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Exploring Preschoolers' Nature Connection: A Comparative Study of a Zoo and Urban School Settings

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ABSTRACT

Understanding the connection to nature (C2N) in early childhood is vital for fostering long-term environmental stewardship. This study examines C2N among preschoolers from distinct educational backgrounds: a zoo-based school (Z School) offering extensive outdoor learning and a more conventional urban school (U School). The research aims to discern how these educational settings affect the children's natural affinity. Participants included 24 preschoolers from both schools. A Games Assessment Tool (MacKeen and Wright, 2020) that uses interactive games to probe the children's ecological perceptions and considers various dimensions of environmental understanding was used to evaluate environmental sensitivity, awareness, and preferences. Participants were tested in the fall and then again in the spring. Initial findings revealed that Z School students exhibited greater environmental awareness, while U School children showed increased environmental sensitivity. A significant observation was the anthropomorphism of inanimate objects by the children and a hesitancy towards forest play. The study highlights the significance of educational environments in shaping children's C2N. It indicates that active engagement with nature across different seasons and within various cultural and geographical contexts is essential for reinforcing a robust C2N. Additionally, the research underscores the importance of reshaping children's perceptions and attitudes toward nature to bolster their environmental understanding and preferences.

Keywords**:** preschoolers, nature connection, connection to nature (C2N), environmental education, early childhood development, comparative study, zoo school, urban school, seasonal variability, environmental attitudes

Scholarly research emphasizes the importance of early exposure to and immersion in nature for children's development, helping foster positive physical and mental health. For example, increased direct contact with nature enhances children's cognitive, attitudinal, emotional, and physical development (Driessnack, 2009; Giusti et al., 2014; Bratman et al., 2015). However, children typically experience limited interaction with the natural world from a young age (David Suzuki Foundation, 2012). Starting as early as preschool, educational settings can restrict the breadth and depth of children's encounters with nature due to factors such as limited access to green spaces and the educational strategies employed (Matz et al., 2019; Giusti et al., 2014; MacKeen et al., 2022). The implications

of reduced contact with nature are significant for fostering a culture of sustainability, as research consistently shows that children's connection to nature (sometimes referred to in the literature as 'bioaffinity' or 'C2N') is cultivated by both indoor and outdoor learning experiences (Omidvar et al., 2019; MacKeen & Wright, 2020). These early experiences are pivotal in the development of pro-environmental attitudes and decision-making (Chipeniuk, 1995; Ewert, Place & Sibthorp, 2005; Rickinson, 2001) and increasing the probability of conservation behaviours and attitudes as adults (Zhang, Goodale & Chen, 2014).

Within the literature, there are many ways of understanding an individual's C2N, including emotional connection (Mayer & Frantz, 2024), an appreciation and understanding of the interconnectedness between humans and other living organisms (Nisbet et al., 2009), a psychological love or attachment for all living things (Cho & Lee, 2018), and a general love for nature (Wilson, 1984). Our study is inspired by these conceptualizations of C2n and broadly defines the term as the degree to which an individual is both emotionally and attitudinally connected to nature.

Educational methodologies, like the Reggio Emilia approach, are designed to augment children's engagement with nature and integrate morepurposeful and intensive nature experiences into preschools' curriculums (Ärlemalm-Hagsér & Sandberg, 2017; Barratt Hacking, Barratt & Scott, 2007). The Reggio-Emilia method is an internationally renowned approach to early childhood environmental education and considered an integrated curriculum that provides children with various nature-related experiences during preschool life (Chartier & Geneix, 2007; Vandermaas, McClain & Fair, 2017). In research conducted by Omidvar et al. (2019), the impact of a Reggio Emilia-influenced curriculum on preschoolers' cognitive, emotional, and attitudinal relationships with nature was assessed using a variant of the Games Testing instrument, initially developed by Giusti et al. in 2014 that was designed to measure bioaffinity in Swedish pre-school children. Findings indicated that despite the Reggio Emilia-inspired curriculum providing more nature-related activities than the Canadian national average, the children's bond with nature was not as strong as anticipated, and the childrens bioaffinity scores were lower than hypothesized (Omidvar et al., 2019). This outcome prompted further investigation into whether the influence of the school's curriculum on children's connection to nature was negligible or if the assessment tool was inadequate for measuring such a connection. To address this, MacKeen and Wright (2020) and Mackeen et al. (2022) refined the assessment tool in consultation with experts and the developmental psychology literature and then conducted psychometric validity and reliability testing to develop an enhanced instrument that can be confidently used with preschool children.

This paper presents a study conducted in collaboration with the Saint Louis Zoo and the Dalhousie University Education for Sustainability Research Group, where the MacKeen and Wright (2020) refined tool was employed to assess the nature-related engagement of two groups of preschoolers in a new geographic setting: a nature-focused zoo school and a conventional urban preschool. The study aimed to evaluate and compare the extent of the children's variations in connection to nature between these two educational environments.

The Study Context and Methods

The Saint Louis Zoo hosts a unique preschool program for children aged three to five, situated within the Zoo's expansive grounds. This nature-based preschool dedicates at least half of its class time to outdoor activities, particularly for the older children, who regularly engage in the diverse ecosystems of the 1,300-acre Forest Park. With its focus on conservation, the Zoo aims to ensure that its educational programs nurture a more profound commitment to wildlife and environmental advocacy. The preschool's curriculum has been specifically designed with these objectives in mind, prompting an interest in assessing the effectiveness of their educational strategies.

Zoo Preschool (Z School) at Saint Louis Zoo embraces the Reggio Emilia approach, championing outdoor experiential learning. (For comparison purposes, each preschool is referred to by an initial. However, IRB approval included the use of Saint Louis Zoo Preschool as a named entity.) Classes meet from September to May for four hours each day; Two- and three-year-olds meet on Tuesdays and Thursdays, and the four-and five-year-old class meets on Mondays, Wednesdays, and Fridays. This older class is the subject of the current study. On Mondays and Wednesdays, the Zoo's facilities become a dynamic classroom, with students venturing out of the classroom daily to see animals in their Zoo habitats as well as explore the natural spaces of the grounds. "Forest Fridays" find them outdoors for their entire 4-hour session, engaging in child-led nature play punctuated with snack times and occasional teacher-led

stories or crafts in Forest Park. This unique setup was designed to foster development of empathy and connection with nature in these early learners.

The chosen comparison preschool called "U School" (name withheld per IRB) was selected for its many similarities to Z School, with the exception of immersive outdoor free play in nature. U School is located near the Zoo and is similar to the Z School in its private operation and commitment to the Reggio-Emilia educational philosophy. In fact, many parents consider both Zoo Preschool and U School when choosing an option for their child. Further, this institution echoes a similar ethos with play-centric, age-appropriate learning experiences. U School also offers one four-and five-year-old preschool class. However, it is a larger, stand-alone facility that offers full-day services for its students, including day care for children ages birth to two and preschool for threes and fours. The "Cardinals," U School's equivalent age group, attend preschool five days a week for eight hours each, with extended daycare options. Their outdoor engagement differs, with approximately two hours daily in a designated play area by the school or local park playgrounds, which is equipped with nature-inspired amenities like garden beds and a mud kitchen, alongside structured play equipment and biking space.

This study focuses on contrasting the impact of Zoo Preschool's extensive outdoor and nature play opportunities with the more traditional outdoor play structure at U School to gauge whether there is a correlation between these differing pedagogical approaches to schooling and the children's connection with the natural world. While the team hypothesized that the Zoo school participants would have greater C2n based on a curriculum that intentionally focuses on nature and outdoor experiences, the study was designed, and the researchers conducted themselves in testing so that these presuppositions would not impact the testing of the participants.

Study Sample

Participants were recruited from the four-and five-year old classes at each school. This process involved communicating the study details to parents and obtaining IRB consent from each student's parents. Students were asked to participate in the games on the day of the assessment. The study sample includes only students who had parental consent and assented to participate in both sessions of the games assessment. From the Z School, eleven students from the "Grizzlies" class joined the research, ranging in age from 3.5 to 5 years (average age of 4.68 years). (Note: the 3.5-year-old child was an exceptional admit to the class that is typically reserved for children already aged four by the start of school.) The gender distribution among these participants included seven males and four females. The U School contributed thirteen "Cardinals" to the study. The ages of these participants spanned from 4.25 to 5 years (average age of 4.67 years), distributed between seven male and six female students. Results of a parent survey yielded no significant differences in SES or parental environmental attitudes and beliefs.

Procedures

To evaluate the children's connection to nature, we employed the Games Assessment Tool developed by MacKeen and Wright (2020), conducting the games with students in the fall of 2022 and then again in the spring of 2023. While a number of C2N measurement tools exist, the MacKeen and Wright (2022) tool was chosen because it is specifically designed for young children and is the only current tool that has been psychometrically validated. In 2022, MacKeen et al. established the validity and reliability of the testing tool. The validity results indicated that further modification was necessary to clarify the foundational concepts used in the tool. Once the additional modifications were complete, reliability results showcased that this version of the environmental knowledge and connection to nature instrument produces representative, generalizable and trustworthy results. More specifically, five of the six games met adequate or excellent internal consistency: the degree to which the items in a test adequately measure the targeted concepts (MacKeen et al., 2022; Henson, 2001; Ponterotto & Ruckdeschel, 2007). This validated version of the tool was used to complete the assessments for this study.

In both the spring and fall, the assessments occurred over several days during times teachers designated the least disruptive. Researchers asked each student whether they would like to play a few games, and those assenting proceeded with the activities in a designated common area adjacent to the children's regular classrooms to maintain a consistent and comfortable environment. Each assessment session lasted about 20 minutes and was administered

by two researchers: one interacted directly with the child, administering the games, while the other recorded scores and observations. While the intent was to complete the series of assessments in one sitting, children were informed they could take a break or stop at any time. Several participants did choose to stop and return to classroom activities. Those children were asked again to participate another day, and some of them continued and finished the assessment in a second session. Only children who completed the assessments in the fall were asked to participate in the spring session. All children included in this analysis completed both fall and spring assessments.:. For accuracy and accountability, each session was audio-recorded, allowing checks for accuracy of recorded responses. Alphanumeric participant codes (i.e., Z1, U1, etc.) were used on the score sheets to maintain the integrity and confidentiality of the data. This process not only preserved the anonymity of the participants but also allowed for an unbiased assessment of the results.

The Testing Tool

The study used a geographically adapted version of the game-based assessment tool crafted by MacKeen *et al.* (2022) to measure the children's connection with nature[1]. This instrument is divided into three sections that explore various dimensions of the children's environmental understanding: environmental sensitivity, environmental awareness, and environmental preference, employing two interactive games in each category. Each of these sections and their games are described below:

Testing for Environmental Sensitivity

Environmental sensitivity refers to one's feelings toward nature, including empathy and concern for the health and well-being of the environment (Giusti, 2012; MacKeen et al., 2022). This section is designed to understand the children's empathetic outlook towards nature.

- The first game, a sorting activity, involves categorizing cut-out images of both animate and inanimate objects. The children discern whether these items can experience harm or feelings, allocating their answers to "yes" or "no" bins, thus yielding binary outcomes.
- The second game employs emotive decision-making, where children are presented with a series of environmental scenarios via photographs. They assign cut-out emoticons of happy or sad faces to these images based on their perceptions of positive or negative environmental actions, such as the act of watering plants versus the occurrence of water pollution, also resulting in binary outcomes of "happy" or "sad."

Testing for Environmental Awareness

Environmental awareness encompasses a knowledge and perception-based understanding of the environment and its functions, such as ecosystem services and human behaviours and their impacts on nature (Giusti, 2012; Mackeen et al., 2022). This section evaluates the children's cognitive grasp of ecological systems and their processes.

- In a matching game, children associate cut-out images with photos representing various ecosystem services on a game board, like linking timber to a picnic table. This exercise offers multiple-choice responses and is analyzed particularly for the choices involving money and vehicles, categorizing them as correct or incorrect matches.
- A two-part game further explores this domain. The initial phase prompts the children to describe their understanding of various forms of pollution and deforestation, generating qualitative, open-ended responses. Following this, a sorting task asks them to consider if these pollutants could harm themselves, animals, vehicles, people, or forests, leading to binary "yes" or "no" answers.

[1] See https://cdn.dal.ca/content/dam/dalhousie/pdf/sites/esrg/ModifiedTool_2021.pdf for copy of tool

Testing for Environmental Preferences

Environmental preferences refer to one's positive or negative feelings towards their surrounding environments, such as being afraid of the ocean or enjoying a neighbourhood park (MacKeen et al., 2022). The final section delves into the children's personal preferences and comfort levels with different natural settings.

- The first game involves a discussion board with images depicting various settings like a playground, indoors, or a forest. Children express their favourite places to play and where they feel most secure, providing qualitative feedback.
- The second game reverses the inquiry, asking them to indicate places they least prefer to play or feel unsafe, also yielding open-ended qualitative responses.

This nuanced methodology aims to capture a spectrum of the children's environmental consciousness, from their intuitive feelings to their informed knowledge and personal preferences, offering a comprehensive view of their relationship with the natural world.

Analysis

Data was gathered in the fall of 2022 and spring of 2023 using scoresheets, which were then systematically transcribed into an Excel spreadsheet to streamline the analysis process. To ensure privacy, each participant was ascribed a unique code that anonymized their identity. The quantitative data derived from sections one and two of the assessment were explored through descriptive statistical methods, as outlined by MacKeen & Wright (2020). Measures of central tendency were employed to discern the average responses within each game, while measures of dispersion were utilized to examine the range and distribution of the data, providing insights into the variability among participants (Payls & Atchison, 2014).

For the qualitative data in sections two and three, an inductive analysis was conducted to uncover patterns and themes, allowing for a rich interpretation of the children's verbal and decision-making responses.

These analytical approaches were uniformly applied to the Z School and U School datasets. After the analysis, the results from each institution were juxtaposed within the same seasons (fall and spring) and longitudinally across the two seasons to capture any developmental shifts or trends over time. This comparison aimed to shed light on the children's environmental understanding and preferences over the academic year.

Results

This results section synthesizes the findings from our research, analysing game data gathered during two distinct periods: fall 2022 and spring 2023. We present a comparative analysis of the outcomes from Games 1A, 1B, 2A, and 2B, followed by an in-depth examination of two primary areas:

1. Specific Question Outcomes: Detailed insights from the responses to questions within the games.
2. Connection to Nature (C2N) Metrics: Evaluation of the study participants' C2N scores and average C2N scores for each participating school.

Subsequently, we explore the results from Games 3A and 3B, which illuminates the participants' preferences. A key aspect of our analysis is the comparative evaluation between two educational institutions: Z School and U School. This comparative lens extends to an analysis of the overall trends observed between the fall and spring data sets.

Fall Results

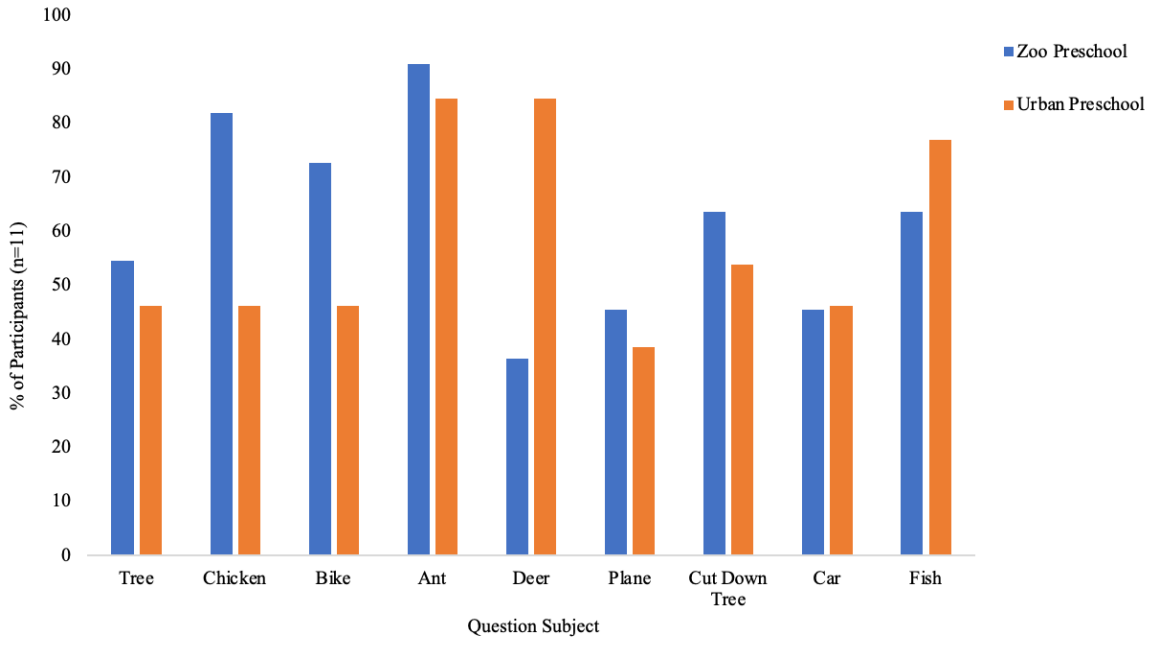
Game 1—Environmental Sensitivity

Game 1A asked participants to determine whether various objects (both animate and inanimate) had the capacity to feel pain. Game 1B involved participants assigning either a happy or a sad face to pictures of various environmental situations (i.e. watering a plant, smoke in the air). The scores associated with the individual questions varied between schools and the objects participants were asked to consider. When it came to the more natural objects (e.g., tree, fish, ant, deer), connection to nature (C2N) (i.e. participants answering "yes" to an object being able to feel pain) was moderate to high. A notable exception was that of the Z School, whose participants exhibited a low connection to specific components of the game, such as the picture of a deer, with only 36.4% of students answering correctly (i.e. stating deer could feel pain) (Figure 1). Alternatively, one of the U School's highest scores was on the deer question, with 84.6% of students answering correctly, suggesting a strong C2N through the image of the deer. The Z School and the U School scored the highest on the ant question, with 90.9% and 84.6% of students, respectively, showing C2N through this image (Figure 1).

Equally as interesting to the C2N scores associated with natural objects is the participants' responses to inanimate objects (e.g. plane, bike, car), with only 45.5% of the students answering correctly, meaning 54.5% felt these objects could feel pain. It is also important to note that 64% of Z School students and 54% of U School students asserted that a cut down tree cannot feel pain, leaving 36% and 46% believing it can feel pain. When considering the cut down tree, our team evaluated the answer of "yes- a cut down tree can feel pain" as not being connected to nature. However, the team could consider this in future iterations of the game's testing, as children may have a more nuanced way of thinking about this once living object.

Figure 1

Zoo Preschool and Urban Preschool participants' (n=11) answers during Fall testing to Game 1A about environmental sensitivity: “Can a (X) get hurt or feel an owie?”



In Game 1B, when pictorial emoticons were matched with positive and negative environmental actions, C2N was quite high. The lowest score for a question amongst both schools was 72.7%. The Z School did not do particularly better than the U School on either the clean and positive questions (i.e. watering plants, planting a tree, cleaning up) or the negative and dirty questions (i.e. plastic on the ground, cutting down trees). Z School students answered the watering plants, dirty ground, and cleaning up questions the best, with 100% of students displaying high C2N. The watering plants question was also the highest C2N amongst the U School students, and the dirty water question,

with 92.3% of students answering them correctly. However, U School students did tend to achieve higher C2N when asked questions associated with a positive and clean environment.

Participant Results and Class Averages: In terms of the participant scores and class averages, both the Z School and U School scored very similarly for Game 1A, exhibiting a moderate C2N with overall averages of 61.6% and 61.5%. In Game 1B, both schools displayed a high C2N, but U School scored 8% higher than Z School with a score of 83.8%, resulting in them achieving a higher overall score of 4% for environmental sensitivity.

Game 2—Environmental Awareness

Game 2A provided students with two sets of pictures. Set 1 included pictures of objects (e.g. a carton of milk, a wool hat, etc.), and Set 2 showed images of sources needed to produce the products (e.g. a cow, money, etc.). Participants were asked to match items from Set 1 with Set 2. Game 2B presented students with images of negative environmental scenarios (e.g. air pollution, cutting down trees) and pictures of different entities that could potentially be impacted by the environmental scenarios (e.g. animal, car, forest, you). Participants were asked whether the entity could be hurt by each of the negative environmental scenarios (i.e. Can a forest be hurt by air pollution? Can you be hurt by air pollution?). Results from both games are presented in terms of scores on the individual questions and scores of the participants and, therefore, the class averages.

The Z School's C2N exhibited in game 2A was relatively low to moderate, with a few outliers with high scores. The students scored highest on the car questions for all environmental scenarios in Game 2B except for cutting down trees, where the car question had the lowest score. Other than this, there were no questions in Game 2B that Z School students did consistently poor or well on. Alternatively, U School students showed a higher connection to the animate objects (i.e. people, animal, forest) as the car question was the worst (more students stated negative environmental situations could hurt the car) across all four sections, showing a lower connection to the inanimate object.

Participant Results and Class Averages: Both schools displayed a moderate C2N across Game 2A and 2B and, therefore, their overall scores for environmental awareness as the scores fell within the 50%-65% range. Z School did 10.3% better than U School in Game 2A, averaging 61.2%. Alternatively, U School did 2.8% better than Z School in Game 2B, averaging 52.3%. Overall, Z School scored higher in the environmental awareness category, with an overall class average of 55.4%. In comparison, U School students averaged 51.6%, but neither school exemplified a strong sense of environmental awareness.

Game 3—Environmental Preferences

Game 3A assessed participant preference by providing images of various settings (i.e. the playground, forest, indoors) and asking where students play the most, where they like best to play, and where they feel the safest to play. Game 3B was the inverse of this, asking students to choose where they play the least, where they do not like to play, and where they feel the least safe to play. The results are assessed differently from the other games as this question cannot be broken down into right and wrong answers.

Among the Z School participants in Game 3A, none stated that the forest was where they played the most or where they felt the safest. However, when asked where they preferred to play, participants chose the outdoor settings, as 18.2% stated they liked the forest, 9.09% preferred a farm or backyard, and 63.6% preferred the playground (Figure 3). This left 0% of students choosing to play in an indoor setting. U School students exhibit a very high connection to a playground setting as it was the most selected answer over all three questions in Game 3A. The second most popular answer amongst U School students was inside. The more natural outdoor settings such as farms, forests, and backyards were rarely selected across all three questions, revealing U School's low connection and preferences for such settings (Figure 2).

In Game 3B, the street was the most common answer, with Z School participants across all three questions of where they play the least, do not like to play, and do not feel safe, with the forest being the second most recorded answer.

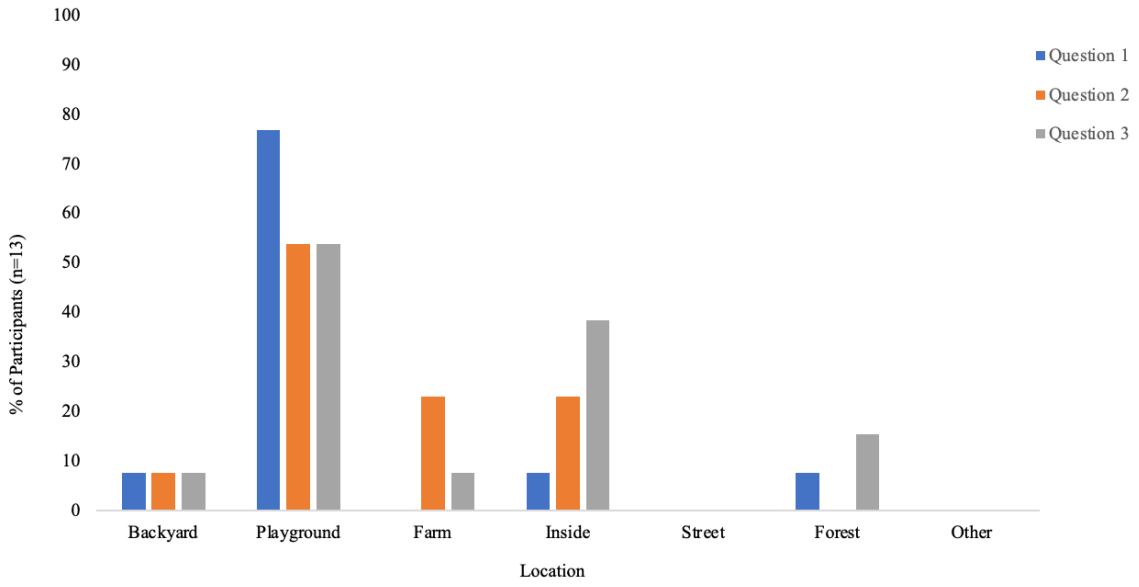
All other settings received low selections from students, if any at all, highlighting a low connection to the street and forest, most notably. For the areas where students do not play, answers were spread relatively evenly over the various settings. However, most U School participants, 46.2%, stated that the forest was their least favourite place to play, while the street and farm were among the other least liked settings. As for where students feel the least safe, the street was overwhelmingly the most recorded answer.

Spring Results

Game 1—Environmental Sensitivity

For Game 1A, the Z School continued to do better on the questions involving animate objects, while questions involving bikes, cars, and planes scored relatively low. Z School students demonstrated a stronger connection to trees compared to their fall results, with 100% of students answering this question correctly, stating that trees could feel pain. The U School exhibited the opposite, with only 53.9% of students having a connection to trees, making it one of their worst. However, U School students demonstrated a strong connection to deer and ants, with these objects having the highest C2N during both fall and spring data collection periods. The car question continued to score low for Z School and U School, as only 36.4% and 53.9% of students stated that cars could not feel pain, respectively. In Game 1B, Z School students showed an observably higher C2N when asked about positive acts towards the environment, including watering plants and planting a tree. Every one of these questions had 90.9% of students showing a C2N, with the highest connection observed among the negative and dirty questions being 72.7% of students. There was no such pattern within the U School data as connection strength varied from scenario to scenario.

Figure 2
Urban Preschool participants' (n=13) answers during Fall testing to their environmental preferences in Game 3A: "Where do you play most (Q1), like to play (Q2), feel most safe playing (Q3)?"



Participant Results and Class Averages: As for the participant results and associated averages, there were observable differences between the fall and spring data within each of the schools and between the two schools. The Z School's average, and therefore C2N, increased by 14.2% from fall to spring to 75.8% C2N for Game 1A (9.1% higher than U School's average), with both schools displaying a moderately high C2N for this game. Game 1B produced much different results as the U School average increased by 7% from fall to spring, making it 17.8% higher than the Z School spring average. This indicates that U School's C2N was notably higher than Z School's in Game 1B. When considering

the overall results (i.e. combining 1A and 1B scores) for environmental sensitivity, the U School scored 4.4% higher than the Z School, keeping consistent with the results of the fall data that showed U School possesses a higher environmental sensitivity.

Game 2—Environmental Awareness

The Z School participants showed a strong connection to animals in Game 2B, as this is the most well answered question across three of the four subsections. There was also a high success rate with the car question, demonstrating no significant difference between answers dealing with animate or inanimate objects among the participants. All of the U School's scores in Game 2B showed a low to moderate level of connectedness, ranging from 23.1%-61.5% C2N. Participants did not do consistently well on any particular question, but the car question remained the lowest C2N for U School students, and their answers overall showed sustained low C2N when inanimate objects were involved.

Participant Results and Class Averages: The Z School displayed a stronger C2N in Game 2A as their average was 11.8% higher than U School's, while U School displayed a stronger C2N in Game 2B with a 4.4% higher average. This resulted in Z School having a higher overall score for environmental awareness by 3.6%. Both Z School's and U School's overall Game 2 spring scores varied slightly from the scores achieved in the fall and, therefore, remained at a moderate C2N.

Game 3—Environmental Preferences

While Z School students' preferences for more natural outdoor locations were low to begin with in the fall, they dropped further during the spring. Similar to the answers recorded in Game 3A during the fall, 0% of Z School students stated they most frequently play or feel safest in the forest, with only 18.2% saying they prefer to play in the forest (Figure 3). Instead, they answered inside or the playground most frequently across all three questions (Figure 3). 0% of U School students answered forest for any of the questions posed, but the most popular answer for where they feel the safest was their backyard, as 46.2% recorded this as their answer (Figure 3).

The forest and street were overwhelmingly the most recorded answer in Game 3B across the fall and spring for both schools. As such, many students do not prefer something other than the street or forest as a location to play.

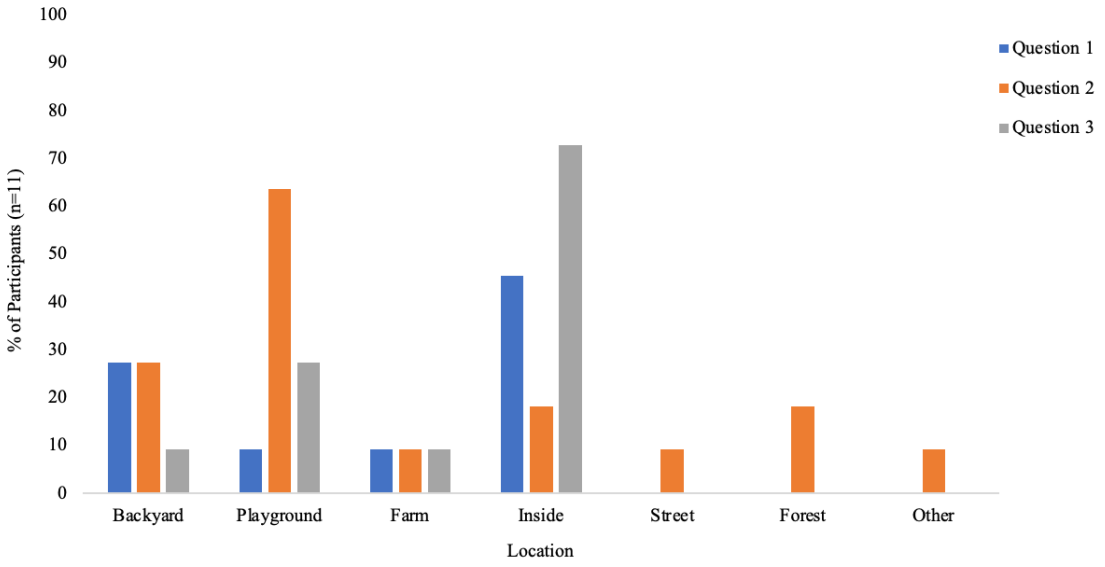


Figure 3
Zoo Preschool participants' (n=11) answers during Spring testing for Game 3A about their environmental preferences: “Where do you play most (Q1), like to play (Q2), feel most safe playing (Q3)?”

Overall Results

When considering all the data from both schools and seasons, U School performed better overall for both games concerning environmental sensitivity (Game 1A and 1B), while the Z School performed better for both the games relating to environmental awareness (Game 2A and 2B) (Figure 6). As for environmental preferences (Game 3A and 3B), neither school particularly favoured many of the more natural outdoor choices except Z School's desire to play in the forest and U School's feeling of safety in backyards. Both schools showed a high disfavour for playing in the street and/or forest.

Discussion and Conclusion

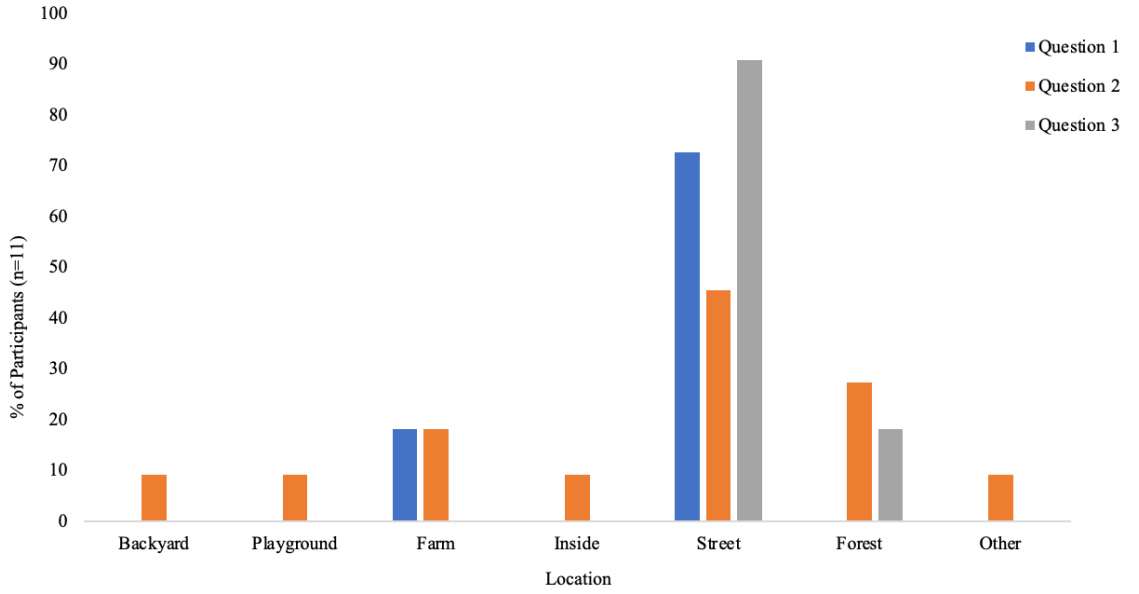
This study aimed to assess the Connection to Nature (C2N) among students from two preschools with differing levels of nature exposure in their preschool settings. Our findings indicate that the C2N of our participants varied depending on the season that the testing took place and the nature of the objects considered.

A notable observation across both Z and U Schools was the diminished C2N scores when children were asked about inanimate objects like cars and airplanes. This could be attributed to the children's age, as media and toys often imbue these objects with life-like qualities (Kail and Barnfield, 2015).. Supporting this, Sommer et al. (2019) found that young children typically ascribe moral value to inanimate objects, perceiving them as capable of experiencing harm, a view that evolves with age. It may also be that children were contemplating the people inside of a plane or a car when asked if the object could be experiencing pain. Further, what is alive can also be disputed amongst scholars. For instance, our team decided that if a child said a cut down tree could feel pain that this was a connection to nature, but some might consider a tree to never feel pain (although there is research now to the contrary) and that a cut tree is dead and therefore could not be considered living. The team will consider this in future iterations of the testing tool, as children may have a more nuanced way of thinking about this once living object.

The study also recorded a drop in C2N scores from fall to spring, which is consistent with other studies of that have demonstrated that children in developed nations tend to spend less time outdoors in colder seasons (Tucker and Gilliland, 2007; Castonguay and Jutras, 2010). This trend could be attributed to the children's reduced interactions with and exposure to key elements of nature during the winter season (Beery et al., 2020; Duffy & Verges, 2010). While the time spent outdoors remained consistent across seasons in both the Z School and U Schools, much of nature itself, such as flowers, trees, wildlife, and insects, are less active during the colder months providing fewer chances for children to form meaningful connections. Studies have supported this idea as they have shown that even with sufficient amounts of outdoor time during the winter season, the reduced abundance of flora and fauna can influence children's perceptions of the environment (Beery et al., 2020). Conversely, Sanderud et al. (2019) suggest that active winter play can enhance children's understanding and appreciation of nature, pointing toward a potential strategy for maintaining or increasing C2N during winter.

This drop in scores could also be associated with external, familial factors that occur beyond preschool hours. One study determined that there is a shift in adults' attitudes towards the environment during the winter months as it is associated with increased challenges such as higher heating bills, seasonal depression, shovelling driveways and defrosting cars, icy walkways/sidewalks, and so on (Nisbet et al., 2011). The children could be influenced by parents who experience these negative feelings, ultimately reducing their connection to nature (Ergler et al., 2016; Castonguay and Jutras, 2010). Additionally, this could lead to families spending less time outdoors during the winter season than they typically would in the warmer spring and summer months (Ergler et al., 2016; Castonguay and Jutras, 2010). Even with Z School and U School keeping the amount of outdoor play similar across all seasons, this potential reduction in cumulative outdoor time can also be contributing to the observed decrease in C2N scores during spring testing (Ergler et al., 2016). Tillmann et al. (2019) observed, seasonal changes impact children's outdoor engagement, with winter often perceived as less inviting.

Figure 4
Z School participants' (n=11) answers during Spring testing for Game 3B about environments that they **do not** like: "Where do you **not** like to play (Q1), where do you **not** like to play the most (Q2), where do you **not** feel safe playing (Q3)?"



In Game 3, we observed a reluctance among students concerning forest play. This aversion could stem from various sources, including parental attitudes, the inherent features of forests, or the children's urban or rural backgrounds (Skar, 2010; Sonti et al., 2020). Sonti et al. (2020) reported that safety concerns lead to avoidance of forested areas, an attitude that may be transmitted to children, affecting their comfort and connectedness with such environments. Further, it may have been that the pictures shown of a forest were unfamiliar to the children. The Z School children regularly have "Forest Fridays," where they play in a forest park with trails. The imagery used in the test depicts a much wilder setting that was perhaps not as attractive to the participants. This reinforces the idea that the pictures used in this tool should be modified for the cultural and geographical context in which it is being used. Further, the team intends to examine the children's parents' attitudes toward nature to determine if there is a correlation between parental C2N and their child's.

When looking at the study overall, some conclusions can be drawn that may be helpful to those conducting this type of research in the future, which we explore below.

Connection to Nature (C2N) Variability: This study demonstrates that the connection to nature among preschoolers may be influenced by various factors, including the nature of the objects considered (animate vs. inanimate), seasonal changes, and preferred play settings. This highlights the complexity of C2N in early childhood education and the need for diverse and adaptive educational strategies.

The Impact of Seasonality on C2N: The study observed a decline in children's C2N scores from fall to spring. This could be due to reduced interactions with nature during the winter months when flora and fauna are less active. Despite consistent outdoor time while the children are at their respective schools across the seasons, external factors such as parents' negative attitudes toward winter and reduced family outdoor activities may also further contribute to the decline in the children's C2N scores, highlighting the importance of fostering positive winter play experiences to maintain or enhance children's connection to nature, and perhaps to impact their parent's attitudes toward seasonal experiences.

Figure 5
U School participants' (n=12) answers during Spring testing for Game 3B about environments that they **do not** like: "Where do you **not** like to play (Q1), where do you **not** like to play the most (Q2), where do you **not** feel safe playing (Q3)?"

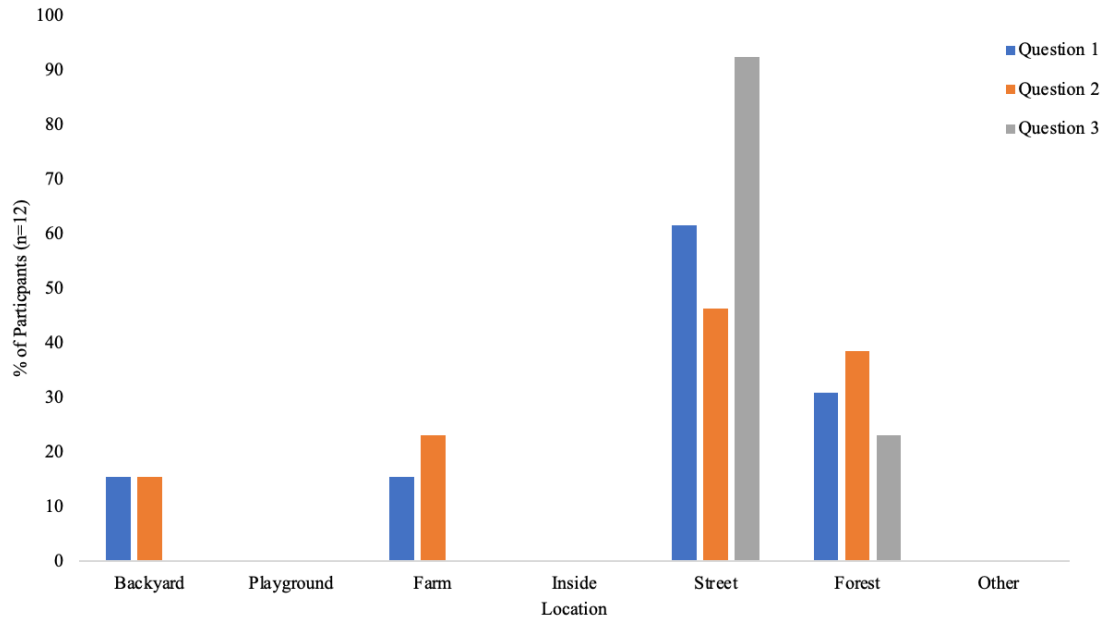
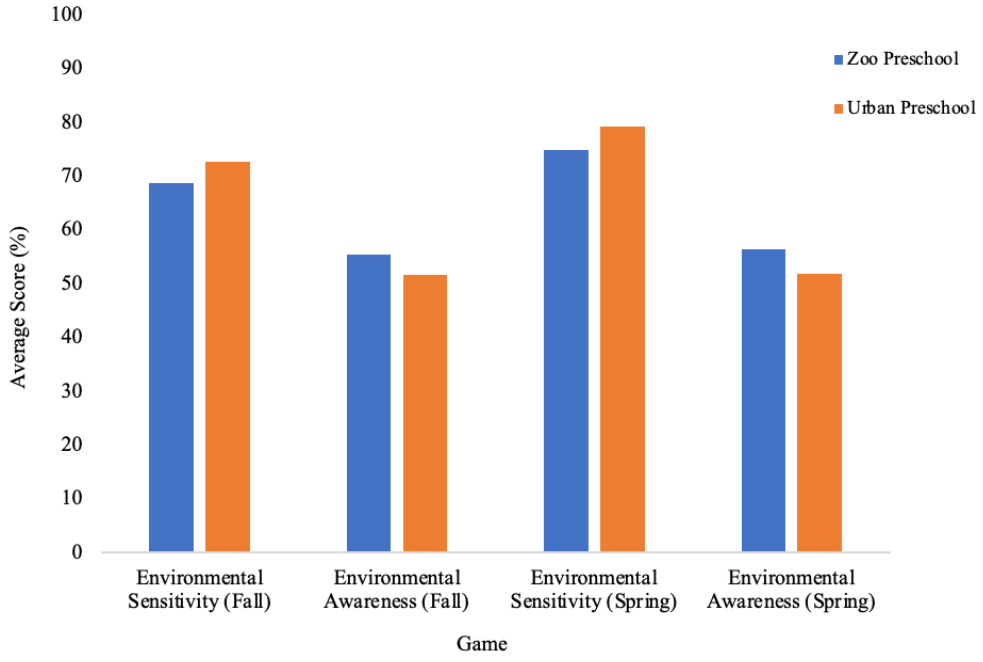


Figure 6
Overall Fall and Spring Z School and U School averages for Game 1—Environmental Sensitivity and Game 2—Environmental Awareness



Influence of Educational Settings: This study compared two educational settings (Z School and U School) with different levels and types of nature exposure. The findings underscore the significance of the academic environment in shaping children's C2N. With its more immersive nature-based education, Z School generally showed better environmental awareness performance, while U School displayed higher sensitivity towards the environment. This also lends credibility to the suggestion to examine to what extent parental attitudes (in addition to the educational setting) can influence a child's C2N.

Children's Perceptions of Inanimate Objects: A notable observation was that the children ascribed life-like qualities to inanimate objects like cars and planes. This could be a reflection of their developmental stage and the complexity of the person-object distinction. Literature suggests that children begin to develop the distinction between animate and inanimate objects as early as 12 months (Opfer & Gelman, 2011). However, in the case of cars and planes, there is the additional layer of people potentially being involved. This issue is related to how children contextualize objects based on the features, such as faces or biological motion (Opfer & Gelman, 2011). This observation highlights how the level of complexity of the chosen object or picture can impact the outcome of the testing results.

Reluctance Towards Forest Play: The study observed a general reluctance or unease among many students concerning forest play. This aversion could stem from various sources, including parental attitudes, the inherent features of forests, or the children's socio-economic and/or cultural backgrounds. It indicates the need for further exploration into how environmental attitudes are shaped and the potential for educational interventions to alter these perceptions positively.

This study's outcomes suggest actionable paths for educators and policymakers. There is a need for tailored educational approaches that consider the diverse factors influencing children's C2N, including seasonal changes, the nature of play settings, and children's developmental stages and cultural contexts. Further, our study opens avenues for future research, particularly in exploring how different environmental and educational interventions can enhance children's C2N on both a small and large scale.

Further, this study showcases the use of the MacKeen and Wright 2020 games testing tool in a new light and its use for comparing connection to nature scores between two educational settings and in a pre-post study design. The pre-post study design allows the researcher to uncover nuances in the data over an extended period and have a more complete understanding of the children's complex connection to nature after curriculum interventions (i.e., a longer period of time in preschool). Finally, there is also scope for longitudinal studies to track how these connections evolve and influence children's long-term attitudes toward nature and environmental stewardship. Our research group encourages such studies and is open to collaborations and information sharing related to future research endeavours in this area.

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