DALHOUSIE UNIVERSITY

EVALUATING PRESCHOOL CHIDLREN'S ENVIRONMENTAL KNOWLEDGE AND CONNECTION TO NATURE USING A GAMES TESTING TOOL

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF BACHELOR OF SCIENCES, HONOURS
DEPARTMENT OF ENVIRONMENTAL SCIENCES
DALHOUSIE UNIVERSITY, HALIFAX, NOVA SCOTIA

April 2022

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Abstract

Establishing a connection to nature as a child is a necessity as it is crucial to enhancing children's cognitive, attitudinal, emotional, and physical development (Driessnack 2009; Giusti *et al.* 2014; Bratman *et al.* 2015; Broom 2017; Glettler and Rauch 2020; Sobko and Brown 2021). Although, barriers including the Coronavirus pandemic and increasing technological advancement limit the opportunities of children to expand their experiences within nature and establish this connection. With these barriers increasing, measuring the relationship between children and nature is pivotal in determining the importance of nature connectedness and nature experiences among preschool aged children. This study sought to analyze the environmental knowledge and nature connectedness on a cohort of 3-5-year-old preschool children in Halifax, NS, Canada. To execute this, a modified psychological games testing tool was employed to determine the extent to which the children in the study demonstrated environmental sensitivity, environmental awareness, and environmental preferences with nature. To measure this relationship, this study conducted the games testing on a cohort of 30 children, and further collected demographics including pre-school attendance and age. This presentation will explore preliminary results including an analysis of each game to determine the relationship of the children in the study and their connection with nature. The analyses will then further investigate these results to determine whether attendance to nature based versus non-nature-based preschools or the age of the children impact the level of their environmental knowledge and connection to nature. Although the results of this study contribute meaningful contribution to measuring nature connectedness using the games testing tool, future studies are needed to conduct this research on a larger and more random sample size.

Key Terms: Connection to nature (C2N), early childhood environmental education, early childhood development, games testing, psychological testing.

List of Abbreviations

C2N Connection to Nature
NS Nova Scotia
REB Research Ethics Board
REI Reggio Emilia Inspired
SD Standard Deviation

Acknowledgements

To begin, I would like to express my deepest appreciation and gratitude to my supervisor Dr. Tarah Wright for the bounty of unwavering support, positivity, and patience she has provided me throughout this research. I am immensely grateful to have been provided this opportunity and the experience to work with someone so knowledgeable and encouraging. Without her dedication and confidence in my abilities throughout many unexpected challenges, this research would not have been possible.

Additionally, I would like to extend great appreciation to Jessica MacKeen for her numerous contributions and guidance throughout this process. I am beyond appreciative to have had the privilege of building upon her, as well as contributing to the Education for Sustainability Research Group. Further, I am sincerely grateful for both Jessica Mackeen and Hope Moon for providing added support, feedback, and compassion throughout this last year.

Finally, I cannot begin to express my sincere appreciation to my family and friends for their unconditional love, guidance, and encouragement throughout my entire undergraduate degree and this research project. I would particularly like to recognize my mother for instilling in me her strength, independence, and ambition; this research and all past endeavors would not be possible without her.

Introduction

Nature provides the basis for life on Earth and is fundamental to the survival of humans. Without it, our species would cease to exist. Despite this, studies have demonstrated that humans are becoming less ecologically literate (Pyle, 2003; Seppelt and Cumming, 2016) and are losing their connection with nature (Soga and Gaston, 2016). For all humans, establishing a connection to nature is vital. Creating a human connection with nature is essential for our ability to care for and willingness to protect the environment (Zylstra *et al.,* 2014; Seppelt and Cumming, 2016). Furthermore, establishing this relationship with nature is crucial for children, as this connection plays an integral role in the proper development of a child. Establishing a connection to nature as a child is a necessity as it is imperative to enhancing children's cognitive, attitudinal, emotional, and physical development (Driessnack 2009; Giusti *et al.* 2014; Bratman *et al.* 2015; Broom 2017; Glettler and Rauch 2020; Sobko and Brown 2021). Despite this, the interaction between children and nature is diminishing (Pyle and Orr, 2008; Driessnack, 2009; Soga and Gaston, 2016). Currently, technological advances are the largest barrier to preventing children with establishing a connection to nature (Driessnack 2009; Soga & Gaston 2016). This lack of connection is increasing with the added barrier of the Coronavirus pandemic increasing the amount of time children are spending immersed in technology, as well as causing children to feel unsafe in outdoor spaces (Moore et al., 2020). Through the impact of these barriers, children are spending less time outdoors which consequently leads to fewer opportunities to build a relationship with the environment.

By spending less time in nature, children are missing out on a multitude of health benefits that arise from spending time outdoors. Establishing a connection to nature throughout childhood

provides multiple benefits including but not limited to, decreases in anxiety and depression (McCurdy *et al.,* 2010), increases to well-being (Cheng and Monroe, 2010) and a lower rate of allergies, diabetes, and attention deficit/hyperactive disorder (Lovasi *et al.,* 2008; McCurdy *et al.,* 2010; Bratman *et al*., 2019). Establishing a connection to nature is not only important for children, developing nature connectedness has cascading effects on the current and future environmental sustainability of society. Childhood nature exposure and experiences in nature is correlated with pro-environmental behaviour (Larson *et al.,* 2015) and conservation attitudes in adulthood (Ewert, Place and Sibthorp, 2005; Zhang, Goodale & Chen 2014; Whitburn, Linklater and Abrahamse, 2019).

Recognizing this importance for children to establish a connection to nature, psychological testing tools have recently been developed in attempt to measure this connection (Mayer and Frantz 2004). While there are many tools that have been developed, this project is particularly informed by a psychological testing tool developed by Giusti *et al.,* (2014) and then later developed for use in Canada (Omidvar, 2018; Omidvar *et al.* 2019). Recently, MacKeen (2020) contributed to the further modifications of this tool by modifying it to be more developmentally appropriate for testing on preschool children (3-5-year-olds) in Canada. The results of MacKeen (2020) led to recommendations for further use of the tool on preschool children in Halifax, NS, Canada; as well as further research to determine if there are differences in the results between participants who attend nature versus non-nature-based preschools or between the age of the preschool children (MacKeen, 2020).

This research is part of a larger study that tests the validity and reliability of the newly modified tool. Using the modified tool, this study will analyze the environmental knowledge and

connection to nature through a pilot test with preschool children in Halifax, NS, Canada. Additionally, this study will examine the differences of environmental knowledge and connection to nature of preschool children who attend nature based versus non-nature-based preschools, and children of different ages.

Background and Definitions

Various studies have demonstrated that children's outdoor experiences and exposure to nature are declining at a fast pace (Clements, 2004; Karsten 2005). Many scholars point to urbanization as a factor that has led to children spending less time spent outdoors as more people are moving to larger cities (Cohen, 2006), while simultaneously the number of green spaces are diminishing (Turner et al., 2004).

A multitude of barriers are preventing children from establishing a connection to nature. Currently, technological advances (i.e., smart phones, video games, etc.) are the largest barrier in preventing children with establishing a connection to nature (Driessnack, 2009; Louv, 2005; Soga and Gaston, 2016). This lack of connection is increasing with the added barrier of the Coronavirus pandemic - increasing the amount of time children are spending immersed in technology and not within nature.

Other barriers to preventing children from connecting to nature include the fear of dangers outdoors for parents/guardians (Carver, Timpeiro, and Crawford 2008) and the lack of green spaces available within urban areas (Louv, 2005). Not only are these barriers preventing children from establishing a connection to nature, but they are contributing to higher instances of

"nature-deficit disorder" through increasing the divide between children and their environment (Louv, 2005).

These barriers that limit the exposure and ability of children to form a connection to nature have cascading negative effects to children in their adulthood. Alternatively, children who are exposed to nature and have outdoor experiences throughout their childhood grow up to become adults with pro-environmental attitudes and behaviours. As identified by Wells and Lekies (2008), the age of 0 to 8 years old is a pivotal portion of childhood that forms a child's ecological identity and relationship with nature. Furthermore, experiences in surrounding environments throughout childhood positively influence a person's environmental attitudes and beliefs (Chawla, 1998; Chawla, 2007; Wells and Lekies, 2008). This relationship with nature throughout childhood

These barriers not only prevent children from connecting with their natural environment but can becoming a factor in limiting a child's ability to become an environmentally sustainable adult. Recognizing these barriers, environmental psychology set out to measure the relationship of humans to their natural environment, specifically young children as this affects their ability to become adults with pro-environmental attitudes and behaviours.

Nature-Based Preschool: Nature-based preschools can be recognized within the scope of this study as a form of environmental education. More specifically, in Halifax, NS, Canada; many nature-based preschools follow the Reggio-Emilia approach.

Knowledge Gaps

This study is part of an Education for Sustainability Research Group, contributing to expanding literature regarding nature exposure and developmental psychology. Additionally, this study contributes to preceding literature conducted by Giusti (2012), Giusti *et al.* (2014), Omidvar (2018), Omidvar *et al.* (2019), and MacKeen (2020). Giusti *et al.* (2014) first developed the psychological games testing tool to measure the connection to nature of children in Stockholm, Sweden. Following the development of the tool, Omidvar (2018) conducted a pilot test using the Giusti *et al.* (2014) games testing tool in Halifax, NS, Canada on participants from two nature-based (Reggio-Emilia Inspired) preschools. Upon retrieving weak results, Omidvar *et al.* (2019) conducted another pilot test, which concluded with further weak results. Through these negative results, Omidvar *et al.* (2019) recommended the Giusti *et al.* (2014) games testing tool undergo modifications. More recently, MacKeen (2020) conducted the modifications to the original Giusti *et al.* (2014) games testing tool to be more appropriate geographically and developmentally appropriate for preschool (3-5-year-old) children in Canada. The newly modified tool was then used to conduct a pilot study on 3-5-year-old preschool children enrolled in nature-based preschools. Following this pilot test, MacKeen (2020) recommended for further pilot testing of the modified games testing tool, specifically on a larger and more representative sample size. Additionally, MacKeen (2020) recommended the results of the modified tool be used to conduct a comparison between preschoolers from nature-based versus non-nature-based preschools to measure the differences in their connection to nature.

This study aims to further the use of the newly modified games testing tool by MacKeen (2020) through conducting a pilot test on a larger and more representative sample of preschool

children in Halifax, NS, Canada. Additionally, this study will conduct a comparative analysis to between preschoolers attending nature-based versus non-nature-based preschools, and between the age cohorts of these children, to analyze the differences in their connection to nature. This will help to determine how age or attendance to nature-based versus non-nature-based preschools influence the level of nature connectedness among preschool (3-5-year-old) children.

Research Questions

1. Using the modified Giusti *et al.* (2014) psychological games testing tool, to what extent do the children in this study demonstrate environmental sensitivity, environmental awareness, and environmental preferences?

   a. Are there differences in the connection to nature between participants who are enrolled in nature-based programs versus non-nature-based programs?

   b. Are there differences in the connection to nature between participants who are three, four, and five years of age?

Research Design

This study will first conduct a pilot study using the modified games testing tool by MacKeen (2020) on a sample of preschool (3-5-year-old) children in Halifax, NS, Canada. Then, the study will conduct a comparison of the results between children who attend nature-based versus non-nature-based schools, as well as between the age cohorts of the sample. To conduct the comparison analysis, early childhood developmental literature will be used to analyze the patterns and trends between the school type and age cohorts of the sample of participants. This

research this research contributes to a larger study to validity and reliability of the modified testing tool by Mackeen (2020) to determine the value of the results of the newly revised tool since the original contribution of Giusti *et al.* (2014).

Scope

This research seeks to evaluate the connection to nature of preschool (3-5-year-old) children within Halifax, Nova Scotia, Canada. Preschoolers will be recruited through a snowball sampling approach using social media and outreach tactics to obtain a minimum sample size of 30 preschool children. Children from all preschool types, both nature-based and non-nature-based, will be chosen to participate in this study.

Study Limitations

The first limitation of this research is temporal as the entire study must be completed within eight months. This time limitation impacts the quality and reliability of the data collected as it does not allow for a large sample of data to be collected or for the testing to be repeated on the sample participant multiple times. Additionally, the time constraint on this study limits the depth to which the data collected can be analyzed. A second limitation to this research is conducting data collection within the fall months. This is a limitation as most children will be attending preschool; therefore, colder weather and more time spent inside may decrease the children's' ability to remember certain aspects of their natural environment when participating in the games testing. A third limitation to this research is the impact of the Coronavirus pandemic as it has limited the capacity for in-person activities, as well as it has increased peoples'

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discomfort around and/or interacting with strangers. This is a limitation as it affects the ability for researchers to collect study participants. As a result of the Coronavirus, snowball sampling was employed. The use of the snowball sampling is a fourth limitation to the study as it does not allow for a representative sample to be collected if the snowball of sampling occurs among the same cohort of the population.

Literature Review

This review explores the literature surrounding the developmental criteria of preschool aged (3-to-5-year-old) children and their connection to nature. To begin, the first part of this literature review will investigate the large field of environmental and developmental psychology, this scope will then narrow to explore the importance of establishing a connection to nature throughout childhood. This will then lead to exploring how a connection to nature and nature exposures throughout childhood lead to pro-environmental attitudes and beliefs throughout adulthood. This review will then explore the declining relationship between children and their environment; and expand on how environmental education programs may be a solution to mitigating this decline. This section will explore how psychological measurement tools are being used to determine the state of this connection during childhood, specifically with preschool (3-5-year-old) children. The second part of this review will focus on examining age-specific developmental criteria of children, specifically on the cognitive, emotional, and attitudinal characteristics of preschool (3-5-year-old) children. Through compiling this previous literature, the information will help to compare the developmental differences in connection to nature between children aged three, four, and five; as well as between children who attend nature-based versus non-nature-based preschools.

Environmental Psychology and Connection to Nature

The field of environmental psychology first began to surface within multiple disciplines in the 1960s and has continued to evolve in the 21st century. The relationship between the environment and psychology was first recognized by Hall (1969) who demonstrated that humans are both affected and connected to their surrounding environment(s). Through further research,

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Hall (1969) demonstrated that humans who hold a connection to nature exhibit a higher level of leadership and productivity. Furthering this idea, environmental psychology and developmental psychology became intertwined as scholars recognized their interconnection. Within this early stage of developmental and environmental psychology literature, scholars recognized the developmental characteristics of cognition, behaviour, perception, and personality as important to establishing a human connection to nature (Craik, 1977; Stokols, 1978). Additionally, Kellert particularly defined children's experiences in nature as contributing to a child's cognitive, affective, and evaluative development (Kellert, 2002). This idea further transpired within environmental and developmental psychology literature, specifically connection to nature studies, focusing on cognitive, emotional, and attitudinal developmental characteristics.

Within this evolving body of literature, many scholars have identified the positive effects of nature exposure throughout childhood and the cascading effects of this exposure in creating adults with pro-environmental attitudes and behaviours. Mayer and Frantz (2004), who developed the Connectedness to Nature Scale, observed that empathy or a willingness to protect nature increases as one becomes more connected to nature itself, particularly to specific places in nature. Additionally, their findings suggested that establishing a connection to nature in childhood is positively correlated to pro-ecological behaviours in adulthood (Mayer and Frantz, 2004). Furthermore, Chawla (1998) and Chawla (2007) concluded that one's experiences and exposures to nature positively affects their environmental attitudes and behaviours. More specifically, Wells and Lekies (2006) identified that the portion of childhood between 0 to 8 years old, is pivotal in forming a child's ecological identity and relationship with nature.

Recognizing the importance of providing children with a connection to nature, as childhood nature exposure experienced a decline (Cheeseman, 2016); environmental education programs were introduced. These environmental education programs are conducted with the purpose of enhancing children's connection to nature and increasing the frequency of nature exposures and experiences (Orr, 2004). More specifically, early childhood environmental education focuses on the development of environmental values and beliefs with the purpose of creating life-long pro-environmental attitudes and behaviours that will continue into adulthood (Palmer, 2002; Giusti et al., 2014).

More recently, the effectiveness of environmental-based curriculums and education programs has been assessed to determine if they are indeed enhancing childhood connection to nature. Cheng and Monroe (2012) collected participants enrolled in an environmental education program and assessed the children on their attitudes towards nature. Their research determined that environmental education programs increase problem solving skills when applied to environmental problems, as well as advances their pro-environmental actions (Cheng and Monroe, 2012). Furthermore, Collado *et al.* (2013) conducted a study on children attending a summer camp with some children exposed to environmental education. They found that long term exposure to nature, such as exposure to environmental education programs; positively nourishes children's emotional connection to nature which positively correlates to environmentally friendly behaviours later in life (Collado et al., 2013).

Within the realm of environmental and developmental psychology, some scholars chose to focus directly on a fundamental concept known as the Biophilia hypothesis created by Edward Wilson (Wilson, 1984). The concept of biophilia is described as the love for and connection to

nature and recognizes that this human love/connection to nature has cognitive, emotional, and attitudinal developmental effects on humans (Kellert and Wilson, 1993). More recently, Giusti (2012) has developed a psychological games testing tool based on this concept to evaluate children's relationship with nature. Specifically, this testing tool evaluates children's connection to nature through measuring their cognitive, emotional, and attitudinal connection with the environment (Giusti, 2012). Within this study, Giusti conducted an evaluation using this tool on a sample of 5-7-year-old children in Stockholm, Sweden and concluded that children's social perception to their environment is a determinant to their connection to that exact environment (Giusti, 2012). Furthermore, he conducted further research using this tool to evaluate the connection to nature between children who attend nature-oriented routine schools versus children who do not (Giusti et al., 2014). The results of this study thus determined that children who participate in daily nature routines show more empathetic behaviour and higher awareness of their connection to nature (Giusti et al., 2014).

The use of this tool was then further imposed in Halifax, NS, Canada through a study conducted by Omidvar *et al.,* (2019) and Omidvar (2018) to investigate the cognitive, emotional, and attitudinal connection to nature of preschool children who attend two nature-based (Reggio-Emilia) preschools. Despite using the same approach and psychological games testing tool developed by Giusti *et al.,* (2014); Omidvar *et al.,* (2019) concluded that children's cognitive connection to nature was weak. More specifically, the results concluded that the children in the sample have an overall weak connection to nature, most notably their empathy towards living things (Omidvar et al., 2019). These results were unexpected through the previous evaluation using the tool by Giusti *et al.,* (2019), as well as through the previous literature regarding the

effects of environmental education. Upon suspicions, Omidvar *et al.,* (2019) recommended the tool be modified, and pilot tested again, to determine if these results were correct in evaluating Canadian preschoolers' connection to nature.

To investigate this further, MacKeen (2020) conducted interviews with Early Childhood Education specialists as well as a plethora of psychological literature to facilitate any modifications that could be applied to the original Giusti *et al.,* (2014) testing tool. Upon review, MacKeen (2020) recognized that the tool is not developmentally or geographically appropriate for preschool (3-5-year-old) children in Halifax, NS, Canada. Recognizing these barriers, modifications were then conducted to improve the games testing tool through adjusting the tool to be appropriate for preschool children, in the geographic and cultural setting of Halifax, NS, Canada. To test these modifications to the original testing tool developed by Giusti *et al.,* (2014), MacKeen (2020) administered a pilot test on a sample of children from one nature-based preschool in Halifax, NS, Canada. The modified games testing tool by MacKeen (2020) proved to be successful through the pilot test that was conducted. The results led to specific recommendations that are vital to this study including the recommendation for further use of the modified games testing tool on a larger and more representative sample size (MacKeen, 2020). Furthermore, MacKeen (2020) recommended the data of the modified tool be used to conduct a comparison between children who attend nature-based preschools versus non-nature-based preschools.

Preschool (3-5-year-old) Children Psychological Development

      As preschool (3-5-year-old) children experience changes at a fast rate, it is vital to understand the significant developmental changes they experience between the 3-years-old and five-years-old. This section will focus on the developmental changes throughout the preoperational stage of cognitive development which was determined by Piaget's 1952 theory. Furthermore, the literature compiled by Kail and Barnfield (2015) will primarily be consulted as it provides distinct developmental changes in children in relation to their outer environment. Through reviewing the specific changes through this stage amongst the cognitive, emotional, and attitudinal developmental criteria; the changes in the connection to nature of the different ages of the children can be better analyzed.

Preschool (3-5-year-old) Children and Cognitive Development

      The preoperational stage of development as coined by Piaget's 1952 theory, involves the changes amongst 2-7-year-old children (Kail and Barnfield, 2015). Most notably, within the preoperational stage, one of the largest changes amongst preschool (3-5-year-old) children is regarding egocentric behaviour (Kail and Barnfield, 2015). Kail and Barnfield (2015) define egocentrism is defined through the inability to view a concept from another person's point of view. Furthermore, a study conducted by Hughes (1975) demonstrated that preschoolers who are 3 years old are more egocentric than those preschoolers who are 5-years-old as egocentrism decreases with further development.

      Amongst the preoperational stage, preschool children vary in the extent of their vocabulary between 3-years-old and 5-years-old. As children from the age of two to the age of

six increase their vocabulary by 10x, children from 3-years-old to 4-years-old to 5-years old

must have vast differences in vocabulary from one another (Bloom, 1998). Therefore, it would

be expected that throughout testing using the modified games testing tool by MacKeen (2020),

that the older children would better comprehend, and therefore better answer each question.

Methods

Using a mixed-methods approach and adopting both qualitative and quantitative techniques, this study aims to pilot test the games testing tool for measuring environmental knowledge and connection to nature of 3-5-year-old children. The games testing tool originally developed in the Giusti *et al.* (2014) study, used by Omidvar (2018) and Omidvar *et al.* (2019), and further modified to be both developmentally and geographically appropriate for 3-5-year-old Canadian children in the MacKeen (2020) will be further tested during this project (see Appendix I for the modified MacKeen (2020) games testing tool). This thesis project is part of a larger study in the Education for Sustainability Research Group that tests the validity and reliability of the modified tool from the MacKeen (2020), analyzes the results of the testing to determine environmental knowledge and connectedness to nature amongst the preschool children (3-5-year old's) participants, and compares the results of the children's connection to nature with a parent survey that collected data on the parent's relationship to nature and demographic information including measures of social and material deprivation. This particular study will focus on assessing the environmental knowledge and connectedness of preschool children. Preceding this study, Omidvar (2018) and Omidvar *et al.,* (2019) tested the Giusti *et al.* (2019) tool amongst only Reggio Emilia Inspired (REI) preschool children, resulting in weak testing scores amongst the children. As REI preschools focus on providing environmental education, these scores were weaker than hypothesized. As a result, the MacKeen (2020) study implemented modifications to the original Giusti *et al.* (2014) testing tool to make the tool more geographically and developmentally appropriate for preschoolers in Canada; in hopes of obtaining more appropriate testing scores amongst the REI preschool children.

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The modifications implemented by MacKeen (2020) to the environmental knowledge and connectedness to nature games testing tool resulted in improved results when pilot tested with a cohort of children from REI preschools within Halifax, Nova Scotia. As previous studies from Giusti *et al,* (2014), Omidvar (2018), Omidvar *et al.* (2019), and MacKeen (2020) applied the test on a cohort of children from REI backgrounds, this study will use the testing tool to apply it to the population of all preschool children (including those not attending REI preschools).

The next sections in this chapter will delineate the methodology that took place to conduct the pilot test to measure the environmental knowledge and connectedness to nature in preschool children; with a focus on three phases including the children's environmental awareness, preferences, and sensitivity. I will not discuss the other aspects of the larger study, but this can be made available by contacting the Education for Sustainability Research Group directly. Additionally, the steps in which each child's age differences, sex, and their attendance to nature versus non-nature-based preschools were analyzed amongst the testing tool scores. It is critical to mention both the testing methods and the amendments were approved and completed by the Research Ethics Board (REB) prior to the conducting the methods of this study (Appendix IX).

Sampling Techniques

Following the approval of the testing tool for environmental knowledge and connectedness to nature in preschool through the REB in the MacKeen (2020) study, pilot test recruitment began employing a non-probabilistic and purposive sampling technique. Unlike the first MacKeen (2020) study, we did not use criterion sampling, but instead recruited participants

from the population of all preschool children in Halifax, Nova Scotia regardless of the curricular focus (i.e., nature-based, vs. regular curriculum). As such, we were able to obtain a wider scope of a sample group. To commence participant recruitment, an initial recruitment email (Appendix II) was sent to administrators at preschools, as well as non-profit organizations around the study area of Halifax, Nova Scotia. Any parent(s)/guardian(s) who expressed interest in participating in the study were informed to email the research group or directly respond to the initial recruitment email. Those parent(s)/guardian(s) who expressed interest were then equipped with another recruitment email (Appendix III) including a brief overview of the study, an information bulletin (Appendix IV) and a consent form (Appendix V). Once the parent(s)/guardian(s) organized an appropriate time for their child to participate in the study and consent was provided, they were sent directions to the testing location (Appendix VIII). Finally, as compensation for their time and participation in the study, parent(s)/guardian(s) were informed that they would receive both a Certificate of Achievement (Appendix VI) as well as a $25.00 gift card to Woozles, a local children's store in Halifax, Nova Scotia following the completion of the testing.

Due to the nature of the coronavirus disease, this pilot study took multiple precautions to prevent the further spread of the virus throughout Halifax, Nova Scotia. One precaution included conducting the study in an outdoor space as opposed to the indoor locations that took place during the pilot tests of the Omidvar *et al.* (2019), Omidvar (2018), Omidvar *et al.* (2019) and the MacKeen (2020) studies. Subsequently to parent(s)/guardian(s) completing the consent form and agreeing to participate in the study, they were provided a map detailing the location of the testing on Dalhousie University's Studley campus to a green space outside of the Life Sciences Centre building. Additionally, to ensure the safety of the children, all research assistants wore

masks during each testing session, as well the children were invited to wear masks depending on the instruction from their parent(s)/guardian(s). To ensure the spread of the coronavirus did not occur through the surfaces of the testing tools, each games sheet/board was laminated and prior to each session the materials used were sanitized using disinfectant wipes, as well as sanitized again following the end of the session. Finally, throughout the entire testing phase, the study adhered to all recommendations distributed by Public Health within the area of Halifax, Nova Scotia to ensure conducting the pilot test study would not further the spread of the coronavirus disease.

Procedure for Data Collection

The modified tool from MacKeen (2020) was tested on a cohort of preschool children within the study area of Halifax, Nova Scotia (n=30). The games testing tool included a total of six games, broken into three phases and each phase was allocated two games. The phases include children's environmental sensitivity, environmental awareness, and environmental preferences, with each phase allocated two games (Appendix I).

The first phase of the pilot test focuses on measuring the children's environmental sensitivity. The first game will ask the child if certain objects can feel pain such as a Tree or a Car (Game 1A). The second game asks the child how they feel about certain behaviours such as dirty water or planting a tree, allowing them to physically place an image of a "happy" or "sad" smile on each behaviour to denote their feelings towards the act (Game 1B). The second phase of the pilot test focuses on measuring the children's environmental awareness. The third game is a matching exercise in which they match an ecosystem service such as a river or wood, with a

product such as a glass of water or wooden table (Game 2A). The fourth game asks each child if

certain types of environmental pollution such as dirty air or dirty water affects the child

themselves, people, animals, trees, or cars (Game 2B). Finally, the third phase of the pilot test

focuses on measuring the children's environmental preferences. The fifth game asks the child

multiple questions regarding where they like to play where the child is given an opportunity to

answer the question openly (Game 3A). The final game similarly is open-ended, however, asks

the child where they do not like to play (Game 3B).

With the permission from parent(s)/guardian(s), each participant was voice recorded as

well as transcribed to ensure an accurate record of the dialogue throughout each game as well as

for further analysis succeeding the data collection process. The demographic information of the

participants' age, sex, and their preschool will be recorded for later data analysis. Additionally,

prior to beginning the games testing tool, consent from the preschool children themselves was

collected using an assent script to ensure each child felt safe through the testing process

(Appendix VII). Once the testing process commenced at the outdoor location, the child was

brought back to their parent(s)/guardian(s) who were typically seated nearby the testing area.

Data Analysis

Through the process of analyzing the data, each participant was assigned a participant

code to ensure the child's identity was kept confidential (C1 to C30). The data collected from the

games testing tool that was quantitative in nature was analyzed using measure of central

tendency and measure of dispersion (Omidvar, 2018; Omidvar *et al.,* 2019; MacKeen, 2020). To

calculate the measure of central tendency, the mean within each game was calculated as this

measure determines the best spread of data amongst groups of unequal sizes. As the measure of dispersion, standard deviation (SD) was calculated along with each mean to determine how the data points deviate from the mean.

Prior to analyzing, the quantitative data was put into an excel spreadsheets, and each calculation was conducted on each of the six games separately. To first attain a description of the spread, count data was used to analyze the overall spread of data amongst the full group of participants. The mean and standard deviation was then calculated to analyze differences in data between the participants attending nature-based versus non-nature-based schools. After calculating the mean of each school type, the SD was then calculated. This step was then repeated to calculate the mean and SD of each age cohort (three, four, and five). To then determine an overall comparison of the participants of age groups within each school type, for each question, the school type cohorts were divided further into age cohorts (i.e., nature-based schools were divided into nature-based participants who were three, four, and five at the time of data collection). Once every cohort of age was determined for each school type, the mean was calculated along with the SD for every age cohort within the group of nature-based participants, and for every age cohort within the group of non-nature-based participants separately.

To analyze the qualitative data, an inductive approach was instilled to analyze the open-ended responses (Game 3A and 3B), this approach developed *a posteriori* codes to discover any emerging themes amongst the participants answers (Omidvar, 2018; Omidvar *et al.*, 2019; MacKeen, 2020). Following the examination of this data, the results of each participant's answers was analyzed to see how the answers differed amongst the cohorts of school type and ages of the participants.

Through the data collection process, researchers played an important role in observing how the games were being understood by the participants to determine any interesting differences or patterns in how each testing game was perceived by the children. Additionally, the data collectors determined if there were any questions in which a large portion of children found difficult, or if the questions were being fully understood by the participants.

Methodology Trustworthiness

The validity and reliability of the environmental knowledge and connectedness to nature games testing tool has yet to be determined, however, this methodology can conform to the criteria for trustworthiness (MacKeen, 2020). It has been noted by many scholars that confirming the significance and usefulness of the research using the criteria of trustworthiness can be used in lieu of the absence of validity and reliability (MacKeen, 2020). Guba and Lincoln (1994) concluded four criteria for trustworthiness including credibility, dependability, confirmability, and transferability.

The first criterion of trustworthiness is credibility which refers to the studies "confidence in the truth" as well as if the study is representing and interpreting the true meaning of the original data (Connelly, 2016; Stahl and King, 2020). The credibility of this study has been achieved as the research questions were asked identically for each participant, as well as previous credibility was gained through the modifications in the MacKeen (2020) study.

The second criterion of trustworthiness is dependability which refers to the stability of the data in which the testing can be completed several times, or researchers can include an "audit trail" of their methods (Connelly, 2016; Stahl and King, 2020). The dependability of this study

was established through the previous MacKeen (2020) study as the modifications and justifications were transcribed in an audit trail, and the exact testing tool was used in this study without any changes.

The third criterion of trustworthiness is confirmability, referring to how the results of the study support the data as well as the degree in which the study can be repeated (Connelly, 2016; Stahl and King, 2020). The confirmability of the study was achieved in this study as this study is consistent with the previous studies, and further established the repeatability of the study.

The final criterion of trustworthiness is transferability, this refers to the ability of the researchers to provide the reader with the descriptive data so it can be applied or transferred to other settings (Connelly, 2016; Stahl and King, 2020). The transferability of this study was gained through the similarities of this study to those conducted through the Omidvar (2018), Omidvar *et al.* (2019), and MacKeen (2020) studies. As a result of the four criteria of trustworthiness being met, the qualitative methodology of this research can be deemed trustworthy.

Limitations and Mitigations

The main limitation of this study is the occurrence of the coronavirus disease and its prevalence in potentially affecting the development of preschool aged children and their exposure to nature. As the participants of the study are 3-5-years of age, the last two years of the coronavirus pandemic may have resulted in these children obtaining fewer social skills which could have affected their answers to the testing if they felt shy/uncomfortable. The participants also may have not been exposed as much as a different generation due to the stay-at-home orders

and spending more time indoors to stop the spread of the virus. This could result in the children not recognizing some of the pictures/items described or shown within the testing tool.

Following the Omidvar (2018), Omidvar *et al.* (2019), and MacKeen (2020) studies, mitigations occurred to decrease the limitations of this study. The first mitigation that occurred was conducting the test on a larger sample size (n=30), opposed to the previous studies that used smaller samples, this increase in participants aids in strengthening the usefulness of the games testing tool itself. Another mitigation that occurred was the use of the games testing tool on the population of preschool children at all preschools within Halifax, Nova Scotia. Therefore, this study tests a more generalized cohort of the population, instead of only children attending REI schools that may have a particular socio-cultural background. Furthermore, as the study was completed within an eight-month period, the study period was condensed; therefore, further testing with larger sample sizes, and more studies through our progress in dealing with the coronavirus will need to be conducted.

Results and Discussion

The following results of the participants in the pilot test are presented below (n=30). The mean age of the population was identified as 4-years-old (3.93). Within the results, the population was divided by school type, the study contained 9 participants from nature-based participants and 21 participants from non-nature-based preschools. Additionally, the sample was divided into age cohorts. The study contained 9 participants who were three years old: 3 participants from nature-based preschools and 6 participants from non-nature-based preschools. Additionally, 12 participants in the study were four years old: 4 participants from nature-based preschools and 8 from non-nature-based preschools. Finally, 7 participants in the study were five years old: 2 participants from nature-based preschools and 5 participants from non-nature-based preschools. It is important to note that only 28/30 of the participants parents/guardian(s) provided the age of their children in the study. In the following sections, Games Testing results are summarized with a subsequent discussion for each game.

Game 1A: Environmental Sensitivity

Game 1A aims to measure a child's environmental sensitivity towards nature (Giusti *et al*., 2014). For this game, answers of the Bike, Plane, Chopped Tree, or Car were attributed to no environmental sensitivity (Giusti *et al*., 2014). In this study, all 30 children were able to understand and answer 'yes' or 'no' to where each of the images shown could get hurt.

The results for game 1A display that many of the children in the study were able to identify animals have feelings, such as (22/30) acknowledging that birds can feel pain (Fig. 1). For this game, the sample population displayed sensitivity for the environment (Mean = 18.78,

SD = 4.12) rather than no sensitivity for the environment (Mean = 11.22, SD = 4.12). As all

children in the sample were able to answer the questions within this game, and 63% of the

sample population provided answers representing a connection to nature, this group of preschool

children displays environmental sensitivity for nature.

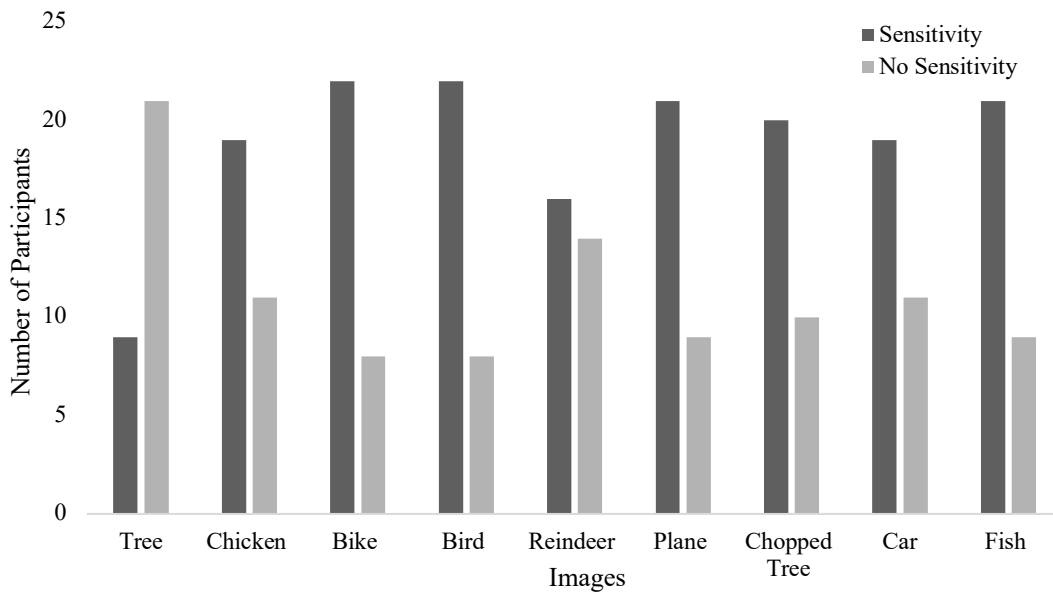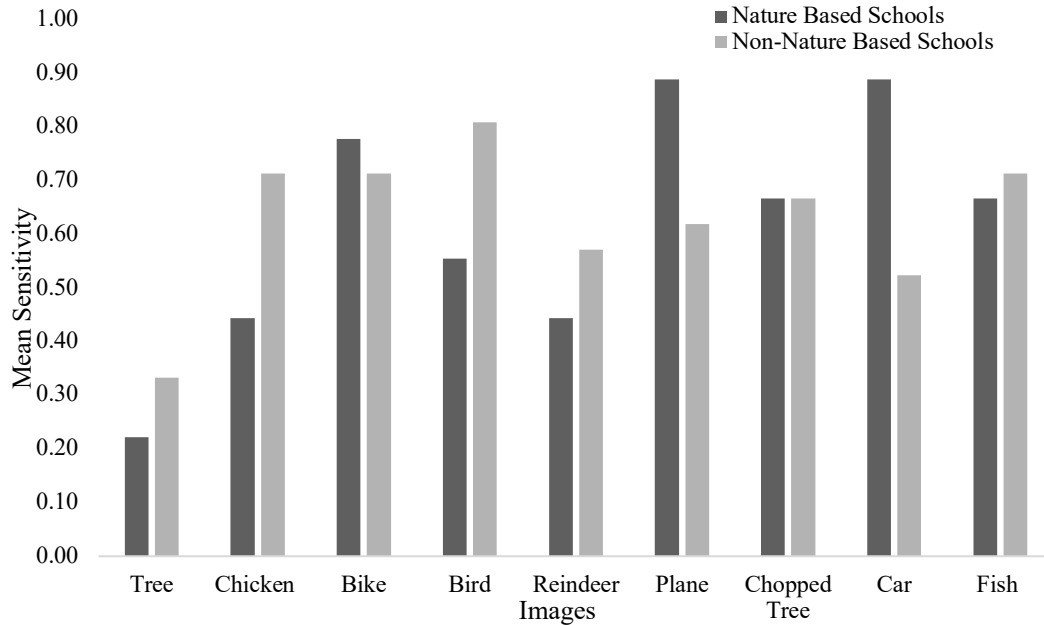Figure 1 Results from Game 1A: measuring environmental sensitivity (n=30).

Figure 2 Results from Game 1A: comparing the mean environmental sensitivity of participants who attend nature-based (n=9) versus non-nature-based preschools (n=21).
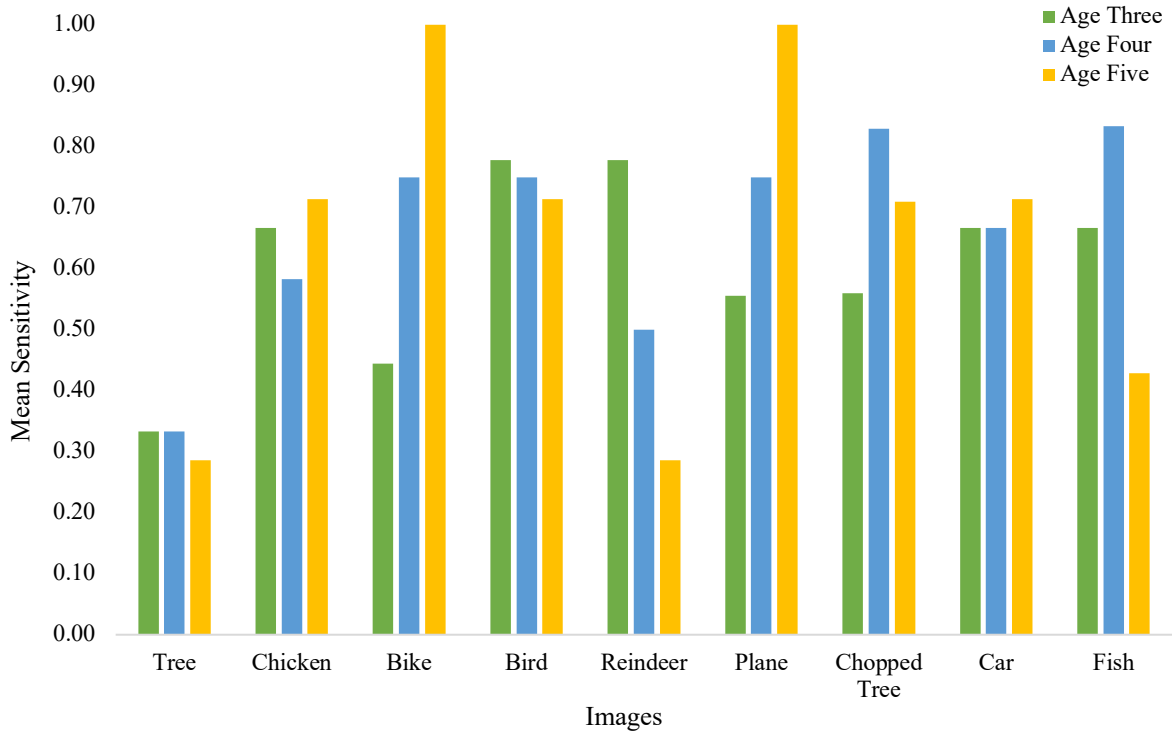

Figure 3 Results from Game 1A: comparing the mean environmental sensitivity of participants who are age three (n=9), age four (n=12), and age five (n=7).

Table 1 Results from Game 1A: comparing the mean environmental sensitivity of participants who are age three and attend nature-based preschools (n=3) versus non-nature-based preschools (n=6), participants who are age four and attend nature-based preschools (n=4) versus non-nature-based preschools (n=8), and participants who are age five and attend nature-based preschools (n=2) versus non-nature-based preschools (n=5).

	Age Three		Age Four		Age Five	
	M	*SD*	*M*	*SD*	*M*	*SD*
Tree	0.33	0.50	0.33	0.49	0.29	0.49
Nature Based Preschools	*0.33*	*0.58*	*0.25*	*0.50*	*0.00*	*0.50*
Non-Nature Preschools	*0.33*	*0.52*	*0.38*	*0.52*	*0.40*	*0.55*
Chicken	0.67	0.50	0.58	0.51	0.71	0.49
Nature Based Preschools	0.33	0.58	0.50	0.58	0.50	0.71
Non-Nature Preschools	0.83	0.41	0.63	0.52	0.80	0.45
Bike	0.44	0.53	0.75	0.45	1.00	0.00
Nature Based Preschools	0.33	0.58	1.00	0.00	1.00	0.00
Non-Nature Preschools	0.50	0.55	0.63	0.52	1.00	0.00
Bird	0.78	0.44	0.75	0.45	0.71	0.49
Nature Based Preschools	0.67	0.58	0.50	0.58	0.50	0.71
Non-Nature Preschools	0.83	0.41	0.88	0.35	0.80	0.45
Reindeer	0.78	0.44	0.5	0.52	0.29	0.49
Nature Based Preschools	1.00	0.00	0.25	0.50	0.00	0.00
Non-Nature Preschools	0.67	0.52	0.63	0.52	0.40	0.55
Plane	0.56	0.53	0.75	0.45	1.00	0.00
Nature Based Preschools	0.67	0.58	1.00	0.00	1.00	0.00
Non-Nature Preschools	0.50	0.55	0.63	0.52	1.00	0.00
Chopped Tree	0.56	0.53	0.83	0.39	0.71	0.49
Nature Based Preschools	0.00	0.00	1.00	0.00	1.00	0.00
Non-Nature Preschools	0.83	0.41	0.75	0.46	0.60	0.55
Car	0.67	0.50	0.67	0.50	0.71	0.49
Nature Based Preschools	0.67	0.58	1.00	0.00	1.00	0.00
Non-Nature Preschools	0.67	0.52	0.50	0.53	0.60	0.55
Fish	0.67	0.50	0.83	0.39	0.43	0.53
Nature Based Preschools	0.67	0.58	0.75	0.50	0.50	0.71
Non-Nature Preschools	0.67	0.52	0.88	0.35	0.40	0.55
Total	5.33	1.50	5.33	1.50	5.43	1.51
Nature Based Preschools	5.67	1.15	5.25	2.06	4.50	0.71
Non-Nature Preschools	5.17	1.72	5.38	1.30	5.80	1.64

Game 1B: Environmental Sensitivity

Game 1B aims to measure the feelings of the children towards images of positive and negative environmental activities (e.g., watering plants, dirty ground, and planting trees). An example of a correct answer is a child choosing a 'happy face' for cleaning up, whereas an incorrect answer is a child choosing a 'sad face' for cleaning up. For this game, answers that are correct are attributed to environmental sensitivity, whereas incorrect answers attribute to no sensitivity for the environment (Giusti *et al.,* 2014). In this study, all 30 children were able to understand and answer with an emotion to each image shown to them.

The results for game 1B display that many of the children in the study were able to identify if the environmental activities were positive or negative, such as 29/30 participants identifying that planting a tree is a positive activity, and 24/30 recognizing that dirty ground is negative (Fig. 2). For this game, the sample population displayed sensitivity for the environment (Mean = 23.22, SD = 2.44) rather than no sensitivity for the environment (Mean = 6.78, SD = 2.44). As all children in the sample were able to answer the questions within this game, and 78% of the sample population provided answers representing a connection to nature, this group of preschool children show an environmental sensitivity for nature.
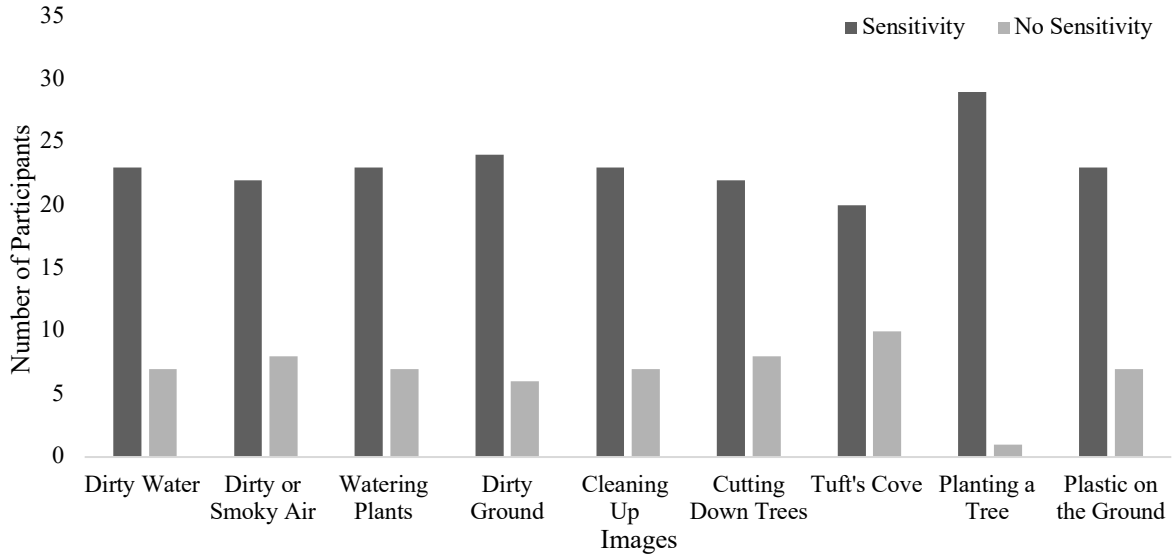
Figure 4 Results from Game 1B: measuring environmental sensitivity (n=30).

Figure 5 Results from Game 1B: comparing the mean sensitivity of participants who attend nature-based (n=9) versus non-nature-based preschools (n=21).
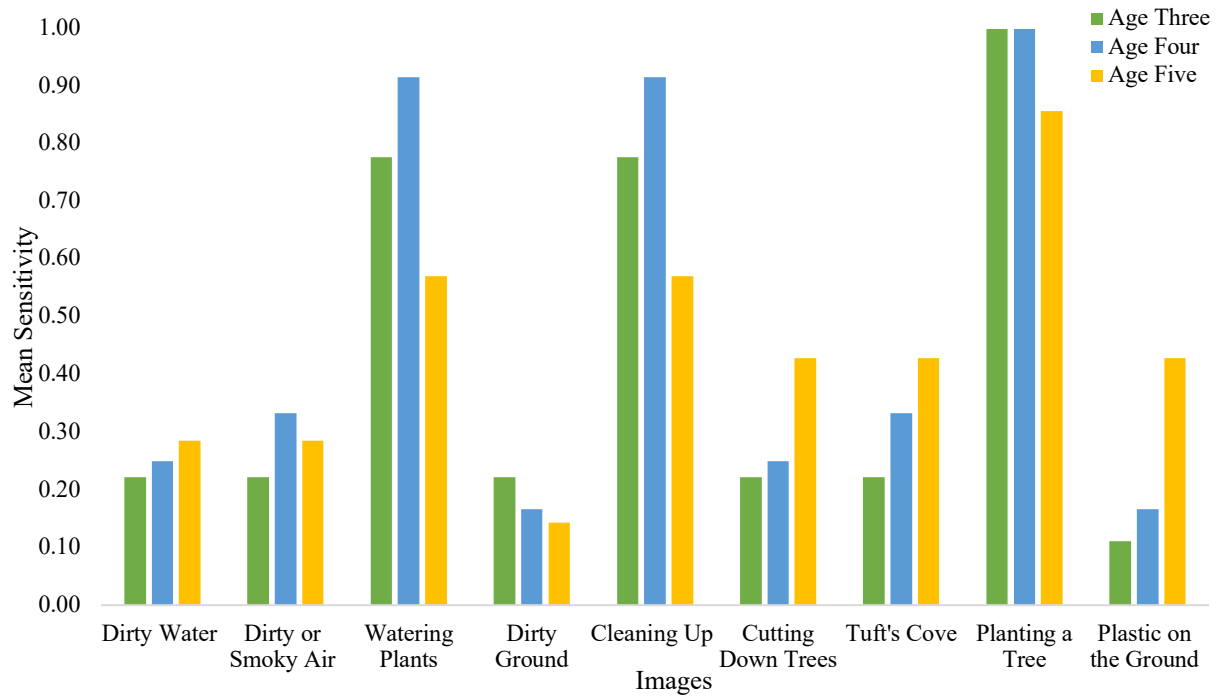
Figure 6 Results from Game 1B: comparing the mean environmental sensitivity of participants who are age three (n=9), age four (n=12), and age five (n=7).

Table 2 Results from Game 1B: comparing the mean environmental sensitivity of participants who are age three and attend nature-based preschools (n=3) versus non-nature-based preschools (n=6), participants who are age four and attend nature-based preschools (n=4) versus non-nature-based preschools (n=8), and participants who are age five and attend nature-based preschools (n=2) versus non-nature-based preschools (n=5).

	Age Three		Age Four		Age Five	
	M	*SD*	*M*	*SD*	*M*	*SD*
Dirty Water	0.22	0.44	0.25	0.45	0.29	0.49
Nature Based Preschools	0.33	0.58	0.25	0.50	0.50	0.71
Non-Nature Preschools	0.17	0.41	0.25	0.46	0.20	0.45
Dirty or Smoky Air	0.22	0.44	0.33	0.49	0.29	0.49
Nature Based Preschools	0.00	0.00	0.50	0.58	0.50	0.71
Non-Nature Preschools	0.33	0.52	0.25	0.46	0.20	0.45
Watering Plants	0.78	0.44	0.92	0.29	0.57	0.53
Nature Based Preschools	1.00	0.00	0.75	0.50	0.00	0.00
Non-Nature Preschools	0.67	0.52	1.00	0.00	0.80	0.45
Dirty Ground	0.22	0.44	0.17	0.39	0.14	0.38
Nature Based Preschools	0.33	0.58	0.25	0.50	0.50	0.71
Non-Nature Preschools	0.17	0.41	0.13	0.35	0.00	0.00
Cleaning Up	0.78	0.44	0.92	0.29	0.57	0.53
Nature Based Preschools	1.00	0.00	0.75	0.50	0.50	0.71

Non-Nature Preschools	0.67	0.52	0.25	0.46	0.60	0.55
Cutting Down Trees	0.22	0.44	0.25	0.45	0.43	0.53
Nature Based Preschools	0.33	0.58	0.25	0.50	0.50	0.71
Non-Nature Preschools	0.17	0.41	0.25	0.46	0.40	0.55
Tuft's Cove	0.22	0.44	0.33	0.49	0.43	0.53
Nature Based Preschools	0.33	0.58	0.50	0.58	0.50	0.71
Non-Nature Preschools	0.17	0.41	0.25	0.46	0.40	0.55
Planting a Tree	1.00	0.00	1.00	0.00	0.86	0.38
Nature Based Preschools	1.00	0.00	1.00	0.00	1.00	0.00
Non-Nature Preschools	1.00	0.00	1.00	0.00	0.80	0.45
Plastic on the Ground	0.11	0.33	0.17	0.39	0.43	0.53
Nature Based Preschools	0.33	0.58	0.25	0.50	0.50	0.71
Non-Nature Preschools	0.00	0.00	0.13	0.35	0.40	0.55
Total	7.33	1.80	7.33	1.61	6.00	2.71
Nature Based Preschools	7.33	1.53	6.50	2.38	4.50	3.54
Non-Nature Preschools	7.23	2.07	7.75	1.04	6.60	2.51

Game 2A: Environmental Awareness

For the third game in the study, children were provided with nine natural resources (e.g., river, garden, truck, and cow) and nine corresponding items (e.g., fish, carrots, and milk). To receive a correct answer, the item must be matched to its natural resource to be considered as environmental awareness (Giusti *et al.,* 2014). If the participant matches a corresponding item to 'Truck' or 'Money', then these answers will be recognized as no environmental awareness (Giusti *et al*., 2014). Additionally, if the participants matched the wrong natural resource to the corresponding items, the answer would be recognized as no environmental awareness (e.g., 'garden' with 'fish'). To see the full spread of this data, the participants answers were noted in two groups: the first group contained all the answers that showed environmental awareness (including 'Truck' and 'Money'), and the second group contained all the answers with environmental awareness not including 'Truck and Money' (Table 3). The answers were

recorded in this manner to see how the spread of environmentally aware versus environmentally unaware answers change once the 'Truck' and 'Money' answers are removed.

The results for game 2A display 7/30 participants as environmentally unaware with 'truck' and 'money' as wrong answers, with 6/30 environmentally aware participants (Table 3). In total, only 21% of the participants are considered as environmentally aware when 'truck' and 'money' are considered as incorrect answers; whereas 50% of the participants were environmentally aware when truck and money were considered as correct answers (Table 3).

Table 3 Results from Game 2A: provisions of ecosystem services measuring environmental awareness (n=30).

	environmentally unaware	weak environmental awareness	average environmental awareness	strong environmental awareness	environmentally aware
Correct Answers	< 2	2 - 4	5	6 - 7	≥ 8
Awareness (including Truck and Money as incorrect answers)	7	10	2	5	6
Awareness (including Truck and Money as correct answers)	0	6	2	8	14

When analyzing the results of game 2A between nature-based and non-nature-based participants, both groups hold the same mean for environmentally aware answers when 'truck' and 'money' are considered incorrect (M = 8.33, SD = 0.58). Although, when looking at environmentally unaware answers for 'truck' and 'money' as incorrect answers, the nature-based participants had no environmentally unaware answers, yet the non-nature-based children had much weaker answers (M = 0.80, SD = 0.45; Table 4). This could be a significant difference as this implies that a large portion of non-nature-based participants correct answers involved trucks

or money; thus, implying that they could be more environmentally unaware. This could be due to non-nature-based preschool children having a more challenging time identifying which items matched with natural resources; or that they struggle to conceptualize the things we use coming from sources other than trucks and money. This could be attributed to egocentric answers as these non-nature-based preschool participants may struggle to recognize more than one viewpoint of these items — i.e., that water can come from both the river and a truck (Kail and Barnfield, 2015).

Table 4 Results from Game 2A: comparing the mean environmental awareness of participants who attend nature-based (n=9) versus non-nature-based preschools (n=21).

| | Awareness (Truck and money as incorrect answers) | | | | Awareness (Truck and money as correct answers) | | | |
| | Nature Based | | Non-Nature Based | | Nature Based | | Non-Nature Based | |
	M	SD	M	SD	M	SD	M	SD
Environmentally Unaware (<2 Correct Answers)	0.00	0.00	0.80	0.45	0.00	n/a	0.00	n/a
Weak Environmental Awareness (2-4 Correct Answers)	2.67	0.58	2.80	1.10	4.00	n/a	3.00	0.71
Average Environmental Awareness (5 Correct Answers)	5.00	n/a	5.00	n/a	5.00	n/a	5.00	n/a
Strong Environmental Awareness (6-7 Correct Answers)	0.00	n/a	6.60	0.55	6.33	0.58	6.33	0.58
Environmentally Aware (≥ 8 Correct Answers)	8.33	0.58	8.33	0.58	8.50	0.58	8.60	0.52

When analyzing the responses from game 2A between ages three, four, and five; it is apparent that the five-year-old's struggled most to identify 'money' and 'truck' as incorrect

answers. This is because when looking at the environmental awareness of the age five cohort, for

truck and money as awareness (correct answers), significantly higher scores were in this category

(M = 8.67, SD = 0.58); then when compared to truck and money as no awareness (incorrect

answers) with no correct answers (M = 0, SD = n/a - no one answered ≥ 8 answers correct (Table

5). This is significant as when examining three-year-old participants, the environmental

awareness for truck and money as awareness is quite similar (M = 8.60, SD = 0.55), to that of

truck and money as no awareness (M = 8.00, SD = 0.00).

Ultimately, this may imply that three-year-old's have a better understanding of

environmental awareness than five-year-old's; however, due to the narrow scope of the sample

population, this cannot be concluded. This skew in data may also represent the size of both age

cohorts as there were 9 participants who were age three, and only 5 participants who were age

five at the time of data collection.

Table 5 Results from Game 2A: comparing the mean awareness of participants who are age three (n=9), age four (n=12), and age five (n=7).

| | Awareness (Truck and money as incorrect answers) | | | | | | Awareness (Truck and money as correct answers) | | | | | |
| | Age Three | | Age Four | | Age Five | | Age Three | | Age Four | | Age Five | |
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Environmentally Unaware (<2 Correct Answers)	1.00	n/a	0.33	0.58	0.67	0.58	0.00	n/a	0.00	n/a	0.00	n/a
Weak Environmental Awareness (2-4 Correct Answers)	2.67	1.15	3.00	1.00	2.50	0.71	3.50	0.71	3.00	n/a	3.00	1.00
Average Environmental Awareness (5 Correct Answers)	5.00	n/a	5.00	n/a	0.00	n/a	0.00	n/a	5.00	0.00	0.00	n/a

Strong Environmental Awareness (6-7 Correct Answers)	7.00	0.00	6.00	0.00	7.50	0.71	6.50	0.71	6.33	0.58	6.00	n/a
Environmentally Aware (≥ 8 Correct Answers)	8.00	0.00	8.67	0.58	0.00	n/a	8.60	0.55	8.50	0.55	8.67	0.58

Game 2B: Environmental Awareness

The results of this game display that the participants consistently view animals getting hurt the same amount in regard air pollution, ground pollution, water pollution, and the cutting down of trees (Fig. 7, Fig. 8, Fig. 9, and Fig. 10). Additionally, the participants viewed animals as getting hurt the most by air pollution (19/30), and ground pollution (21/30). The participants also viewed that animals and people can get hurt the same by cutting down trees (18/30, Fig. 10); as well as the participants view animals, people, and cars as getting hurt the same by water pollution (16/30, Fig. 9). It is increasingly important to note that although the participants consistently viewed people as being hurt the most, the participants view 'you'/themselves as getting hurt the least by air pollution (14/30, Fig. 7) and ground pollution (13/30, Fig. 8). Regarding themselves, more participants view 'you' as not being able to get hurt (no awareness) by air pollution (16/30, Fig. 7), ground pollution (17/30, Fig. 8), and water pollution (16/30, Fig. 9). As many participants were able to view 'people' as getting hurt by these types of pollution, but not themselves; this could potentially be due to the egocentrism of viewing something happening to someone else on yourself and the struggle to view a concept from multiple perceptions (Kail and Barnfield, 2015). Additionally, this could also be due to self-deception as a result of threatening thoughts where oneself is perceived to feel not-secure; therefore as a form

of self-protection they view themselves in an optimistic light (Paulhus, 1984). This is further perpetuated using impression management, where children (or adults) may deliberately lie to not be perceived as weak (Paulhus, 1984; Oerke and Bogner, 2011). Thus, children may want to be perceived as strong because of the fear of air pollution, ground pollution, water pollution, and the cutting down of trees.
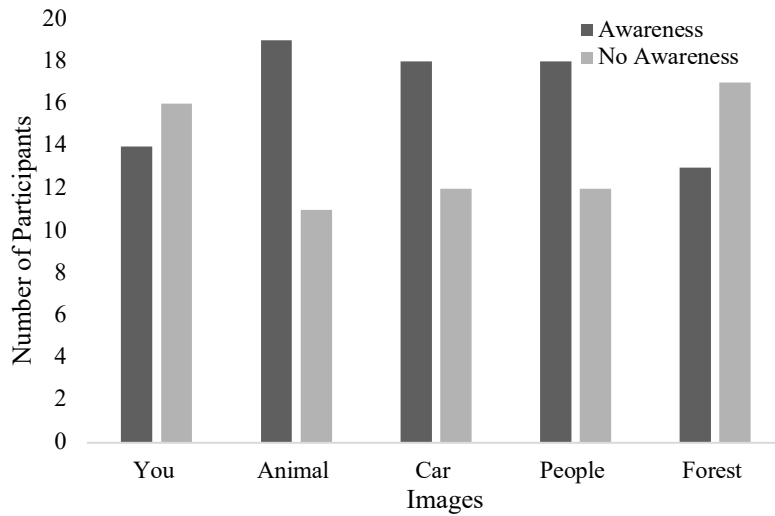

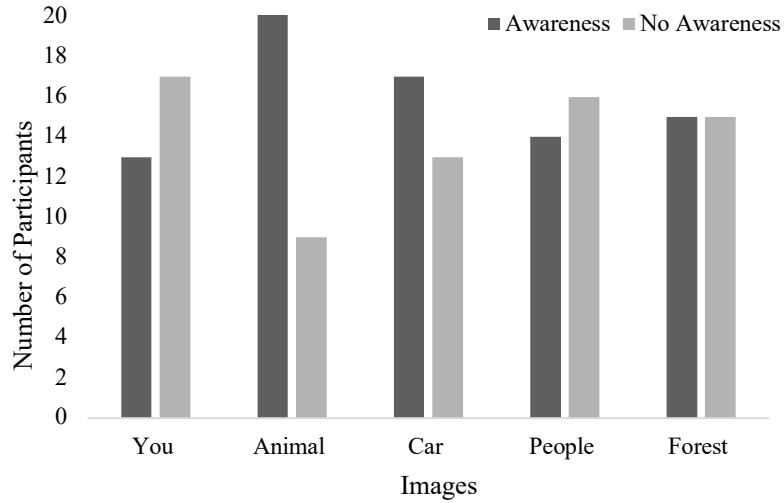Figure 7 Results for air pollution from Game 2B: measuring environmental awareness (n=30).

Figure 8 Results for ground pollution from Game 2B: measuring environmental awareness (n=30).
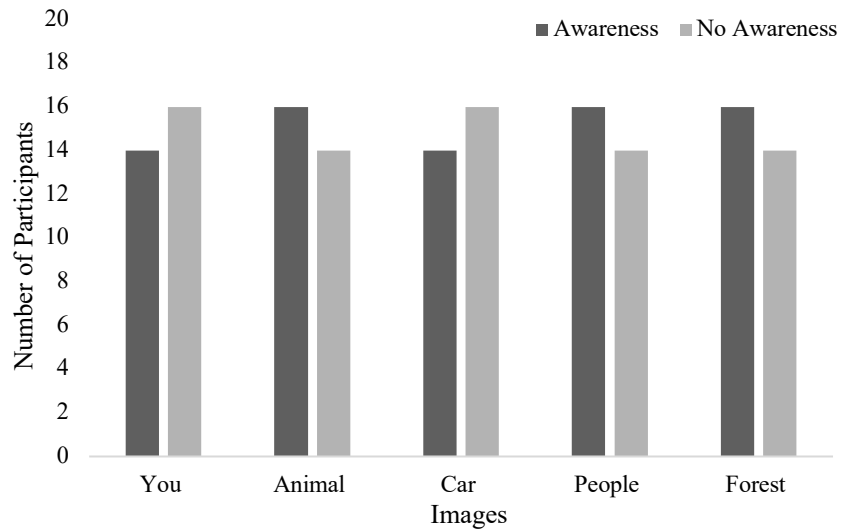
Figure 9 Results for water pollution from Game 2B: measuring environmental awareness (n=30).
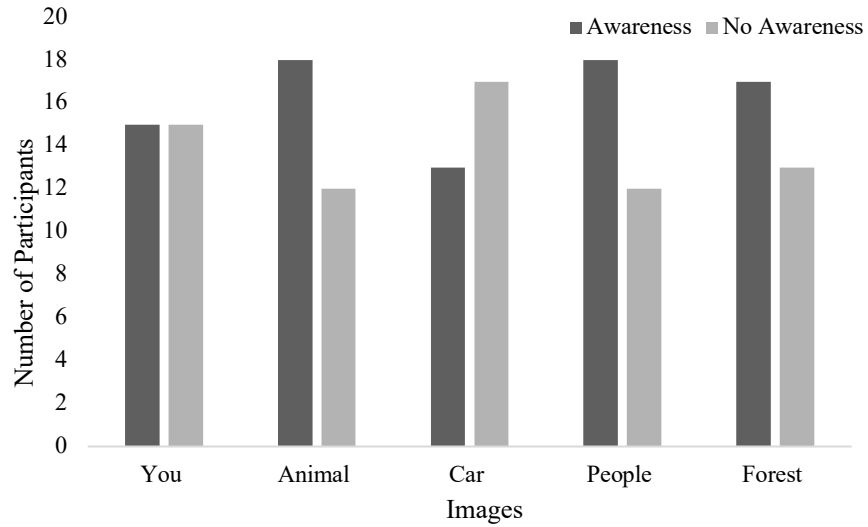
Figure 10 Results for cutting down trees from Game 2B: measuring environmental awareness (n=30).

When analyzing the results from game 2B for differences in the environmental awareness of nature-based participants versus non-nature-based participants, nature-based participants view you (themselves) as able to get hurt more than non-nature-based children, except for water pollution (Table 6). Although, non-nature-based children were able to identify people as able to get hurt more than nature-based children for every pollution (Table 6).

Table 6 Results from Game 2B: comparing the mean environmental awareness of participants who attended nature-based (n=9) versus non-nature-based preschools (n=21).

	Nature Based Schools		Non-Nature Based Schools	
	M	*SD*	*M*	*SD*
Air Pollution				
You	0.56	0.53	0.43	0.51
Animal	0.78	0.44	0.57	0.51
Car	0.56	0.53	0.33	0.48
People	0.56	0.53	0.62	0.50
Forest	0.67	0.50	0.33	0.48
Ground Pollution				
You	0.44	0.53	0.43	0.51
Animal	0.89	0.33	0.62	0.50
Car	0.44	0.53	0.43	0.51
People	0.33	0.50	0.52	0.51
Forest	0.56	0.53	0.48	0.51
Water Pollution				
You	0.44	0.53	0.48	0.51
Animal	0.56	0.53	0.52	0.51
Car	0.56	0.53	0.52	0.51
People	0.44	0.53	0.57	0.51
Forest	0.44	0.53	0.57	0.51
Cutting Down Trees				
You	0.56	0.53	0.48	0.51
Animal	0.78	0.44	0.52	0.51
Car	0.67	0.5	0.52	0.51
People	0.56	0.53	0.62	0.50
Forest	0.67	0.50	0.52	0.51

Through observing the results of game 2B for differences amongst the cohorts of age three, age four, and age five; the results were extremely skewed. For air pollution, children aged three view animals, people, and themselves as being hurt less by air pollution than children aged four and five (Fig. 11). This is the opposite to ground pollution as children who are 3 years old viewed animals as being hurt significantly more than the other children (M = 0.78, SD = 0.44). Additionally, children who are 3 years old in the study believe that animals are hurt more by

water pollution than children ages four and five (M = 0.67, SD = 0.50). Within the realm of air pollution, there is a clear upscale trend in the ability of each You, People, and Animal to get hurt (Fig. 11). This could be explained through the increase an environmental awareness over this age group as children are able to understand more developed concepts such as pollution at an older age.
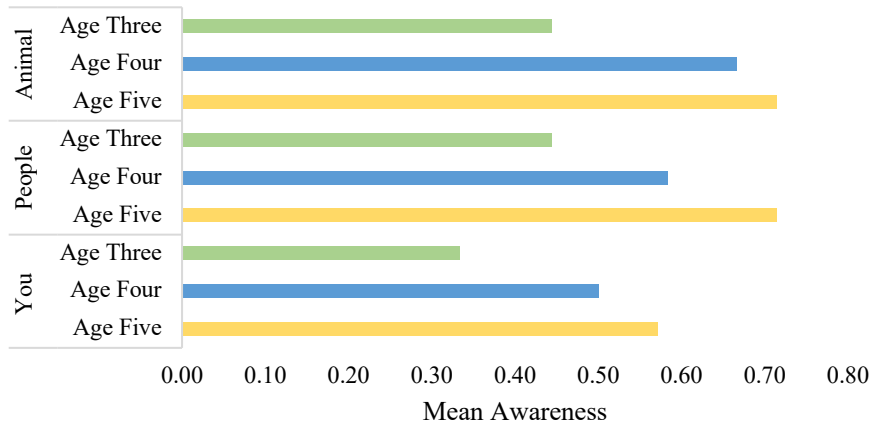

Figure 11 Results for air pollution from Game 2B: comparing the environmental awareness of participants who were age three (n=9), age four (n=12) and age five (n=7).
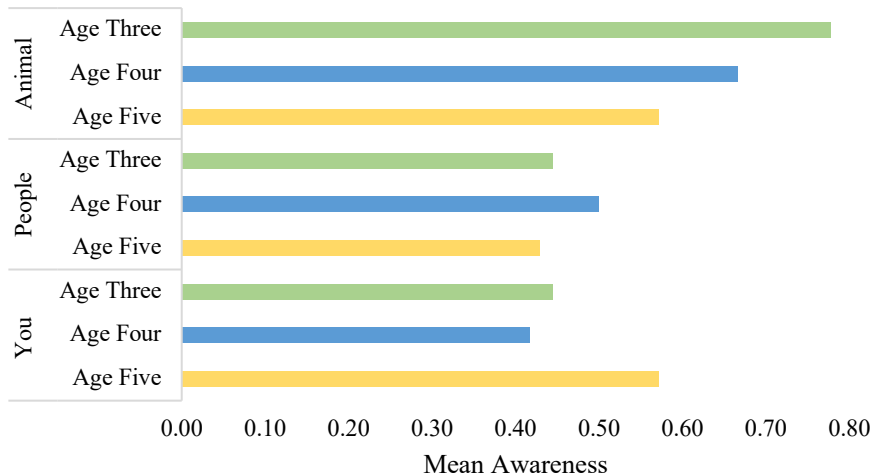
Figure 12 Results for ground pollution from Game 2B: comparing the environmental awareness of participants who are age three (n=9), age four (n=12) and age five (n=7).
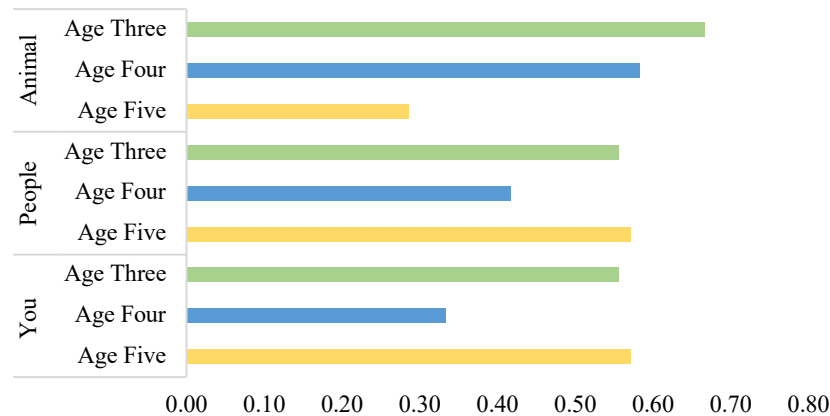
Figure 13 Results for water pollution from Game 2B: comparing the environmental awareness of participants who are age three (n=9), age four (n=12) and age five (n=7).

Games 3A and 3B: Environmental Preferences

The final two games of the testing tool, game 3A and 3B, measured the children's environmental preferences through asking them questions regarding where they play, where they like to play the most, and where they feel safe to play; and where they do not play, where they do not like to play the most, and where they do not feel safe to play.

Game 3A

The results for game 3A are standard in which most children answered either playground or indoors for all questions. The results from game 3A question one indicates that a high majority of children prefer to play on the playground (20/30, Fig. 14), with indoors being the second highest preference (7/30, Fig. 14). For question two, the results indicated that most children prefer to play the most inside (10/30, Fig. 14) and secondly prefer to play at the playground (7/30, Fig. 14). The final question illustrates that most children feel the safest playing indoors (12/30, Fig. 14) or at the playground (10/30, Fig. 14).
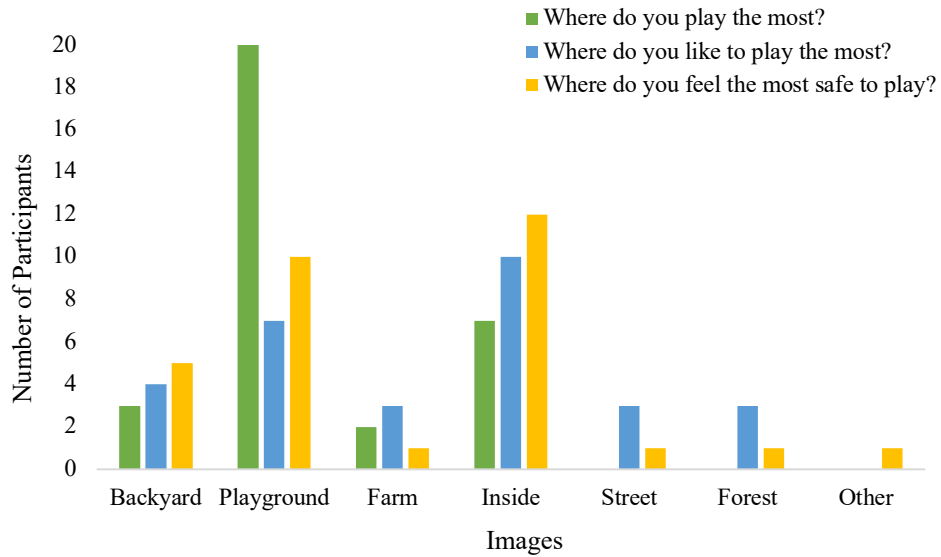
Figure 14 Results from Game 3A: measuring environmental preferences (n=30).

Game 3B

The results from game 3B question one indicates that most children do not like to play on the street (12/30, Fig. 15) or in the forest (9/30, Fig. 15). These results are identical for question two, displaying that most children do not like to play the most on the street (12/30, Fig. 15), or in the forest (9/30, Fig. 15). For question three, the participants did not feel safe to play on the street (13/12, Fig. 15) or in the forest (8/30, Fig. 15).
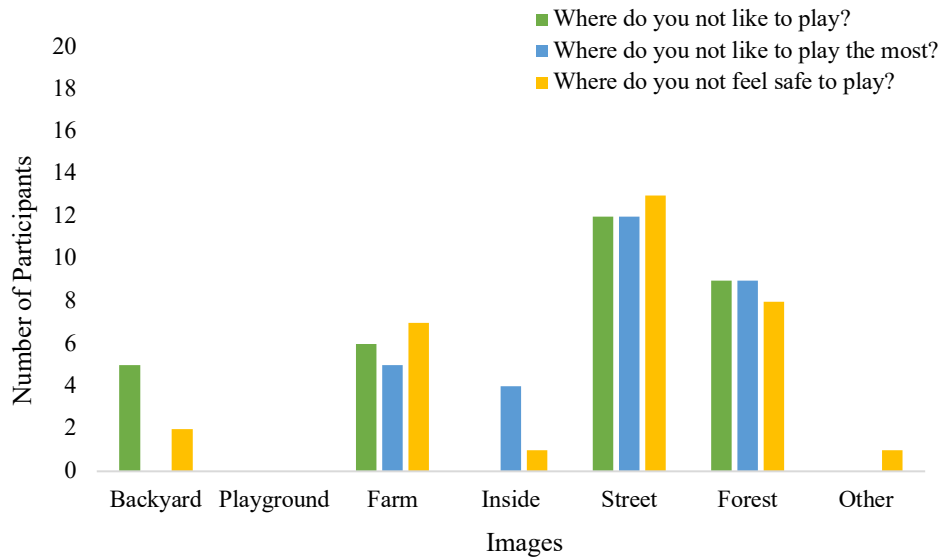
Figure 15 Results from Game 3B: measuring environmental preferences (n=30).

Compared to MacKeen (2020), there were a lack of response from participants to want to play inside the forest, and most of these participants viewed the forest as somewhere they would not like to play. This could be a result of the higher population of non-nature-based children (21/30) in this study versus the number of nature-based children (9/30).

Chapter Summary

This thesis sought to analyze the environmental knowledge and connection to nature using a games testing tool amongst preschool (3-5-years-old) in Halifax, NS, Canada. This research sought to contribute to the testing of these children, as well as conduct a comparison on age and preschool curriculum. Although in most cases age and attendance to a nature-based versus non-nature-based school did not make a difference regarding environmental knowledge and connection; there were many perceived differences between the groups. Although

determining these exact differences is beyond the group of this thesis, ideas within the realm of environmental psychology as well as the stages of psychological development within preschool aged children may explain these differences.

Conclusion

This study was developed in response to previous research conducted by MacKeen (2020), which improved the original Giusti *et al.* (2014) games testing tool through modifications of the geographical and cultural appropriateness for use in Halifax, Canada, and age appropriateness of the tool for preschool (3-5-year-old) children. Through the modifications made by MacKeen (2020), further research was required to increase the use of the tool within Halifax, NS, Canada. Additionally, increased examination of differences amongst the preschool children was required to determine trends amongst the sample population in regard to age and the attendance to nature-based versus non-nature-based preschools. Through this need for research as recommendations by MacKeen (2020), this research sought to answer the follow research questions:

1. Using the modified Giusti *et al.* (2014) games testing tool, to what extent do the children in this study demonstrate environmental sensitivity, environmental awareness, and environmental preferences?

    a. Are there differences in the environmental knowledge and connection to nature of participants who are enrolled in nature-based curriculum versus non-nature-based curriculum preschools?

    b. Are there differences in the environmental knowledge and connection to nature of participants of aged three, four and five?

To answer these research questions, literature was consulted, a pilot study was conducted, and a comparison occurred to assess the perceived differences in environmental knowledge and connection to nature of preschool curriculum and age of the children.

Recommendations

This study presented many areas for further and more extensive research. First, more studies should be conducted using the games testing tool on populations within Halifax, NS, Canada to determine further data on the environmental knowledge and connection to nature of 3-5-year-old preschool children.

Second, further research must investigate the if there are statistical differences in environmental knowledge and connection to nature of nature-based versus non-nature based preschool children.

Third, further research is necessary to determine if there are statistical differences in the environmental knowledge and connection to nature between preschool children of age three, age four, and age five.

Finally, use of the tool must be conducted on a more general and larger population to gain further insight into the environmental knowledge and connection to nature of preschool children, therefore, further outreach is needed when collecting study participants.

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Appendices

Appendix I: Modified Research Instrument, MacKeen (2020) (Games Testing for Emotional, Cognitive and Attitudinal Affinity with the Biosphere, Giusti *et al.,* 2014)

Overarching Recommendations

1. If possible, bring an assistant to help with recording the results;
2. It is advised that each session be audio-recorded upon consent from the parent(s)/guardian(s) of each participant;
3. Enlarge the suggested tables to poster size to establish a game board;
4. Enlarge the loose pictures to an appropriate size to use as game pieces;
5. Play one game at a time to allow for clarity for the participants;
6. Shuffle the loose cards in between participants for games 1A and 2A;
7. Finally, have a dance party, tell some knock-knock jokes, and/or have a puppet on hand to facilitate breaks in between games if the participant is losing interest or at the end of the session for some additional fun (not necessary if the participant is engaged).

Before Starting the Games Testing

The opening exercise will have the child draw a picture of themselves on a blank square piece of paper (this piece of paper should be the same size as the cut outs for game 1A). This is a great ice breaker, and the picture will be used later in game 2B.

- Begin by explaining the task to the child:
    o Example: "Before we start, I would like you to draw a picture of yourself on this piece of paper".
- Set this picture aside, so it can be used later in game 2B.

It is essential to go over the concepts of dirty water (water pollution), dirty/smoky air (air pollution), and dirty ground (ground pollution) briefly without iterating the environmental issues and consequences associated with each one. This will allow the children to have some understanding, without creating bias in the answers received from each participant. Examples are as follows:
- Example of explanation: "Before starting the games, I am going to go over some ideas that you will see today";
- Example for dirty water: "Dirty water can happen when trash and chemicals get in the water";

- Example for dirty/smoky air: "Dirty or smoky air can happen when too many harmful gases and smoke are in the air";
- Example for dirty ground: "Dirty ground can happen when garbage gets into the environment".

These phrases can be referred to upon conducting the games that involve these challenging concepts (Game 1B and Game 2B). Thus, giving the child some understanding without saying it in a way that will influence their responses.

Section 1: Environmental Sensitivity

Game 1A

Recommendations:

It is advised that the researcher enlarges, prints, and laminates the pictures found in the table below. Additionally, it is advised that the researcher bring two separate containers to make yes and no bins, to facilitate sorting (may be beneficial to use a green coloured checkmark and a red coloured 'x' alongside the "yes" and "no" signs, as some children respond best to visual cues). Finally, another option to keep the child engaged is to place the bins on opposite sides of the testing area, allowing the game to have a task and movement. If this is the case, then it is advised that the researcher explains the bins to each participant before beginning the game.

Instructions:

1. Begin by explaining the exercise to the child:
    a. Example: "In this first game, I will hand you a picture and ask if the thing in the picture can feel an owie or get hurt, and then you will sort them into the yes or no bins (demonstrate while explaining)";
2. Show the child one picture after the other from the table below (laminated cut-out versions of the pictures). For every picture, ask they/them:
    a. Example: "Can (ex. a tree) go owie? Can (this picture) get hurt?";
3. For each picture, ask the child to sort their answer either in the yes bin or the no bin, allowing the child to partake in a sorting exercise;
4. Therefore, the game result will be a simple list of "yes" and "no" matching each picture in the table below;
5. Record the results on the scoresheet as "yes" or "no";
6. Note: It is important to shuffle the loose cards in between participants.

Tree	Chicken	Bike
Bird	**Reindeer**	**Airplane**
Cut Down Tree	**Car**	**Fish**

Game 1B

Recommendations:

It is advised that the researcher prints and laminates an enlarged version of the table. Additionally, it is recommended that nine of each of the happy and sad smiley faces are enlarged, printed, and laminated so the children can place them on top of the pictures.

Instructions:

1. Begin by explaining the exercise to the child:
   a. Example: "We are going to play a game of happy and sad faces, and I would like you to put a happy smile or sad face on each photo you see here (demonstrate while explaining)";
2. Then for each picture, have a smiley and sad face in your hands providing the child with the option to pick and place one or the other on top of each picture (there will be a total of 18 happy and sad face cut outs);
3. Ask the child to place a happy or sad face image on top of each of the pictures in the table below one after the other (you could use your finger to point to each picture);
   a. Example: "We'll start with dirty water, which smiley would you like to place there (the researcher should have both a happy and sad face in their hand)?"
   b. The researcher must ensure that they do NOT ask any questions to the child and do NOT explain what the picture means;
4. Record results on the scoresheet as "happy" or "sad" smile.

"Happy smile" and "sad smile"

Dirty Water	Dirty or Smoky Air	Watering Plants

Dirty Ground	Cleaning up	Cutting Down Trees
Dirty or Smoky Air	**Planting a Tree**	**Plastic on the Ground**

Section 2: Environmental Awareness

Game 2A

Recommendations:

It is advised that the researcher enlarges, prints, laminates, and cut out *List 1* found below (cut outs similar to Game 1A). Then, similar to the previous game (1B), enlarge, print, and laminate the pictures in *List 2*. This exercise is a matching game.

Instructions:

1. Place the table with the pictures from *List 2* in front of the child and pile the pictures from *List 1*. Then begin by explaining the exercise:
   a. Example: "In this game, I am asking you to match a picture from *List 1* with a picture from *List 2* (demonstrate while explaining)";
2. Show the child one picture at a time from *List 1* and ask they/them to find a picture among the ones already placed in front of they/them (*List 2*) and ask they/them to answer:
   a. "What do you need to have (this picture)?", then ask "why did you match those two pictures";
   b. Example: "What do you need to make a picnic table?", and then ask, "why did you match those two pictures?";
3. What the picture represents must be clearly stated to make the child understand:
   a. Example: the image is a "WOODEN table" or that the image represents

"BLUEBERRIES" and not every kind of berry;

4. Continue this process for every image in *List 1*;
5. Record which item from *List 1* was paired with in *List 2*. To the question "Why?" the child does not have to select any picture, but reply in words, this implies that researchers must synthesize it and write down children's answers in the scoresheet;
6. Note: It is important to shuffle the loose cards in between participants.

List 1		
Picnic Table	**Eggs**	**Tuna can**
Carrots	**Glass of milk**	**Tap water**
Wool hat	**Paper**	**Blueberries**

List 2		
Wood	**Fish**	**Cow**
Chicken	**Garden**	**Money**
River	**Truck**	**Sheep**

Game 2B

Recommendations:

It is advised that the researcher enlarges, prints, and laminates the pictures found in the table below, *List 1* (cut outs similar to Game 1A). Comparable to the previous Game 1B, it is recommended that the researcher organizes the pictures from *List 2* into a table, as well as to enlarge, print, and laminate the table. *The picture that the child drew of themselves at the beginning of the testing should be placed under the "you" category in *List 2* along with three other cards that have the word "YOU" written on them.

Additionally, bring enlarged, printed, and laminated versions of each individual (3 of each) picture in *List 2*. Finally, utilize the bins from Game 1A to facilitate the sorting of the "yes" and

"no" segment (may be beneficial to use a checkmark and an 'x' alongside the "yes" and "no" signs, as some children respond best to visual cues).

Instructions:

1. Begin by explaining the exercise to the child:
   a. Example: "In this game, I will first ask you to explain what you see, and then I will ask you if the picture I show you (from *List 1*) can hurt each of the pictures in *List 2* by getting you to sort them into the yes or no bins again (demonstrate while explaining)"; Part 1:
2. Show the child one picture from *List 1* (representing different kinds of pollution) and place it visibly in front of they/them. The picture should NOT be explained again at this time;
3. Ask the child what the environmental issue (from *List 1*) means and record their answer:
   a. Example: "What is air pollution/dirty air?";
4. For this question the child does not have to select any picture, but reply in words, this implies that researchers must synthesize it and write down children's answers in the scoresheet.
5. After the first step is complete, place the pictures (*List 1*) and table (*List 2)* in front of the child;

Part 2:

6. Then show the child by pointing, one after another, at the images in *List 2* and ask they/them for every set of pictures the following and record their answer:
   a. "Can (the first picture) hurt (the second picture)/make (the second picture) go owie?";
   b. Example: "Can (ex. dirty or smoky air) hurt (ex. an animal)/make (ex. an animal) go owie?";
   c. If the child says "yes", encourage them to place it in the "yes" bin and vice versa;
   d. Then move onto the next photo from *List 1* and go through each item in *List 2*:
7. The game will result in a simple list of "yes" and "no" for each picture in *List 1* corresponding to each set of pictures in *List 2*. Record the results on the scoresheet.

List 1

Dirty or Smoky Air	Dirty Ground	Dirty Water	Cutting Down Trees

List 2

You	Animal	Car	People	Forest

Section 3: Environmental Preferences

Game 3A

<u>Recommendations:</u>

It is advised that the researcher prints and laminates an enlarged version of the table. It is important to note that the participants <u>are allowed to pick as many options</u> as they would like for each question provided below.

<u>Instructions:</u>

1. Begin by explaining the exercise and saying what each of the pictures in the table are:
    a. Example: "I am going to show a table of pictures and ask you some questions that will require you to pick a photo (demonstrate while explaining)";
    b. Then go through the table and say what each picture is:
        i. Example: "This is a picture of children playing in a backyard, this is a picture of a playground, etc.";
    c. Example: "Then I will ask you questions, such as where do you usually play the most? And I would like you to pick a picture from this table."
2. Place the table of pictures in front of the child and ask they/them to select from the pictures to answer the following questions:
    a. Question 1: "Where do you play the most?" and "Why?"
    b. Question 2: "Where do you like to play the most?" and "Why?"
    c. Question 3: "Where do you feel the most safe to play?" and "Why?"
3. First record where they play on the scoresheet. To the question "Why?" the child does not have to select any picture, but reply in words, this implies that researchers must synthesize it and write down children's answers in the scoresheet.

Backyard	Playground	Farm
Inside	Street	Forest
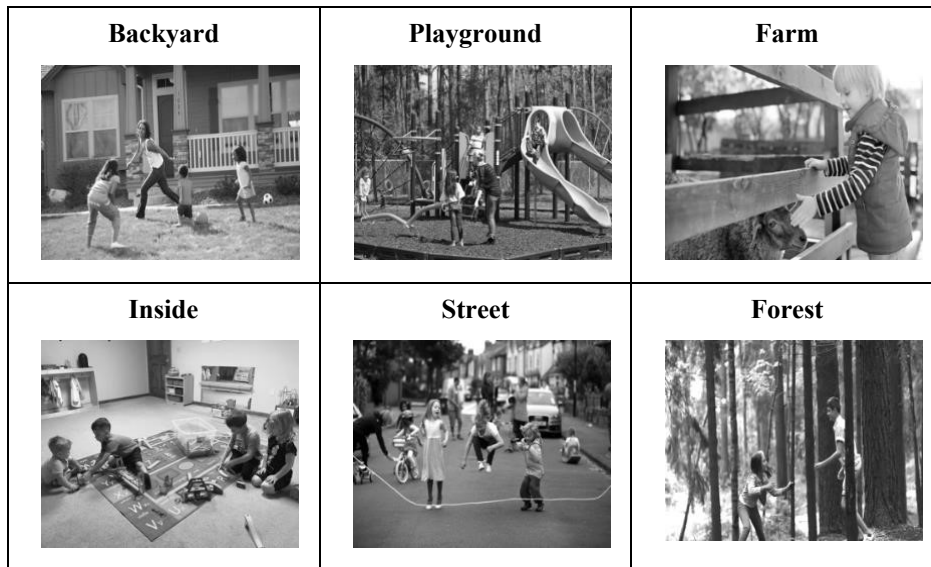
Game 3B

Recommendations:

It is advised that the researcher uses the same table of pictures from Game 3A. It is important to note that the participants <u>are allowed to pick as many options</u> as they would like for each question provided below.

Instructions:

1. Begin by explaining the exercise to the child:
    a. Example: "This game will be similar to the last one (Game 3A), where I will ask you questions, and you will point to a photo in the table (demonstrate while explaining)";
2. Place the table of pictures in front of the child (from Game 3A) and ask they/them to select from the pictures to answer the following questions:
    a. Question 1: "Where DO you NOT like to play?" and "Why?"
    b. Question 2: "Where DO you NOT like to play the most?" and "Why?"
    c. Question 3: "Where DO you NOT feel safe to play?" and "Why?"
3. First record where they play on the scoresheet. To the question "Why?" the child does not have to select any picture, but reply in words, this implies that researchers must synthesize it and write down children's answers in the scoresheet.

Debrief

After completing the games testing with the participant, it is recommended that the researcher debriefs the child by explaining pollution in simple terms. It may be beneficial to bring materials along with you, such as a jar showing clean water and a jar showing dirty water.

- Go over dirty water (water pollution), dirty ground (ground/soil pollution), and dirty or smoky air (air pollution); o <u>Example:</u> "Today we have been talking about different kinds of pollution. I will now go over these ideas with you. If you have any questions, please ask";
    - o <u>Example of water pollution</u>: Water pollution can happen when waste and chemicals are found in a body of water (e.g., the ocean or river). The waste and chemicals can make the water not safe for fish and other animals to live in;
    - o <u>Example of ground pollution</u>: Ground pollution can happen when garbage is found in the environment (e.g., on the side of the road or on the ground). When garbage gets into the environment it can cause health problems for animals and humans;
    - o <u>Example of air pollution</u>: Air pollution can happen when too many chemicals and harmful gases are in the air. This can cause the air to become smoggy or have a smoky look to it and can cause health problems for animals and humans (e.g., makes it hard to breathe).
    - o <u>Example of cutting down trees</u>: Deforestation can happen when humans take too many trees from the forest. This can have a negative impact on the wildlife and ecosystems in the forest.
- Finally, ensure to ask the participant again if they have any questions.

Appendix II: Initial Recruitment Email Sent to Halifax Preschool(s), Montessori School(s), and Local Non-Profit Environmental Organization(s)

Warmest Greetings!

My name is Tarah Wright. I am a Full-time Professor in the Earth and Environmental Sciences Department at Dalhousie University and the Director of the Education for Sustainability Research Group. Currently, I am also a lead researcher working on a project that is looking at assessing a bioaffinity (one's love of/for or connection to nature) test with 3-5-year-old children.

The tool that we want to pilot test aims to examine the influence of different outdoor and indoor natural exposures in a preschool's curriculum on children's affinity with the biosphere, by using a questionnaire which is called "Modified Research Instrument: Games Testing for Emotional, Cognitive and Attitudinal Affinity with the Biosphere". In a previous study, we successfully modified the tool to become more appropriate for Canadian 3-5-year-olds. Working with Jessica MacKeen, a master's student at Dalhousie University, and Hope Moon and Honours student in Environmental Science, we are determining the validity (ensuring that the tool does what it intends to do) and reliability (ensure that the test gets the same outcome after repeated trials) of the modified tool and pilot test the new tool to test for validity and reliability. In order to test validity and reliability of the refined tool, we are looking to test it with a cohort of 3–5-year-old preschoolers (30 children in total). By completing this study, we hope to further determine the appropriateness of the measure for younger children and prepare the tool for future use by confirming whether the tool can produce trustworthy and generalizable data. Further, once the reliability and validity testing are established, we will analyze the bioaffinity results of the Halifax participants to determine their emotional, cognitive, and attitudinal affinity with the biosphere. In addition, a survey of the parents of the children enrolled in the study will be conducted to determine whether outside influences like time spent in nature outside of school has an impact on the children's overall bioaffinity.

With this in mind, we would like to request permission to send an invitation email to the parent(s)/guardian(s) of the preschool children attending your school for voluntary participation of their children and themselves as a pair in the study. If permission is granted, we would like to ask that the invitation comes directly from you and/or the teacher who leads the preprimary class(es).

Please let me know if you have any questions or concerns. Thank you for your consideration in advance. You may contact me by responding to this e-mail or by calling me at 902-497-1831.

Respectfully yours,
Tarah Wright, Ph.D.
Dalhousie University
Environmental Science
1355 Oxford St.

Appendix III: Initial Recruitment Email sent to the Parent(s)/Guardian(s) of the Preschool Children

Dear parents,

This email is to invite you to consider you and your child's participation together in a research study called "Determining the Validity and Reliability of a Modified Games Testing Tool to Evaluate the Bioaffinity of Preschoolers". This study is being conducted by myself, Dr. Tarah Wright, and my research assistant Jessica MacKeen who is a master's student at Dalhousie University. In addition, Hope Moon, an undergraduate research assistant, will be completing their Honours degree at Dalhousie and will be supporting the project.

If you and your child agree to participate in the study, your child will be asked to complete a set of games. While your child is playing the games, you will be asked to fill out a survey about your family's activities and demographic information. Taking part in the study is up to both of you; it is entirely your choice. You and your child's participation is voluntary and remains voluntary throughout the entirety of the study. The testing with your child will be held at an outdoor location on Dalhousie University campus to allow for physical distancing, and the testing material will be laminated to allow for sanitization in between each participant. You can choose to fill out the survey in whatever location is most comfortable for you while your child is being tested (i.e. you should feel free to take the survey away to a coffee shop, or anywhere else that works for your situation).

You and your child's participation will be required for roughly 15-35 minutes. Upon completion of the games testing, your child will receive a Certificate of Achievement, and we will offer you one $25.00 gift card to Woozles children's store for your collective participation in the study.

It is important to note that you and your child's participation is completely voluntary. This research is not being done nor is endorsed by the Director or the teachers sending this email. The research will be conducted by the Research Assistant, Jessica MacKeen, who is master's student attending Dalhousie University and Ms. Hope Moon under the direction of Dr. Tarah Wright.

For further explanation, we ask you to read the information bulletin attached to this email. We have also provided a brief biography about the research assistant, Jessica MacKeen, in hope that you gain familiarity with who will help facilitate the testing with your child. If you have any questions about the study, and/or are interested in your child participating in the study, you may contact Tarah Wright, the lead researcher, via responding to this email (tarah.wright@dal.ca) or telephone (902-497-1831). Thank you for considering this request.

Respectfully yours,
Tarah Wright, Ph.D.
Dalhousie University

Environmental Science
1355 Oxford St.
PO BOX 15000
Halifax, NS B3H 4R2

Appendix IV: Information Bulletin for Parent(s)/Guardian(s)

Hello,

My name is Dr. Tarah Wright, I am a Director of the Education for Sustainability Research Group and Full Professor in the Faculty of Science at Dalhousie University.

I am writing you today to see if you will consent to your child being part of a pilot study in which we are testing a tool that aims to measure children's emotional, cognitive and attitudinal affinity with nature (also known as bioaffinity or one's love of nature). The intention is to pilot test our tool to make sure that it is both valid and reliable, and then use the tool for a larger study that will look at whether increase in nature experience in curriculum creates a greater bioaffinity in children.

This is where you and your child come in. We need to pilot test tour tool with 3–5-year-old preschoolers and one of their parents/guardians. If you and your child agree to participate in the study, the child will be asked to complete a set of games. These games are comprised of picture matching, yes/no and short answer questions to which your child can respond by pointing to a picture of a happy or sad face or other images that will be provided. Your child's participation would be required for roughly 15-35 minutes. It is intended for the games to be played at an outdoor location on the Dalhousie University campus to allow for physical distancing, and the testing material will be laminated to allow for sanitization in between each participant.

As for you as a parent, your contribution to the study will involve filling out a single survey. You can choose to fill out the survey in whatever location is most comfortable for you while your child is being tested (i.e., you should feel free to take the survey away to a coffee shop, or anywhere else that works for your situation).

As mentioned in the invitation email, each parent/child group who partake in the games testing will receive a Certificate of Achievement (for your child) and a single $25.00 gift card to Woozle's Children's store. It is important to note, even if you decide to remove yourself and your child from the study after the testing is complete, you and your child will still be compensated.

Throughout the entire research process, you and your child's name and any other information pertaining to their identity will be kept confidential. If you are interested in you and your child participating, we will gladly send you a consent form and my contact information should you have any questions. After signing the consent form you do have the opportunity to withdraw from the study at any point without repercussions. During the testing, if your child decides they do not want to continue participating or becomes uncomfortable during the interview process they are encouraged to tell the researchers and they will be removed from the research setting. Please see the attached consent form for more details on the ethical considerations associated with this study.

A previous study by MacKeen and Wright (in press) used the modified games testing tool that is being asked for your child to be tested with, and studies by Omidvar (2018) and Omidvar et al. (2019) studies used the original testing tool did not have any instances of uncomfortableness occur. However, if your child is fidgeting, cowering away from the testing (looking away, standing by the door wanting to leave, or showing increased signs of uncomfortableness, such as crossing their arms), the researcher will stop and ask the child if they are okay. If the child indicates they merely uncomfortable due to needing to use the washroom, then the Research Assistant and Lead Researcher/Volunteer will handle this accordingly. If the child is unwilling to voice their feelings, then that will be the determinant of stopping the study. To expand on this, if the child becomes increasingly unwilling to participate in the games testing (not responding or looking away), this will facilitate a reason to stop and ask the child is they are okay. Furthermore, if the child does not respond, that will be taken as the child is too uncomfortable to continue the testing, therefore, the child would be returned to the class or to their parent/guardian depending on the chosen study location. Finally, if this was to occur, which it should not as the testing was completed in three separate schools with 20 children in the Omidvar (2018) and Omidvar et al. (2019) and with 9 children in the MacKeen and Wright (in press) study, and this did not happen, the Research Assistant and Lead Researcher/Volunteer would follow up with the parent to ensure the child went back their normal level of comfort upon ending the testing.

If you have any questions or concerns regarding the research process and/or ethical issues, please contact Tarah Wright (at 902-497-1831, tarah.wright@dal.ca) at any time. I will also inform if any new information comes up that could affect your decision to participate.

If you wish for your child to participate in the study, please RSVP to this email. Thanks again for your consideration.

Thank you for your interest,

Respectfully yours,

Tarah Wright, Ph.D.
Dalhousie University
Environmental Science

1355 Oxford St.
PO BOX 15000
Halifax, NS B3H 4R2

Appendix V: Consent form for the Parent(s)/Guardian(s)

Consent Form

Project Title: Determining the Validity and Reliability of a Modified Games Testing Tool to Evaluate the Bioaffinity of Preschoolers

Dear Parent(s)/Guardian(s),

We invite your child to take part in a research study being conducted by Dr. Tarah Wright and research assistants Jessica MacKeen and Hope Moon. Taking part in the research is up to you and your child; it is entirely your choice. Even if you consent to participate, your child will not participate if they do not want to. Both you and your child may leave the study at any time for any reason. It is important to note, even if you decide to remove yourself and your child from the study after the testing is complete, you and your child will still be compensated. The information below tells you about what is involved in the research, what your child will be asked to do and about any benefit, risk, inconvenience or discomfort that your child might experience. Please ask as many questions as you like. If you or your child have any questions later, please contact the lead researcher.

Who is Conducting the Research Study

Principal Investigator:
Dr. Tarah Wright, Full Professor, Dalhousie University, Environmental Science,

tarah.wright@dal.ca

Other researchers:
Jessica MacKeen, Master's Student, Dalhousie University, School for Resource and Environmental Studies,

jmackeen@dal.ca

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Hope Moon is an undergraduate research assistant who is completing their Honours degree at Dalhousie and will be supporting the project as a research assistant.

Hope.moon@dal.ca

Purpose and Outline of the Research Study

This pilot study aims to evaluate the validity and reliability an existing modified psychological games testing tool that has been previously utilized to assess young children and their love of nature (bioaffinity with nature). The games testing tool is called "Modified Research Instrument: Games Testing for Emotional, Cognitive, and Attitudinal Affinity with the Biosphere". The intention is to pilot test our tool to make sure that it is both valid and reliable, and then use the tool for a larger study that will look at whether an increase in nature experience in curriculum creates a greater bioaffinity in children/increased positive relationship with nature. In other words, this project focuses on determining the validity and reliability of the games testing tool and proving it can generate trustworthy, generalizable results and its appropriateness (usability) for testing Canadian preschoolers (3-5-year-old's). In order to prove that the tool is appropriate for future use, psychological measures validity and reliability will be used; validity is whether or not the tool does what it's supposed to do, and reliability is whether or not the results of the tool stay consistent. Furthermore, this study will test the reliability of the modified emotional, cognitive, and attitudinal Games Testing tool with the collected of data from this pilot test. In order to test the validity and reliability of the modified tool, we are looking to test it with a cohort (group) of 3–5-year-old preschoolers. By completing this study, we hope to accomplish (a) assess the modified tool's face and content validity by sending a questionnaire and conducting semi-structured interviews with Bioaffinity, Early Childhood Education and Psychological Testing Tool Experts (b) further refine the modified tool through consultation with Bioaffinity, Early Childhood Education and Psychological Testing Tool experts, and (c) determine the modified tool's internal consistency reliability through pilot testing with preschoolers. By meeting these three objectives we will determine the appropriateness of the measure for younger children, and whether refining the tool accordingly will produce trustworthy and generalizable data resulting in the confirmation that tool is ready for future use. In addition, we will be analyzing the test data collected in games testing with the children to examine their affinity to nature. Finally, we will be using a parent survey to determine whether outside influences (i.e., time spent in nature outside of school), has an impact on the children's overall bioaffinity scores.

Who Can Participate in the Research Study

Participation must occur in adult/child pairs. A pair involves (1) Any junior and senior preschooler, between the ages of 3-5 year, and (2) one parent/guardian of the aforementioned child. Given the age of your child, consent needs to be given by you as their parent/guardian (please see below). Although you are providing consent for participation in this study, please review this document with your child to ensure they also agree to participate.

What Your Child Will Be Asked to Do

To help us determine the appropriateness of the measure for younger children via validity and reliability of the games testing tool, we will ask your child to complete six games which are related to children's cognitive, emotional, and attitudinal bioaffinity. These games will comprise of picture matching games, yes/no and short answer questions that your child can reply with using the picture of happy/sad faces or the images that will be provided. The games will be conducted at an outdoor location on Dalhousie

University campus to allow for social distancing, and the total amount of time needed to perform a complete set of games is ~15-35 minutes. To obtain an accurate and complete report of your child's responses, it is asked that the session be audio-recorded upon permission.

Upon the day of the testing, your child will be asked if they would like to play a game with the researcher. If they agree, the game testing will begin. If not, the researcher will wait awhile and ask the child again. If they still do not want to 'play' with the researcher, then they will not be tested. You are welcome to see a copy of the Games Testing questionnaire and images prior to deciding of signing the consent form. We are aiming to conduct the testing anywhere between June 2021 through September 2021, pending REB approval. Therefore, after consenting to your child's participation specific dates and times can be discussed based on your availability and at your convenience.

What Your Will Be Asked to Do

While your child undergoes the games testing portion of the study (as described in your child's consent form), we will be asking you to fill out a survey (approximately 20-25 minutes) that tries to determine factors outside of school that may influence your child's degree of connectedness with nature. The survey will ask you to describe your child's exposure to natural experiences outside of school time, answer general demographic questions, and will have you rate 16 statements related to your connection with nature.

Possible Benefits, Risks and Discomforts

Parents and children who participate will indirectly contribute to knowledge in the field of formal and non-formal environmental education.

Given the nature of this study, the perceived risks and/or discomforts for participants are minimal. Potential discomforts that may be felt by participants include inability to understand what an interview question is asking them, and/or feeling upset about the pictures related to negative environmental behaviors. For example, children will be asked to answer, "Is this picture (without mentioning air pollution) harmful to animals?". The child will be shown photos of a type of pollution and asked to think about if it would harm an animal, which may result in some children feeling uncomfortable having to think of an animal being harmed by pollution.

In order to address any potential discomfort, the lead researcher will be available to answer any questions the participants may have before, during, and after data collection. In addition, if your child feels uncomfortable, they may leave the study room with no penalty by verbally informing the primary

investigator that they would no longer like to play. It should be noted that none of the pictures used in the set of games contain any example of violence, gore, crime, or depressive component. Since the games are full of different entertaining features, it is anticipated that feelings of boredom and fatigue will not be a problem. However, due to the time commitment, if feelings of boredom and fatigue are noticeable, we will employ the use of puppets or a dance break in hopes to make the games more interactive and enjoyable. If your child decides to discontinue the Games Testing, their data will be destroyed, because a fully completed test is required for the analysis.

Compensation / Reimbursement

Alongside a Certificate of Achievement for your child, the pair of you will be offered one $25.00 gift card to Woozles children's store.

Privacy and Confidentiality

In order to keep personal information confidential, you and your child will only be identified by a participant code. These codes will be alphanumeric codes (e.g., A1, A2, B2). Any identifying information, including names of preschoolers, age and sex, will be kept separately from other data on a password-protected computer within an encrypted file. The final results of the research are to be shared in (a) a thesis format, (b) scholarly publications, (c) a report format, and (d) conference presentations. Any identifying information will not be present in any of these final documents, ensuring that you and your child's identity will always remain private.

In specific instances, a direct quote that you or your child made in the game's process may be used in these final formats. By signing this consent form, you agree that your child's direct quotes may be used within the thesis, publications, report, and/or conference presentations. To reiterate, no identifying information will connect you or your child to these quotes; only the assigned code will be used.

Once all relevant data has been gathered, it will be put into electronic documents and compiled into a computer program called SPSS. This program is popular in social science research as it provides a researcher with the tools necessary to organize, compile, analyze and make connections between different types of data. Games responses will remain in SPSS, on a password-protected computer in a locked research lab on Dalhousie campus to ensure that only the research team has access to this data. Back-up copies of the electronic data will be put on an encrypted external hard-drive that will remain in the locked lab throughout the research process. The hard copies of the games will be stored in a locked filing cabinet on Dalhousie campus.

For the parent survey, once all relevant data has been gathered, it will be put into electronic documents and compiled into an Excel spreadsheet. Survey responses will remain on a password-protected computer in a locked research lab on Dalhousie campus to ensure that only the research team has access to this data. Back-up copies of the electronic data will be put on an encrypted external hard-drive that will remain in the locked lab throughout the research process. The hard copies of the surveys will be stored in a locked filing cabinet on Dalhousie campus.

Upon completion of the study, all data will be cleaned (de-identified) and retained until September of 2022 as encrypted, password-protected data on a secure digital storage, managed and maintained by

Dalhousie University. It is retained until September of 2022 in order to properly analyze the data and illustrate results of the study, after which the data will be destroyed. All paper copies of the answer sheets will be scanned and stored as digital files along with the other data, and the hard copies will be destroyed (shredded and recycled). Audio-recorded data will only be used to supplement the written answers in the score sheet if they are missing or not comprehensible. Transcribed audio will also be retained until September of 2022 as encrypted, password-protected data on a digital storage, managed and maintained by Dalhousie University.

In extreme cases, confidentiality may need to be broken. In particular, with this type of study it must be clear that it is the researcher's legal responsibility to report any information that may indicate a participant has been subjected to abuse or harm to the proper authorities.

Additional information:

You or your child are free to leave the study at any time. If you or your child decides to withdraw from the study after testing is completed, data collected from the testing will be excluded from the study. You can also decide for up to two (2) months if you want us to remove their data. After that time, it will become impossible for us to remove it because it will already be analyzed and published in various academic writings.

We are happy to talk with you about any questions or concerns you may have about your child's participation in this research study. Please contact Dr. Tarah Wright (at 902 497-1831, tarah.wright@dal.ca) at any time with questions, comments, or concerns about the research study (if you are calling long distance, please call collect). We will also tell you if any new information comes up that could affect your decision to participate.

If you have any ethical concerns about your child's participation in this research, you may also contact the Catherine Connors, Director, Research Ethics, Dalhousie University at (902-494-1462), or email: ethics@dal.ca

Finally, we are also recruiting students and parents via snow-ball sampling, which relies on chain referral. If you feel comfortable and know of someone who may be interested in their child participating in this study, please reply back to this email with their information (name and email).

Reference

Giusti, M., Barthel, S., & Marcus, L. (2014). Nature routines and affinity with the biosphere: A case study of preschool children in Stockholm. Children, Youth and Environments, 24(3), 16-42.

Signed Consent

Project Title: Determining the Validity and Reliability of a Modified Games Testing Tool to Evaluate the

Bioaffinity of Preschoolers

Lead Researcher: Dr. Tarah Wright, Dalhousie University, 902 497-1831, tarah.wright@dal.ca

Please read the following statement before signing the consent form:
I have read the explanation about this study. I have been given the opportunity to discuss it and my questions have been answered. I agree that my child and I will take part in this study. My child and I understand that participation is voluntary and that we are free to leave the study at any time. I understand that direct quotes from the study may be used in the final report. If used, direct quotes will be referenced using participant codes and will not contain any personal or identifying information.

[ ] I agree to have my child's games testing session audio recorded.

[ ] Please check this box if you like to receive an emailed copy of the study's results. If so, results should be expected in August 2022. We ask that you leave you phone number and email address below in order to receive these results.

_____   Phone #: (_____) - _____ - _____
Participant's Name (Child)

_____   Email Address: _____
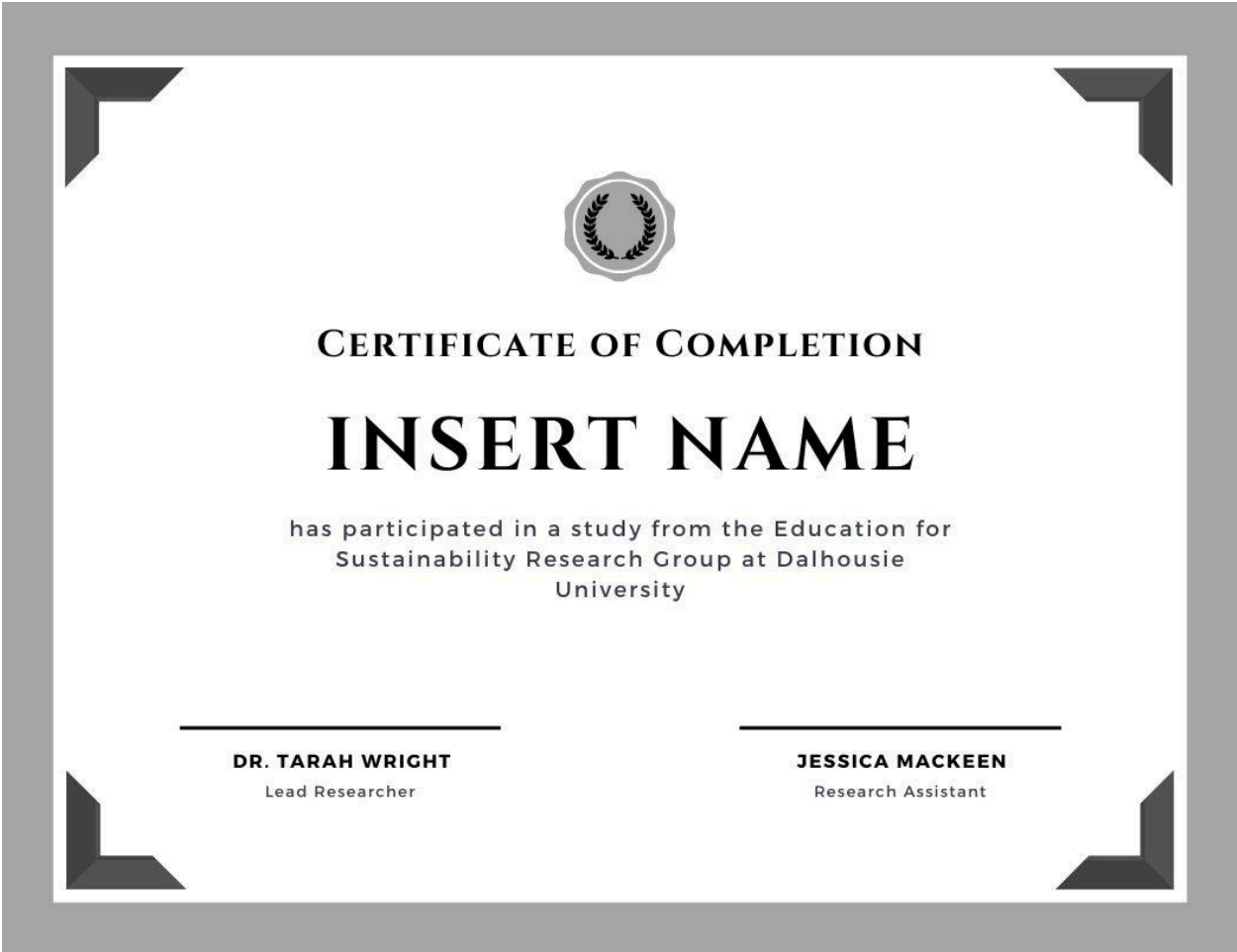Participant's Parent/Guardian Name

_____
Parent/Guardian Signature

Appendix VI: Certificate of Achievement

CERTIFICATE OF COMPLETION

INSERT NAME

has participated in a study from the Education for
Sustainability Research Group at Dalhousie
University

DR. TARAH WRIGHT
Lead Researcher

JESSICA MACKEEN
Research Assistant

Appendix VII: Assent Script

Project Title: Refining a games testing Tool for Various Cultural, Social, and Geographic Situations to Evaluate Pre-School Children's Bioaffinity

Lead Researcher: Tarah Wright
Research Assistant: Jessica MacKeen

Hi, my name is _____ (Jessica or Tarah) and this is _____ who will be helping me today. We are going to go play some games and then bring you right back to class/your mother. If you have any questions about what I am telling you or what we are doing, you can ask me at any time.

Today we are going to play 5 games in total. We will play them on paper. And by playing these games you will help us figure out if the games works.

If you have to go to the bathroom, feel uncomfortable or upset, too tired, or for any reason want to stop, just tell me and we will stop, and I will take you back to class/your parent/guardian. Playing these games is totally up to you and no one will be mad at you if you change your mind about playing the games, it is okay to ask to stop.

Your parent(s)/guardian(s) and teacher have said its okay for you to play these games.

Are you still okay with playing the games?

End of verbal script. To be completed by person obtaining verbal assent from the participant:

Child's/Participant's response: Yes [ ] No [ ]

Check which applies below:

[ ] The child/participant is capable of understanding the study.

[ ] The child/participant is not capable of understanding the study.

_____
Child's/Participant's Name (printed by lead researcher/research assistant)

_____   _____
Name (printed) and Signature of Person Obtaining Consent   Date

Appendix VIII: Directions provided to parent(s)/guardian(s) for parking and to the pilot study testing location.

Directions for Testing

Parking Information

You can park in front of the Wallace McCain Learning Commons Building, no permit necessary. This parking lot can be found at the end of Lord Dalhousie Drive.
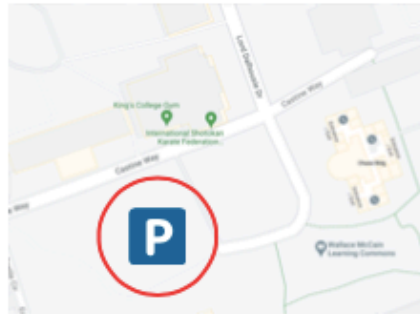
Navigating the LSC

Our testing site will be in the LSC quad. To find your way there:

1. **Enter through the Wallace McCain Learning Commons entrance.** Walk through the common area into the bricked LSC building.
2. **Turning slightly to the right**, walk along the hallway until you reach the Tim Horton's.
3. At the Tim Horton's, **turn left.**
4. Then, go a little ways down that hallway until you find a set of **double doors on the right** that will lead you to the quad area.

Contact Information

If you need to contact one of the members of the research team to come meet you and help find your way, please call Jessica at 902-877-0815.

Find us here in the LSC quad

Appendix IX: Supplementary Tables and Graphs

Table 7 Results from Game 2B: comparing the mean environmental awareness of participants who are age three (n=9), age four (n=12), and age five (n=7).

	Age Three		Age Four		Age Five	
	M	*SD*	*M*	*SD*	*M*	*SD*
Air Pollution						
You	0.33	0.50	0.50	0.52	0.57	0.53
Animal	0.44	0.53	0.67	0.49	0.71	0.49
Car	0.44	0.53	0.42	0.51	0.29	0.49
People	0.44	0.53	0.58	0.51	0.71	0.49
Forest	0.56	0.53	0.17	0.39	0.71	0.49
Ground Pollution						
You	0.44	0.53	0.42	0.51	0.57	0.53
Animal	0.78	0.44	0.67	0.49	0.57	0.53
Car	0.56	0.53	0.42	0.51	0.14	0.38
People	0.44	0.53	0.50	0.52	0.43	0.53
Forest	0.44	0.53	0.50	0.52	0.57	0.53
Water Pollution						
You	0.56	0.53	0.33	0.49	0.57	0.53
Animal	0.67	0.50	0.58	0.51	0.29	0.49
Car	0.56	0.53	0.58	0.51	0.43	0.53
People	0.56	0.53	0.42	0.51	0.57	0.53
Forest	0.56	0.53	0.42	0.51	0.71	0.49
Cutting Down Trees						
You	0.67	0.50	0.42	0.51	0.43	0.53
Animal	0.67	0.50	0.50	0.52	0.57	0.53
Car	0.56	0.53	0.58	0.51	0.57	0.53
People	0.67	0.50	0.58	0.51	0.57	0.53
Forest	0.50	0.53	0.58	0.51	0.71	0.49