Refining a Games Testing Tool for Various Cultural, Social, and Geographic Situations to Evaluate Pre-School Children's Bioaffinity

by

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Abstract

Time spent in nature has been proven to enhance children's cognitive, attitudinal, emotional, and physical development (Driessnack, 2009; Giusti *et al*. 2014; Bratman *et al*. 2015; Kardan *et al*. 2015; McClain and Vandermaas-Peeler, 2016; Broom, 2017). Previous studies by Giusti *et al.* (2014), Omidvar (2018) and Omidvar *et al.* (2019) have used psychological games testing to measure children's bioaffinity (a child's love of/for or connection to nature). While Giusti *et al.* (2014) found positive bioaffinity results with 5-year-old Swedish children, the Omidvar *et al.* (2018 and 2019) studies conducted with 3-5-year-old children at Reggio-Emilia Inspired preschools in Halifax, NS, Canada found that children's affinity with nature was weak. The discrepancies between the Swedish and Canadian studies led Omidvar (2018) and Omidvar *et al.* (2019) to recommended further research and testing to determine the appropriateness of the Giusti *et al*. (2014) measure for younger children, and whether refining the tool will increase participant understanding of the test questions and therefore more accurate results. As such, this study sought to modify the Giusti *et al.* (2014) tool to be more geographically and developmentally appropriate for younger children and then tested it on a cohort of 3-5-year-old Canadian preschool children. Results of the test modification and subsequent pilot test suggest that the modifications made to the Giusti *et al.* (2014) tool were effective in enhancing the children's understanding of the games testing primarily because of the reduction in the time needed to complete the testing, an increase in child engagement via physical games, and the modification of the test to include culturally and geographically relevant questions. Further, preliminary analyses of the pilot tests showed positive bioaffinity results amongst the children. While the results showcase the benefits of cultural and developmental modifications to the test, future studies are necessary to determine the validity and reliability of the modified tool.

Key Terms: Early childhood environmental education, early childhood education, environmental education, early childhood development, bioaffinity, games testing, psychological testing.

List of Abbreviations

ECE Early Childhood Education
NS Nova Scotia
REB Research Ethics Board
REI Reggio Emilia Inspired
SD Standard Deviation
SES Socioeconomic Status
SSHRC Social Sciences and Humanities Research Council

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Introduction

Nature is undoubtedly necessary for the survival of the human race and is critical for our proper development as a species. More specifically, nature is crucial for the proper development of children. Research shows that direct contact with nature and unstructured free-play in nature enhances children's cognitive, attitudinal, emotional, and physical development (Driessnack, 2009; Giusti *et al*. 2014; Bratman *et al*. 2015; Kardan *et al*. 2015; McClain and Vandermaas-Peeler, 2016; Broom, 2017). However, human interaction with nature, especially for young children, is continuously diminishing (Driessnack, 2009; Soga and Gaston, 2016). This is true in Canada, where 70% of children spend one hour or less per day outdoors (David Suzuki Foundation, 2012). Further, children aged 7-to-14 in Canada spend only 2.3 hours per day outdoors, while they spend 8.3 hours per day engaging in sedentary behaviours (Statistics Canada, 2016). Similar statistics are currently unavailable for younger children. Many point to an increase of technology use as a primary barrier to a child's connection and interaction with nature (Driessnack 2009; Louv, 2005; Soga and Gaston 2016). A study by Kabali *et al*. (2015) showed that 72% of children surveyed between the ages of 0-to-8 years used a mobile device regularly. Further, when looking more closely at children who were 2 years of age or less, 38% used a mobile device (Kabali *et al*. 2015). These and many other studies are beginning to paint a picture of children spending less time outdoors and increasingly staying indoors and using electronics.

As a consequence, children are lacking the many health benefits associated with spending time in the environment. Benefits to access and time spent in nature include lower infant mortality (Dzhambov, Dimitrova and Dimitrakova, 2014), a lower rate of asthma and allergies (Lovasi *et al.*, 2008; Hanski *et al.*, 2012; Ruokolainen *et al.*, 2015), reduced chance of anxiety and depression (Maas *et al.*, 2009), better concentration (Faber Taylor and Kuo, 2009), and

better development of imaginative, creativity and problem-solving skills (Malone and Tranter, 2003; Chawla, 2015). A lack of nature exposure can also have long-term consequences for environmental sustainability on a societal level. Nature exposure in childhood is positively correlated with developing pro-environmental attitudes, knowledge and beliefs as an adult (Chipeniuk, 1995; Ewert, Place & Sibthorp, 2005; Rickinson, 2001), influencing education, recreation and work preferences (Bixler, Floyd & Hammitt, 2002), as well as increasing the probability of conservation behaviours and attitudes later in life (Zhang, Goodale & Chen, 2014).

In an effort to document the impacts of nature exposure on a child's relationship with nature, many psychological testing tools have been developed to measure children's relationships with nature (Lincoln *et al*. 2009; Mayer and Frantz, 2004; Nisbet *et al*. 2009). Other studies by Giusti *et al.* (2014), Omidvar (2018), and Omidvar *et al.* (2019) use games testing to measure children's bioaffinity (a child's love of/for or connection to nature) and to analyze a child's relationship with nature within the context of a child's nature exposure through schooling. For example, Omidvar (2018) and Omidvar *et al*. (2019) investigated the effect of nature-related routines on preschool children's (3-5-year-olds) affinity with nature. The studies used a tool developed by Giusti *et al*. (2014) that was established for use in Stockholm, Sweden. The study found that students in Reggio-Emilia schools in Sweden had increased bioaffinity over those in less nature-based schools. However, in their study with 3-5-year-old children at Reggio-Emilia Inspired (REI) preschools, the Omidvar studies found that while children at these schools were exposed to nature more than the average Canadian child, the children's cognitive, emotional, and attitudinal affinity with nature was much weaker than hypothesized. These results of the Omidvar (2018) and Omidvar *et al*. (2019) studies led to two questions: (1) did the Regio-Emilia curriculum have no impact on the participant children's bioaffinity, or (2) was the Giusti *et al.*

(2014) tool unable to measure the children's bioaffinity? Omidvar *et al.* (2019) recommended that further research be conducted using the Giusti *et al*. (2014) games testing to determine the appropriateness of the measure for younger children, and whether refining the tool for a younger developmental stage could facilitate more accurate bioaffinity results (Omidvar *et al*. 2019).

This study is an extension of the work of Omidvar (2018) and Omidvar *et al.* (2019) and contributes to the evolving body of research regarding preschool children and their relationship or love of/for nature (bioaffinity) by focusing on the modification of the Giusti *et al*. (2014) bioaffinity test adopted by the Omidvar studies. The modifications are informed by a thorough examination of the childhood developmental literature and interviews with Early Childhood Education (ECE) experts. Further, this study piloted the modified bioaffinity tool with one cohort (n=9) of 3-5-year-old preschoolers to assess the appropriateness of the tool for this age group and developmental stage as well as the cultural and geographical setting.

Background

Since the start of the 20th century, there has been a sharp acceleration in the human population, resource use, transportation, communication, and technology (The World Bank, 2019; UNEP, 2017; OECD, 2018; Bartels, 2017; Costanza *et al*. 2007). The industrial revolution has truly transformed nature with regard to how the human race interacts and relies on it (such as the growth of transportation and technology, and the impacts both sectors have had on the environment, including the clearing of land and extensive resource extraction in order to support the growth of these sectors). Resource use alone is expected to double by 2050, largely based on trends such as the extraction of resources like biomass and fossil fuels reaching 88.6 billion tonnes in 2017 – three times more than the resource use of these sources in 1970 (UNEP, 2017). Therefore, it is highly expected that these numbers will continue to rise (UNEP, 2017).

Moreover, the human population has placed value on the advancement of these sectors, for reasons such as urban sprawl causing individual citizens to rely on transportation or technology finding solutions for cancer, which sparks eagerness and inspiration to establish more of these outcomes. Therefore, the industrial revolution changed how humanity places value on nature and what it has to offer or what it has to offer via loss of that environment.

Cowan (1976) wrote about the loss of her surroundings and revealed that "When we think about the interaction between technology and society, we tend to think in fairly grandiose terms: massive computers invading the workplace, railroad tracks cutting through the vast wildernesses, armies of woman and children toiling in the mills. These grand visions have blinded us…" (p. 1). The loss of nature Cowan illustrated, has been replaced with excessive use of electronics at an early age, increased negative mental health cases, and parents fearing the dangers of outdoor settings (Kalish, 2010; Martin, 2011 Bratman, 2019). A Statistics Canada (2016) study found that the average 7-14-year-old Canadian spends only 2.3 hours per day free-playing outdoors and spends approximately 8.3 hours per day indoors being sedentary. Due to the decrease in nature interactions, the term 'nature deficit' has been coined by Louv (2005) to describe this social shift away from nature. This deficit has continued to increase, with a Nature Conservancy Canada (2014) study finding that 75% of parents said, instead of their children coming home to play outside after school, they are now coming home to watch television or play electronic games.

With an increasing amount of literature discussing the loss of nature and children's diminishing relationship with the outdoors, practices such as the Reggio-Emilia approach have been created and utilized to enhance children's interactions with nature. The Reggio-Emilia approach is grounded in research regarding Early Childhood Education, early childhood development and environmental education (Omidvar, 2018). This internationally known practice

refers to an inquiry and constructivist-based approach to Early Childhood Education, with a focus on the fundamental belief that children have the right to influence and construct their educational knowledge (Vandermaas-Peeler *et al*. 2017; Inan, Trundle, and Kantor, 2010). Moreover, the practice emphasizes the extensive inclusion of natural science education and nature play with respect to the needs of that particular group of children, such as their interests, inquiries, and influences regarding their surrounding environment (Inan, Trundle, and Kantor, 2010). Therefore, the approach varies based on cultural and societal characteristics, the developmental norms, and other contextual features relating to that particular group of students and their location (Inan, Trundle, and Kantor, 2010). Additionally, Giusti *et al*. (2014) claimed that the Reggio-Emilia approach can vary due to access and availability of nature. Therefore, with literature discussing this reduction and disconnect from nature, the Giusti *et al*. (2014) study explored whether children at Reggio-Emilia schools in Stockholm, Sweden, were influenced by the loss of nature.

Furthermore, in the Giusti *et al*. (2014) study, results showed a positive connection between the Reggio-Emilia approach and 5-year-old children's bioaffinity. In comparison, the Omidvar (2018) and Omidvar *et al*. (2019) studies found a much weaker bioaffinity connection between 3-5-year-old children attending a preschool with REI curriculum and approach in Halifax, NS. Therefore, Omidvar (2018) and Omidvar *et al*. (2019) pontificated that the Giusti *et al*. (2014) games testing tool might not have been geographically or developmentally appropriate for 3-5-year-old preschoolers. Moreover, the Omidvar studies recommended future research be conducted to determine these factors.

Definitions

This interdisciplinary study utilizes research and literature from the topics of biophilia, developmental psychology, and related research methodology. These concepts have numerous definitions; therefore, the context and definitions used for this study are outlined below.

Biophilia. The biophilia hypothesis was established by Wilson (1984), who initially explained the theory as a tendency to connect with natural things (Verbeek and Waal, 2002). The Latin meaning of the term biophilia is 'love of life,' and through analysis, research connected this meaning to a psychological love or attachment for all living things (Orr, 1993; Cho and Lee, 2018). For simplicity, this study describes biophilia as an inner psychological affection for nature, which can be reinforced by positively interacting with natural elements (Ballouard *et al*., 2012). In this study, a person's biophilia measure will be referred to as their bioaffinity.

Developmental Psychology. More than 100 years ago, developmental psychology became a vast and diverse catalogue of knowledge that seeks to improve the lives of children (Kail and Barnfield, 2015). Developmental psychology refers to analyzing development through description, explication, modification and optimization and discovering what factors are powerful change agents (Baltes, Reese and Nesselroade, 1988). Due to developmental psychology evolving into such a vast discipline, it encompasses development throughout all stages of life, from birth to death. This study focuses on developmental psychology relevant to 3-5-year-old preschool children. Therefore, modification of Giusti *et al*. (2014) tool will utilize early childhood developmental literature specifically regarding 3-5-year-old development criteria.

Validity. Carmines and Zeller (1979) referred to validity as a device doing what it is intended to do. For example, Giusti *et al*. (2014) games testing tool was created to measure the bioaffinity of children attending Reggio-Emilia schools. Since the results showed a positive

relationship, the tool is considered to have met the purpose of what it set out to do and deemed valid (Carmines and Zeller, 1979).

Reliability. The concept of reliability is established when "an experiment, test, or any measuring procedure yields the same results on repeated trials" (Carmines and Zeller, p. 11, 1979). In regard to Mayer and Frantz conducting five studies, the reliability of their tool continued to increase, because results stayed consistent throughout repeated trials (Mayer and Frantz, 2004; Carmines and Zeller, 1979).

Trustworthiness. The trustworthiness of qualitative research seeks to evaluate a study's quality by assessing the confidence in data, interpretation, and methodology used (Pilot and Beck, 2014; Connelly, 2016). Scholars have suggested the use of four criteria outlined by Guba and Lincoln (1994), which includes credibility, dependability, confirmability, and transferability.

Problem Statement

The psychological games testing tool established in Giusti (2012) and used in Giusti *et al*. (2014) aimed to measure the bioaffinity of 5-year-olds children enrolled in Reggio-Emilia schools in Stockholm, Sweden. While the Giusti *et al*. (2014) study found positive bioaffinity results, using the same tool in Canada, Omidvar (2018) and Omidvar *et al*. (2019) found negative bioaffinity results. The problem that this thesis seeks to address is based on Omidvar's (2018) question of whether the Giusti *et al*. (2014) tool was unable to measure Canadian children's bioaffinity due to a different cultural context and using the tool on a younger population. This study seeks to determine whether the psychological games testing tool developed by Giusti and used in the Omidvar studies can be made more culturally and developmentally appropriate for the Canadian context (specifically with 3-5-year-olds in Halifax, Nova Scotia).

Knowledge Gaps and Motivation

This study contributes to the evolving body of literature on nature exposure and developmental psychology. Further, this study builds upon the research established in Giusti (2012), Giusti *et al*. (2014), Omidvar (2018), and Omidvar *et al*. (2019). Omidvar (2018) thoroughly examined, and pilot tested the Giusti *et al*. (2014) Game Testing tool in two REI schools in Halifax. It was hypothesized in Omidvar (2018) that results would show a similar positive relationship between specialized environmental education and bioaffinity found in Giusti *et al*. (2014). However, the results were much weaker than anticipated. The Omidvar *et al*. (2019) study furthered this research by conducting the testing again and found similar negative results to Omidvar (2018). This study aims to modify the Giusti *et al*. (2014) tool to become more geographically and developmentally appropriate for 3-5-year-old preschoolers.

Other studies, such as Mayer and Frantz (2004) and Nisbet *et al*. (2009), have used pilot testing to determine the validity and reliability of newly established and modified psychological testing tools. Results for both studies determined their tools as reliable and valid only after making modifications throughout their pilot testing processes (Mayer and Frantz, 2004; Nisbet *et al*. 2009). This study will establish the modifications necessary for future research to then determine the validity and reliability of the newly revised version of the Giusti *et al*. (2014) games testing tool. Moreover, the study will rely on the criteria of trustworthiness (credibility, dependability, confirmability, and transferability) to ensure the "usefulness" and value of the methodology applied in this research.

Research Questions

1. Will the modification of the Giusti *et al*. (2014) games testing tool be more effective in allowing the sample population of 3-5-year-old to understand and complete the test?;

2. To what extent can the Giusti *et al*. (2014) games testing tool be modified to become more culturally appropriate for a Canadian sample population of 3-5-year-olds?;
3. To what extent can the Giusti *et al*. (2014) games testing tool be modified to become more developmentally appropriate for a Canadian sample population of 3-5-year-olds?.

Research Objectives

Results from Omidvar *et al*. (2018 and 2019) suggest that children's cognitive, emotional, and attitudinal affinity with nature was much weaker than hypothesized, even though the study was conducted at two REI preschools in Halifax, NS. Moreover, results showcased enhanced opportunities within the REI curriculum and classrooms, but this was not reiterated within bioaffinity results measured by the adopted psychological testing tool (Omidvar, 2018; Omidvar *et al*. 2019). Whereas, Giusti *et al*. (2014) found increased bioaffinity in children attending Reggio-Emilia schools in Sweden; however, the children were 5-year-old Swedish children. Therefore, both Omidvar reports recommended further studies be conducted using Giusti *et al*. (2014) games testing to determine the appropriateness of the measure for young children, and whether modifying the tool will facilitate positive results (Omidvar *et al*. 2019). As hypothesized, the tool is seemingly not geographically or developmentally appropriate for the Omidvar *et al*. (2019) cohort. Thus, more research is needed to evaluate the tool with relevance to 3-5-year-old children. The objectives of this study are as follows:

- Modify Giusti *et al*. (2014) bioaffinity games testing tool through a thorough investigation of the child developmental research;
- Refine the bioaffinity tool through consultation with Early Childhood Education (ECE) experts;

- Examine and determine the outcome of the modifications via pilot testing at Shambhala School in Halifax, NS, Canada.

Research Design

The psychological games testing tool used in Giusti *et al*. (2014) will be modified using Early Childhood Education and development literature. Kail and Barnfield's (2015) "*Children and Their Development*" will be the primary source of information used to make the modifications, alongside supplementary peer-reviewed journal articles to support the main findings. Then, interviews with ECE experts will draw on knowledge about their experiences when conducting psychological testing with young children and provide feedback on the preliminary alterations made to the testing tool. Subsequently, the tool will be modified again, incorporating the expert's feedback. This process will focus on making pictures and language used in the tool more location-specific, relatable to 3-5-year-old children's developmental criteria, and possibly to reduce the length of time required for games testing. Following alterations, the revised games testing tool will be pilot tested with preschoolers at Shambhala School or their parent(s)/guardian(s) choice of location.

Scope

The scope of this study involves two segments, the first is to modify Giusti *et al*. (2014) games testing tool, and second is to pilot test the newly modified tool. Therefore, there are two different populations involved. In the first segment, after early childhood development literature is used to make initial modifications, ECE experts will be consulted to assist and guide further modification of the bioaffinity testing tool. Two ECE experts from Mount Saint Vincent University, one ECE expert from Dalhousie University, and the Head Teacher of the preschool class at the Shambhala School were asked to share their knowledge on childhood development

and the testing of children. The second segment focused on 3-5-year-old preschool children as the population recruited for pilot testing. Recruitment of preschoolers was from Shambhala School, with no more than n=9 children being asked to participate.

Limitations

The first limitation is temporal due to only having eight months to finish the study. This time constraint has halted the determination of the validity and reliability of the bioaffinity testing tool because enough time must be allotted to facilitate multiple rounds of testing, recruit a larger sample size, and adequate time to analyze the data collected. A second limitation is the limited number of preschoolers in attendance at Shambhala School. Therefore, it constrained the desired recruitment of ~20 preschoolers down to n=9. A third limitation is the time commitment required for testing (Omidvar (2018) needed roughly 30-40 minutes to complete the testing with each participant), which could result in some participants losing focus and interest throughout the testing process.

Summary

With children's opportunities to interact with nature continuously diminishing, establishing accurate ways to measure this relationship is critical in determining the importance of nature exposure at an early age. More specifically, by modifying and pilot testing the Giusti *et al*. (2014) tool, the games test and the results regarding children's bioaffinity in Halifax will be more geographically and developmentally appropriate and accurate for 3-5-year-old preschoolers. Furthermore, future studies will be equipped with a developmentally appropriate tool to further research concerning the measurement of 3-5-year-olds love of/for nature (bioaffinity) in various geographical locations.

Literature Review

As the literature regarding the developmental criteria for 3-5-year-olds is age-specific, this literature review explores various criteria to facilitate the modification of the Giusti *et al.* (2014) psychological games testing tool to become more geographically and developmentally appropriate for preschool children in the setting of Halifax, NS, Canada. First, the review delves into an overview of particular aspects of the overarching body of knowledge called environmental psychology, before narrowing the scope for the study at hand. The review then explores the interdisciplinary interaction between developmental and environmental psychology, specifically regarding preschool children. Finally, the literature will present specific developmental criteria that will inform modifications of the original Giusti *et al.* (2014) games testing tool (Appendix I). By investigating and compiling previous literature, the modifications made to the tool will optimistically facilitate positive outcomes when conducting the pilot testing.

Environmental Psychology

Environmental Psychological Testing

Various studies regarding environmental psychology emerged between 1960 to 1990 and established the basis for more specialized psychological testing in the 21st century. Furthermore, the studies provided a pivotal framework for future studies and allowed for those future studies to delve into greater depths of environmental psychology. Hall (1969) established the importance of analyzing and preserving naturally occurring behaviour and its ecological environment. The study focused on the ecological aspect and suggested that humans are influenced and connected to their surrounding environment, and therefore, it should be taken into account when furthering psychological research (Hall, 1969). Hall conducted three rounds of pilot testing to showcase his

theory, and his results showed that the subjects demonstrated more leadership and productivity, as well as they were more focused and curious (Hall, 1969). Proshansky, Ittelson and Rivlin (1970) compiled several pioneering studies regarding environmental psychology, such as Craik's study, which outlined different research paradigms for environmental psychology. Stokols and Altman (1987) co-edited the *Handbook of Environmental Psychology*. The handbook includes a compilation of early environmental, psychological studies, such as Geller's study regarding behavioural analyses that he applied to conservation behaviour. Finally, Stokols (1987) published his study in the handbook, which combined both environmental psychology and developmental psychology. It included various developmental characteristics such as cognitive, personality, and social psychological links with the surrounding environments of individuals. Therefore, specific sub-topics in the field were beginning to emerge, paving the way for new studies.

More recently, there has been an increase of studies relating to the body of literature focused on the relationship between environmental and developmental psychology, with a focus on developmental characteristics such as cognitive, emotional, and attitudinal. Cheng and Monroe (2010) developed a nature index for assessing children's attitudes towards their natural environments. After testing the index, they found that there were four main dimensions of children's relationship with nature, including the enjoyment of nature, empathy for creatures, sense of oneness, and sense of responsibility (Cheng and Monroe, 2010). They concluded that these dimensions, in addition to their previous individual and family experiences in nature, positively influence the child's connection to nature and their intention to participate in nature-based activities in the future (Cheng and Monroe, 2010). Another article explored connections between the amount of nature exposure and people's attitudes and actions towards the

environment as a result (Broom, 2017). The results showed a positive connection between participants who had childhood experiences in nature and the translation of sustainable attitudes and actions towards the environment in their adult years (Broom, 2017). Clements (2004) study surveyed eight hundred and thirty mothers and their children regarding the mother's nature experiences as children in comparison to their nature experiences as adults, as well as their child's current experiences with nature. She found that, in comparison to the mother's nature exposure as a child, their children spent considerably less time playing outdoors than their mothers did during their adolescent years (Clements, 2004). In correlation with Clements, Louv found that parents increasingly prohibited their children from interacting and exploring wild natural areas, primarily due to concerns for their safety and receding access to nature (Louv, 2005). His findings suggest that as time progresses and more industrialization occurs, children's contact with nature will continue to decline, resulting in Louv coining the term "nature deficit disorder" (Louv, 2005).

Other studies have emphasized the positive effect of nature on children's psychological wellbeing. Wells and Evans found that a child's life stress was lower if they reside near nature or among nature (Wells and Evans, 2003). Mustapa *et al*. (2018) shared results expressing the importance of reconnecting children with nature through their daily routine, mainly due to his argument that children are the future guardians of the earth. However, they emphasized that children's views and voices should be taken into consideration when interacting with nature (Mustapa *et al*. 2018). Dopko *et al*. (2019) concluded that children who spent more than four hours in nature had increased positive moods, pro-sociality and a more positive attitude towards nature, specifically, an increase in their willingness to protect nature. Finally, Engemann *et al*. (2019) reiterated Dopko *et al*. findings that increasing a child's interactions with nature improves

the mental health of children and how it reduces the rising global burden of psychiatric disorders. This progression of studies created room for more branches of environmental psychology to be explored.

As environmental psychology studies progressed, another branch of research emerged regarding the relationship between biophilia and environmental behaviours. Edward Wilson was one of the research pioneers regarding the relationship between the environment and biophilia. His theory established an understanding of the human tendency to relate with life and natural processes, which he theorized should be considered an expression of a biological need for physical and mental growth (Wilson 1984). Kellert and Wilson (1993) went on to be editors of a book called *The Biophilia Hypothesis.* Their book gathered information and exploratory articles discussing environmental behaviours and biophilia, such as Richard Nelson's piece that, instead of focusing on diminishing nature connections, he focused on questioning how human culture has veered away from nature, with a focus on consumerism (Kellert and Wilson, 1993).

More recently and specifically in regard to this study, Giusti (2012) investigated how children develop an emotional relationship with nature via different socio-ecological environments. He measured this relationship by creating a psychological games testing tool that evaluated children's cognitive, emotional and attitudinal affinity with nature, another form of biophilia relations (Giusti, 2012). The Giusti (2012) tool was developed to test 5-7-year-old children residing in Stockholm, Sweden. His study concluded that the environment children grow up in, and the social perception of that environment is a significant determinant of children's connection to that environment (Giusti, 2012).

Based on findings in his 2012 article, Giusti teamed up with two other authors to analyze children's bioaffinity with nature (exposure to nature) concerning their nature access on their

route to attending specific schools (Giusti *et al*. 2014). They measured this relationship via the psychological testing tool Giusti established in his 2012 study. The Giusti *et al*. (2014) results determined children who attend schools with more abundant access to nature in their daily routines resulted in children being more empathetic, concerned for non-human life forms, and more aware of their dependence and relationship with nature. The next study that is explained constituted reasoning to conduct the current study.

Omidvar *et al*. (2019) was a study conducted for the larger master's thesis published by Omidvar in 2018. The Omidvar *et al*. study established weak results between preschool (3-5-year-old) children's cognitive, emotional and attitudinal affinity with nature, in preschool children attending two different Reggio-Emilia (environmental education based) schools in Canada (Omidvar *et al*. 2019). The Omidvar (2018) article was a master's thesis which looked at the larger picture. The Omidvar (2018) research found four main results. The first being that both schools provided sufficient opportunities for the preschool children to be exposed to nature via its indoor biophilic design and outdoor nature access (Omidvar, 2018). Secondly, through interviewing the teachers at both schools, results indicated that even though teachers placed importance on children's relationship with nature, the overall curriculum was not exclusively focused on increasing children's affinity with nature (Omidvar, 2018). Omidvar's third finding was analyzed in the Omidvar *et al*. (2019) study, via utilizing the Giusti *et al*. (2014) games testing tool, they found that at both school's children's cognitive affinity with nature was weak (Omidvar, 2018; Omidvar *et al*. 2019). The final finding reiterated children's weak affinity with nature, specifically in regard to their emotional affinity as they were unable to distinguish between living and non-living things and could not answer questions related to non-human feelings (Omidvar, 2018). For example, children who responded by matching a picture of eggs

with a pig or paper sheets with lettuce were deemed incorrect, resulting in weak bioaffinity scores (Omidvar, 2018). The following section explores psychological methods for analyses concerning the topic of environmental, psychological testing tools and frameworks.

Psychological Analyses

With a focus on modifying the psychological games testing tool to become more appropriate for preschoolers in Canada, this next section will discuss previous studies that have either established a psychological testing tool or modified an existing one. Predominantly, reliability and validity measures have been used to verify whether the established or modified testing tool is appropriate for use. Borke (1973), Mcdevitt and Carey (1978), and Bryant (1982) are three studies that illustrate the historically prevalent use of reliability and validity to assess psychological testing tools. For example, Bryant's (1982) study examined the appropriateness of a psychological testing tool that measures empathy in children and adolescents. First, she created a new index of empathy for children and adolescents and then conducted three different tests, with three different age groups to test the reliability and validity (Bryant, 1982). Results showed satisfactory reliability and preliminary construct validity, therefore suggesting the tool is appropriate to use for further testing (Bryant, 1982). Thus showcasing, reliability and validity have been used in measurement theory and psychology for decades. Carmines and Zeller (1979) wrote a book about these methods, differentiating between different methods and results that reliability and validity measures can perform and illustrate, such as preliminary construct validity.

More recently, there is still evidence of researchers using reliability and validity including all six of the following studies: Dunlap *et al*., 2000; Pell and Jarvis, 2001; Mayer and Frantz, 2004; Lincoln *et al*. 2009; Nisbet *et al*. 2009; Coster *et al*. 2011. These studies

specifically used environmental or developmental psychological testing tools. For example, Dunlap *et al.* (2000) sought after revising an existing phycological tool, called the 'New Environmental Paradigm Scale' (NEP), that measures pro-environmental orientation. The original tool was comprised of twelve Likert items that measure beliefs about humanity's ability to upset the balance of nature, limits to growth for human societies, and humanity's right to rule nature (Dunlap *et al.* 2000). Objectives for the revision of the tool included achieving a better balance between the NEP statements and broaden the content of the scale beyond the initial three subjects mentioned above (Dunlap *et al.* 2000). Dunlap *et al.* 2000 created this new scale, now called the New Ecological Paradigm Scale, via modifying the tool (by adding new items and modifying the existing language) and pilot testing the tool to establish reliability and validity (similar to the methods in this study).

Similarly, in Nisbet *et al.* (2009), they set out to establish a new 'nature relatedness scale' through modification and pilot testing, as well as they also used reliability and validity to conclude whether or not their new scale was appropriate. Results showed positive reliability and validity for the newly modified testing tool. Previous environmental and developmental psychological studies are crucial to support and affirm proper modification of the Giusti *et al.* (2014) games testing tool.

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

Preschool children are growing at a rapid rate. These young children are vastly different when growing, which results in a three-year-old being very developmentally different compared to a five-year-old. Therefore, when modifying the Giusti *et al.* (2014) testing tool, it is crucial to use developmental characteristics that embody as many developmental characteristics of preschoolers as possible. Kail and Barnfield (2015) emphasize that at roughly four years of age,

there is a fundamental change in the child's understanding of the world around them. For example, at the age of three, children are unable to understand why people do things, whereas a four-year-old can understand and explain why people do certain things. By studying the developmental criteria of each stage for a Canadian preschooler (3-5-year-olds), the modifications made to the Giusti *et al.* (2014) tool will be well informed and as specific as possible.

Cognitive Development

The Giusti *et al.* (2014) games testing tool encompasses three main areas of child development, including cognitive, emotional, and attitudinal. Omidvar (2018) and Omidvar *et al.* (2019) concluded that children's cognitive affinity with the biosphere was weak. Therefore, the cognitive-developmental criteria will inform modifications in regard to the pictures and language used within the tool (Appendix I). The following literature will focus on information that will advise modification of the pictures.

As discussed in Kail and Barnfield (2015) and reaffirmed in Chappell and Steitz (1993), the preoperational development stage (2-7-years-old), as determined by Paiget's 1952 theory, is characterized by a child's use of symbols to represent objects and events. Symbols in this regard refer to words, gestures, graphs, maps and models (Kail and Barnfield, 2015; Chappell and Steitz, 1993). During this stage, children are known to be egocentric (Kail and Barnfield, 2015; Hughes, 1975). Egocentrism, concerning preoperational children, refers to "young children's difficulty in seeing the world from another's viewpoint" (Kail and Barnfield, p. 196, 2015). Due to children's egocentrism, it is essential to use very location-specific photos concerning modifications made to the Giusti *et al.* (2014). For example, currently, there is a photo of a cartoon tree in section' 1a: Emphatic Behavior Instruction' of the Giusti *et al.* (2014) tool, which

should be modified to either a Canadian known tree or a Canadian tree located at the study location (the child's school). Kail and Barnfield (2015) emphasize that one should be even more specific in order to have a more positive outcome. Due to preoperational children's cognitive skills developing at vastly different rates, it is increasingly important to make the instruction as specific as possible (Kail and Barnfield, 2015). Therefore, if possible, it would be most effective to use a Canadian tree located at the child's school.

The socio-cultural perspective of preoperational children is also important for informing pictures because children are products of their culture (Kail and Barnfield, 2015; Lonner and Malpass, 1994). Culture varies from country to country, even from city to city. Therefore, it is important to use pictures that are informed by Canadian culture. For example, one school might allow the children to use calculators to assist during math class, whereas another school would ask the children to do the calculations by hand. Lonner and Malpass (1994) echoed Kail and Barnfield (2015) that cognitive processes are individualistically specific and are greatly influenced by culture. Specifically, in regard to section' 2a: Provision of Ecosystem Services Instructions' of the Giusti *et al*. (2014) tool, memory is a key cognitive determinant of whether the preschoolers will be able to understand the game. During the preoperational stage, children use early memory strategies that are mainly driven by sight and touch (Kail and Barnfield, 2015; Dasen, 1994). Therefore, it may be useful to make this section of the tool interactive. For example, make the pictures tactile by using animal figurines or cut-outs of the animals. Smith (2000; 2009) strengthens this point by highlighting in her study that the shape of things plays a central role in learning and understanding objects and words. Ultimately, the cognitive differentiation among the preschool years is pivotal regarding modifying pictures appropriately within the Giusti *et al*. (2014) games testing tool.

Preschoolers (3-5-year-olds) also use language that differs significantly at different ages, especially in these very early years. It is essential to understand these differences in order to have the language used in the Giusti *et al*. (2014) testing tool be developmentally appropriate for this specific age group. Children by the age of two have a vocabulary of a few hundred words, whereas on average, by age six, a child has over 10,000 words in their vocabulary (Kail and Barnfield, 2015; Bloom, 1998). Therefore, the words used in the Giusti *et al*. (2014) tool need to be developmentally appropriate for three, four and five-year-olds. In order to do so, the language used in the tool will need to be generic enough for a three-year-old to understand.

An example would be the use of the word chicken vs. hen. Currently, in section' 2a: Provision of Ecosystem Services Instructions', the word hen is used to describe one of the pictures. However, it is possible that a three-year-old child has not created a sub-category under chickens to include the word hen (Kail and Barnfield, 2015; Bloom, 1998). Therefore, it will be beneficial to use the word chicken instead of hen. Smith's theory reiterates this reasoning as she explains "children first associate names with a single object: "Ball" is associated with a specific tennis ball, and "cup" is associated with a favourite sippy cup" (Smith, 2000; 2009 in Kail and Barnfield, p. 319, 2015). Therefore, it is important to investigate what language is normalized in the child's environment who is being studied. Finally, language is also greatly influenced by culture (Kail and Barnfield, 2015). Children will have different vocabularies when they are exposed to different qualities and usages of language (Kail and Barnfield, 2015). Hence, the term hen may be more prominently used in Sweden, whereas in Canada, we broadly refer to them as chickens or roosters. By becoming aware of the differences in understanding and using language throughout the individual years of preschoolers, the Giusti *et al*. (2014) tool will become more appropriate for testing.

Emotional and Attitudinal Development

Understanding preschooler's emotional and attitudinal development is crucial for informing the Giusti *et al.* (2014) tool due to certain feelings being attached to words and pictures. It is assumed that since Omidvar (2018) and Omidvar *et al.* (2019) explicitly stated that preschoolers were not emotionally affiliated with nature and had a negative attitude towards natural environments, that it is crucial to investigate emotional and attitudinal developmental characteristics further to inform modifications that will result in positive outcomes.

By the time a child is in preschool or, more specifically, three years of age, they experience both basic and complex emotions, including happiness, anger, fear, pride, guilt and embarrassment (Kail and Barnfield, 2015). However, the extent of these feelings are constrained by the geographical location and cultural influences experienced by the child (Kail and Barnfield, 2015). For example, situations that may prompt pride in one area or culture may evoke shame in another (Kail and Barnfield, 2015). Therefore, some locations and cultures may place emphasis on the environment, where another may not. Interestingly, a child's emotional and attitudinal characteristics are not only influenced by the available surrounding environment nor cultural influences but are also impacted by genetics and the socioeconomic status (SES) of the child's family (McLoyd, 1998). McLoyd's (1998) article concludes that a child's socioemotional functioning is greatly influenced by the SES status of their family. For example, SES impacts exposure to health risks such as greater exposure to lead, which directly relies on the SES status of the parent/guardian because it determines where the family is able to reside (McLoyd, 1998). Therefore, SES status should be considered a determinant in how children's access to nature and perception of nature are affected, for example, SES can go as far as to influence a child's choice between what candy bar a child decides to purchase. Furthermore, this suggests that it is critical to discuss SES when analyzing the results found in this study.

As previously discussed, and with regard to cognitive development, preoperational children (preschoolers) use animism to understand objects (Kail and Barnfield, 2015). However, sometimes preschool-aged children get caught up in their egocentrism, which causes them to believe an object or a thing, thinks and feels the way the child does (Kail and Barnfield, 2015). This can be translated to a child's association with a car, for example, to explain further, the child may believe since they have fun driving in the car that the car also has fun, therefore, the child would not associate the car with bad feelings, or more specifically air pollution. In section' 2b: Pollution Awareness Instruction' in the Giusti *et al*. (2014) testing tool, a picture of car pollution is shown. A three-year-old may not have acquired the word 'pollution' and, therefore, may associate the car with feelings of happiness, due to their experiences concerning the car. Moreover, it may be difficult for three years old to separate the car from their daily routine, for example, singing in the car with their parent, which they would associate with happiness (Kail and Barnfield, 2015).

Preschool children's emotions and attitudes towards objects and concepts are mainly influenced and learnt through hearing and watching parents and adults talk about their feelings and attitudes (Kail and Barnfield, 2015). Therefore, if the parents or adults do not talk about, express or encourage positive feelings towards the environment, then the child is less likely to have positive feelings and attitudes towards the environment. This theory could also explain why some children in the Omidvar (2018) and Omidvar *et al*. (2019) studies may have expressed negative feelings, which suggests that the parents or adults may not have expressed positive feelings towards the environment. Preschool children are particularly sensitive to grasping and imitating the feelings and attitudes of the parents and adults surrounding them. Therefore, it is

crucial to understand how children acquire feelings and attitudes in order to perform proper modification to the testing tool.

Knowledge Gaps

The central knowledge gap apparent in this literature review is that there is no guide on how to modify a testing tool for early childhood children. Therefore, psychological development literature regarding the developmental characteristics of preschoolers was used to make the case that the Giusti *et al*. (2014) testing can be transformed to become more appropriate for this specific age group. Understanding how a child's thoughts and feelings are expressed at such an early age is crucial for informing the proper use of pictures and language, as well as the expectation of emotional and attitudinal outcomes. Upon modifying the Giusti *et al*. (2014) testing tool to become more appropriate for testing preschools regarding their cognitive, emotional and attitudinal developmental characteristics, this gap will be tapered. Therefore, this study will contribute to not only environmental education literature, but also assist psychological literature.

Specifically, the results of this study will determine whether modifying a psychological testing tool is viable and will facilitate positive testing outcomes. So long as the modifications provide increased positive results, this study will also be the basis for using the newly modified testing tool to enhance investigations of preschool children's affinity with nature. Therefore, the outcome of this study could contribute to a new framework for future studies regarding children and their relationship with nature. By narrowing this knowledge gap, this study may also facilitate broader use of the newly modified Giusti *et al*. testing tool and constitute increased use of it internationally. This study has the potential to inform many future studies regarding the

topic of children and their relationship with nature and provide multiple interdisciplinary benefits.

Though there are previous studies regarding the topic of environmental and developmental psychology, the literature does not explicitly instruct how to modify a psychological tool accurately. Ultimately, the particular accumulation of literature reviewed illustrates a pathway for modifying the Giusti *et al*. (2014) psychological games testing tool to become more geographically and developmentally appropriate for Canadian preschoolers (3-5-year-olds). The review has demonstrated that even though there is research to inform these modifications, there is also the need for a compilation of developmental literature regarding modifications of psychological testing tools, specifically in relation to children.

Previous studies have investigated the relationship between children and nature. However, despite this evidence, most studies focused on establishing their measure or building upon another researcher's measure by mainly conducting more studies in various settings. Therefore, leaving a gap of how developmental characteristics of children play into the testing of the psychological tools in reality. Children are vulnerable subjects and develop uniquely at each age. The developmental psychology research highlights the uniqueness of preschoolers, and how that would affect the outcome of using the Giusti *et al*. (2014) testing tool. By focusing on the complex development criteria of a child's cognitive, emotional and attitudinal characteristics, the modifications of the tool will allow for the pictures, language and feelings intertwined in the tool to be more appropriate for these young children to understand and respond to.

Therefore, suggesting the outcome of the pilot testing should result in increased positive results, so long as the tool has been modified accordingly. This review has weaved literature critical for informing the proper modification of the Giusti *et al*. (2014) games testing tool to a

Canadian setting. Due to nature receding throughout history, the modifications made to the tool will create a foundation for future studies to look at children's affinity with nature in depth. The outcome of this research will determine whether this tool and literature are successful in facilitating positive results between children and their affinity and relationship with nature.

Methods

Through a mixed-methods approach employing qualitative and quantitative techniques, this study aims to modify, refine and pilot test the bioaffinity tool created in the Giusti *et al.* (2014) study and used in the Omidvar (2018) and Omidvar *et al.* (2019) studies (see Appendix I for a copy of the original Giusti *et al.* (2014) games testing tool). This study is part of a larger research program in the Education for Sustainability Research Group (SSHRC project) that is focused on measuring the bioaffinity of preschoolers (3-5-year-old's). When testing the Giusti *et al.* tool with preschool children in REI schools (which have a focus on environmental education) in Nova Scotia, Omidvar (2018) and Omidvar *et al.* (2019) found a weak bioaffinity relationship. Further, Omidvar *et al.* (2019) found that while children at these schools were exposed to nature more than the Canadian average, the children's cognitive, emotional, and attitudinal affinity with nature was much weaker than hypothesized. The results of the study led to two questions (1) whether time in nature and/or nature-based curriculum in school has no impact on children's bioaffinity, or (2) whether the tool was unable to measure the children's bioaffinity (Omidvar *et al.* 2019). Therefore, Omidvar *et al.* (2018) and Omidvar *et al.* (2019) recommended further studies to be conducted using the Giusti *et al.* (2014) games testing to determine the appropriateness of the measure for younger children, and whether refining the tool accordingly will facilitate positive results (Omidvar *et al.* 2019). As such, this study focuses on modifying the

Giusti *et al.* (2014) games testing tool to become more geographically and developmentally appropriate for Canadian preschoolers and facilitate a better measure of bioaffinity.

In order to modify the Giusti *et al.* (2014) tool, an array of psychological literature was used, in addition to expert information provided by Early Childhood Education specialists gathered through semi-structured interviews. After alterations were made to the Giusti *et al.* (2014) tool, a pilot test was conducted with preschool (3-5-year-old) children to establish data to compare to that of the results found in Omidvar (2018) and Omidvar *et al.* (2019). In addition, a comparison analysis was conducted to ascertain whether modifying and refining the Giusti *et al.* (2014) games testing procedure was able to facilitate a more geographically and developmentally appropriate tool for Canadian preschool children. The following section will outline and explain the methodology used to conduct this study. It is important to note that these methods were approved by the Research Ethics Board (REB) before conducting any of the methods outlined below, and amendments to the REB were completed accordingly (see Appendix XIII for the approval letter). Additionally, the four criteria of trustworthiness (credibility, transferability, dependability, and confirmability) were followed to ensure rigour, integrity, and legitimacy of the qualitative methodology applied to aid in the modification of the Giusti *et al.* (2014) tool.

Introduction to Procedures

Before commencing the pilot testing with the children, the bioaffinity tool created in Giusti *et al.* (2014) and used in Omidvar (2018) and Omidvar *et al.* (2019), was refined using Early Childhood Education and development literature as well as through interviews with Early Childhood Education experts. The refining process focused on enhancing the tool to be more location-specific, relatable to 3-5-year-old preschool developmental criteria, and possibly to

reduce and/or break up the time each participant spends in testing. The modification of the tool took place in two stages:

Stage 1

Stage 1 involved a thorough review of recent Early Childhood Education (ECE) literature to make certain that the bioaffinity test tool was appropriate given current knowledge and understandings of childhood development in the field. The Giusti *et al.* (2014) tool was then modified accordingly (see hypothetical sample table below).

Table 1 Hypothetical Sample of the Justification and Modification Chart Utilized to Document any Changes Made to the Giusti *et al.* (2014) games testing Tool.

Areas Added or Requiring Change	**Justification**	**Modifications**
Game Design (Identified During Interviews…)	During the interviews with ECE experts…	1. Question 3 changed from cartoon to picture… 2. Question 4 modified from…
Cartoon vs. Real Pictures (Identified in Omidvar, 2018…)	Omidvar (2018) recommended…	1. Question 5 modified to…
Use of Language (Identified in Developmental Psychology Literature…)	Kail and Barnfield (2015) discussed…	1. The term ____ was modified to the term ____…
Length of Time (Identified in previous studies…)	Previous studies stated…	1. Questions have been reduced to only 10 questions… OR 2. Administer the test with a snack break in between…

Stage 2

Interviews with four Early Childhood Educational scholars (including research experts and educators) were conducted to gain feedback on the appropriateness of the original Giusti *et al.* (2014) tool and modify it accordingly, recording it in the same table again (see hypothetical sample table above). The interview questions were open-ended in nature, and the scholars were asked to provide feedback on the appropriateness of the language and pictures utilized in the bioaffinity testing tool and to give general feedback on the tool itself. Once the bioaffinity test was modified (from Stages 1 and 2 above), a pilot test was conducted using the refined tool with preschool children (see details below).

By collecting data from different sources (literature and interviews), asking the same research questions of the different study participants, and doing member checks with the experts interviewed, it addresses the credibility component of trustworthiness in the qualitative methods used. Additionally, by documenting the modifications and justification (via literature and interviews) of the testing tool, it adheres to the trustworthiness factor of dependability and confirmability, primarily due to the establishment of traceability and an audit trail.

Study Area and Sampling Techniques

Interviews

The first part of the study focused on the modification of the Giusti *et al.* tool through relevant literature and knowledge obtained during semi-structured interviews with Early Childhood Education experts, including psychology development experts and one of the Head Teachers at the Shambhala School. The recruitment for interviewees was carried out through a non-probabilistic and purposive sampling technique, which specifically focused on a combination of stakeholder and criterion sampling (Payls and Atchison, 2014). Stakeholder

sampling refers to identifying and interviewing significant stakeholders who are intimately involved in the matter at hand; ECE experts and educators (Payls and Atchison, 2014).

An initial recruitment email (Appendix II) was sent out to the experts which included a brief overview of the study, the Omidvar *et al.* (2019) study, a copy of the Giusti *et al.* (2014) psychological bioaffinity games testing tool, and finally the consent form for the interviewing process (Appendix III). Upon agreeing to be interviewed, the experts were sent options for when and where the interview would take place. Decisions concerning the time and place of the interview were determined as per the convenience of the interviewees.

Pilot Test

After the modifications made to the Giusti *et al.* (2014) games testing tool were informed by the psychological development literature review and the interviews with Early Childhood Education experts, the modifications were then manually completed, and a modified test was the result. The alterations completed based on the literature and information from the interviews was sent to the REB as an amendment and approved (the focus being on the new games testing tool) before moving forward with the pilot testing.

Alongside approval from the REB, it is essential to note that a preliminary meeting with the Director and Head Teacher of the preschool class was conducted to discuss the study and ask for formal permission to complete the study with the students (see Appendix IV for initial email). Upon approval from the Shambhala School and the REB, recruitment for the pilot test commenced. Pilot test recruitment followed a non-probabilistic and purposive sampling technique, with a focus on criterion sampling. Criterion sampling refers to finding individuals or a group of individuals who meet a specific criterion; preschool children attending an REI school (Payls and Atchison, 2014). An initial recruitment email (Appendix V) was sent out to the

parent(s)/guardian(s) of each prospective participant in the preschool class chosen for testing at the Shambhala School.

The recruitment email (Appendix V) was sent out by the Director and Head Teacher to the parent(s)/guardian(s) of children aged 3-5 who are enrolled at the Shambhala School. The initial email included a brief overview of the study, an information bulletin (Appendix VI), a brief biography (Appendix VII) about the researcher who will be completing the testing, and a consent form (Appendix VIII). The parent(s)/guardian(s) were then instructed to respond to the initial recruitment email if they were interested in their child participating in the study. Additionally, the parent(s)/guardian(s) were given the choice of three locations for where the study could be conducted: (1) at Dalhousie University Education for Sustainability Research lab; (2) at the Shambhala School (a separate room will be set up for the children to be tested), or (3) at the child's residence. Finally, the parent(s)/guardian(s) were made aware that if their child was to partake in the study (undergo the testing), then they would be offered a Certificate of Achievement (Appendix IX) and a $25.00 gift card to the children's store Woozles in Halifax, NS.

Procedure for Data Collection

Interviews

Interviewing was chosen in order to strengthen and support the literature reviewed that was used to inform the modifications of the Giusti *et al.* (2014) games testing tool. The interviews were conducted face-to-face, and the questions were semi-structured due to the advantages and flexibility of this type of interviewing (Payls and Atchison, 2014). A few specific advantages include close to an 80-90% participation rate, minimized volunteer bias, increased clarity, and overall enhanced data collected (Opdenakker, 2006; Payls and Atchison, 2014). The interviews were also recorded, which allows for the interviewer to pay increased attention to the

interview in real-time, as well as recording provides a complete and accurate record of the interview dialogue (Payls and Atchison, 2014). Therefore, as mentioned above, in order to obtain specific information to inform modifications of the testing tool, Early Childhood Education experts (psychological development experts) and educators were interviewed through this qualitative form (see Appendix X for interview questions). The time needed to complete an individual interview was estimated to be 30-60 minutes. As mentioned above, all interviews were audio-recorded for data accuracy upon the consent of the experts.

Pilot Test

For the pilot test, the revised tool was tested on one cohort of recruited students from the Shambhala School (n=9). The games testing tool is divided into three phases: children's emotional affinity with nature, children's environmental awareness, and children's attitudinal affinity with the biosphere (Appendix I). There is a total of six games to be played before the testing is considered complete, with each phase consisting of two games. The first phase includes one game that will ask the child, "Does this [image] have feelings?", and the second game asks the child to show their reaction to positive and negative environmental behaviours using the image of a smiling or sad face. The second phase is designed to measure environmental awareness that includes, first, a matching exercise (game 3) where the child will have to match an ecosystem service with a product, and the second (game 4) asks the child if environmental pollution affects people, animals, plants, and vehicles. Finally, the third phase includes, first (game 5), a game that asks various questions about where the child feels safe playing and why, with the second game (game 6) asking where the child does not feel safe playing and why. In the third phase, both games five and six allows the children to rationalize their choices using their own words. Therefore, all answers were audio-recorded upon the consent of the parent(s)/

guardian(s)and transcribed for further analysis.

Before conducting the games testing on the chosen day, an assent script was used (Appendix XI). Additionally, throughout the games testing, a puppet or stuffed animal was on hand in case the participant showed signs of boredom while undergoing the testing. The puppet or stuffed animal was either from the Shambhala Children's Centre, borrowed from another children's centre, or brought in by the researchers. After games testing was completed in the parent(s)/guardian(s) choice of location, the child was escorted back to their classroom or to the parent/guardian.

Data Analysis

Interviews

Data collected via audio recording during the interview processes was transcribed into a Word document. After transcription, the data was sifted through, and specific information with regard to informing modification was charted in a documentation table (see Table 2).

Pilot Test

Quantitative data collected from the pilot test/games testing was analyzed using descriptive statistics including, central tendency and measures of dispersion (Payls and Atchison, 2014; Omidvar, 2018; Omidvar *et al.* 2019). Open-ended verbal responses were analyzed using an inductive approach, developing *a posteriori* codes to find emerging themes (Omidvar, 2018; Omidvar *et al.* 2019). As seen in Omidvar (2018) and Omidvar *et al.* (2019), in order to keep the participating children's identity confidential, each child was assigned a participant code (C1-C20). After data was analyzed, a comparison analysis was conducted between the new results and the results found in the Omidvar (2018) and Omidvar *et al.* (2019) studies. This analysis was conducted to help determine whether modifying the Giusti *et al.* (2014) games testing tool

allowed for more positive bioaffinity results. In addition to the use of statistics, researcher observation was used to determine how well the test was received (i.e. did the children understand the question, were there children who dropped out, did the children recognize the nature items that they were presented with, etc.).

This analytical methodology aids in addressing the transferability (a component of trustworthiness), due to providing the fundamental information necessary to establish a degree of similarity between the previous Omidvar studies and the new findings. Moreover, these methods rely on interdisciplinary information to inform the research strengthening the transferability of this study.

Limitations and Mitigations

The main limitation of this study is the sample size of n=9 participants used for the pilot test, which was also noted in Omidvar (2018) and Omidvar *et al.* (2019). The results of this study are not generalizable to all REI schools in Halifax, but instead, this is a non-probabilistic study that attempts to strengthen a bioaffinity tool for use in future probabilistic studies. The reason for still going ahead with the smaller sample size was primarily due to both the Omidvar (2018) and Omidvar *et al.* (2019) recruiting a similar sample size of preschool children, as well as for clarity regarding the comparison analysis. It is also justifiable on the nature of this study being non-probabilistic and exploratory, so it is recommended that more studies be conducted after this study as long as the modifications to the testing tool meet construct validity and showcase positive bioaffinity results. Another limitation in regard to the study being particular is the socio-cultural background of the recruited preschool children from the Shambhala School. It is critical to recognize that due to the different socio-cultural backgrounds of the children, their outlook and relationship with nature may be affected (Omidvar, 2018; Omidvar *et al.* 2019).

Another limitation mentioned in the Omidvar publications (2018; Omidvar *et al.* 2019) was concerning the timing of the testing. Due to this study also taking place in the winter months, as did the Omidvar studies, seasonal depression or negative notions about nature may influence the child's point of view and emotions during the time of testing (Omidvar, 2018; Omidvar *et al.* 2019). Moreover, due to the study having to be finalized within eight months, the study was condensed to ensure the quality of the research produced. Therefore, the newly modified games testing tool will need to be further tested with a larger sample size and in various seasons and cultures (Omidvar, 2018; Omidvar *et al.* 2019).

Trustworthiness of Qualitative Methodology

Due to the temporal time constraint restricting the determination of validity and reliability of the modified games testing tool, it is important to ensure the qualitative methodology utilized to conduct the revisions is trustworthy. Scholars have noted that if validity and reliability are unable to be met or are not relevant to the current study, then the researcher could instead confirm the significance and usefulness of the research via the four criteria of trustworthiness. Thus, establishing grounds for future studies to utilize and build upon the research confidently. The discussion of trustworthy qualitative research methodology emerged in the 1990s when researchers such as Eisenhart and Howe (1992) and Altheide and Johnson (1994) debated criteria including plausibility, relevance, credibility, completeness, appropriateness, comprehensiveness, and significance.

Guba and Lincoln (1994) went on to refine the criteria for trustworthiness, explicitly focusing on ensuring rigour, so they concluded with credibility, dependability, confirmability, and transferability. Later, Morse *et al*. (2002) added that "without rigour, research is worthless, becomes fiction, and loses its utility" (p. 14). Moreover, rigour is known to attest to the integrity,

legitimacy, and competence of the methods at hand (Aroni *et al.*, 1999). Studies went on to further establish the applicability of Guba and Lincoln's four particular criteria, such as Tobin and Begley (2004), Williams and Hill (2012), Polit and Beck (2014), Amankwaa (2016), Connelly (2016), and more. Various reports went on to use this criterion to ensure the methodology was sound including the following studies: trustworthiness of counselling psychology (Morrow, 2005), interpretive practices in various disciplines (Schwandt, 2007), education and policy (Anney, 2015), and tourism research (Decrop, 2004).

The first component, credibility, refers to the confidence in the truth of the study and findings, and in some cases, whether or not the study represents a credible interpretation of the original data, such as "prolonged engagement with participants, persistent observation, peer-debriefing, member-checking, and reflective journaling" (Polit and Beck, 2014; Connelly, p. 435, 2016; Lincoln, Guba and Pilotta, 1985). Dependability refers to "the stability (reliability) of data over time and over conditions", and studies have related this factor to reliability in quantitative research, but instead of repeating the testing various times, a researcher can include an "audit trail" of their methods (Polit and Beck, p. 492, 2014; Connelly, 435, 2016).

The third component, confirmability, is known as how well the findings of the study are supported by the data or how strong the connection is between the data and the results, as well as to what degree the findings are consistent and could be repeated (Kyngas, Kaariainen, and Elo, 2019; Polit and Beck, 2014; Connelly, 2016). Lincoln, Guba and Pilotta (1985) stated the final factor, transferability, calls for the researcher to be responsible for providing sufficient descriptive data in the study so that the reader can evaluate its transferability ("…the extent to which qualitative findings can be transferred to (or have applicability in) other settings") (Polit and Beck, p. 492, 2014).

By asking the same research questions of the different study participants (experts and the pilot test cohort), collecting the data to inform the modifications via different sources (literature and interviews), and conducting member checks with the experts, credibility has been addressed. Through the analytical method of establishing similarity between the previous Omidvar studies and the new findings, as well as relying on interdisciplinary information to inform the research, transferability was recognized.

Dependability was established by thoroughly documenting the modifications and justifications used to revise the Giusti *et al.* (2014) games testing tool, thus creating traceability and an audit trail. Finally, the results showcase an apparent connection between the modification of the tool and the pilot test outcomes, as stated above. Moreover, this study is consistent with the previous studies and continued to establish a framework for future studies to repeat, which constitutes confirmability of the study has been achieved. Therefore, the qualitative methodology used throughout this research can be deemed trustworthy.

Results and Discussion

The following section presents the significant findings from the literature review, interviews with Early Childhood education experts, and pilot testing with children. In the presentation of results, works by Omidvar (2018) and Omidvar *et al.* (2019) are referred to considerably in order to discuss the extent to which the modifications made to the bioaffinity testing and tool were effective for the games testing of Canadian three-to-five-year-olds. Finally, while it is methodologically impossible to determine whether the results of this study showcase the tool is better able to measure the bioaffinity of the children (such a study would necessitate a different type of testing and analysis than we completed in this study), the bioaffinity results of this cohort are presented in this section and compared with the Omidvar (2018) bioaffinity

results in order to provide a foundation for future studies that will test reliability and validity associated with the newly modified games testing tool.

Literature Review and Interview Results

The review of the developmental psychology literature and the interview data were collected, analyzed and used to inform the modification of the Giusti *et al.* (2014) games testing tool. The results from the literature review and interviews have been combined and are presented in table format (see Appendix XII Modification Chart), with the tables outlining the areas added or requiring change, justification and modifications for each of the six games within the tool. As seen in Table 1, the results from the literature and interview data were compiled into the first two columns of the modification chart, 'areas added or requiring change' and 'justification.' These areas aimed at providing other scholars with an understanding of why the modifications were made and how the research supported them. During analysis, four major themes emerged from this data that ascertained the aspects of the tool needing revision: (1) game design, (2) cartoon versus real pictures, (3) use of appropriate language, and (4) length of time (Appendix XII).

Table 1 showcases the areas requiring change and justification for the modifications made to game 1A: emphatic behaviour instructions. For each theme, it was displayed how and where the changes arose from, such as for 'game design', the change was "identified during interviews with ECE experts, 2019" (table 1). In this case, the following column, justification, would then explain the reasoning via using the literature and interview results. For example, during an interview with Dr. Daniel Seguin, he stated, "Kids are hands-on. They light up when they think they are helping you…because of that age; they still have an egocentric nature, so they will want to tell you or show you", which resulted in point three, as seen under justification for game design in table 1. The justification for the second theme, 'cartoon vs. real pictures', was

identified in the Omidvar (2018) and Omidvar *et al.* (2019) studies, during the interviews with ECE experts, and supported by developmental psychology literature (table 1; Kail and Barnfield, 2015; Hughes, 1975; Dasen, 1994). One of the final recommendations from the Omidvar studies was to "choose more meaningful and easily understandable pictures and using the images of local locations may help children in better comprehending and relating to the question" (Omidvar, p. 108, 2018). This recommendation was supported by ECE experts when asked about cartoons vs. real pictures, such as Dr. Daniel Seguin's quote, "if you are looking for answers to a realistic question about the environment, a realistic photo is good."

Furthermore, developmental psychology literature complemented these suggestions. For example, Kail and Barnfield (2015) and Hughes (1975) discuss preschool children's egocentrism and how this causes the children to have difficulty viewing the world from another's point of view. Therefore, this implied that children might struggle to understand the original pictures used in the Giusti *et al.* (2014) testing tool because they were selected for preschool children in Stockholm, Sweden. Finally, the Dasen (1994) study also supported the need for local photos due to the influence of culture, which may impact the child's ability to understand the pictures (e.g. children in Sweden may be exposed to a different kind of chicken or hen than Canadian children). The third theme, use of language, was identified and supported by the developmental psychology literature (Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009). It was apparent that if the pictures were to be modified to a Canadian context, then the language should follow suit. Additionally, the initial Giusti *et al.* (2014) tool was developed strictly for four-to-five-year-old's and then used with three-to-five-year-old's in Halifax, Nova Scotia. Literature shows that the vocabulary of a two-year-old is roughly a few hundred words, and the vocabulary

of a six-year-old is over 10, 000 words (Kail and Barnfield, 2015; Smith, 2000). Therefore, the vocabulary and literacy of a three-year-old would be vastly different from that of a five-year-old.

The final theme, length of time, was first identified during the Omidvar (2018) and Omidvar *et al.* (2019) studies, where it was highlighted that it took roughly 30-40 minutes to complete the games testing for one individual participant. Literature states that preschool children have increased difficulty staying focused as their attention spans are merely beginning to develop (Kail and Barnfield, 2015). Finally, the ECE experts were also in agreeance that requiring a three-to-five-year-old to stay engaged for a 30-minute exercise is taxing. Dr. Donna Varga put it simply that a 30 minutes exercise "…is a lot," and suggested we "break it up," and Dr. Daniel Seguin agreed by saying, "they will be bored out of their minds." However, the experts were confident that by including movement, incorporating tasks, creating game boards and game piece, and having interlude material (puppet, dance party, etc.) would aid in curbing their boredom and lack of interest.

Table 2 Condensed table portraying the literature review and interview data results (justification) that constitute the modifications for game 1A – emphatic behaviour instructions (Appendix XII).

Areas Added or Requiring Change	**Justification**
Game Design (Identified during Interviews will ECE experts, 2019)	• The incorporation of 'sorting' for game 1A was influenced by all four of the ECE Experts; some highlights include: • Leah Noonan encouraged tasking, pictures becoming tactile and incorporating various kinds of movement throughout the testing; • Dr. Daniel Seguin affirmed that children are particularly hands-on during the preoperational stage; • Therefore, it was highly recommended that the games transform to include these qualities.
Cartoon vs. Real Pictures (Identified in Omidvar, 2018 and Omidvar *et al.*	• Kail and Barnfield (2015) and Hughes (1975) discuss that due to preschool children's egocentrism, they are

2019; Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Hughes, 1975; Dasen, 1994; Identified during Interviews with ECE experts, 2019)	inclined to have difficulty viewing the world from another's point of view; • Therefore, modifying the pictures from a Swedish context to a Canadian context is crucial to ensure the child has an increased chance of knowing and understanding the images they will see and are expected to use throughout the tool; • Dasen (1994) reiterated the need for local context due to the influence of culture fluctuating from country to country; • Additionally, the ECE Experts called for consistency concerning the pictures used throughout the tool; • Thus, they all suggested that for the sake of clarity to choose either cartoon or real images; • As a result, real pictures were selected due the egocentrism and the influence of culture because there is a possibility that some children may not be exposed to cartoons, whereas all children are exposed to real objects in some capacity.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000)	• Since the tool was initially developed to measure the bioaffinity of exclusively 4-to-5-year-old Swedish children, the original language used may be too developmentally complex or not used in a Canadian or Nova Scotia cultural context (Giusti *et al.* (2014); • This is supported by Kail and Barnfield's (2015) and Bloom's (1998) studies that highlighted the vast difference between the vocabulary of a two-year-old (roughly a few hundred words) to that of a six-year-old (over 10, 000 words); • Therefore, it was essential to cater to the younger participants (3-year-old's) to ensure the highest level of understanding.
Length of Time (Identified in previous studies Omidvar, 2018; Omidvar *et al.*, 2019; Identified in Developmental Psychology Literature Kail and	• Omidvar (2018) noted that the amount of time needed to complete the games testing was roughly between 30-40 minutes;

Barnfield, 2015; Identified during interviews with ECE experts, 2019).	• Thus, various strategies have been used to try and reduce the time needed including bringing the games to life (incorporating movement and task through game boards and game pieces), reducing some of the questions and pictures used, and greyscaling the images; • This modification is also supported by ECE experts, such as Dr. Daniel Seguin resonating with transforming the game into game boards and game pieces, which he believed would reduce the time to roughly five minutes per game; • Additionally, Dr. Sophie Jacques discussed the need to reduce the time due to 3-year-old's having short attention spans. Therefore, she advised to change activities frequently in order to keep the children engaged; • Kail and Barnfield (2015) note that three-year-olds will have a decreased attention span compared to that of a five-year-old, to which they offered frequently reminding the child to try and stay focused as a strategy to keep them engaged.

Throughout the subsequent five games, the identification and justification for themes (2) cartoon vs. real pictures, (3) use of language, and (4) length of time stayed consistent and referred back to the reasoning provided in table 1 above and table 2 of the modification chart in appendix XII. Whereas, theme (1) game design, varied for game 2B: pollution awareness instructions, where the change was identified during an interview with Dr. Tarah Wright, Dr. Daniel Seguin, and Nazanin Omidvar (2019) and supported by interviews with the ECE experts. Dr. Donna Varga expressed that this particular game was "filled with anthropomorphism" concerning the pictures used and that there was underlying bias assuming the children would be

able to understand or have lived experience with the three pollutants water pollution, air pollution, and ground pollution. Furthermore, Dr. Tarah Wright, Dr. Daniel Seguin, and Nazanin Omidvar (2019) noted that it was difficult to determine whether the child provides an answer based on the images in front of their or based on their previous knowledge of the pollutants. Therefore, modifications were made accordingly.

Aside from the areas added or requiring change, justification, and modifications made to each of the six games, additional revisions were made to the overall delivery of the tool and recommendations were inputted to assist researchers who choose to use the modified tool in the future. As seen in table 2, there was a total of five concepts added to the tool. The first idea, 'general recommendations for how to prepare and conduct the testing,' was created to equip future researchers with an understanding of how to execute the testing similar to the testing conducted with this cohort (table 2). This section was identified and supported by the previous Omidvar (2018) study, and during an interview with Dr. Tarah Wright, Dr. Daniel Seguin, and Nazanin Omidvar (2019), where suggestions such as audio recording each testing session were mentioned. The second and fifth idea, 'overview of water pollution, ground pollution, and air pollution before starting the games testing' and 'debrief,' as a result of an interview with Dr. Tarah Wright, Dr. Daniel Seguin, and Nazanin Omidvar (2019), where it was recommended to include a learning experience for the children concerning the three pollutants that they would encounter during the testing (table 2). Initially, the tool assumes that three-five-year-olds understand the mature concept of pollution and requires them to apply the associated impacts to various cognitive, emotional and attitudinal exercises.

However, literature states that the development characteristics and capabilities of a three-year-old are vastly different from that of a five-year-old (Kail and Barnfield, 2015). As discussed

in the literature review, at the age of four, there is a fundamental change in a child's understanding of the world and how it relates to them as an individual (Kail and Barnfield, 2015). Therefore, a three-year-old's understanding and use of the three pollutants are expected to be considerably different from a five-year-old's understanding and use of these concepts. It is important to note that the overview at the beginning of the testing does not iterate the impacts associated with the pollutants, such as air pollution causing health risks to humans and animals. The descriptions merely iterate what is seen in the images associated with the pollutants used throughout the tool (Fig. 3). This is to ensure bias is minimized but still equip the children with the same information concerning pollution before undergoing the testing (Fig. 3). Later in the debrief section, the statements used in the overview were expanded to include the implications of the pollutants.

The third idea, 'overall game design,' reiterates and solidifies the justification for the subsequent game design modifications (table 2). All of the ECE experts supported the notion to create game boards and game pieces, such as Leah Noonan discussing the inclusion of tasks and movement and emphasizing, they should be "interactive, so they can actually manipulate." The fourth and final idea, 'colour vs. greyscale', was primarily identified by ECE expert Dr. Sophie Jacques and supported by developmental psychology literature (table 2; Pitchford and Mullen, 2003; Bonnardel and Pitchford, 2006; Regier and Kay, 2009). When asked about the pictures used to illustrate the pollutants, Dr. Sophie Jacques stressed that "what you have to be careful of, is to not make ugly looking images all be related to pollution," and that "some kids really like certain colours, everything red is perfect, doesn't matter what it represents." Therefore, she recommended that all of the pictures throughout the tool either needed to be greyscaled, or additional measures would need to be implemented to minimize the colour bias, such as using

multiple photos (e.g. 3-5 images) for each pollutant to guarantee the child's response is not affected by the colours. As seen in table 2, preoperational (preschool) children are just beginning to develop the cognitive skills used to categorize colours, which means young children rely on primary colours or their favourite colours when partaking in daily tasks and activities (Pitchford and Mullen, 2003; Bonnardel and Pitchford, 2006; Regier and Kay, 2009). Thus, instead of adding additional pictures for each of the pollutants, all of the pictures throughout the tool were greyscaled.

Table 3 Condensed table portraying the literature review and interview data results (justification) the overarching modifications added to the tool (Appendix XII).

Areas Added or Requiring Change	Justification
General Recommendations for How to Prepare and Conduct the Testing (Identified in previous study Omidvar, 2018; Identified During an Interview with Wright, Omidvar, and Seguin, 2019).	• In Omidvar (2018), it was recommended that various revisions should be made to the Giusti *et al.*, (2014) tool. Therefore, this was extended to not only the individual games but the overall tool itself; • During an interview with Wright, Omidvar, and Seguin (2019), suggestions were made regarding the delivery of the tool, such as the prescription to audio record each session.
Overview of Water Pollution, Ground Pollution, and Air Pollution Before Starting the games testing (Identified During Interview with Wright, Omidvar, and Seguin, 2019)	• This section was recommended to facilitate a learning experience for the children about the three pollutants seen throughout the tool.
Overall Game Design (Identified During Interview with ECE Experts, 2019)	• As mentioned in table 1, all four ECE experts supported the decision to "bring the games to life" and make them more interactive; • Additionally, the experts believed the transformation of the games would reduce the time needed to complete the testing.
Colour vs. Greyscale (Identified during interview with ECE Experts, 2019; Identified in Developmental Psychology Literature Pitchford	• Between the ages of three-to-five-year-old, children begin to develop categories for colours (Pitchford and Mullen, 2003);

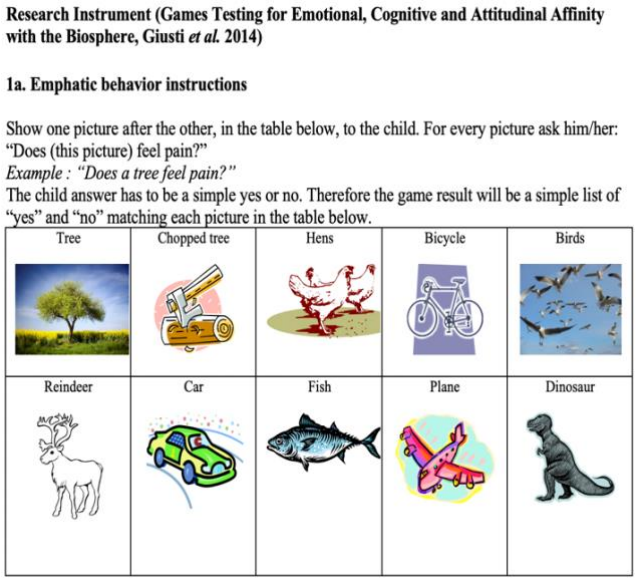
and Mullen, 2003; Bonnardel and Pitchford, 2006, Regier and Kay, 2009**)**	• Bonnardel and Pitchford (2006) discussed how preschool children rely on primary colours over complex colours; • Additionally, children tend to gravitate towards their 'favourite' colour when partaking in daily tasks and activities (Regier and Kay, 2009); • ECE expert Dr. Sophie Jacques affirmed these notions and suggested that the entire tool was either greyscaled or other bias reducing tactics should be implemented; • Therefore, all pictures used throughout the tool were greyscaled.
Debrief (Identified During Interview with Wright, Omidvar and Seguin, 2019)	• Similar to the overview section, the debrief was identified during the interview with Wright, Omidvar, and Seguin (2019); • This section was included to complement the overview section, and provide an understanding of the pollutants that may resonate with them once they leave the testing; • Moreover, the overview and debrief may stimulate children to ask more questions about pollution that they see in their daily routines.

The rationalizations established via the literature review and interview data were fundamental for informing the modification of the Giusti *et al.* (2014) games testing tool. This discourse aids in filling a gap concerning the revision of early childhood games testing tools, by providing complete transparency and reasoning for how and why the particular changes were made.

Modification Results

The following section discusses the modifications made to the tool according to the areas added or requiring change and the justifications divulged in the above section. As previously mentioned, in addition to the revisions made related to the four emerging themes, additional adjustments to include an opening and closing section, and recommendations for the researcher

using the instrument were implemented (Fig. 2). Initially, the games testing tool was played on standard printer paper (8.5 x 11) and included minimal instructions (Appendix I; Fig. 1). Figure 1 displays the first page of the original Giusti *et al.* (2014) games testing tool.



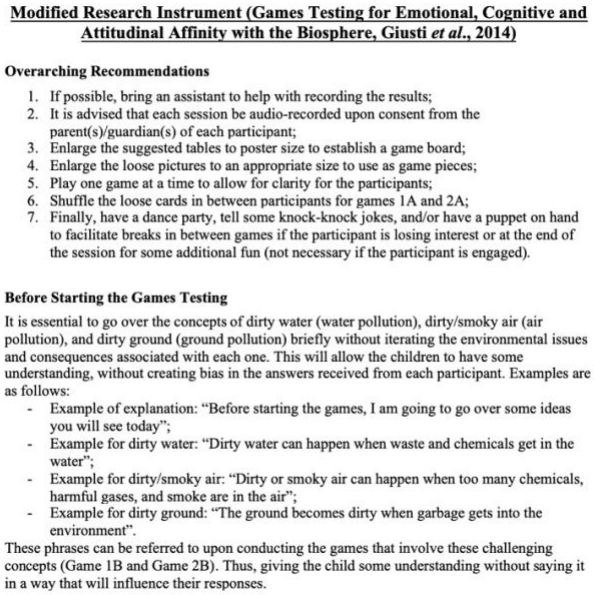
Research Instrument (Games Testing for Emotional, Cognitive and Attitudinal Affinity with the Biosphere, Giusti *et al.* 2014)

1a. Emphatic behavior instructions

Show one picture after the other, in the table below, to the child. For every picture ask him/her: "Does (this picture) feel pain?"
Example : "Does a tree feel pain?"
The child answer has to be a simple yes or no. Therefore the game result will be a simple list of "yes" and "no" matching each picture in the table below.

Tree	Chopped tree	Hens	Bicycle	Birds
Reindeer	Car	Fish	Plane	Dinosaur

Figure 1 Snapshot of the first page in the Giusti *et al.* (2014) games testing tool (Appendix I).



Modified Research Instrument (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

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 you will see today";
- Example for dirty water: "Dirty water can happen when waste and chemicals get in the water";
- Example for dirty/smoky air: "Dirty or smoky air can happen when too many chemicals, harmful gases, and smoke are in the air";
- Example for dirty ground: "The ground becomes dirty 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.

Figure 2 Snapshot of the first page in the newly modified version of the games testing tool (Appendix XII).

As seen in Figure 2, the opening page of the tool was modified to include these additional segments. The “overarching recommendations” section was created to include suggestions gathered throughout interviews with ECE experts and discussed in Omidvar (2018) regarding the overall testing experience. For example, Omidvar (2018) wrote about each testing session taking roughly 30-40 minutes to complete. Therefore, one recommendation was to bring a scribe or research assistant to aid in collecting the data, as well as to audio record the session facilitating an accurate record of the dialogue. Having someone to collect the data allows the researcher to focus on administering the testing, which results in a reduction in the duration of time needed to complete the testing. This is because it removes the need for the researcher to pause and manually record. Another recommendation was to bring a puppet or have practical jokes prepared to curb boredom if necessary, which was also suggested in Omidvar (2018).

Additionally, the list also included prompts to assist the researcher with transforming the games into life-size game boards and game pieces, such as “enlarge the suggested tables to poster size to establish a game board” (Fig. 2). The following section, ‘before starting the game’s testing,’ is where the three pollutants are introduced to the children. As discussed above, this section was created to incorporate a learning exercise within each testing session (Fig. 2). This opening segment briefly states what the participant would see throughout the testing: water pollution (dirty water), air pollution (dirty/smoky air), and ground pollution (dirty ground). It is important to reiterate, to minimize bias, the beginning statements did not include any implications associated with the pollutants. For example, “dirty water can happen when waste and chemicals get in the water” was used to describe water pollution. As seen in Figure 3, this statement describes what is seen in the picture. Therefore, it is assumed that the opening segment

would not provide the participants with any additional information that is not already seen within the photos used throughout the testing.

Figure 3 The three pollutants air pollution, ground pollution, and water pollution with their corresponding modified pictures found in game 2B: pollution awareness instructions (Appendix XII).

Finally, at the end of the tool, a 'debrief' section was added where the participant was encouraged to ask questions after learning about the three pollutants one more time (table 2). In this section, the statements were extended to include the consequences associated with each type of pollution, such as "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" (Appendix XII). Ultimately, even if the participant had not encountered pollution within their daily routine, home life, or at school, the additional and reiterated information regarding pollution is thought to leave the participant with more knowledge about these concepts than when they entered the testing. The following four subsections elaborate on the four major themes in relation to the specific modifications made to the individual games (Appendix XII).

Game Design

The first significant result from the modification chart (Appendix XII) was the game design. The original Giusti *et al.* (2014) games testing tool was played on standard printer paper,

with small images and varying types and colours of pictures (Fig. 1). Overall, all of the games were revised to become tangible games, meaning they are now set up as game boards with game pieces, or game pieces paired with tasks (see Fig. 4 for an example). Table 1 is an abbreviated version of the different game design modifications that were made to the Giusti *et al.* (2014) tool (see Appendix XII for the full version). Figure 4 illustrates the outcome of the revised game design for 'Game 1B', where you can see the game board in poster form with the game pieces, which in this case are the smiley faces.

Table 4 Abbreviated table of game design revisions pulled from the Modification Chart (see Appendix XII).

Game 1A	**Game 1B**	**Game 2A**
This section is now a 'sorting game'. This involves 'yes' and 'no' bins that are placed on opposite ends of the testing space in order to facilitate the sorting.	This game has been modified to be called "a game of happy and sad smiles". The table of images provided was enlarged and printed as a game board and eight of the happy and sad smiles (total = 16) were enlarged and printed in colour.	The game has been modified to facilitate a 'matching game'. Therefore, the table for list 2 was enlarged and printed to create a game board, and the pictures in list 1 were individually enlarged and printed to use as matching pieces.
Game 2B	**Game 3A and 3B**	

The game has been modified into two parts. Part 1 asks the child to explain the concepts of air pollution/dirty or smoky air, ground pollution/dirty ground, and water pollution/dirty water. Part 2 is similar to the original version found in Giusti *et al.* (2014), where the child is asked whether the type of pollution (found in list 1) can hurt the things found in list 2 (animal, car, and people). However, it is now set up as a sorting game, with three of each item found in list 2 made into cut outs, so the participant can sort their answer into the 'yes' or 'no' bin utilized for game 1A.	The table of images provided was enlarged, and printed as a game board, with the question portion remaining similar to the original testing tool.

Revised game designs were supported by both the literature and the ECE experts, as discussed above. Kail and Barnfield (2015) explained that during the preoperational stage (2-7-years-old), a child's memory strategies are developed and driven by sight and touch. Moreover, Smith (2000; 2009) strengthened their point by highlighting that the shape of things creates a connection to specific objects and words. Similarly, all four ECE experts were unanimous in supporting the transformation to hands-on games, with responses such as:

"Yes…hands on and a little bit of movement would help"
– Leah Noonan, Shambhala School

"Cards games are good things to do with kids. You can get kids to sort cards into two bins"; "You have to vary, going from a card game, to a computer… they do much better"
– Dr. Sophie Jacques, Dalhousie University

"100%. That would help a lot. Kids are hands on… Kids because of that age still have an egocentric nature, so they will want to tell you or show you." – Dr. Daniel Seguin, Mount Saint Vincent University

"Certainly better" – Dr. Donna Varga, Mount Saint Vincent University

Therefore, all six of the games were lifted off the page and translated into real-life games. Another layer regarding game design is found in game 1B: concern for sensitivity instructions, where the children are asked to match either a happy or sad face with each picture found on the game board (Fig. 4).

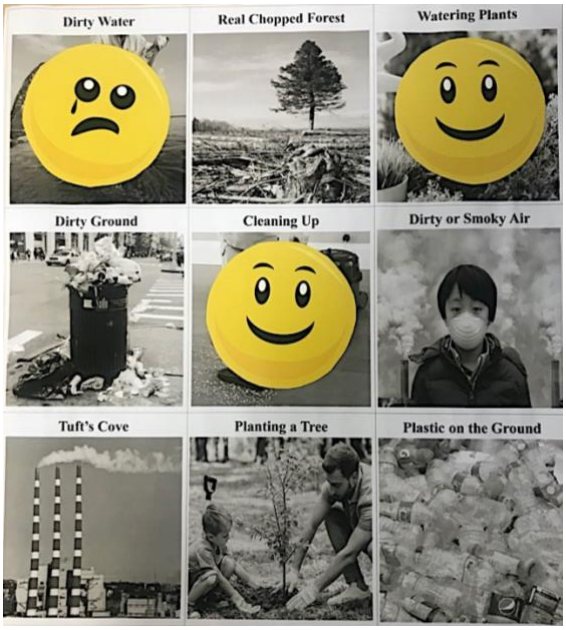


Figure 4 Picture of modified game 1B: concern and sensitivity instructions with the game board and game pieces.

Within this game, two local photos concerning pollution in Halifax were incorporated, to see whether the children can resonate and understand pollution in a local context better than in a general one. To further explain, common or general pictures of water pollution, ground pollution, and air pollution were utilized throughout the tool (Fig.3). In this game, a picture of Tufts Cove and a picture of plastic pollution were added to this game, with the thought that children may come across these sources of pollution more often than the other three (Fig. 4). The outcome of this experiment can be found in the pilot test results section.

Cartoon vs. Real Pictures

The second theme was cartoons versus real pictures (e.g. a picture of a tree in Halifax instead of a cartoon photo of a tree). Within this category there were four main revisions made the original pictures: (1) grey scaling all of the pictures, (2) using all real pictures, (3) using culturally appropriate (real and local) pictures, (4) using developmentally appropriate pictures (understandable and straightforward). The first modification, as mentioned above, was to greyscale all pictures. This was identified during an interview with ECE experts and supported by the literature. This modification was a result of an interview with Dr. Sophie Jacques, where it was stated that our team "…might want to control and have them all greyscaled so that there are not brighter colours" (Dr. Sophie Jacques, Dalhousie University). She elaborated by discussing how children gravitate towards specific colours, especially during the preschool years, which is supported by the developmental psychology literature. According to Pitchford and Mullen (2003) and Regier and Kay (2009), preoperational children are only beginning to develop categories for colour, and during this time, they still rely on primary colours red, blue, and yellow (see literature review and interview results above for further explanation).

The second modification to use either all cartoon or real pictures was primarily identified in the literature and supported by the ECE experts. As seen in Figures one and five, a variety of different pictures were utilized throughout the initial Giusti *et al.* (2014) games testing tool. Omidvar (2018) discussed how the different pictures might have affected the results due to the children's lack of familiarity with the photos provided in the original tool. One of the explanations provided in the modification chart is the following excerpt:

> *"As discussed in Kail and Barnfield (2015) and Hughes (1975), due to preschool children's egocentrism, they are inclined to have difficulty viewing the world from another's point of view…Furthermore, Dasen (1994) reiterated*

the need for local context due to the influence of culture fluctuating from country to country. Additionally, ECE Experts touched on a separate note of finding consistency throughout the tool. All four experts noted the inconsistency of the use of real and cartoon pictures in the tool. Therefore, they all suggested that for the sake of clarity to choose either cartoons or real images. Ultimately, real pictures were selected due to the developmental literature discussing egocentrism and the influence of culture because there is a possibility that some children may not be exposed to cartoons, whereas all children are exposed to real objects in some capacity." – Found in table 3 of the modification chart (Appendix XII)

The quote touches on the second, third and fourth modification mainly due to the revisions being intertwined in nature. For example, by choosing all real pictures, it not only seeks to minimize a child's egocentrism but also to minimize cultural variance by providing a local context (see literature review and interview results above for further explanation). Finally, after deciding to modify all pictures to real and local pictures, the last step was to provide simplicity and clarity, which was determined mainly to reduce confusion caused by the wide variety of different photos used (Fig. 5). This resulted in using one picture for each category, rather than using multiple (Fig. 5). Examples of specific picture modifications include: changing a cartoon picture of a 'plane' to a real picture of an Air Canada jet plane, the removal of the cartoon picture of a "dinosaur," revising the picture of the "birds" flying in the sky to a real picture of a single Pigeon, and the three pictures of 'animals' (Fig. 5) have been modified to a single picture of a domestic house dog, specifically a golden retriever, which are very common in North America (Fig. 1; Fig. 5; Appendix XII).

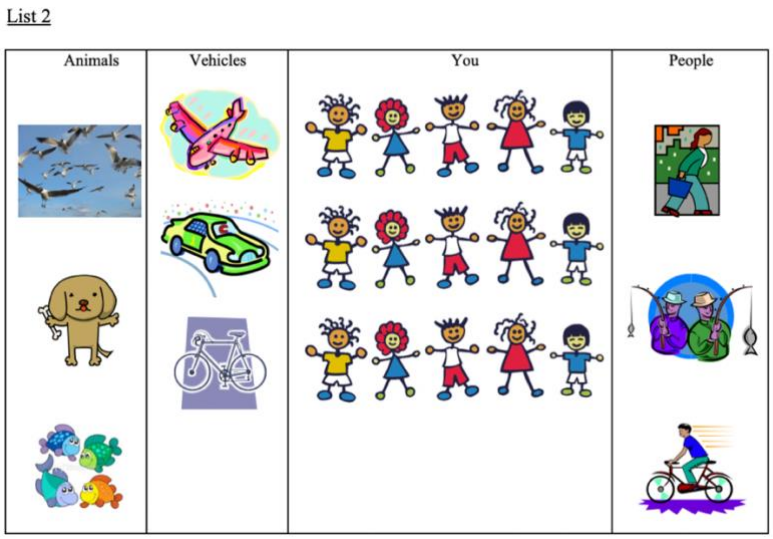


Figure 5 Snapshot of game 2B: pollution awareness instructions from the Giusti *et al.* (2014) games testing tool.

Use of Language

The use of culturally appropriate language is critical during the preoperational stage, largely due to the children's egocentrism (Kail and Barnfield, 2015). As mentioned in the above literature review and interview results section, there is a vast difference between the vocabulary of a two-year-old and a six-year-old (Kail and Barnfield, 2015; Bloom 1998). Therefore, it was determined that the language needed to cater to the younger participants (3-year-old's) to ensure the highest level of understanding. For example, an excerpt from the modification chart is as follows: "the language in the tool was modified to words that are often used in Canada and simplified for clarity (i.e. the use of "hens" was altered to "chicken" and the use of "pain" was modified to "owie"); (Fig. 1; Appendix XII). Another noticeable change in language was concerning the three pollutants. Initially, the pollutants were named as is, such as "water pollution." However, it was identified during an interview with Dr. Tarah Wright, Dr. Daniel Seguin, and Nazanin Omidvar (2019) that revising these words would be beneficial as well. Therefore, throughout the modified tool, the pollutants are now referred to as dirty water (water pollution), dirty or smoky air (air pollution), and dirty ground (ground pollution).

Length of Time

The final theme pertains to the duration of time required to complete the games testing. As previously mentioned, Omidvar (2018) discussed that the amount of time needed to complete a session was roughly 30-40 minutes. As described in the modification chart, "various strategies have been used to try and reduce the time needed, including bringing the games to life (incorporating movement and task), reducing some of the questions and pictures used, and grey-scaling the images" (Appendix XII). During interviews with ECE experts they were asked to reflect on their experience administering testing to young children that lasted approximately 30 minutes, and responses included:

"Some probably couldn't manage that time" – Leah Noonan, Shambhala School

"They will be bored out of their minds. After a couple minutes they will not be on board" – Dr. Daniel Seguin, Mount Saint Vincent University

"It's a lot. You will need to break it up… you could get up and dance party or sing a song" – Dr. Donna Varga, Mount Saint Vincent University

"You have to change activities frequently. You have to vary because they will get bored" – Dr. Sophie Jacques, Dalhousie University

As a result, modifications made to each of the six games sought to reduce the amount of time. The revisions in this regard reduced the time needed to conduct the testing to an average of 15.25 minutes. The longest session during the pilot testing took 23 minutes, and the shortest session was 10 minutes. Therefore, this showcases the revisions worked to keep children more engaged and interested in the games testing, which resulted in the time being significantly reduced.

Pilot Test Results and Observations Regarding the Efficacy of the Test Modifications

As mentioned previously, while it is methodologically impossible to compare the bioaffinity results of this study to that of Omidvar (2018) in order to determine the reliability and validity of the new tool, (such a study would necessitate a different type of testing and analysis than we completed in this study), the bioaffinity results of the children in our pilot test are presented below and compared with the Omidvar (2018) tests in order to provide a foundation for future studies.

Game 1A: Emphatic Behavior Instructions

Games 1A and 1B aim to measure a child's emotional affinity with nature (Giusti *et al.*, 2014). For the first game, answers concerning vehicles represent non-affinity with nature (Giusti *et al*., 2014). Omidvar (2018) noted that eleven children were unable to understand the question at hand, with three of those children not responding at all and eight answering with 'yes' or 'no' to all of the pictures. In comparison, all nine children in this study were able to understand the modified question "Can this [image] get hurt or feel an owie?" and provide answers. However, two children either answered all 'yes' or 'no', with C3 answering all 'yes' and C6 answering all 'no' to the pictures. Therefore, the data for these two participants was removed (Fig. 6).

Interestingly, C6 gave reasoning for answering all 'no', with contradicting statements such as "a chicken can't get hurt because it's real" and "a plane can't get hurt because it doesn't talk or anything". Thus, suggesting these two children were able to respond but not fully grasp the exercise with relation to differentiating between living and non-living things, and how the world impacts them and their feelings. This outcome directly relates to egocentrism during the preoperational stage of development, which refers to "young children's difficulty in seeing the world from another's viewpoint" (Barnfield and Kale, p. 196, 2015). As noted in Omidvar

(2018), Giusti *et al.* (2014) did not report any difficulty or concerns with this game. Whereas this game is persisting with not being entirely developmentally appropriate for Canadian three-five-year-olds.

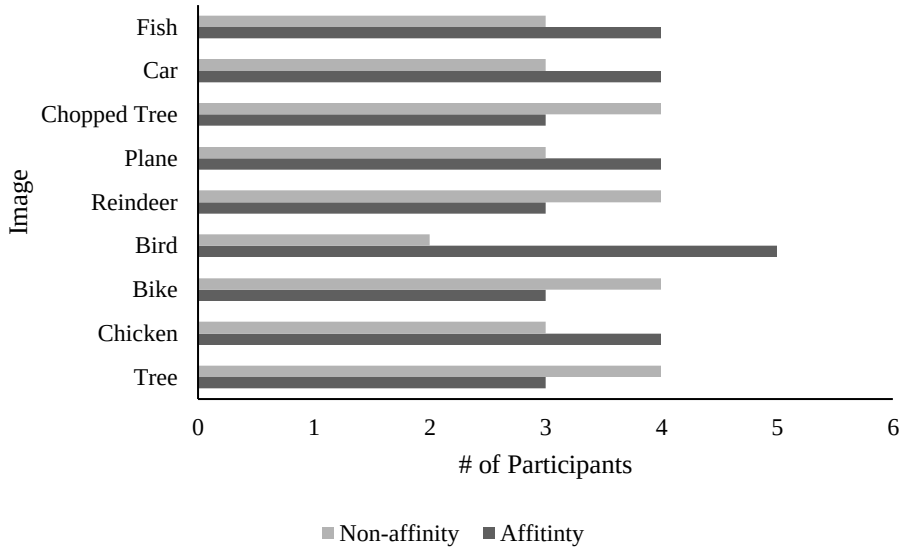


Figure 6 Results from game 1A: emphatic behaviour instructions measuring emotional affinity with the biosphere (n=7).

The results for game 1A were consistent with the Omidvar (2018) results, with many of the children identifying animals as having feelings, such as (6/9) deeming birds were able to get hurt. Moreover, this is similar to Omidvar (2018) because (9/9) children deemed birds were able to get hurt. Furthermore, in this study emotional affinity with nature (Mean = 4.6, SD=0.7) outweighed non-affinity (Mean = 4.3, SD =0.7) with nature. It is believed that due to eleven of the children in Omidvar (2018) not being able to complete the game, it was determined that the cohort did not have an emotional affinity with nature. Since all children were able to complete the games testing and provide answers, and 51% of the cohort provided answers that represent affinity with nature – this cohort as a whole does have an emotional affinity with nature, however; it is weak. Thus, this suggests the modifications did not facilitate a significant improvement for this game.

Game 1B: Concern and Sensitivity Instructions

For the second game, children were given a game board with positive and negative environmental activity images (e.g. watering plants, planting trees, dirty ground, and plastic pollution), alongside cut out smiley and sad faces to help them express their feelings towards each picture. An example of a correct answer, in this case, is a child choosing a happy for cleaning up and a sad face for dirty water. As seen in Figure 7, the majority of children felt happy about the positive environmental tasks such as, watering plants (8/9) or cleaning up (6/9), as well as a good amount of children felt sad when looking at the negative environmental activity pictures, such as dirty water (7/9) or plastic on the ground (7/9). Furthermore, the ratio of answers representing emotional affinity with nature (Mean = 5.6, SD=1.8, N=9), outweighed the answers representing non-affinity with nature (Mean = 3.3, SD = 1.8, N = 9). As a result, this cohort had an emotional affinity with nature largely due to 62% of the children providing 'correct' answers. In contrast, Omidvar (2018) reported an average of 8.5, which translates to 42.5% of the cohort had an emotional affinity with nature. Therefore, suggesting the modifications made to this game allowed for a better understanding of the pictures utilized and the associated task.

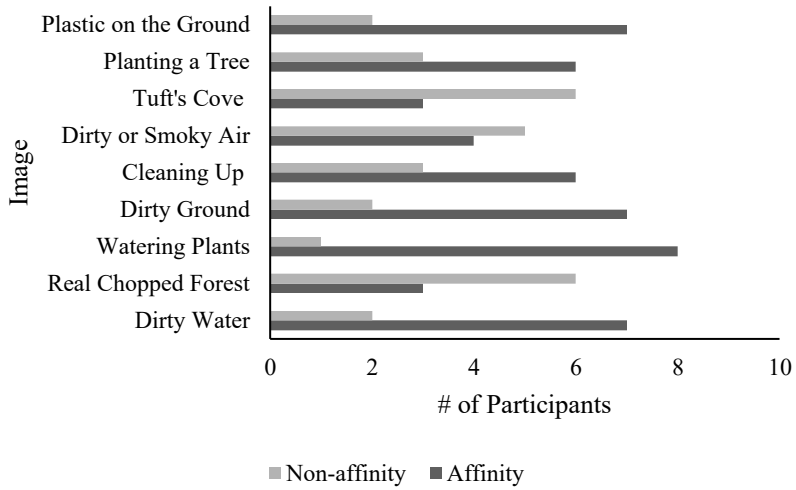


Figure 7 Results from game 1B: concern and sensitivity instructions measuring emotional affinity with the biosphere (n=9).

As mentioned above, two local pictures representing pollution in Halifax, NS, Canada were added to the game board. Interestingly, plastic on the ground or plastic pollution was among the highest affinity answers with (7/9) deeming plastic pollution as a sad image (Fig. 7). These results suggest that this cohort of children do have some understanding of these pollutants. However, Tuft's Cove, which utilized a picture of its well-known smokestacks, was considered positive with (6/9) placing a smiley face on the picture. Moreover, dirty or smoky air was also seen as a positive with (5/9) children placing a smiley face on the photo. These results shed light on the complexity of a child's ability to understand these mature concepts regarding pollution at an early age. The picture used for dirty or smoky air was modified to that of a child wearing a mask with multiple smokestacks behind them, which is similar to the picture of Tuft's Cove three smokestacks. Ultimately, it was difficult to determine what caused the children to see air pollution as a positive while considering water pollution, ground pollution, and plastic pollution as negatives.

Game 2A: Provisions of Ecosystem Services Instructions

For the third game, children were provided with a game board filled with natural resources (e.g. cow, river, and chicken) along with nine cut-outs with corresponding items (e.g. milk, water, and eggs). In this game, responses that correctly matched an item with its natural resources were considered positive or affinity with nature, while answers that utilized the items 'money' or 'truck' were considered negative or non-affinity with nature (Giusti *et al.,* 2014). In Omidvar (2018), results showed (11/20) of children were placed in the 'environmentally unaware' category, with greater than two correct answers. This was primarily due to children matching eggs with pigs and paper sheets with lettuce in Omidvar (2018), whereas this cohort had the majority (6/9) children placed in the next category 'weak environmental awareness', with two to four correct answers. Moreover, fewer incorrect answers or answers showing a lack of knowledge between human needs and nature, as discussed in Omidvar (2018). Therefore, this indicates a small improvement in the outcome of this game, which could be attributed to the enhanced clarity of the pictures and language used to administer the testing. However, overall, the cohort was still considered to have a weak affinity with nature, suggesting there may still be a disconnect between how Canadian three-five-year-olds perceive environmental concepts and relate them to the world around them.

Table 5 Results from game 2A: provisions of ecosystem services instructions measuring cognitive affinity with the biosphere (n=9).

	Environmentally unaware (<2 correct answers)	weak environmental awareness (2-4 correct answers)	average environmental awareness (5 correct answers)	strong environmental awareness (6-7 correct answers)	environmentally aware (>8 correct answers)
Responses	1	6	0	1	1

Furthermore, these results suggest that some of the Canadian three-five-year-old's in this cohort have not developed the compartmentalization nor the categorization skills necessary to complete this game with success (Kail and Barnfield, 2015). This causes the children to answer egocentrically because they have only established the foundation for one use or outlook of an individual item (Kail and Barnfield, 2015). For example, in Halifax, NS, Canada most, if not all, items are transported to the local grocery stores on the peninsula. With Shambhala School being located on the peninsula, it is safe to assume that if the participant is also living on the peninsula, then they may have witnessed a truck being used to transport certain items, like milk or bottles of water. This resulted in children responding with the following answers:

Matched milk with truck (C6) – "milk is like beer and comes in the truck";

Matched tuna can with truck (C8)– "because sometimes metal goes in trucks";

Matched blueberries with truck (C9) – "because blueberries are in trucks too".

Ultimately, this implies that this game is still too complex or not developmentally appropriate for that of Canadian three-five-year-olds. Another indication of this was due to (6/9) children using money in their responses. With money being considered a negative answer, it heavily swayed the outcomes to be considered non-affinity with nature. The participant was not wrong in using money as their answer (largely because this is how the items are obtained), but this reaffirms that the game is lacking cognitive coherence, and the participant does not understand what is being asked of them. However, it is important to note (2/9) children were able to complete the game with high affinity with nature successfully, so there is an indication that few were able to understand. Additionally, these results still contrasted the findings of Giusti *et al.* (2014), where they found that 77% of the children had strong environmental awareness, with

>8 correct answers. Overall, even though there was a slight improvement, these results show there is still room for improvement.

Game 2B: Pollution Awareness Instructions

Game four was broken into two parts: the first part asked children to describe the three pollutants water pollution (dirty water), air pollution (dirty or smoky air), and ground pollution (dirty ground), and the second part asked the children about harmful impacts of environmental pollution on people, an animal, and a car. Therefore, the results will be displayed separately.

Part 1

The first half of this game was a new addition in which the children were asked to provide a verbal descriptive response for the three pollutants. This new section aimed to get a full grasp of whether or not Canadian three-five-year-olds understand the concepts that the tool is expecting them to manipulate and apply them throughout different exercises. Each pollutant and the associated responses were divulged separately. Overall, results showed that all nine children were able to provide some response to the question "what is dirty or smoky air…what is ground pollution…and what is water pollution". Therefore, the question at hand was well understood. In relation to responses for air pollution (2/9) children responded by merely saying "smoke" (C3) or "smoky" (C5), whereas other responses varied:

"if there is something going on in a factory or a smokestack then it might make smoky air" (C1);

"try to find a better way to make air not polluted" (C2);

"makes people sneeze" (C6);

"dirty" (C9).

As seen in the responses, there is some indication that the children partially understand what air pollution is and its consequences, such as C6 claiming it "makes people sneeze".

However, one participant claimed that air pollution "comes from different types of schools" (C8). These mixed results reiterated this measure might not be developmentally appropriate for Canadian three-five-year-olds. Similarly, for ground pollution, all nine children were able to provide some form of response. However, 4/9 children responded with merely "garbage" or "trash", which suggested they did not fully understand the concept of ground pollution. Other responses included:

"it's polluting, people just throw stuff on the ground or a garbage can overflows" (C1);

"makes pollution to the Earth so you should find another trash can" (C2);

"when garbage cans come and dump all of it out and it makes a big mess" (C6);

"clean up" (C8).

These four statements include inklings of what ground pollution encompasses; however, they were still not fully developed. Finally, for water pollution (2/9), children had difficulty answering, with one participant not responding at all (C4) and the other responding with "fish" (C3). Other responses varied:

"if people pollute the water then you have to take animals out" (C1);

"pollutions for the animals and the sea, and river and ocean animals" (C2);

"water is gooey" (C5);

"when water gets all dirty" (C6);

"dirty" (C7);

"they need to clean the water" (C8);

"means that things don't be in water anymore" (C9).

In the end, even though the children were able to provide a basic understanding and descriptions of the three pollutants, they were still unable to adequately describe what air pollution, ground pollution, and water pollution fully entail. All of the games in this testing tool involve the children having to apply how these pollutants can harm people and nature. However, these statements suggest that the cognitive capacity of this cohort of Canadian three-five-year-old's is not fully developed to allow them to apply these concepts to different exercises. It is important to note, that it is hard to differentiate between whether the entire cohort is not developmentally able to engage in these exercises because few children were able to apply the concepts successfully.

Part 2

The results for the second half of the game are strong concerning the children's affinity with nature, which is similar to the overall positive result found in Omidvar (2018). However, modifications were thought to assist the tool in being more simplistic in its delivery, as well as in its cognitive demand. To further explain, Omidvar (2018) stated that even though the overall outcome was deemed positive or to have a strong affinity with nature, the answers were anthropocentric. For example, Omidvar (2018) wrote about the score being higher for people (e.g. people can get hurt by pollution), whereas responses were lower for animals (e.g. pollution does not harm animals the same way it does humans). This resulted in the analysis that egocentrism and the culture of fear of nature were at play during this game (Omidvar, 2018).

In contrast, this cohort of children responded with results showing that animals and humans can get hurt the same amount by ground pollution and water pollution, as seen in Figures nine and ten. Therefore, this suggests by removing various cartoons and confusing wording; the children were better able to answer the question at hand. Nevertheless, it is still important to note that (7/9) children believed cars could be hurt by water pollution, further solidifying the claim

that some children in this three-five-year-old age range are unable to understand the concept of pollution and its consequences thoroughly.

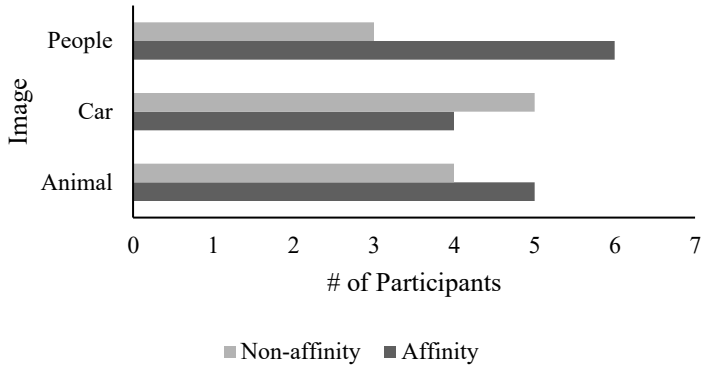


Figure 8 Results for air pollution from game 2B: pollution awareness instructions measuring cognitive affinity with the biosphere (n=9).

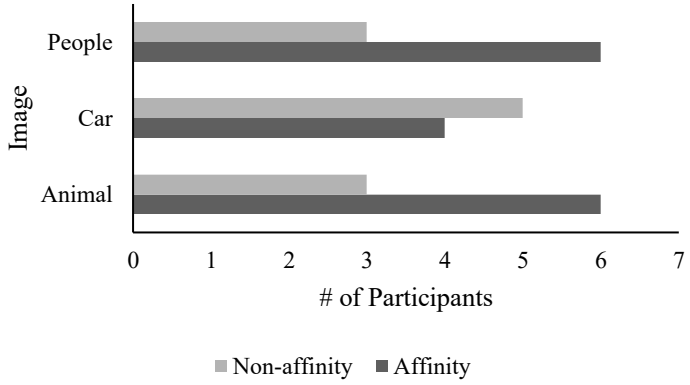


Figure 9 Results for ground pollution from game 2B: pollution awareness instructions measuring cognitive affinity with the biosphere (n=9).

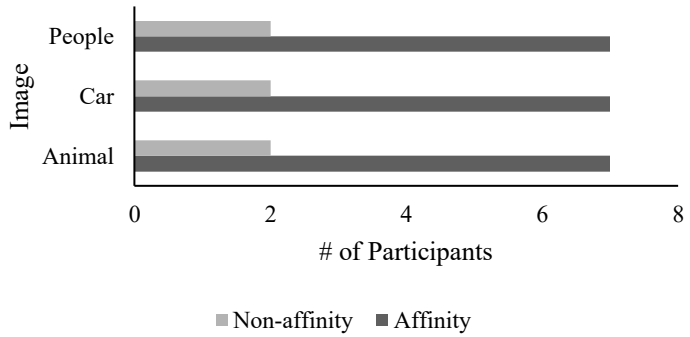


Figure 10 Results for water pollution from game 2B: pollution awareness instructions measuring cognitive affinity with the biosphere (n=9).

Game 3A and Game 3B: Favorite and Disfavored Environmental Quality

Game 3A

The final two games measure children's attitudinal affinity with nature by asking them where they usually play, where they like to play the most, and where they feel safe to play or where they do not play, where they do not like to play the most, and where they do not feel safe to play (children were able to pick more than one picture). Similar to Omidvar (2018), the results from game 3A, question one indicates that the majority of children play outdoors the most, with the playground (5/9) and forest (3/9) as the top choices for this cohort. Responses included:

Picked playground – "because my baby brother is there... it's fun and we get to play" (C5);

Picked playground – "because it's really fun" (C6);

Picked forest – "I like to play in forest. I like to play with my aunts and grandparents. I learned that moss can make a smoky fire" (C1);

Picked forest – "I like to climb the trees" (C7).

Question two also displays results that the children most prefer to play outdoors (Table 3). Conversely, Omidvar (2018) results that showed (8/20) children said they play indoors the most and (6/20) most preferred to stay inside to play. Interestingly, no children picked inside (0/9) as their preferred location to play, with responses varying for outdoor places, as seen in the following statements:

Picked Forest – "You have a lot of room" (C1);

Picked Backyard/outdoors/forest – "you can climb through roots and the forest goes a long way" (C2);

Picked street/playground – "I like the playground stuff" (C4);

Picked farm – "because we go in the farm" (C6);

Picked trees/forest – "because they are so much fun, because snakes" (C9).

It is important to note that one (1/9) child or 11% were unable to provide a reason for their answer. To explain, the child initially picked one (playground) but then retracted their answer and did not provide another. Thus, this was deemed not worrisome, as the question was asking where they like to play the most, so the child could have been undecided on which location they liked most. Therefore, this suggests there was still slight improvement in the clarity of the language and question at hand. The final question, as seen in Table 3, illustrates results similar to Omidvar (2018), with (7/9) children feeling the safest when inside. Some examples of responses for inside are: "because its fresh and warm in there" (C7); and "because my mommy is there sometimes" (C8). Moreover, three of the nine participants chose the farm as the safest place to play with responses such as, "because we go in the farm" (C6); and "because it's so nice and fun" (C9).

Game 3B

The disfavoured results were mixed, and the outcome varied concerning the results in Omidvar (2018), where it was reported that various children could not provide an answer to the questions. For example, it was documented that (3/20) children were unable to respond to the first question, (3/20) did not respond to the second question, (7/20) did not respond to the third question (removed from the modified tool), and (7/20) did not respond to the fourth question (Omidvar, 2018). Moreover, 15% (3/20) were unable to respond to questions one and two, and 35% (7/20) were unable to respond to questions three and four. In contrast, (1/9) or 11% of children were unable to provide reasoning for the first question, (2/9) or 22% were unable to respond to the second question, and (1/9) or 11% were unable to respond to the third question.

Therefore, the outcome for questions one and three showed improvement in the response rate, primarily due to revisions made to the game, but question two had an increase in the percentage of children who were unable to respond. As a whole, this indicates there was some

improvement in the delivery of the game, yet more testing is necessary to deem whether children persist in having an issue responding to question two. The verbal responses to the first question, "where do you NOT like to play", received wide-ranging results with (3/9) children not playing in the street the most. Statements for the first question included:

Picked street – "might get hit by a car" (C2);

Picked farm – "I don't go there" (C7);

Picked backyard – "because there is not much toys" (C9).

However, some answers reiterated the children's fear of outside, such as one child who picked outside/forest and stated: "people can take me" (C3), and another who picked farm and said, "because there's animals there" (C8). The second question followed suit with similar, varying results and statements such as one child who picked inside and said "small house, so not a lot of room to play", as well as responses again indicating fear of the outside with statements including: Picked forest – "because it's dark" (C5); and Picked forest – "there is really scary things" (C6). Results for the final question showed that one child did not feel safe indoors, (5/9) children do not feel safe playing in the street, and (4/9) children to not feel safe playing in the forest and backyard. When asked to elaborate, responses included: picked outside – "because no mummies are there"; picked backyard – "the grass has bugs in them, and I don't like them" (C5); and picked street – "streets have lots of cars" (C9). The results from games 3A and 3B are similar to the findings found in Omidvar (2018) and Giusti *et al.* (2014); even though children prefer to play in outdoor settings, they also indicate they feel most safe indoors and have various fears regarding the outdoors. However, overall the results improved slightly in regard to less confusion from the pictures and language used; thus, the results are deemed to have a moderate affinity with nature.

Table 6 Results from games 3A and 3B: favorite and disfavoured environmental quality measuring attitudinal affinity with nature.

Positive Questions	**Backyard**	**Playground**	**Farm**	**Inside**	**Street**	**Forest**
Q1: "Where do you play the most?" and "Why?"	0	5	0	2	0	3
Q2: "Where do you like to play the most?" and "Why?"	1	3	2	0	2	3
Q3: "Where do you feel the most safe to play?" and "Why?"	0	0	3	7	0	0
Negative Questions						
Q1: "Where DO you NOT like to play?" and "Why?"	2	1	2	1	3	1
Q2: "Where DO you NOT like to play the most?" and "Why?"	1	1	1	2	1	3
Q3: "Where DO you NOT feel safe to play?" and "Why?"	2	0	0	1	5	2

Results of the Modified games testing

The following table aids in concluding whether the modifications made to the initial Giusti *et al.* (2014) games testing tool were able to facilitate an increase in positive outcomes from each of the six games (Table 4). These results are not a complete nor reliable representation of the children's bioaffinity in comparison to Omidvar (2018), as the tool and cohort are different. Nevertheless, the establishment of this data is essential for future studies in order to facilitate comparative analyses. The results show the revisions allowed for an improvement in the overall outcome of the games testing. Omidvar (2018) utilized the same table to document the overall conclusions and found that 4/6 games were considered low in bioaffinity.

In contrast, two of the games (games 3/2A and 6/3B) were enhanced and placed in the moderate bioaffinity category. This denotes that the revisions improved the tool, thus allowing this cohort of Canadian three-five-year-olds to have an increased understanding of the games testing, more specifically, a better understanding of the pictures, words, and overall game design. However, the results indicate that there is more room to improve due to two of the games (games 1/1A and game 5/3A) staying in the low bioaffinity category.

Table 7 Results from the six newly modified games and their corresponding strength of bioaffinity scores.

Game	Strong Bioaffinity	Moderate Bioaffinity	Low Bioaffinity
1			*
2		*	
3		*	
4	*		
5			*
6		*	

Chapter Summary

This thesis sought to modify the Giusti *et al.* (2014) games testing tool to determine whether the revisions would produce a new tool that was more culturally and developmentally appropriate for Canadian three-to-five-year-old's, as well as to establish preliminary trustworthiness of the new tool. Improvements were seen throughout the pilot test results principally in the form of more children being able to respond and the reduction of the amount of time necessary for testing. This indicates an increase in the children's understanding, engagement and eagerness to complete the games testing. For example, in game 1A, Omidvar (2018) reported that (11/20) children or 55% of the cohort were unable to respond to the exercise, whereas all nine participants in the current study were able to respond to the modified exercise. Additionally, the game was quick, suggesting children were more engaged due to the

task of having to sort the cut-out pictures into the ‘yes’ or ‘no’ bins, which increased clarity of the pictures and language utilized. Furthermore, children were excited to run or dance the pictures to each of the bins with enthusiasm, such as one child spinning back and forth between the bins.

Game 1B also showed signs of an enhanced outcome, with the game again being very quick in delivery and children showing delight for the cut-out happy and sad faces. Moreover, there was no hesitation in this game and children were eager to place the happy or sad face on the game board. For example, one child exclaimed, “I like those happy faces” (C9) and started jumping up and down before beginning the game. Another indication can be seen in the bioaffinity increasing from 42.5% in Omidvar (2018) to 62%. The modified tool must undergo further reliability and validity testing to achieve representative bioaffinity results. Nevertheless, this game showed an overall improvement in its delivery and clarity.

Game 2A showed signs of enhancement primarily because children were better able to match the items with the associated nature source. Omidvar (2018) found that the majority (11/20) of children were placed in the first category, ‘environmentally unaware (<2 correct answers)’, because of mismatching the items (see above section for examples). Whereas, the majority (6/9) of this cohort was placed in the second category ‘weak environmental awareness (2-4 correct answers)’, suggesting there was more clarity in the pictures, language and delivery of the game. Finally, this game was also short, and children were again engaged and eager to try and match the cut-out photos.

Game 2B, part one, was implemented in the new tool to showcase the children’s understanding of the three pollutants and to gauge the understanding of the new pictures used for the pollutants (Fig. 3). Results showed that all nine children were able to provide some

description for the pollutants. This suggests there was either an increase in children understanding the pollution concepts, or they were able to understand and describe what they saw in the pictures. Therefore, this indicates that the modified pictures and language used for water pollution, ground pollution, and air pollution are more culturally and developmentally appropriate for Canadian three-five-year-olds. Results for the second half of the game revealed that children's answers were less anthropocentric then findings recorded in Omidvar (2018). During an interview, the Omidvar (2018) conclusion was solidified by Dr. Donna Varga's observation that the pictures and language used in the Giusti *et al.* (2014) tool were anthropomorphic. Dr. Varga stated the pictures were "filled with anthropomorphism…nothing is real…imagery is so confusing," with specific regard to this game. Since children were able to identify animals and human being affected by pollution, this suggests the anthropocentric answers were reduced, and the modifications were successful.

The final two games showed signs of enhanced understanding primarily because the cohort was quick to pick a picture on the game board as their answer. This indicated that the pictures and language increased in clarity. Additionally, in Game 3B, the uncompleted responses were reduced from 15% to 11% for the first question, and from 35% to 11% for the third question. However, the second question increased in uncompleted responses from 15% to 22%, which shows the cohort experienced slight difficulty. This finding would need to be further solidified in future testing as the data is not representative of Canadian three-to-five-year-olds. Ultimately, these results showcase that modifications made to the Giusti *et al.* (2014) games testing tool were successful in enhancing the child's understanding of pictures and language used. The revisions resulted in a significant reduction of time needed to complete the testing

(from 30-40 minutes to an average of 15.25 minutes) and increased the overall engagement, willingness, and joy for the children playing the games.

Conclusions

This study was developed in response to the work of Omidvar (2018) and Omidvar *et al.* (2019), which found that a cohort (n=20) of preschoolers were not emotionally affiliated with nature while using the Giusti *et al.* (2014) games testing tool, but who also questioned whether the Giusti *et al*. (2014) test was appropriate for the age, geographic region and cultural setting of Halifax Canada. While psychological evaluation concerning environmental education is commonly conducted by scholars (Dunlap *et al*., 2000; Pell and Jarvis, 2001; Mayer and Frantz, 2004; Nisbet *et al.*, 2009; Coster *et al.*, 2011), there is a lack of transparent literature instructing researchers of ways to transform psychological testing tools to be more appropriate for different cultural, geographical and developmental stages. As a result, and with direct reference to the findings of Omidvar (2018) and Omidvar *et al*. (2019), this thesis sought to answer the following four research questions:

1. Will the modification of the Giusti *et al*. (2014) games testing tool be more effective in allowing the sample population of 3-5-year-old to understand and complete the test?;
2. To what extent can the Giusti *et al*. (2014) games testing tool be modified to become more culturally appropriate for a Canadian sample population of 3-5-year-olds?;
3. To what extent can the Giusti *et al*. (2014) games testing tool be modified to become more developmentally appropriate for a Canadian sample population of 3-5-year-olds?.

To answer these questions, an extensive literature review, interviews with ECE experts, modifications, and a pilot test were conducted. The following two sub-sections will provide a synopsis of the individual outcomes.

Modifications and the Cultural and Developmental Appropriateness

The literature review and interviews with experts revealed four themes that ascertained which aspects of the tool needed revision: (1) game design, (2) cartoon versus real pictures, (3) use of appropriate language, and (4) length of time. The modifications were consistent with these themes. For game design, each of the six games was altered to be tactile through the use of game boards (e.g. posters with pictures on them) and game pieces (e.g. cut out pictures). Cartoon pictures were revised to real pictures, with local (Halifax or Canadian context) pictures used as frequently as possible (e.g. the cartoon picture of the "fish" was modified to a real picture of a brook trout, which is a native Canadian fish commonly found in NS, Canada). Various changes were made to the language used throughout the tool, such as changing the words' hens' to 'chicken' and 'hurt' to 'owie.' The length of time was targeted through the first three themes with the idea that the modifications would increase clarity and engagement for the participants, resulting in a reduction of time necessary to complete the testing.

The modifications produced a new version of the Giusti *et al.* (2014) testing tool and a chart (Appendix XII) to establish a step-by-step transparent guide outlining in what way the tool was revised while justifying the revisions via the literature review and interview results. Finally, the pilot test outcomes suggest the modifications were successful in enhancing the children's understanding of the games testing primarily because there was a significant reduction of time needed to complete the testing (avg. 15.25 mins), an increase in engagement, and an increase in positive bioaffinity results. Upon completion of this study, it is apparent that the modifications

made to the Giusti *et al.* (2014) games testing tool have enhanced the cultural and developmental appropriateness for the evaluation of the Halifax, NS, preschoolers. Therefore, this indicates that the revision of the testing tool produced an enhanced and more effective measure for Canadian preschooler's bioaffinity.

Observations on Test Efficacy

Omidvar (2018) stated that throughout the testing, children had difficulty answering various questions. The study found that the cohort (n=20) struggled to relate to non-human feelings (e.g. asking them if an airplane can get hurt), were unable to distinguish living from non-living things, unable to connect the role of ecological resources with everyday products, and showed weak ability to recognize the harmful impacts of the three pollutants on animals (Omidvar, 2018). Additionally, Omidvar (2018) reported that the approximate amount of time needed to complete the games testing was 30-40 minutes, which caused the children to experience boredom and get distracted.

In contrast, this cohort (n=9) showed an increased ability to respond and stay engaged throughout the games testing, which resulted in a reduction of time and improved bioaffinity results; down to an average of 15.25 minutes to complete the testing and two of the games moved from low bioaffinity to moderate bioaffinity (table 6). During the testing, none of the children asked any questions to aid in completing the six games, and instead, the majority of children showed enthusiasm and curiosity, which implies they had an increased understanding of the new game design and instructions. The cohort was intrigued by the new localized photos, such as many of the participants noticing the picture of a playground used in games 3A and 3B was the one located at the Shambhala School, which they attend. However, there was difficulty reported during games 3A and 3B where, even though all nine participants were able to choose

an answer from the pictures (e.g. picking playground or farm), some children were unable to provide reasoning for their answers. This could have been a result of fatigue as these were the final two games of the testing or that there was a persisting lack of understanding concerning the questions being asked. Further testing using the modified tool is necessary to determine whether these two games will continue to display children having difficulty completing the entire game's testing. Overall, it is arduous to determine whether some additional aspects or questions should be removed or modified in the new testing tool without a larger cohort and more rounds of testing conducted.

Implications for Researchers and Practitioners

This study contributes to the evolving body of literature on early childhood environmental education, nature exposure, and developmental psychology by examining children's love of/for nature (bioaffinity) who attend environmentally oriented schools in Halifax, NS, Canada. With the tool being modified to a Halifax and Canadian context, scholars who go on to utilize the tool in various locations will need to adjust the tool to their local context. Researchers and practitioners can use the modification chart (Appendix XII) as a guide, which provides recommendations and instructions for how to revise and use the tool in a similar fashion. Additionally, the use of new early childhood developmental psychology literature and knowledge of ECE experts will aid in ensuring the modifications continue to benefit preschoolers' cognitive, emotional, and attitudinal rigour.

This research is a meaningful demonstration of interdisciplinary work, which contributes invaluable information concerning the developmental characteristics that aid in the appropriate facilitation of cognitive, emotional, and attitudinal testing of preschoolers. However, with the gap of instructional literature concerning the updating of testing tools for preschoolers,

researchers and practitioners should continue to investigate the developmental functions of 3-5-year-old's, particularly 3-year-old's, in order to keep the testing tool up to date with the current literature. The findings from this research are significant for both scholars and early childhood educators when evaluating preschool children's cognitive, emotional, and attitudinal characteristics.

Recommendations

Due to the nature of this study, several future analyses are necessary before the games testing tool can be used as a reliable form of evaluation for the bioaffinity of preschoolers. First, more studies using the modified tool should be conducted in Halifax, NS, Canada, to further establish the bioaffinity of preschoolers who attend environmental education-oriented schools.

Second, the tool must be utilized in various geographical locations with modifications made to tool incorporating the local cultural context of those chosen sites. For example, the original picture of a tree in the Giusti *et al.* (2014) games testing tool was revised to a real picture of a tree located in Halifax, NS, Canada. Therefore, similar changes must be made to the tool before using it in various locations.

Third, future studies concerning the establishment of reliability and numerous validity testing (e.g. construct and content validity) are essential for determining whether the newly modified tool is appropriate for measuring the bioaffinity of preschoolers. Moreover, reliability and validity testing should take place in various cultural locations in order to assure the continual revision of the tool for different settings is beneficial for preschooler's understanding and engagement while undergoing the games testing.

Fourth, once the tool is deemed reliable and valid, future studies should investigate nature-based (e.g. Reggio-Emilia inspired and environmental education) versus non-nature-based

schools (e.g. public schools) to examine how much time each cohort spends in nature, as well as to measure the differences in bioaffinity.

Fifth, studies, including a survey of parental input, is necessary to determine the extent of the children's exposure to nature, similar to the methods used in the Giusti *et al.* (2014) study.

Finally, recurring research concerning the biological and developmental growth of 3-5-year-old's is necessary in order to keep the modified testing tool relevant and appropriate for assessing preschooler's bioaffinity.

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Appendices

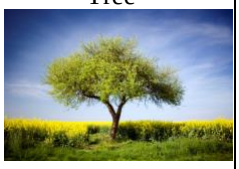
Appendix I: Research Instrument (games testing for Emotional, Cognitive and Attitudinal Affinity with the Biosphere, Giusti *et al.* 2014)

1a. Emphatic behaviour instructions

Show one picture after the other, in the table below, to the child. For every picture ask him/her: "Does (this picture) feel pain?"

Example : "Does a tree feel pain?"

The child answer has to be a simple yes or no. Therefore the game result will be a simple list of "yes" and "no" matching each picture in the table below.

Tree 	Chopped tree 	Hens 	Bicycle 	Birds 
Reindeer 	Car 	Fish 	Plane 	Dinosaur 

1b. Concern & sensitivity instructions

Give to the child both images with smiles ("happy smile" and "sad smile"). Show him/her the images in the table below one after the other. Do NOT ask any question to the child and do NOT explain what the picture means. Ask the child to show to the teacher one of the smiles after he/she has shown the picture. Take annotation of the result and show the next picture of the table below.

"Happy smile" and "sad smile"

Table of images

Water pollution 	Real chopped forest 	Watering plants 	Ground pollution 
Image chopped forest	Planting tree **(Saying that is not taking the tree off!)**	Cleaning up	Air pollution




2a. Provision of ecosystem services instructions

Place in front of the child all images in "List 2" of the table below. All pictures have to be fully visible to the child from his/her position. Show one picture of "List 1" to the child and ask him/her to find a picture, among the ones already placed in front of him/her ("List 2") and clearly ask him to answer:

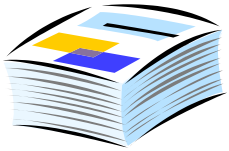
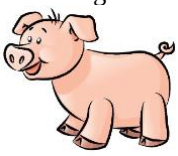
"What do you need to have (this picture)?"

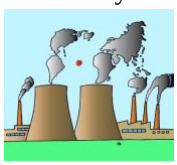
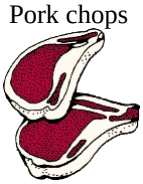
Example: "What do you need to have a wooden table?"Answer: child picks the image of "wood"

What the picture represents has to be clearly stated to make the child understand for example that the image is a WOODEN table or that the image represent BLUEBERRIES and not every kind of berry.

This process have to continue for every image in "List 1" without taking away the pictures of List 2 in front of him/her. There are more picture in "List 2" than in "List 1" for experimental purposes.

The game result will be a table were for each image in "List 1" there will be the picture that the child has selected from "List 2".

List 1			List 2	
Wooden table 	Eggs 		Wood 	Forest 
Tuna can 	Paper sheets 		Tuna 	Cow 
Carrot 	Glass of milk 		Hens 	Pig 

Tap water 	Blueberries 		Vegetable garden 	Industry 
Wool hat 	Pork chops 		River 	Transportation 
			Sheep 	Money 
				Tractor 

2b. Pollution awareness instructions

Show to the child one picture in "List 1" (representing different kinds of pollution) and place it visible in front of him/her. What this picture represent has NOT to be said to the child. Then, show to the child one after another all sets of images in "List 2" and ask him/her for every set of pictures (animals/vehicle/you/people):

"Is (the first picture) harmful to (the second picture)?"After have shown all sets of pictures in "List 2" for one picture in "List 1" show to the child the next picture in "List 1" and follow the same process described above.

Example: "Is this picture (without mentioning air pollution) harmful to animals?"; "Is this picture (without mentioning air pollution) harmful to vehicles?"; "Is this picture (without mentioning air pollution) harmful to you?"; "Is this picture (without mentioning air pollution) harmful to people?"; "Is this picture (without mentioning ground pollution) harmful to animals?", etc…

The game result will be a simple list of 4 "yes" and "no" for each picture in "List 1" corresponding to each set of pictures in "List 2".

List 1

Air pollution	Ground pollution	Water pollution
		

List 2

Animals	Vehicles	You	People
  	  		  

3a. Favorite environmental quality instruction

Place all the sets of picture below in front of the child and ask him/her to select ONE picture to answer the following questions. To the question "Why?" the child doesn't have to select any picture, but reply in words, this implies that teachers have to synthesize it and write down children's answers:

1. "Where do you usually play the most?"
2. "Where do you like to play?" and "Why?"
3. "Where do you feel the most free to play?" and "Why?"
4. "Where do you feel the most safe to play?" and "Why?"

Recreational	Indoor videogames	Playground	Farm
			
Indoor toys	Green area	Outdoor street	Forest




3b. Disfavored environmental quality instruction

Place all the sets of picture above in front of the child and ask him/her to select ONE picture to answer the following questions:

1. "Where DO NOT you usually play?"
2. "Where DO NOT you like to play?" and "Why?"
3. "Where DO NOT you feel free to play?" and "Why?"

"Where DO NOT you feel safe to play?" and "Why?"

Appendix II: Initial Recruitment E-Mail For The ECE Experts

Dear,

This email is to invite you to consider your participation in a research study called "Refining a games testing Tool for Various Cultural, Social, and Geographic Situations to Evaluate Pre-School Children's Bioaffinity". This study is being conducted by myself, Dr. Tarah Wright, and my research assistant Jessica MacKeen who is an Honours undergraduate student at Dalhousie University.

Upon consent to participating in the study, a face-to-face interview will be conducted. The interview can take place at your location of choice, either at your work location (Mount Saint Vincent University) or at my Education for Sustainability Research (ESR) lab in the Life Science Centre at Dalhousie University. During the interview, you will be asked to provide your expertise on the appropriateness of the language and pictures used in the Omidvar *et al.* (2019) study and to provide general feedback regarding the tool and testing on junior and senior preschoolers (see attachment for tool and Omidvar *et al.* 2019 study).

With permission, we would like to record the interview. The interview will be open ended in nature and will not ask any questions of personal nature, as well as copies of the recording will be destroyed within 30 days of the completion of the study. In any reports related to this study, both your identities will be identified as Early Childhood Education Scholars who contributed their expertise to the project, as well as using personal identification (name and institution).

For further information, we ask you to read the information bulletin and consent form attached to this email. If you have any questions about the study or the informational meeting, and/or interested in your child participating in the study, you may contact Tarah Wright, the lead researcher ,via 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

T: 902-497-1831

Appendix III: Consent Form For The ECE Experts

DALHOUSIE UNIVERSITY
Inspiring Minds

Consent Form

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

Dear Dr.

We invite you both to take part in a research study being conducted by Dr. Tarah Wright and research assistant Jessica MacKeen. Taking part in the research is up to you; it is entirely your choice. Even if you consent to participating, you have the liberty to withdraw from the study at any time, for any reason. The information below tells you about what is involved in the research, what you will be asked to do and about any benefit, risk inconvenience or discomfort that you might experience. Please ask as many questions as you like. If you have any questions late, 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, Undergraduate Student, Dalhousie University, College of Sustainability,
js529911@dal.ca

Purpose and Outline of the Research Study

This pilot study aims to modify an existing 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 "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 modifying the games testing tool and proving 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 reliability and validity will be used; reliability is whether or not the results of the tool stay consistent and validity is whether or not the tool does what it's supposed to do. Furthermore, this study will test validity and reliability of Giusti *et al.* (2014) emotional, cognitive, and attitudinal games testing tool, in comparison with a modified version of the tool. In order to test reliability and validity of the refined tool, we are looking to test it with 2 cohorts (groups) of 3-5 year-old preschoolers. By completing this study, we hope to accomplish (a) modify the bioaffinity test tool through a thorough investigation of the child developmental research (b) modify the bioaffinity test through consultation with Early Childhood Education experts, and (c) examine the reliability and validity of the newly developed bioaffinity test through pilot testing. By meeting these three

objectives we determine the appropriateness of the measure for younger children, and whether refining the tool accordingly will facilitate positive results.

Who Can Participate in the Research Study

_____, Halifax, NS are eligible to participate in the study.

What You Will Be Asked to Do

To help us gain expertise for how to modify the tool aptly for junior and senior preschoolers, we will ask you to participate in an one-on-one, semi-structured interview about the appropriateness of the tool used in the Omidvar *et al.* (2019) study and to provide general feedback regarding the tool and testing on junior and senior preschoolers. In this interview you will be asked a total of 12 questions regarding the appropriateness of the language and pictures, and general feedback on the testing tool. In case of your agreement, the interview will be audio-recorded. Otherwise, notes will be taken by hand. The total amount of time needed to conduct a complete interview is approximately 60 minutes.

Possible Benefits, Risks and Discomforts

By participating in this research study, you will indirectly contribute to knowledge in the field of formal and non-formal environmental education. There is also potential for practical benefits to result from the completion of this study. For example, results may indicate useful criteria that can be used to modify other games testing tools which, if addressed could lead to increased emotional, cognitive, and attitudinal relevance in testing tools.

Given the nature of the interview, the perceived risks and/or discomforts for participants are minimal. The potential discomfort that may be felt by participants is lack of clarity around what an interview question is asking them. In order to address this potential discomfort, the lead researcher and research assistant will be available to answer any questions the participants may have before, during, and after data collection. To mitigate the risk of potential discomfort, participants should only answer questions with which you are comfortable. Nonetheless, the risks are no more than you would likely encounter in your day-to-day life.

It should be noted that your participation is purely voluntary and you may withdraw at any time, with no penalty, by informing the primary investigator that you would no longer like to participate. If you withdraw, you have the choice of whether or not to withdraw any data that you have provided up to that point. However, after the data has been analysed (about two months after the interview) it will not be possible to withdraw your data.

Compensation / Reimbursement

There will be no compensation / reimbursement for your participation in this study.

Privacy and Confidentiality

Upon completion of the study, all raw data from the interviews will be retained for 5 months as encrypted, password-protected data on secure digital storage, managed and maintained by Dalhousie University. 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). 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. Upon consent identifying information will be present in any of these final documents, and be identified as Early Childhood Education

Experts. In this regard, we encourage you to provide only information that you are comfortable sharing. In specific instances, a direct quote that you made in the interview process may be used in these final formats. By signing this consent form, you agree that your direct quotes may be used within the thesis, publications, report, and/or conference presentations. To reiterate, identifying information will connect you to these quotes.
In the inlikely case of implications from using identifying information, there is a very low chance of hurting your reputation if the study is unsuccessful.

Additional Information:
You are free to leave the study at any time. You can also decide for up to two (2) months if you want us to remove your data. After that time, it will become impossible for us to remove it because it will already be published in various academic writings.
We are happy to talk with you about any questions or concerns you may have about your 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. 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 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

Signed Consent
Project Title: Refining a games testing Tool for Various Cultural, Social, and Geographic Situations to Evaluate Pre-School Children's Bioaffinity
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 to take part in this study. I realize that participation is voluntary and that I am free to leave the study at any time. I realize that direct quotes from the study may be used in the final report. If used, direct quotes will be referenced using identifying information.

□ I agree to the use of audio recording during the interview.

□ Please check this box if you like to receive an emailed copy of the study's results. If so, results should be expected in June 2019. We ask that you leave you phone number and email address below in order to receive these results.

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

Email Address: _____

Appendix IV: Initial E-Mail For The Pre-School Director

Warmest greetings!

It has been a delight to work with the Shambhala School in the past on various research projects related to environmental education. I was encouraged by our conversation the other day about the current research project I am involved in looking at modifying and testing a bioaffinity (or love of nature) test with 3-5 year-old children. This test will be of interest to the Shambhala School as the test aims to look at the cultural, social, and geographic factors that impact children's nature exposure. As I mentioned to you in person the other day, we are hoping to recruit students for our pilot test from the preschool students at the Shambhala School.

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 "games testing for Emotional, Cognitive and Attitudinal Affinity with the Biosphere". In a previous study, we found that the test was not well developed for preschool children. Working with Jessica MacKeen, an undergraduate student at Dalhousie University, studying Sustainability and Political Science, we are modifying and refining the tool and then will pilot test the tool to test for validity and reliability. In order to test reliability and validity of the refined tool, we are looking to test it with 2 cohorts of 3-5 year-old preschoolers (20 children in total). By completing this study, we hope to determine the appropriateness of the measure for younger children, and whether refining the tool accordingly will facilitate positive results.

With this in mind, we would like to request a meeting with you to discuss the study further with you and the preschool staff and then approach parents in the classes for voluntary participation of their children in the study.

Please let me know if you have any questions or concerns, and when would be a good time for us to come by for a meeting. Again, I thank you for your support of our research projects in the past and I look forward to working with you again in the future. You may contact me by responding to this e-mail or by calling me at 902-497-1831.

Respectfully yours,
Tarah Wright, Ph.D.

Appendix V: Initial Recruitment E-Mail For The Parent(s)/Guardian(s)

Dear parents,

This email is to invite you to consider your child's participation in a research study called "Refining a games testing Tool for Various Cultural, Social, and Geographic Situations to Evaluate Pre-School Children's Bioaffinity". This study is being conducted by myself, Dr. Tarah Wright, and my research assistant Jessica MacKeen who is an Honours undergraduate student at Dalhousie University.

If you and your child agree to participate in the study, your child will be asked to complete a set of games. Taking part in the study is up to you and your child; it is entirely your choice. Your child's participation is voluntary and remains voluntary throughout the entirety of the study. Choice of the study location is also up to you and your child to determine. Participation in the study can be conducted at Shambhala Children's centre during school hours, in the comfort of your home, or my Education for Sustainability Research (ESR) lab in the Life Science Centre at Dalhousie University.

Depending on which cohort (group) your child is in, their participation will be required for 30-90 minutes. If your child is within the 2nd and 3rd cohort, there is the option to do the testing at two different locations. Furthermore, if you would like your child to complete the 2nd round of testing during school hours, and have the 3rd round of testing in the lab or in the comfort of your own home, that is possible (please see information bulletin for further explanation). Upon completion of the games testing, your child will receive a Certificate of Achievement, and we will offer you and your child a $25.00 gift card to Woozles children's store. If your child is in the 2nd and 3rd cohort they will need to attend both sessions to receive the Certificate of Achievement and the gift card.

It is important to note that your child's participation is completely voluntary, and will not impact their child's experience or outcome in the class. This research is not being done nor is endorsed by Shambhala or the teachers sending this email. The research will be conducted by the Research Assistant, Jessica MacKeen, who is an honours undergraduate student attending Dalhousie University. A brief biography about Jessica will be attached to this email. Jessica MacKeen will always be accompanied by a volunteer who is regularly involved with children, such as Nazanin Omidvar who established this study in Halifax (has conducted this testing with children previously) and/or Justine Hayward who is taking her Bachelors of Education at Mount Saint Vincent, who is also undergoing her practicum, which means she is practicing her teaching in real classrooms.

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 hopes you gain familiarity with who will help facilitate the testing with you 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
T: 902-497-1831

Appendix VI: 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. If you and your child agree to participate in the study, they 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. Children who participate will be assigned to a Cohort (Cohort 1, and Cohort 2). Children in Cohort 1 will be asked to take the games only one time (~30 minutes). Children in Cohort 2 will be asked to play the games two times, two weeks apart from each other (for a total of ~90 minutes, but never more than 30 minutes every two weeks). It is intended for the games to be played at the school (and individual room will be set up and the child will be invited to play with the researchers in that room), or we can host your child at our lab at the university or come to your home if you prefer.

As mentioned in the invitation email, all participating children who partake in the games testing will receive a Certificate of Achievement and a $25.00 gift card to Woozle's Children's store. It is important to note, even if you decide to remove your child from the study after the testing is complete, you and your child will still be compensated.

Throughout the entire research process your child's name and any other information pertaining to their identity will be kept confidential. If you are interested in 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.

The Omidvar (2018) and Omidvar *et al*. (2019) studies both used the games testing that is being asked for your child to be tested with, and both studies 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 two separate schools with 20 children in the Omidvar (2018) and Omidvar *et al*. (2019) and this did not happen, the Research Assistant and Lead Researcher/Volunteer would follow up with the teacher to ensure the child went back their normal level of comfort upon returning to class.

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.
T: 902.497-1831

Appendix VII: Brief Biography About The Research Assistant Jessica MacKeen

My name is Jessica MacKeen. I am the research assistant for the study you are being asked to participate in. I am in the final year of my Honour's undergraduate degree at Dalhousie University. I am majoring in Sustainability and Political Science. I am passionate about this study because understanding a child's perspective on their education is important for facilitating the highest quality education possible. Moreover, ensuring children are connecting with nature through their own lens is something I lacked as a child and find it captivating that there are specialized schools that strive to enhance a child's relationship with nature.

I have worked with children in the past through various experiences – the most relevant experience being the time I spent as a child minder at the Canada Games Centre. As a child minder I was required to look after children ranging in ages from 3 months to 12 years. It was my duty to look after these children on my own (without supervision or another worker) for hours at a time while the parent was using the facility. This job included changing diapers, calming and comforting children if they were upset, facilitate snack time if someone was hungry, and engaged in playing with the children for the majority of the time. I would organize games that a group of children could play together or if the children were not interested in group play, I would allow them to play separately and do my best to divide my play time between all the children. This was a great experience that I will always be grateful for.

Growing up I also volunteer taught dance classes at Maritime Dance Academy, where I would assist young dancers with putting their shoes on, take children to the washroom, and help facilitate the class. I was also on the Bedford Beavers swim team and my friends and I would regularly help out with the young children on swim meet days. Finally, I was also a reading buddy at Bedford Academy and babysat growing up as well.

I would like to finish by saying I will always be accompanied by an observer when conducting this research. The observer will either be the lead researcher Dr. Tarah Wright, who has had over 20 years of research experience, or an experienced volunteer for Dr. Wright's research lab who has been trained, has full police clearance and has been approved by the Director of the Shambhala School. Having an observer will enhance the experience of the games testing for your child by ensuring your child and safe and comfortable throughout the testing.

Appendix VIII: Consent Form For The Parent(s)/Guardian(s)

DALHOUSIE UNIVERSITY
Inspiring Minds

Consent Form

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

Dear Parent(s)/Guardian(s) of Preschoolers in Shambhala Children's Center,

We invite your child to take part in a research study being conducted by Dr. Tarah Wright and research assistant Jessica MacKeen. Taking part in the research is up to you and your child; it is entirely your choice. Even if you consent for your child to participate, your child will not participate if they do not want to. If your child does take part, your child may leave the study at any time for any reason. 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, Undergraduate Student, Dalhousie University, College of Sustainability,
js529911@dal.ca

Purpose and Outline of the Research Study

This pilot study aims to modify an existing 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 "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 modifying the games testing tool and proving 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 reliability and validity will be used; reliability is whether or not the results of the tool stay consistent and validity is whether or not the tool does what it's supposed to do. Furthermore, this study will test validity and reliability of Giusti *et al.* (2014) emotional, cognitive, and attitudinal games testing tool, in comparison with a modified version of the tool. In order to test reliability and validity of the refined tool, we are looking to test it with 2 cohorts (groups) of 3-5 year-old preschoolers. By completing this study, we hope to accomplish (a) modify the bioaffinity test tool through a thorough investigation of the child developmental research (b) modify the bioaffinity test through consultation with Early Childhood Education experts, and (c) examine the reliability and

validity of the newly developed bioaffinity test through pilot testing. By meeting these three objectives we determine the appropriateness of the measure for younger children, and whether refining the tool accordingly will facilitate positive results.

Who Can Participate in the Research Study

Any junior and senior preschooler registered at the Shambhala School, between the ages of 3-5 years is eligible to participate in the study. Given the age of your child, consent needs to be given by you as their parent/guardian (please see below). Participating in this study has no impact on your child's role in the class. 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 three 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 your choice of location, and the total amount of time needed to perform a complete set of games is maximum ~45 minutes. The time requirement may vary depending on which cohort your child ends up, the differentiation is as follows:

- Test 1 will use the non-modified games testing tool, and the total amount of time needed with be 30-40 minutes;
- Test 2 and 3 will pilot test the newly modified games testing tool on two separate occasions. The hope is to shorten the time required to do the testing, therefore, there is a maximum time requirement of 60- 90 minutes for both occasions of testing. We offer a maximum of 60-90 minutes in case the modifications do not shorten the testing time, however, we hope that this is not the case. We believe this will not be the case, due to the modifications providing easier pictures and language for the preschoolers to understand and respond to.

You will have the choice of three locations for the testing to be conducted: (1) at Dalhousie University Education for Sustainability Research lab (the lead researchers lab); (2) at the Shambhala School (a separate room will be set up for the children to be tested), or (3) in the comfort of your own residence. Your child will be asked if he or she would like to play a game with the researcher. If he or she agrees, the game testing will begin. If not, the researcher will wait awhile and ask the child again. If he or she still does not want to 'play' with the researcher, then he or she 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 December 2019 through March 2020, 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.

Possible Benefits, Risks and Discomforts

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 behaviours. 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 in hope to make the games more interactive and enjoyable. If your child decides to discontinue the games testing, his or her data will be destroyed, because a fully completed test is required for the analysis.

Compensation / Reimbursement

Alongside a Certificate of Achievement, the parents of all participants who participate in the testing process will be offered at $25.00 gift card to Woozles children’s store.

Privacy and Confidentiality

In order to keep personal information confidential, 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 your child’s identity will always remain private.

In specific instances, a direct quote that 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 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 two computer programs called NVivo. These programs are popular in social science research as they provide a researcher with the tools necessary to organize, compile, analyze and make connections between different types of data. Games responses will remain in NVivo, 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.

Upon completion of the study, all data will be cleaned (de-identified) and retained for 5 months as encrypted, password-protected data on secure digital storage, managed and maintained by Dalhousie University. It is retained for 5 months in order to properly analyse 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).

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:

Your child is 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 analysed 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

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

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 may take part in this study if he/she wishes to. My child and I understand that participation is voluntary and that my child and I 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.

[ ] Please check this box if you like to receive an emailed copy of the study's results. If so, results should be expected in June 2019. We ask that you leave you phone number and email address below in order to receive these results.

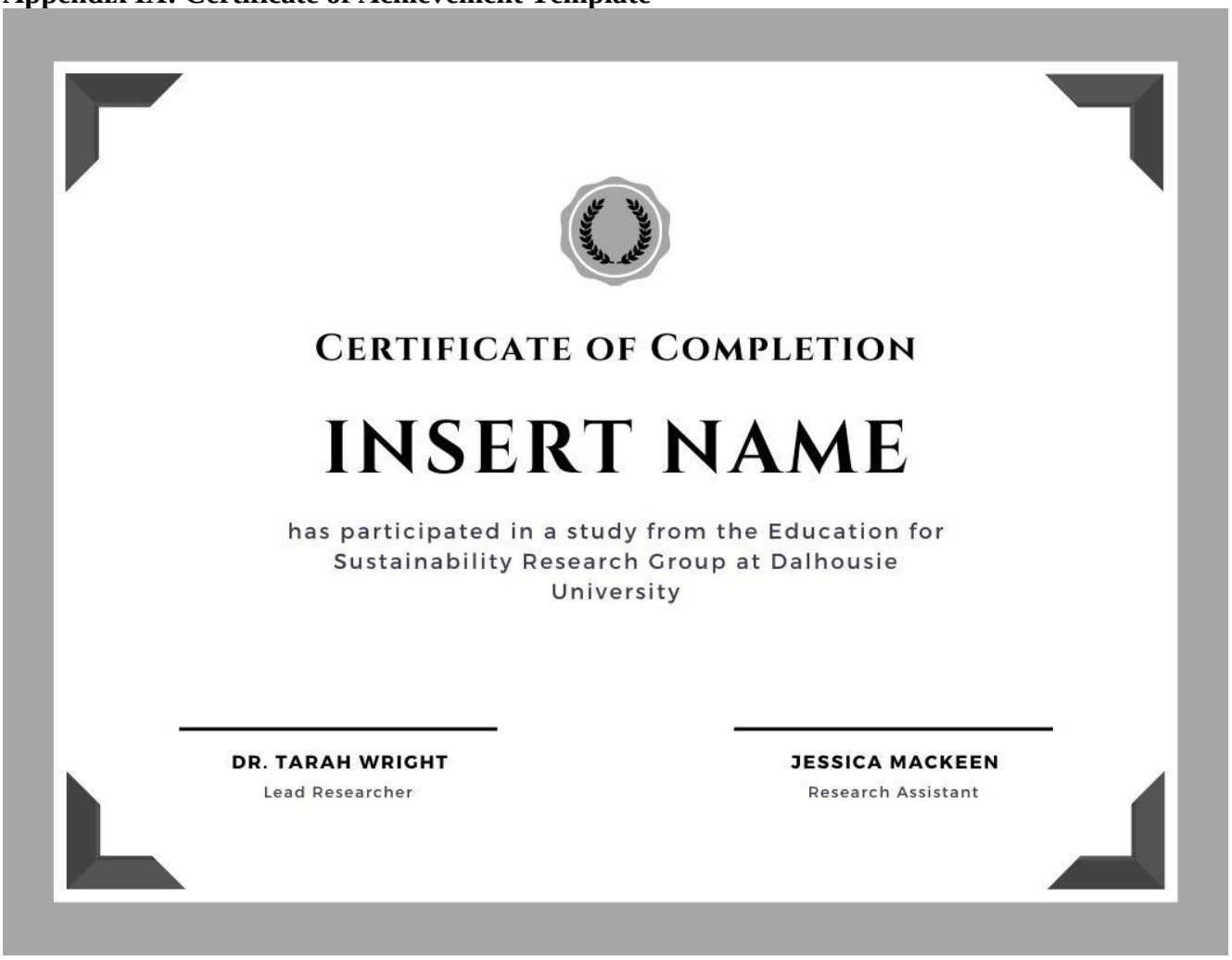
_____ Phone #: (____) - ____ - _____

Participant's Name (Child)

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

_____
Parent/Guardian Signature

Appendix IX: Certificate of Achievement Template



Appendix X: Interview Questions for ECE Experts

Before we begin the interview, I would like to remind you that upon consenting to this interview, you have consented to the use of your identifying information in a published article which may include direct information. Therefore, it is important that you only offer answers you would feel comfortable having published. Furthermore, if throughout the interview you would like to retract an answer to stay off the record, that is possible, just let me know.

1. Can you please tell me a bit about your background in developmental psychology?
2. You have now reviewed the test and see that man of the questions include cartoon representations of nature. Based on your experience, do children respond better to real photos found within their daily settings in comparison with cartoon photos?
3. I'd like you to look at the pictures used in this tool and give feedback on the use of real versus cartoon images (e.g. The sixth photo seen in section '1a: Emphatic Behavior Instructions' is a cartoon photo of a reindeer, in your expert opinion, should I merely modify this photo to a real picture of a Caribou? Or should I go as far to modify this photo to a picture of a Canadian deer instead of a reindeer/caribou?)
4. With regard to difficult/sensitive concepts such as, a photo of a real chopped forest or a photo of ground pollution, in your opinion how would you portray these concepts differently from the photos provided in the tool currently?
    a. Do you think the young children would associate these photos with a sad (frowning) face?
5. From your experience with children, how do they respond to a 30 minute exercise?
    a. Do you believe a puppet is sufficient to mitigate any potential boredom?
    b. Do you have any other suggestions?
6. With regard to the matching exercises in section '2a: Provisions of Ecosystem Services Instructions' do you think that modifying this section to be interactive (have cut outs of the photos so they can physically match the items) would be a better approach?
7. With relation to section '2b: Pollution Awareness Instructions', in your own words, how would you ask a child whether one item (air pollution) hurts the other photo (animals) without iterating the items?
8. Ultimately, do you feel that this games testing tool is appropriate for examining emotional, cognitive and attitudinal affinity of children with the biosphere? Can you please elaborate?
9. In your opinion, is there anything else that should be modified in the test that I have not already asked you about?

Appendix XI: 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/guardian 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 XII: Modification and Documentation Charts for the Giusti et al. (2014) testing tool

The following appendix provides justification and documentation for the alterations made to the Giusti *et al.* (2014) psychological games testing tool. There are three sections in each chart:

1. The first column "Areas Added or Requiring Change" outlines what features in the tool have been modified or added, and provides the corresponding supporting sources (previous studies, developmental psychology literature, and interviews);
2. The second column "Justification" describes the reasoning for why the modification was made;
3. The final column "Modification" explains the particular modification.

Table 8: Overarching Modifications

Areas Added or Requiring Change	Justification	Modifications
General Recommendations for How to Prepare and Conduct the Testing (Identified in previous study Omidvar, 2018; Identified During Interview with Wright, Omidvar, and Seguin, 2019).	General and specific recommendations for how to prepare and construct each game, and how to conduct the testing were provided throughout the testing tool. Suggestions range from how to modify individual photos, to which tables to enlarge to poster size, or tips for how to keep a participant engaged. These prompts were established for clarity during future use of the tool, and to ensure consistency when constructing the games for use.	A list of initial recommendations was added at the beginning of tool to guide the researcher on how to utilize it, as well as additional suggestions were made for each individual game throughout the rest of the tool (overarching recommendations can be found on p. 1 of the modified tool and more suggestions can be found in the 'recommendations' section of each game that follows – Appendix I).

Overview of Water Pollution, Ground Pollution, and Air Pollution Before Starting the games testing (Identified During Interview with Wright, Omidvar, and Seguin, 2019)	After receiving a final round of feedback from Early Childhood Education experts, it was suggested that this section should be added for clarity and to incorporate a learning experience.	Upon starting the game's testing, the researcher is now required to go over the concepts/ideas of water pollution (dirty water), air pollution (dirty/smoky air), and ground pollution (dirty ground), without iterating the consequences associated with the form of pollution.
Overall Game Design (Identified During Interview with ECE Experts, 2019)	All four ECE experts encouraged the decision to "bring the games to life", or make them more interactive. One quote from Daniel Sequin (2019) was "kids are hands-on". Another from Leah Noonan (2019) was concerning the incorporation of tasks, and she emphasized that the games should be "interactive, so they can actually manipulate". Overall, the interviewees believed a 'hands-on' experience would enhance the possibility of engagement from the participants, as well as reduce the testing time.	All six of the games were turned into real 'board' games. The four tables used throughout the testing tool (games 1B, 2A, 2B, 3A and B) were enlarged and printed to become the size of a board game, and the associated pictures were enlarged to complement the size of the game board. When possible, tasking was embedded into the games, such as the sorting mechanism used in the first game.
Colour vs. Greyscale (Identified during interview with ECE Experts, 2019; Identified in Developmental	Between the ages of 3-5-years of age, children begin to develop categories for colour. However, with this being the early phase of development, children rely on primary colours over complex colours, such as the colour	All pictures throughout the testing tool were modified to greyscale.

Psychology Literature Pitchford and Mullen, 2003; Bonnardel and Pitchford, 2006, Regier and Kay, 2009)	teal. Moreover, children tend to gravitate towards their 'favourite' colour when partaking in daily tasks. One of the ECE experts stressed that colour might influence the answers provided by the children. ECE expert Dr. Sophie Jacques added, saying "what you have to be careful of, is to not make ugly looking images all be related to pollution" and "Some kids really like certain colours, everything red is perfect, doesn't matter what it represents".	
Debrief (Identified During Interview with Wright, Omidvar and Seguin, 2019)	After receiving a final round of feedback from Early Childhood Education experts, it was suggested that this section should be added for clarity and to incorporate a learning experience. By discussing these complex concepts (ground pollution, air pollution, and water pollution), children will hopefully leave the testing with a deeper understanding of these ideas. Moreover, this may also stimulate children to ask more questions about pollution that they see in their daily routines.	The researcher is now required to review the concepts/ideas presented at the beginning and throughout the testing, including the consequences associated with each form of pollution.
References for Debrief:		

Ducksters. (n.d.). “The Environment: Water Pollution”. *Ducksters Education Site: Science, Earth Science and Environment*. Retrieved from https://www.ducksters.com/science/environment/water_pollution.php

Ducksters. (n.d.). “The Environment: Land Pollution”. *Ducksters Education Site: Science, Earth Science and Environment*. Retrieved from https://www.ducksters.com/science/environment/land_pollution.php

Ducksters. (n.d.). “The Environment: Air Pollution”. *Ducksters Education Site: Science, Earth Science and Environment*. Retrieved from https://www.ducksters.com/science/environment/air_pollution.php

Natural Beach Living. (n.d.) “Teaching Kids About Pollution – Air, Land, and Water Pollution Activities and Printable”. Retrieved from https://www.naturalbeachliving.com/teaching-kids-about-pollution/

Table 9: Modifications for Section 1A - Emphatic Behavior Instructions

Areas Added or Requiring Change	**Justification**	**Modifications**
Game Design (Identified During Interview with ECE Experts, 2019)	The decision to incorporate ‘sorting’ was influenced by all four of the ECE Experts. From Leah Noonan encouraging tasking, pictures becoming tactile and incorporating movement, to Daniel Seguin’s quote, “kids are hands-on”, it was highly recommended that the games transform to include these qualities.	This section is now a ‘sorting game’. This involves ‘yes’ and ‘no’ bins that are placed on opposite ends of the testing space in order to facilitate the sorting. Therefore, after asking a question about each of the 9 pictures, the child will sort it into the chosen bin.
Cartoon vs. Real Pictures (Identified in Developmental Psychology Literature Kail and Barnfield, 2015;	As discussed in Kail and Barnfield (2015) and Hughes (1975), due to preschool children’s egocentrism, they are inclined to have difficulty viewing the world from another’s point of view. Therefore, modifying the	1. A picture of a green check mark was added to the game to place on one of the sorting bins; 2. A picture of a red ‘x’ was added to the game

Hughes, 1975; Lonner and Malpass, 1994)	pictures from a Swedish context to a Canadian context is crucial to ensure the child has an increased chance of knowing the images they will see in the tool. Furthermore, Lonner and Malpass (1994) reiterated the need for local context due to the influence of culture fluctuating from country to country. Additionally, ECE Experts touched on a separate note of finding consistency throughout the tool. All four experts noted the inconsistency of the use of real and cartoon pictures in the tool. Therefore, they all suggested that for the sake of clarity to choose either cartoons or real images. Ultimately, real pictures were selected due to the developmental literature discussing egocentrism and the influence of culture because there is a possibility that some children may not be exposed to cartoons, whereas all children are exposed to real objects in some capacity.	to place on the other sorting bin; 3. The picture of a "tree" is now a real picture of a tree located at Dalhousie University, Halifax, NS, Canada; 4. The cartoon picture of a "chopped tree" is now a real picture of a tree that has been chopped, located in Michigan, U.S.; 5. The cartoon "hens" have been changed to a real picture of a silver gray dorking, which is a type of poultry commonly found in North America. Moreover, this specific picture was taken on Ross Farm, New Ross, NS, Canada; 6. The cartoon picture of a "bicycle" is now a real picture of a bicycle meant for 3-5-year-old's and includes training wheels;

		7. The picture of the "birds" flying in the sky has now been modified to a real picture of a Pigeon, which is commonly seen in North America, and more specifically, in Halifax, NS, Canada; 8. The cartoon picture of the "reindeer" has been modified to a real picture of a caribou located at Shubenacadie Wildlife Park, Hants County, NS, Canada; 9. The cartoon picture of the "car" has now been modified to a real picture of a regular car, specifically a Honda civic which is a very popular car in NS, Canada. The picture was taken in Halifax, NS, Canada; 10. The cartoon picture of the "fish" has now been modified to a real picture of a brook trout, which is a native

		Canadian fish commonly found in NS, Canada; 11. The cartoon picture of the "plane", has now be changed to a real picture of an Air Canada jet plane, as it is a commonly used and recognized airline in Canada; 12. Finally, the cartoon picture of a "dinosaur" has been removed from the tool.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009)	With the tool being developed initially to measure the bioaffinity of 5-7-year-old Swedish children, the language used may be too complex or not used in a Canadian or Nova Scotia cultural context. Kail and Barnfield (2015) and Bloom (1998) both discussed the vast difference between the vocabulary of a two-year-old (roughly a few hundred words) to that of a six-year-old (over 10, 000 words). Therefore, it was essential to cater to the younger participants (3 year old's) to ensure the highest level of understanding. As such, the language in the tool was modified to words that are often used	1. The original question "does a tree feel pain" has been modified to "Can (ex. a tree) go owie? Can (this picture) get hurt?; 2. The term hens has been modified to the term chicken; 3. The term bicycle has been modified to bike; 4. The term plane was modified to the term airplane;

	in Canada and simplified for clarity (i.e. the use of "hens" was altered to "chicken" and the use of "pain" was modified to "owie") (Smith, 2000).	5. The term birds was changed to the singular tense, bird.
Length of Time (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Identified in previous studies Omidvar, 2018; Omidvar et al. 2019; Identified During Interview with ECE Expert Sequin, 2019)	One of the challenges noted in Omidvar (2018), was the amount of time needed for testing, which was roughly 45 minutes. Therefore, it was suggested that this be targeted in future studies. Various strategies have been used to try and reduce the time needed including, bringing the games to life (incorporating movement and task), reducing some of the questions and pictures used, and grey-scaling the images. ECE Expert Daniel Seguin supported the idea that by modifying the tool to a true game format (bringing it to life) will reduce the time by roughly five to ten minutes.	By making the modifications above, it is expected that the participating child will be able to respond to the pictures at a faster rate, due to the images being more egocentric, culturally appropriate, and linguistically specific to children attending the Shambhala Children's centre. Therefore, section '1a: Emphatic Behavior Instructions' may be conducted in a shorter amount of time.

References for New Pictures:

Checkmark

VectorStock. (n.d.). "Green Tick Checkmark Icon Vector Image". Retrieved from https://www.vectorstock.com/royalty-free-vector/green-tick-checkmark-icon-vector-22691505

'X'

Shutterstock. (n.d.). "X Images". Retrieved from https://www.shutterstock.com/search/x

Bike

Shpock. (2019, August 13). "Girls Bike Suit 3-5 Year Old". Retrieved from https://www.shpock.com/en-gb/i/XVJtSkC4YBrRNlTM/girls-bike-suit-3-5-year-old

Bird

Gifford, J. (2006, November 20). “Rock Dove (Columba Livia)”. *Flickr: Photostream*. Retrieved from https://www.flickr.com/photos/jimgifford/2175759757/in/photostream/

Car

MacKeen, J. (2019). A Honda Civic in Lower Sackville, Nova Scotia.

Chicken

Nova Scotia Communities, Culture and Heritage (NSCCH). (n.d.). “Poultry”. *Ross Farm: A Living Heritage Farm*. Retrieved from https://rossfarm.novascotia.ca/what-see-do/animals/poultry

Chopped Tree

Rodriguez, K. (2018, October 23). “Brother Face $450,000 Fine for Removing Trees Without Town’s Permission”. *Breitbart.* Retrieved from https://www.breitbart.com/politics/2018/10/23/brothers-450000-fine-removing-trees/

Fish

Fleming, J. (n.d.). “Easter Brook Trout”. *National Park Service*. Retrieved from https://www.nps.gov/yell/learn/nature/eastern-brook-trout.htm

Plane

Thomas, S. (2019). “Flying Air Canada in May or June? What you Need to Know”. *Vancouver Courier: News and Travel.* Retrieved from https://www.vancourier.com/news/flying-air-canada-in-may-or-june-what-you-need-to-know-1.23777910

Reindeer

Province of Nova Scotia. (n.d.). “Reindeer”. *Shubenacadie Wildlife Park*. Retrieved from https://wildlifepark.novascotia.ca/animals/reindeer.asp

Tree

Ngo, T. (2019). Tree Outside Sherriff Hall at Dalhousie University Halifax, Nova Scotia.

Table 10: Modifications for 1B: Concern and Sensitivity Instructions

Areas Added or Requiring Change	**Justification**	**Modifications**
Game Design (Identified During Interview with ECE Experts, 2019)	See Tables 1 and 2 above for justification.	This game has been modified to be called "a game of happy and sad smiles". The table of images provided was enlarged, and printed as a game board and the eight of the happy and sad smiles were enlarged and printed in colour. Therefore, for each picture found in the table/board, the participant is able to place either a happy or sad smile on top of the picture on the board.
Cartoons vs. Real Pictures (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Hughes, 1975; Chappell and Steitz, 1993; Lonner and Malpass, 1994)	See Table 2 above for justification.	1. The picture of "water pollution" has been modified to a picture of a bird being pulled out of oil polluted water. 2. The picture of a "real chopped forest" has been modified to a real picture of a clear cut seen in Shelbourne County, NS, Canada; 3. The cartoon picture of "watering plants" has been modified to a real picture of "watering plants"; 4. The picture of "ground pollution" has been modified to

		a picture of an overflowing trash can; 5. The cartoon picture of "image chopped forest" has been removed; 6. The picture of the action "planting tree" has been modified to real people "planting a tree" 7. The cartoon picture of "cleaning up" has been modified to a real picture of a child "cleaning up" using a vacuum; 8. The picture of "air pollution" has been modified to a picture of air pollution caused by industry (smoke stacks) with a child wearing a mask; 9. A picture of "Tuft's Cove" located in Halifax, NS, Canada was added to the table; 10. A picture of "plastic on the ground" was added to the table.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009)	See Table 2 above for justification.	1. "Water pollution" has been modified to "dirty water"; 2. "Ground pollution" has been modified to "dirty ground"; 3. "Planting tree" has been modified to "planting a tree";

		4. "Air pollution" has been modified to "dirty or smoky air"; 5. "Tuft's Cove" was added; 6. "Plastic on the ground" was added.
Length of Time (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Identified in Previous Studies Omidvar, 2018; Omidvar et al. 2019; Identified During Interview with ECE Expert Sequin, 2019)	See Table 2 above for justification.	The length of time will be influenced slightly by removing one of the pictures (image chopped forest).

References for New Pictures:

Cleaning Up

Freepik. (n.d.). "Little Henry Vacuum Cleaner Toy". Retrieved from http://ourhouzz.site/little-henry-vacuum-cleaner-toy/

Dirty Ground

Braun, A. (2019). "The Internet of Trash is Here to Make Your City Cleaner". IoT Trends. Retrieved from https://www.iottechtrends.com/internet-of-trash-make-city-cleaner/

Dirty/Smoky Air/Air Pollution

Hickey, E. (2017). "Tuffs Cove Three, Dartmouth Nova Scotia". *Flickr: Photostream*. Retrieved from https://www.flickr.com/photos/earle/32164764792

Dirty Water/Water Pollution

Virginia League of Conservation Voters. (n.d.). "Offshore Drilling Needs to Stay Off Limits". Retrieved from https://valcv.org/actions/offshore-drilling-needs-to-stay-off-limits/

Planting a Tree

Murphy, R. P. (2019). "In New "Mind-Blowing" Study, Planting Trees Reduces Carbon Better Than Carbon Taxes". *MisesInstitute: Mises Wire*. Retrieved from https://mises.org/wire/new-mind-blowing-study-planting-trees-reduces-carbon-better-carbon-taxes

Plastic on the Ground

Talmazan, Y. (2017). "Vancouver Aquarium Bans Single-Use Plastic Water Bottles to Advocate for Plastic-Free Oceans". *Global News: Environment*. Retrieved from https://globalnews.ca/news/3373950/vancouver-aquarium-bans-single-use-plastic-water-bottles-to-advocate-for-plastic-free-oceans/

Real Chopped Forest

CBC News. (2019, June 11). "How a Grade 9 Class is Fighting a Planned Clearcut in Shelburne Country. *CBC News: Nova Scotia*. Retrieved from https://www.cbc.ca/news/canada/nova-scotia/high-school-students-launch-campaign-against-clear-cut-1.5169586

Tuft's Cove

Hickey, E. (2017, January 14). "Tufts Cove Three, Dartmouth, Nova Scotia". *Flickr*. Retrieved from https://www.flickr.com/photos/earle/32164764792

Watering Plants

Carruthers, A. (2019, May 2). "Watering Gardens: Learn How to Water a Garden". *Knowing your Local Community and it's Garden Projects: Community Activities*. Retrieved from http://www.yourcommunitycouncil.co.uk/watering-gardens/watering-gardens-learn-how-to-water-a-garden/

Table 11: Modifications for Game 2A - Provision of Ecosystem Services Instructions

Concept	Justification	Modifications
Game Design (Identified in Developmental Psychology Literature Identified in previous	See Tables 1 and 2 above for justification.	The game has been modified to facilitate a 'matching game'. Therefore, the table for list 2 was enlarged and printed to create a

studies Omidvar, 2018; Omidvar et al. 2019; Identified During Interviews with ECE Experts, 2019)		game board, and the pictures in list 1 were individually enlarged and printed to use as matching pieces. Thus, allowing the participant to use the picture from list 1 to match with the photo found on the game board (list 2).
Cartoons vs. Real Pictures (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Hughes, 1975; Chappell and Steitz, 1993; Lonner and Malpass, 1994)	See Table 2 above for justification.	List 1: 1. The cartoon picture of a "wooden table" has been modified to a real picture of a wooden "picnic table"; 2. The picture of "eggs" has been modified to a picture of eggs found in the local grocery store, Sobeys, NS, Canada; 3. The picture of the "tuna can" has been modified to a real picture of a "tuna can" found in the local grocery store, Sobeys, NS, Canada; 4. The cartoon picture of "paper sheets" was modified to a real picture of "paper sheets"; 5. The cartoon picture of a "carrot" was modified to a real picture of "carrots" local grocery store, Sobeys, NS, Canada;

		6. The cartoon picture of a "glass of milk" was modified to a real picture of a glass of 'Farmers' milk, which is a common milk brand seen in local grocery stores throughout NS, Canada; 7. The cartoon picture of "tap water" was modified to a real picture of a glass of "tap water"; 8. The cartoon picture of "blueberries" was modified to a real picture of blueberries found in the local grocery store, Sobeys, NS, Canada; 9. The cartoon picture of a "wool hat" has been modified to a real picture of a "wool hat"; 10. The picture of the "pork chops" was removed. List 2: 1. The cartoon picture of "wood" has been modified to a real picture of "wood"; 2. The cartoon picture of the "forest" has been removed;

		3. The cartoon picture of a "tuna" has been modified to a real picture of a "tuna"; 4. The cartoon picture of a "cow" has been modified to a real picture of a "cow"; 5. The picture of the "hens" has been modified to a real picture of a silver gray dorking "chicken" as seen in game 1A; 6. The picture of the "pig" has been removed; 7. The picture of the vegetable garden has been modified to a picture of garden boxes; 8. The cartoon picture of "industry" has been removed; 9. The picture of a "river" has been modified to a picture of the Mersey "river", located in NS, Canada; 10. The cartoon picture of "transportation" has been modified to a real picture of a Midland transport "truck", which is a common truck seen in NS, Canada; 11. The cartoon picture of a "sheep" has been modified

		to a real picture of a "sheep" located in NS, Canada; 12. The cartoon picture of "money" has been modified to a real picture of Canadian "money"; 13. The cartoon picture of a "tractor" has been removed.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009)	See Table 2 above for justification.	List 1: 1. "Wooden table" has been modified to "picnic table"; 2. "Paper sheets" has been modified to "paper"; 3. "Carrot" has been modified to "carrots"; List 2: 1. "Hens" has been modified to "chicken"; 2. "Vegetable garden" has been modified to "garden"; 3. "Transportation" has been modified to "truck";
Length of Time (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Identified in Previous Studies Omidvar, 2018; Omidvar et al. 2019; Identified During	See Table 2 above for justification.	The length of time may be diminished by making the tables more simplistic and inviting for children. This was done by making the lists into two separate tables that can now be placed above or beside one another during testing.

Interview with ECE Expert Sequin, 2019)		

References for New Pictures:

Blueberries

MacKeen, J. (2019). Blueberries from Sobeys Halifax, Nova Scotia.

Carrots

MacKeen, J. (2019). Carrots from Sobeys Halifax, Nova Scotia.

Chicken

Nova Scotia Communities, Culture and Heritage (NSCCH). (n.d.). "Poultry". *Ross Farm: A Living Heritage Farm*. Retrieved from https://rossfarm.novascotia.ca/what-see-do/animals/poultry

Cow

The Canadian Press. (2019, February 15). "Runaway Cow Disrupts Traffic, Leaves Kids Stuck at School in Nova Scotia Suburb". The Star: Halifax. Retrieved from https://www.thestar.com/halifax/2019/02/15/runaway-cow-disrupts-traffic-leaves-kids-stuck-at-school-in-nova-scotia-suburb.html

Eggs

MacKeen, J. (2019). Eggs from Sobeys Halifax, Nova Scotia.

Glass of Milk

MacKeen, J. (2019). Milk from Sobeys Halifax, Nova Scotia.

Money

TheCurrent. (2019, April 19). "Canadian Dollar Improving". *Business and Currency*. Retrieved from https://blog.continentalcurrency.ca/canadian-comeback/

Paper

MacKeen, J. (2019). Printer Paper and Loose Leaf Halifax, Nova Scotia.

Picnic Table

Up Public Relations. (n.d.). "LakeCity Plastics". *LakeCity Works*. Retrieved from https://www.lakecityworks.ca/plastics

River

Nova Scotia Immobilien. (n.d.). “Mersey River Lodge”. Retrieved from https://www.novascotia-immobilien.de/en/for-rent/canada-eastcentral/nova-scotia/mersey-river-lodge/

Sheep

PSBANS. (n.d.). “Sheep”. *Purebred Sheep Breeders Association of Nova Scotia*. Retrieved from https://www.sheepnovascotia.ns.ca/sheep/

Tap Water

MacKeen, J. (2019). Tap Water from a Kitchen Tap Halifax, Nova Scotia.

Truck

Midland. (n.d.). “Drive With Us”. Retrieved from https://www.midlandcourier.com/

Tuna

Burnley, R. (2017, May 15). “Beautiful Brawn”. *Anglers Journal*. Retrieved from

Tuna Can

MacKeen, J. (2019). Tuna Can from Sobeys Halifax, Nova Scotia.

Wood

Firewood Ottawa. (n.d.). “Green Firewood”. Retrieved from https://firewoodottawa.com/product/wood/

Wool Hat

HandM. (n.d.). “Kids Exclusive: Rib-knit Hat in Soft Wool”. Retrieved from https://www2.hm.com/en_ca/productpage.0820252001.html

Vegetable Garden

Whimn. (2016, November 2). “How to Create the Ultimate Veggie Patch With Your Kids”. *Kidspot*. Retrived from https://www.kidspot.com.au/lifestyle/home/renovations/how-to-create-the-ultimate-veggie-patch-with-your-kids/news-story/c56c7f7f23e787fb694d404e3582e92d

Table 12: Modifications for Game 2B - Pollution Awareness Instructions

Areas Added or Requiring Change	Justification	Modifications
Game Design (Identified During Interviews with Wright, Omidvar and Seguin, 2019; ECE Experts, 2019)	During the consultations with ECE Expert Donna Varga, she expressed that the original format of game 2B included bias that the participants understand or have lived experience concerning the three concepts of pollution. Furthermore, during the final round of revisions, it was reiterated that it is difficult to differentiate between whether the child provides an answer based on the images or based on their knowledge of pollution. Therefore, it was suggested that this game be prefaced by asking the child for their definition or understanding of each of the three pollutants.	The game has been modified into two parts. Part 1 asks the child to explain the concepts of air pollution/dirty or smoky air, ground pollution/dirty ground, and water pollution/dirty water. While Part 2 is the same as the original version found in Giusti et al. (2014), where the child is asked whether the type of pollution (found in list 1) can hurt the things found in list 2 (animal, car, and people).
Cartoons vs. Real Pictures (Identified in Developmental Psychology Literature	See Table 2 above for justification.	List 1: 1. The picture of "air pollution" has been modified to a picture of air pollution

Kail and Barnfield, 2015; Hughes, 1975; Chappell and Steitz, 1993; Lonner and Malpass, 1994)		caused by industry (smoke stacks) with a child wearing a mask; 2. The picture of "ground pollution" has been modified to a picture of an overflowing trash can; 3. The picture of "water pollution" has been modified to a picture of a bird being pulled out of oil polluted water. List 2: 1. The three pictures of "animals" have been modified to a single picture of a domestic house dog, specifically a golden retriever, which are very common in North America; 2. The three cartoon pictures of vehicles have been modified to the same picture of a car used in previous section. It is the picture of a Honda civic, located in Halifax, NS, Canada; 3. The picture and category "you" has been removed; 4. The cartoon pictures of "People" have been modified

		to a real picture of children rather than adults.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009)	See Table 2 above for justification.	• The question "is this picture (without mentioning air pollution) harmful to animals?" has been modified to "Can (the first picture) hurt (the second picture)/make (the second picture) go owie?". List 1: • "Air pollution" has been modified to "dirty or smoky air"; • "Ground pollution" has been modified to "dirty ground"; • "Water pollution" has been modified to "dirty water". List 2: 1. "Animals" has been modified to the singular tense, "animal"; 2. "Vehicles" has been modified to "car".
Length of Time (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Identified in previous studies	See Table 2 above for justification.	By removing the use of multiple cartoon pictures in List 2, and replacing them with singular real photos, the time may be reduced. Additionally, by reviewing the pollution concepts/ideas before conducting the testing, participants

Omidvar, 2018; Omidvar et al. 2019; Identified d=During Interview with ECE Expert Sequin, 2019)		may have an easier time navigating the same ideas being used in this game.

References for New Pictures:

Animal

B, S. (2016). "Golden Retrievers are Friendly". *Thinglink.* Retrieved from https://www.thinglink.com/scene/847881793909555207

Car

MacKeen, J. (2019). A Honda Civic in Lower Sackville, Nova Scotia.

Dirty Ground

Braun, A. (2019). "The Internet of Trash is Here to Make Your City Cleaner". IoT Trends. Retrieved from https://www.iottechtrends.com/internet-of-trash-make-city-cleaner/

Dirty Water/Water Pollution

Virginia League of Conservation Voters. (n.d.). "Offshore Drilling Needs to Stay Off Limits". Retrieved from https://valcv.org/actions/offshore-drilling-needs-to-stay-off-limits/

Dirty/Smoky Air/Air Pollution

Hickey, E. (2017). "Tuffs Cove Three, Dartmouth Nova Scotia". *Flickr: Photostream*. Retrieved from https://www.flickr.com/photos/earle/32164764792

People

CFCA. (2016). "Stronger Communities, Safer Children". *Australian Government and Australian Institute of Family Studies: Publications*. Retrieved from https://aifs.gov.au/cfca/publications/stronger-communities-safer-children

Table 13: Modifications for Game 3A - Favorite Environmental Quality Instructions

Areas Added or Requiring Change	Justification	Modifications
Cartoons vs. Real Pictures (Identified in	See Table 2 above for justification.	1. The picture of children playing "indoor

Developmental Psychology Literature Kail and Barnfield, 2015; Hughes, 1975; Chappell and Steitz, 1993; Lonner and Malpass, 1994)		videogames" has been removed; 2. The picture of a cartoon playground has been modified to a real picture of the playground located at the Shambhala School, Halifax, NS, Canada; 3. The cartoon picture of the farm has been modified to a real picture of a farm located in Prince Edward Island, Canada, which is located roughly three hours from Halifax; 4. The picture of "indoor toys" has been modified to a less distracting picture of a child playing with a toy; 5. The picture of "green space" has been removed; 6. The picture of an "outdoor street" has been modified to a picture of children playing in a street.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009)	See Table 2 above for justification.	• "Recreational" has been modified to "backyard"; • "Indoor toys" has been modified to "inside"; • "Outdoor Street" has been modified to "street"; • Question #3 "Where do you feel the most free to play?" and "Why?";

		Questions 1, 2, and 4 were modified from and to the following: From: • "Where do you usually play the most?"; • "Where do you like to play?" and "Why?"; • "Where do you feel the most safe to play?" and "Why?". Modified To: • "Where do you play the most? And "Why?"; • "Where do you like to play the most?" and "Why?"; • "Where do you feel the most safe to play" and "Why?".
Length of Time (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Identified in Previous Studies Omidvar, 2018; Omidvar et al. 2019; Identified During Interview with ECE Expert Sequin, 2019)	See Table 2 above for justification.	Via the removal of a question and clarification of the language used to deliver the questions, it is expected the time needed to conduct the questions will diminish.

References for New Pictures:

Backyard

Giusti, M., Barthel, S., and 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. Retrieved from http://www.jstor.org/action/showPublication?journalCode=chilyoutenvi

Farm

Department of Agriculture and Land. (n.d.). "Environmental Farm Plans". *Government of Prince Edward Island: Agriculture and Land.* Retrieved from https://www.princeedwardisland.ca/en/information/agriculture-and-land/environmental-farm-plans

Forest

Sierra Club Canada. (n.d.). "Wild Child Forest School". Retrieved from https://www.sierraclub.ca/en/feature-slide/wildchild

Inside

Anchaleeyates. (n.d.). "Indoor Portrait Preschool Boy Playing in Kid Club with Vintage Tone". *FreepikCompany*. Retrieved from https://www.freepik.com/premium-photo/indoor-portrait-preschool-boy-playing-kid-club-with-vintage-tone-child-having-fun-playing-colorful-toys-kid-playroom-kid-boy-playing-with-educational-toys-kindergarten-education-concept_4994641.htm

Playground

MacKeen, J. (2019). Shambhala School Playground Halifax, Nova Scotia.

Street

Playing Out. (n.d.). "Possible Concerns". Retrieved from https://playingout.net/why/possible-concerns/

Table 14: Modifications for Game 3B - Disfavored Environmental Quality Instructions

Areas Added or Requiring Change	Justification	Modifications

Cartoons vs. Real Pictures (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Hughes, 1975; Chappell and Steitz, 1993; Lonner and Malpass, 1994)	See Table 2 above for justification.	1. The picture of children playing "indoor videogames" has been removed; 2. The picture of a cartoon playground has been modified to a real picture of the playground located at the Shambhala School, Halifax, NS, Canada; 3. The cartoon picture of the farm has been modified to a real picture of a farm located in Prince Edward Island, Canada, which is located roughly three hours from Halifax; 4. The picture of "indoor toys" has been modified to a less distracting picture of a child playing with a toy; 5. The picture of "green space" has been removed; 6. The picture of an "outdoor street" has been modified to a picture of children playing in a street.
Use of Language (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Bloom, 1998; Smith, 2000; 2009)	See Table 2 above for justification.	• "Recreational" has been modified to "backyard"; • "Indoor toys" has been modified to "inside"; • "Outdoor Street" has been modified to "street"; • Question #1 "Where DO NOT you usually play" was removed;

		Questions 2, 3, and 4 were modified from and to the following: From: • Where DO NOT you like to play?" and "Why?"; • "Where DO NOT you feel free to play?" and "Why?"; • "Where DO NOT you feel safe to play?" and "Why?". Modified to: • "Where DO you NOT like to play?" and "Why?"; • "Where DO you NOT like to play the most?" and "Why?"; • "Where DO you NOT feel safe to play?" and "Why?".
Length of Time (Identified in Developmental Psychology Literature Kail and Barnfield, 2015; Identified in previous studies Omidvar, 2018; Omidvar et al. 2019; Identified During Interview with ECE Expert Sequin, 2019)	See Table 2 above for justification.	Via the removal of a question and clarification of the language used to deliver the questions, it is expected the time needed to conduct the questions will diminish.
References for New Pictures: **Backyard**		

Giusti, M., Barthel, S., and 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. Retrieved from http://www.jstor.org/action/showPublication?journalCode=chilyoutenvi

Farm

Department of Agriculture and Land. (n.d.). "Environmental Farm Plans". *Government of Prince Edward Island: Agriculture and Land.* Retrieved from https://www.princeedwardisland.ca/en/information/agriculture-and-land/environmental-farm-plans

Forest

Sierra Club Canada. (n.d.). "Wild Child Forest School". Retrieved from https://www.sierraclub.ca/en/feature-slide/wildchild

Inside

Anchaleeyates. (n.d.). "Indoor Portrait Preschool Boy Playing in Kid Club with Vintage Tone". *FreepikCompany*. Retrieved from https://www.freepik.com/premium-photo/indoor-portrait-preschool-boy-playing-kid-club-with-vintage-tone-child-having-fun-playing-colorful-toys-kid-playroom-kid-boy-playing-with-educational-toys-kindergarten-education-concept_4994641.htm

Playground

MacKeen, J. (2019). Shambhala School Playground Halifax, Nova Scotia.

Street

Playing Out. (n.d.). "Possible Concerns". Retrieved from https://playingout.net/why/possible-concerns/

Appendix XIII: REB Letter of Approval

Social Sciences & Humanities Research Ethics Board
Letter of Approval

November 08, 2019
Tarah Wright
Science\Environmental Science Program

Dear Tarah,

REB #: 2019-4941
Project Title: Refining a games testing Tool for Various Cultural, Social and Geographic Situations to Evaluate Pre-School Children's Bioaffinity

Effective Date: November 08, 2019
Expiry Date: November 08, 2020

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.
Sincerely,

Dr. Karen Foster, Chair

FUNDED
Dal U SSHRC Explore Grants
Internal University Grant

Post REB Approval: On-going Responsibilities of Researchers
After receiving ethical approval for the conduct of research involving humans, there are several ongoing responsibilities that researchers must meet to remain in compliance with University and Tri-Council policies.

1. Additional Research Ethics approval

Prior to conducting any research, researchers must ensure that all required research ethics approvals are secured (in addition to this one). This includes, but is not limited to,

securing appropriate research ethics approvals from: other institutions with whom the PI is affiliated; the research institutions of research team members; the institution at which participants may be recruited or from which data may be collected; organizations or groups (e.g. school boards, Aboriginal communities, correctional services, long-term care facilities, service agencies and community groups) and from any other responsible review body or bodies at the research site

2. Reporting adverse events

Any significant adverse events experienced by research participants must be reported **in writing** to Research Ethics **within 24 hours** of their occurrence. Examples of what might be considered "significant" include: an emotional breakdown of a participant during an interview, a negative physical reaction by a participant (e.g. fainting, nausea, unexpected pain, allergic reaction), report by a participant of some sort of negative repercussion from their participation (e.g. reaction of spouse or employer) or complaint by a participant with respect to their participation. The above list is indicative but not all-inclusive. The written report must include details of the adverse event and actions taken by the researcher in response to the incident.

3. Seeking approval for protocol / consent form changes

Prior to implementing any changes to your research plan, whether to the protocol or consent form, researchers must submit a description of the proposed changes to the Research Ethics Board for review and approval. This is done by completing an Amendment Request (available on the website). Please note that no reviews are conducted in August.

4. Submitting annual reports

Ethics approvals are valid for up to 12 months. Prior to the end of the project's approval deadline, the researcher must complete an Annual Report (available on the website) and return it to Research Ethics for review and approval before the approval end date in order to prevent a lapse of ethics approval for the research. Researchers should note that no research involving humans may be conducted in the absence of a valid ethical approval and that allowing REB approval to lapse is a violation of University policy, inconsistent with the TCPS (article 6.14) and may result in suspension of research and research funding, as required by the funding agency.

5. Submitting final reports

When the researcher is confident that no further data collection or participant contact will be required, a Final Report (available on the website) must be submitted to Research Ethics. After review and approval of the Final Report, the Research Ethics file will be closed.

6. Retaining records in a secure manner

Researchers must ensure that both during and after the research project, data is securely retained and/or disposed of in such a manner as to comply with confidentiality provisions specified in the protocol and consent forms. This may involve destruction of the data, or continued arrangements for secure storage. Casual storage of old data is not acceptable.

It is the Principal Investigator's responsibility to keep a copy of the REB approval letters. This can be important to demonstrate that research was undertaken with Board approval, which can be a requirement to publish.

Please note that the University will securely store your REB project file for 5 years after the study closure date at which point the file records may be permanently destroyed.

7. Current contact information and university affiliation

The Principal Investigator must inform the Research Ethics office of any changes to contact information for the PI (and supervisor, if appropriate), especially the electronic mail address, for the duration of the REB approval. The PI must inform Research Ethics if there is a termination or interruption of his or her affiliation with Dalhousie University.

8. Legal Counsel

The Principal Investigator agrees to comply with all legislative and regulatory requirements that apply to the project. The Principal Investigator agrees to notify the University Legal Counsel office in the event that he or she receives a notice of non-compliance, complaint or other proceeding relating to such requirements.

9. Supervision of students

Faculty must ensure that students conducting research under their supervision are aware of their responsibilities as described above, and have adequate support to conduct their research in a safe and ethical manner.

Appendix XIV: Modified Research Instrument (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

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 you will see today”;
- Example for dirty water: “Dirty water can happen when waste and chemicals get in the water”;
- Example for dirty/smoky air: “Dirty or smoky air can happen when too many chemicals, harmful gases, and smoke are in the air”;
- Example for dirty ground: “The ground becomes dirty 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.

Game 1A: Emphatic Behavior Instructions

Recommendations:

It is advised that the researcher brings an enlarged, printed and laminated version of 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 are visual learners). 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 ask you if each picture I hand to you can feel an owie or get hurt, and then you will sort them into the yes or no bins (demonstrate while explaining)”;
2. Show one picture after the other, in the table below (laminated cut-out versions of the pictures), to the child. For every picture, ask they/them:
    a. Example: “Can (ex. a tree) go owie? Can (this picture) get hurt?”;
3. The child’s answer will be a simple yes or no. 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** 
Chopped Tree 	**Car** 	**Fish** 

Game 1B: Concern & Sensitivity Instructions

Recommendations:

It is advised that the researcher prints and laminates an enlarged version of the table. Additionally, it is recommended that nine of each 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 or sad smiles, I would like you to put a happy smile or sad smile 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 smiles);
3. Ask to place the happy or sad smile images on 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 smiley 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”

Table of images

Dirty Water 	**Real Chopped Forest** 	**Watering Plants** 
Dirty Ground 	**Cleaning up** 	**Dirty or Smoky Air** 
Tuft’s Cove 	**Planting a Tree** 	**Plastic on the Ground** 

Game 2A: Provision of Ecosystem Services Instructions

Recommendations:

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

Instructions:

1. Place the table with pictures from *List 2* in front of the child and line up 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 have a picnic table? "Answer: child picks the image of "wood", and then ask "why did you match those two pictures?";
3. What the picture represents has to 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 have to 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 	**Tuna** 	**Cow** 
Chicken 	**Garden** 	**Money** 
River 	**Truck** 	**Sheep** 

Game 2B: Pollution Awareness Instructions

Recommendations:

It is advised that the researcher brings an enlarged, printed and laminated version of 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. Additionally, bring enlarged, printed, and laminated 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 are visual learners).

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?";
    b. If the child is losing focus, use a puppet and ask, "Can you explain air pollution/dirty air to the puppet (thus, providing a task)?";
4. For this question the child does not have to select any picture, but reply in words, this implies that researchers have to 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 result will be a simple list of 4 "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**
		

List 2		
Animal	**Car**	**People**
		

Game 3A: Favorite Environmental Quality Instructions

Recommendations:

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

Instructions:

5. 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 which 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: "Where do you usually play the most? I would like you to pick a picture form this table.";
6. Place the table of pictures in front of the child and ask they/them to select ONE picture 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?"
7. 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 have to synthesize it and write down children's answers in the scoresheet.

Backyard	**Playground**	**Farm**
		
Inside	**Street**	**Forest**

Game 3B: Disfavored Environmental Quality Instructions

Recommendations:

It is advised that the researcher uses the same table of pictures from Game 3A. It is important to note that the participants are allowed to pick as many options 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 ONE picture 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 have to 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);
    - Example: "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";
    - Example of water pollution: 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;
    - Example of ground pollution: 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;

    - Example of air pollution: 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).
- Finally, ensure to ask the participant again if they have any questions.