	104	.923
Parent's Age (in years)	37	6.06	37	4.61	.755	92	.452
Child age (months)	50	10.57	52	9.36	-.960	104	.339

Note: M-PrK = Montessori Preschool, T-PrK = Traditional Preschool, M = mean, SD = Standard Deviation.

Comparisons between Montessori vs Traditional students across primary variables

Composite variables representing evolutionarily relevant classroom and developmental milestone outcomes were created by summing individual items rated on a scale of 1 to 5. However, Cronbach's alpha (α) was computed for each variable, revealing moderate to high levels of internal reliability among the developmental outcome variables. Further, Montessori preschool children (M = 45.45) experienced significantly greater exposure to evolutionary-relevant classroom environments (M = 39.58) compared to Traditional preschool children, ($t(104) = 7.46$, $p < .001$). Alternatively, the only significant difference identified across developmental milestone variables was that Montessori preschoolers scoring higher on practical life skills. (See Table 2). Correlational analyses revealed a statistically significant positive relationship among the evolutionarily relevance variable and cognitive development ($r(49) = 0.334$, $p = 0.019$), motor skills ($r(49) = 0.397$, $p = 0.005$), language ($r(49) = 0.358$, $p = 0.012$), practical life skills ($r(49) = 0.337$, $p = 0.018$), and attention/concentration ($r(49) = 0.287$, $p = 0.045$) for Montessori preschool children. However, no statistically significant correlations were discovered between the evolutionary relevance variable and developmental milestones for Traditional preschool children (See Table 3). The differences between Montessori and

Traditional Preschool children are attributed to the evolutionary-friendly classroom environments and experiences provided by each educational approach.

Table 2.
t-test Results for Evolutionarily Relevant Environments and Developmental Outcomes

Variable	Montessori		Traditional		*t*	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Evolutionary Relevance	45.45	4.11	39.58	3.97	7.46	<.001**	1.45
Cognitive	64.69	4.93	64.21	7.53	.404	.687	0.08
Socio-emotional	64.08	7.53	63.64	7.47	.296	.768	0.06
Motor Skills	106.82	14.62	102.58	13.88	1.53	.129	0.30
Language	91.27	8.68	90.16	10.11	0.60	.550	0.12
Practical Life	36.84	5.94	33.93	5.39	2.64	.010*	0.51
Attention/Concentration	26.80	4.71	27.02	4.41	-2.50	.803	0.05
Adjustment/Enjoyment	70.61	7.28	69.12	9.65	.896	.373	0.29

Note: $p < .05$ *, $p < .01$ ** M = Mean. SD = Standard Deviation

Table 3.

Correlations with the Evolutionary-relevance Variable for Montessori vs. Traditional Samples (and Combined Dataset)

Variable	Montessori	Traditional	Combined
Cognitive	.334*$_a$	-.064$_b$	.094
Motor Skills	.397**$_a$	-.001$_b$	.241*
Social-emotional	.132	.123	.120
Language	.358*	.070	.191*
Practical Life	.337*	.176	.348**
Attention/Concentration	.287*	-.035	.084
Adjustment/Enjoyment	.216	.096	.166

Note: $p < .05$ *, $p < .01$**, *Subscripts of a and b indicate significant differences in magnitude*

Discussion

The results of this study support the hypothesis that Montessori preschools inherently foster a more evolutionarily friendly environment compared to traditional preschool education. The findings of the study highlight significant relationships in developmental areas such as cognitive, motor skills, practical life, and attention/concentration within Montessori settings. The findings are further explored in the sections below, which also address the study's limitations, and suggest directions for future research. The final sections discuss the major conclusions and their significant implications for early childhood education.

Montessori preschools which are found to provide evolutionary-relevant learning contexts, may offer a more supportive atmosphere for overall development than traditional preschools. Additionally, Montessori children are reported to have greater practical life skills compared to those in traditional preschool settings. The general findings found in the Montessori group indicate that as children experience the benefits of an evolutionary-friendly learning space, their cognitive, motor, practical life, and attention/concentration skills tend to improve. In contrast, the small, insignificant correlations found in the traditional group suggest that evolutionary relevance does not seem to play a substantial role in development within traditional educational settings. This potentially stems from the observation that traditional educational environments typically do not incorporate evolutionary principles, thus highlighting the profound influence of evolutionarily rooted Montessori education (Gruskin & Geher, 2018).

Environments designed with Montessori principles often encourage children to participate in tasks that mimic real-world activities and promote critical thinking, thereby nurturing holistic development across several domains. Traditional preschools, however, may not prioritize these aspects of a learning environment to the same extent. While they also aim to

support children's development through structured activities and play, the emphasis may be heavily placed on academic readiness or standardized curricula rather than holistic development. A study conducted by (Al et al., 2012) explored how Montessori schools integrate their educational principles into their physical learning environments and how this affects students. By examining three different schools in the Netherlands, the research assessed the physical conditions and spatial features of these schools through observations and interviews with school staff. The study developed design criteria to enhance educational buildings, aiming to better support student learning and motivation in line with Montessori philosophy. This design should include flexible, articulated spaces rather than traditional rigid classrooms, allowing for small group work, observation, and interaction. Classroom environments should aim to accommodate children at different age levels and enable personalization to foster a sense of belonging. Unlike in traditional schools, hallways should not just connect spaces but also serve as areas of rest, socialization, and various activities, enhancing students' independence and engagement.
This difference in educational approach could help explain why evolutionary relevance was not predictive of the same outcomes for participants in traditional settings.

The influence of Montessori philosophies on development is not only theoretical but is also supported by existing empirical evidence. Studies have shown that Montessori-educated children often demonstrated higher levels of executive function, and academic achievement, often performing, on average, one full year ahead by sixth grade in comparison to their peers in traditional educational settings (Randolph et al., 2023). These advantages are thought to stem from the child-centered approach of education, which encourages curiosity, independence, and cultivates a long-term passion for learning. Furthermore, the Montessori approach utilizes evolutionary principles by providing an environment that mirrors the natural learning process of early human development. With a heavier emphasis placed on hands-on activities, mixed-age classrooms, and self-directed learning Montessori resonates with the ways children have historically acquired folk knowledge and skills for necessary survival. This natural alignment with evolutionary practices may contribute to the holistic development observed in Montessori-educated children making this approach a compelling model for early childhood education (Bjorklund, 2022). Therefore, traditional educational models should adopt more evolutionary-friendly approaches, like those seen in Montessori and Sudbury schools. As mentioned by Peter Gray (2011) Sudbury schools prioritize allowing children to spend time doing activities that suit their personal interests.

Limitations and Implications

While the findings of this study provide valuable insights into the comparative effectiveness of Montessori and traditional preschool environments on various developmental outcomes, several limitations must be discussed. Foremost, the reliance on parent-reported data introduces a potential bias, as parents may overestimate or underestimate their children's abilities based on beliefs or expectations. Additionally, the cross-sectional design of the study limits the ability to establish causal relationships between preschool environments and developmental milestones. Another limitation is the potential variability within each preschool type; for example, not all Montessori or traditional classrooms are identical in nature, and differences in teacher proficiency, classroom resources, and curriculum implementation could influence results. In recent years, Montessori education in the U.S. has expanded into the public sector, raising questions about its alignment with public education standards. A study of South Carolina's public Montessori programs found that most adhere to Montessori principles despite challenges, with program age being linked to high fidelity. However, African American, Hispanic, and lowincome students were disproportionately enrolled in programs with lower implementation fidelity, highlighting both the potential and challenges of integrating Montessori models into public education (Fleming et al., 2023). That said, subsequent studies ought to examine the implementation and recourse allocation of Montessori programs both across public and private schools to address discrepancies and enhance the effectiveness of the approach.

Further, the sample size and demographic characteristics of the participants may not be representative of the broader preschool populations, thereby limiting the generalizability of these findings. Future research could address these limitations by utilizing longitudinal designs to track developmental changes over time, using objective measures of child development in addition to parent reports, and broadening the sample to include a more diverse and representative population. One study conducted by (Lerner, 2006) compared Montessori and non-Montessori students understanding of base-10 (decimal system), place value and arithmetic strategies. While Montessori students initially excelled in base-10 representation in kindergarten, this advantage did not persist into later grades, and there were no differences in place value understanding or addition accuracy by 2nd and 3rd grade. However, Montessori students employed different strategies for addition, but these did not impact overall accuracy compared to their non-Montessori peers. Building on the exploration of Montessori education outcomes, it is also important to consider broader aspects of Montessori schools, such as their demographic makeup. Another study previously examined the racial and economic diversity of 300 public Montessori schools in the U.S that fully implement the Montessori Method. It explores concerns that school choice programs, including Montessori, may lead to increase racial and socioeconomic segregation. Findings of this study show that public Montessori schools typically exhibit strengths in diversity but also face challenges, especially among Montessori charter schools. The study offers strategies to help public Montessori schools improve their racial and economic diversity (Debs, 2016). Additionally, incorporating diverse samples in the analysis of specific elements within Montessori environments is crucial for identifying which components are most beneficial for promoting evolutionary relevance and overall development, thereby enhancing the ability to generalize findings to broader, inclusive populations.

The results of this current study also have remarkable implications for education policy, classroom design, and future research. Regarding educational policy, policymakers may consider incorporating elements of the Montessori approach, such as hands-on learning and mixed-age classrooms, into traditional educational frameworks to enhance student development. Policies could offer professional development opportunities for teachers to implement more child-centered and self-directed learning practices. In addition, educators could prioritize creating environments that facilitate exploration, independence, and collaboration among students. Future research could also aim to explore the long-term effects of Montessori education on various aspects of emotional and physical well-being, using longitudinal studies with diverse samples. Moreover, investigating the adaptability of Montessori principles across different educational contexts and populations could provide insights into optimal educational practices for students with various needs and preferences. An evolutionary perspective on education may hold an essential key for best understanding preschool education.

References

Al, S., Sari, R. M., & Kahya, N. C. (2012). A different perspective on education: Montessori and montessori school architecture. *Procedia - Social and Behavioral Sciences*, *46*, 1866–1871. https://doi.org/10.1016/j.sbspro.2012.05.393

Bagby, J., Barnard-Brak, L., Sulak, T., Jones, N., & Walter, M. (2012). The Effects of Environment on Children's Executive Function: A Study of Three Private Schools. Journal Of Research In Childhood Education, 26(4), 418-426. doi:10.1080/02568543.2012.711431.

Bettmann, Joen. (2000). Nurturing the Respectful Community through Practical Life. NAMTA Journal, 25, 101-16.

Bjorklund, D. F. (2022). Children's evolved learning abilities and their implications for Education. *Educational Psychology Review*, *34*(4), 2243–2273. https://doi.org/10.1007/s10648-022-09688-z

Bjorklund, D. F., & Bering, J. M. (2002). The evolved child: Applying evolutionary developmental psychology to modern schooling. *Learning and Individual Differences*, *12*(4), 347–373. https://doi.org/10.1016/s1041-6080(02)00047-x

Bowlby, J. (1969). Attachment and loss. New York: Basic Books.

Boyer, P. (2000). Evolutionary psychology and cultural transmission. *American Behavioral Scientist*, *43*(6), 987–1000. https://doi.org/10.1177/00027640021955711

Brandl, E., Mace, R., & Heyes, C. (2023). The cultural evolution of teaching. *Evolutionary Human Sciences*, *5*. https://doi.org/10.1017/ehs.2023.14

Cole, S. (2020, October 15). *How a montessori education teaches adaptability*. Fountainhead Montessori Blog. https://blog.fms.org/how-a-montessori-education-teaches-adaptability

Debs, M. C. (2016, November 15). *Racial and economic diversity in U.S. public montessori schools*. Journal of Montessori Research. https://journals.ku.edu/jmr/article/view/5848

Dwards, J.L. (1971*). In Loco Parentis: Definition, Application, and Implication.* South Carolina *Law Review*, 23(1), 11.

Elcombe, E. (2017, November 11). *Effects of practical life exercises on fine motor development in a montessori children's house classroom*. MINDS@UW Home. https://minds.wisconsin.edu/handle/1793/77255

Emmott, E. H., & Page, A. E. (2019). *Alloparenting*. https://doi.org/10.31219/osf.io/mcpv2

Fleming, D. J., Culclasure, B. T., Warren, H., & Riga, G. (2023). The challenges and opportunities of implementing Montessori education in the Public Sector. *Journal of Montessori Research & Education*, *4*(1). https://doi.org/10.16993/jmre.19

Gangestad, S. W., Haselton, M. G., & Buss, D. M. (2006). Authors' response: Toward an integrative understanding of evoked and transmitted culture: The importance of specialized psychological design. *Psychological Inquiry*, *17*(2), 138–151. https://doi.org/10.1207/s15327965pli1702_3

Geary, D. C. (2005). *The origin of mind: Evolution of brain, cognition, and general intelligence*. American Psychological Association.

Geary, D. C. (2012). Evolutionary educational psychology. *APA Educational Psychology Handbook, Vol 1: Theories, Constructs, and Critical Issues.*, 597–621. https://doi.org/10.1037/13273-020

Geary, D. C., & Berch, D. B. (2016). Evolution and children's cognitive and academic development. *Evolutionary Psychology*, 217–249. https://doi.org/10.1007/978-3-319-29986-0_9

Geary, D., & Berch, D. (2016). Evolutionary Perspectives on Child Development and Education. *Evolutionary Psychology*. https://doi.org/10.1007/978-3-319-29986-0

Gelman, S. A., & Roberts, S. O. (2017). How language shapes the cultural inheritance of categories. *Proceedings of the National Academy of Sciences*, *114*(30), 7900–7907. https://doi.org/10.1073/pnas.1621073114

Glenn Geher, P. (2014, October 10). *Evolutionary psychology 101*. Google Books.

Gray, P. (2011). The evolutionary biology of education: How our hunter-gatherer educative instincts could form the basis for education today. *Evolution: Education and Outreach*, *4*, 28-40.

Gray, P. (2013). Free to learn: Why unleashing the instinct to play will make our children happier, more self-reliant, and better students for life. New York: Basic Books.

Gray, P. (2019). Evolutionary functions of play. *The Cambridge Handbook of Play*, 84–102. https://doi.org/10.1017/9781108131384.006

Gray, P., & Feldman, J. (2004). Playing in the zone of proximal development: Qualities of self-directed age mixing between adolescents and young children at a democratic school. *American Journal of Education*, *110*(2), 108–146. https://doi.org/10.1086/380572

Gruskin, K., & Geher, G. (2018). The evolved classroom: Using evolutionary theory to inform elementary pedagogy. *Evolutionary Behavioral Sciences*, *12*(4), 336–347. https://doi.org/10.1037/ebs0000111

Hrdy, S. (2009, May 3). *Meet the alloparents*. Meet the Alloparents | Natural History Magazine. https://www.naturalhistorymag.com/features/15270/meet-the-alloparents?page=2

Hasibuan, E. M. S. (2024). Importance of practical life activity for the development of self-regulation skills in children aged 4-5 years. *International Journal Of Humanities Education and Social Sciences (IJHESS)*, *3*(4). https://doi.org/10.55227/ijhess.v3i4.887

Herry, Y., Maltais, C., & Thompson, K. (n.d.). *Abstract*. ECRP. Vol 9 No 2. Effects of a Full-Day Preschool Program on 4-Year-Old Children. https://ecrp.illinois.edu/v9n2/herry.html

Hess, F. (2023, June 13). *Do American students need more time in school?*. Forbes. https://www.forbes.com/sites/frederickhess/2023/06/12/do-american-students-need-more-time-in-school/

Johnson, K. (2012, November 30). *Montessori and nature study: Preserving wonder through school gardens.* Montessori Life: A Publication of the American Montessori Society. https://eric.ed.gov/?id=EJ1044104

Kramer, R. (2017). *Maria Montessori: A biography*. Diversion Books.

Laski, E. V., Vasilyeva, M., & Schiffman, J. (2016). Longitudinal comparison of Montessori versus non-montessori students' place-value and arithmetic knowledge. *Journal of Montessori Research*, *2*(1), 1. https://doi.org/10.17161/jomr.v2i1.5677

Lerner, R. M. (2006). *Handbook of Child Psychology. vol. 1, theoretical models of Human Development*. John Wiley & Sons.

Lillard, A. (2011). Mindfulness Practices in Education: Montessori's Approach. Mindfulness, 2:78-85. doi: 10.1007/s12671-011-0045-6.

Lillard, A. S. (2017). *Montessori: The science behind the genius* (3rd ed.). Oxford University Press.

Lillard, A. S., Heise, M. J., Richey, E. M., Tong, X., Hart, A., & Bray, P. M. (2017). Montessori preschool elevates and equalizes child outcomes: A longitudinal study. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.01783

Lillard, A., & Else-Quest, N. (2006). Evaluating montessori education. *Science*, *313*(5795), 1893–1894. https://doi.org/10.1126/science.1132362

Long, R. F., (2017). Prosocial Activity in a Montessori Primary Classroom: A Case Study. *(Dissertation, Ph.D)*, State University of New York at Albany. https://summit.sfu.ca/item/17688

Lopata, C., Wallace, N. V., & Finn, K. V. (2005). Comparison of academic achievement between Montessori and traditional education programs. *Journal of Research in Childhood Education*, *20*(1), 5–13. https://doi.org/10.1080/02568540509594546

Manner, J. C. (2006). Montessori vs. Traditional Education in the Public Sector: Seeking Appropriate Comparisons of Academic Achievement https://files.eric.ed.gov/fulltext/EJ1099115.pdf

McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., & Stallings, M. C. (2013). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly*, *28*(2), 314–324. https://doi.org/10.1016/j.ecresq.2012.07.008

Mesoudi, A. (2016). Cultural evolution: Integrating psychology, evolution and culture. *Current Opinion in Psychology*, *7*, 17–22. https://doi.org/10.1016/j.copsyc.2015.07.001

Montessori, M. (1967). *The absorbent mind*. Holt, Rinehart and Winston.

Montessori, M. (1973). *From Childhood to Adolescence:* Schocken.

Montessori, M. (2012). *The 1946 London Lectures* (Vol. 17). Montessori-Pierson.

Montessori, M. (2016). *The child, society and the world*. Montessori-Pierson Publishing Company.

Morgan, R. (2014, March). The Children's Happiness Scale.

Muller, K. (2010). Evolutionary educational psychology: The disparity between how children want to learn and how they are being taught. *EvoS Journal*, *2*(1). https://doi.org/10.59077/tnxf9539

National Center for Education Statistics. (n.d.). *Home*. U.S. Department of Education. https://nces.ed.gov

Pianta, R. C., & Stuhlman, M. W. (2019). Teacher-child relationships and children's success in the first years of school. *School Psychology Review*, *33*(3), 444–458. https://doi.org/10.1080/02796015.2004.12086261

Polk Lillard, P. (1996) Montessori Today: A Comprehensive Approach to Education from Birth to Adulthood. New York, NY: Schocken.

Randolph, J. J., Bryson, A., Menon, L., Henderson, D. K., Kureethara Manuel, A., Michaels, S., rosenstein, debra leigh, McPherson, W., O'Grady, R., & Lillard, A. S. (2023). Montessori education's impact on academic and Nonacademic Outcomes: A systematic review. *Campbell Systematic Reviews*, *19*(3). https://doi.org/10.1002/cl2.1330

Riedman, M. L. (1982). The evolution of alloparental care and adoption in mammals and birds. *The Quarterly Review of Biology*, *57*(4), 405–435. https://doi.org/10.1086/412936

Robinson, E. H. M., & Curry, J. R. (2005). Promoting altruism in the classroom. *Childhood Education*, *82*(2), 68–73. https://doi.org/10.1080/00094056.2006.10521349

Rogoff, B. (2007). The cultural nature of human development. *PsycEXTRA Dataset*. https://doi.org/10.1037/e612832007-002

Sear, R. (2016). Beyond the nuclear family: An evolutionary perspective on parenting. *Current Opinion in Psychology*, *7*, 98–103. https://doi.org/10.1016/j.copsyc.2015.08.013

Sparks, S. D. (2020, November 20). *U.S. students and teachers top global peers for time spent in school in OECD study*. Education Week. https://www.edweek.org/policy-politics/u-s-students-and-teachers-top-global-peers-for-time-spent-in-school-in-oecd-study/2019/09

Sweller, J. (2008). Instructional implications of David C. Geary's evolutionary educational psychology. *Educational Psychologist*, *43*(4), 214–216. https://doi.org/10.1080/00461520802392208

Trivers, R. (1971). The Quarterly Review of Biology. In *The Evolution of Reciprocal Altruism* (pp. 35–57). essay, The University of Chicago Press Journals.

Woods C. "Back to Basics" for the Montessorian: The Practical Life Foundation. Montessori Life [serial online]. Winter2000 2000;12(1):38-41. Available from: Education Research Complete, Ipswich, MA. Accessed November 1, 2015.

Wilson, D. S. (2016). *Does altruism exist?: Culture, genes, and the welfare of others*. Yale University Press.

Öngören, S., & Turcan, A. İ. (2009). The effectiviness of montessori education method in the acquisition of concept of geometrical shapes. *Procedia - Social and Behavioral Sciences*, *1*(1), 1163–1166. https://doi.org/10.1016/j.sbspro.2009.01.209

Appendix A

The following are 13-items included in Composite Evolutionary-Relevance Variable Measured With a 1-5 Likert Scale. Items coded with an asterisk is reverse coded.

My child interacts with different-age peers in their class.
My child engages in same-age class activities (i.e., activities meant for a certain age) *.
My child engages in free play in their classrooms.
My child engages in structured play (i.e., activities prepared for them) *.
My child gets to choose what they want to play with.
My child has a say in whether they participate in circle time (i.e., can choose to sit out and do another activity instead).
My child learns from hands-on learning.
My child learns from teacher-led activities (e.g., lectures and speeches) *.
My child uses manipulatives (e.g., pattern blocks, place value blocks, etc.).
My child uses tools that are specifically for children*.
My child uses tools that are similar or the same to those used by adults and professionals.
My child is allowed to spend a significant amount of time outdoors.
My child only goes outside for structured break times*.

Appendix B

The following are sample items used in the *Assessment of Academic Success based on Developmental Milestones Measured with a 1-5 Likert Scale,* ranging from 1 *(Never)* to 5 *(Always),* with options including Rarely, Sometimes, and Often.

Cognitive Development
My child can identify ordinary/everyday objects (e.g., telephone, brush, fork)
My child can point to get other's attention
My child can Identify body parts
My child can follow one-step-verbal commands without gestures (e.g., pick up toys, sit in the chair, etc.)
My child can recognize some letters
My child can draw a self-portrait
My child can recognize the cover of a book
My child can match colors
My child can name 4 or more colors
My child can count 5 to 10 things
My child understands opposites (e.g., big/little)
My child can understand positional words (e.g., middle, end)
My child uses materials to build/construct things (e.g., block tower, clay, etc.)
My child can recount a recent story
Socio-Emotional
My child communicates their emotions to adults and peers (e.g., a child might say that hurts; please don't touch my body)
My child waits their turn
My child enjoys sharing with others
My child copies adults and peers
My child is able to self-regulate
My child shows signs of empathy when another child cries
My child separates easily from family members
My child takes an interest in cleaning (e.g., sweeping, wiping tables, etc.)

My child can show empathy towards others emotions (e.g., Sam is crying, he's sad, is he okay?
My child can initiate play with other children
My child engages in imaginary play (e.g., dress up)
My child is interested in other friends
My child follows expectations at home
My child can tell what's real vs make-believe
My child is aware of their sex/gender expression
My child uses language to express themselves rather than their bodies (e.g, hitting, pushing, biting)
Gross Motor
My child can balance on one foot
My child can throw a ball under and or overhand
My child can swing their arms when walking
My child can hop on one foot 3-5 times
My child can walk on a balance beam
My child can slide down the slide without assistance
My child can skip (instead of walking)
My child can jump sideways
My child can kick a stationary ball straight
My child can swim doggy paddle
My child can stand on tiptoes without moving for 5-8 seconds
My child can independently ride a bike with training wheels
Fine Motor
My child learned to move a spoon to and from mouth
My child can pull off socks and or shoes
My child can scribble with control
My child can stack two objects
My child can button and/or zip their clothes
My child draws simple shapes
My child cut with scissors
My child can trace thick lines

My child can use one hand consistently for most activities

My child can thread a sequence of small beads onto a string

My child colors inside the lines

My child can copy numbers or letters

My child can complete 8-12 pc puzzles

Language

Receptive

My child learns new words quickly

My child knows most common object names

My child understands the concept of “two”

My child understands the difference between things that are the same and things that are different (e.g., grownups vs children)

My child say’s all the syllables in a word

My child recognizes a “STOP” sign

My child tells stories from a book/movie

My child can compare things using words “*bigger* and *smaller”*

My child demonstrates interest in reading

My child uses grammatically correct sentences

My child follows simple directions

My child produces most consonants correctly

My child’s speech is understandable in conversation

Expressive

My child correctly use plurals, pronouns, and/or prepositions

My child asks “why” and/or “what questions”

My child uses complete sentences of 3 to 4 words

My child uses the past tense of words

My child can describe something that has happened to them

My child can carry on a conversation with another person

My child calls people by their relationship to others such as “Albert’s Mom”

Attention/Concentration

My child an pay attention for 7 minutes or longer

My child looks at me when communicating

My child can focus and refocus their attention by themselves

My child can focus on one activity at a time

My child is starting to control their focus

My child can focus on an activity and can also listen to what is being said without stopping their activity and looking at the speaker

My child can tune out unwanted and unrelated information when exploring material

Practical Life

My child can brush their teeth

My child washes their hands with soap and water

My child can dress and undress themselves

My child enjoys helping with the laundry

My child can set the table

My child can pick up after themselves

My child can serve food and water

My child can self-clean after using the toilet

My child is interested in cleaning (e.g., sweeping, wiping tables, etc.)

Adjustment/Enjoyment

When my child is at school they are treated fairly

When my child is at school they are anxious

When my child is at school they are proud of themselves

When my child is at school they spend time with friends

When my child is at school they know the class routine

When my child is at school they feel safe

When my child is at school they are bullied
When my child is at school they have fun
When my child is at school they enjoy learning new things
When my child is at school they are confused about what’s going on
My child enjoys going to school
My child is easily depressed at school
My child likes their teachers at school
My child associates school with happy feelings and emotions
My child cries during drop-off
My child gets excited about school activities and materials

AI STATEMENT:

Please note the writing found herein was written completely by me. I did not copy and paste any of this content from the internet or from any other source. Further, I did not use ChatGPT or any other AI-writing software. I have put all the content into ZeroGPT and the results suggested that this was human-written.