

WHERE TO RAISE HAPPY AND SKILLED CHILDREN: HOW ENVIRONMENT SHAPES HUMAN DEVELOPMENT AND EDUCATION

EDITED BY: Sabine Pirchio, Blanca Silvia Fraijo-Sing and Ylenia Passiatore
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WHERE TO RAISE HAPPY AND SKILLED CHILDREN: HOW ENVIRONMENT SHAPES HUMAN DEVELOPMENT AND EDUCATION

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Editorial: Where to Raise Happy and Skilled Children: How Environment Shapes Human Development and Education

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Editorial on the Research Topic

Where to Raise Happy and Skilled Children: How Environment Shapes Human Development and Education

Child development consists of a series of changes that occur in the individual, driven by genetic, biological, social, cultural, and environmental resources and constraints (Bronfenbrenner, 1979; Hendry and Kloep, 2002). Child development has been described and explained through different perspectives, focusing on the changes in different components (e.g., cognition, emotion, relations, language, etc.) implying different developmental processes (e.g., continuous vs. discontinuous, quantitative vs. qualitative, maturational vs. social processes) and using different scientific methodologies (e.g., lab experiments, field observations, cross-sectional vs. longitudinal research designs).

This long research tradition has helped uncover the many ways in which a newborn grows into an adult, offering important insights into interventions, education, and social policies.

Following a basic assumption of environmental psychology, human beings, as all forms of living organisms, are shaped by the physical and social characteristics of their life's environments, impacting on the development of their skills, preferences, habits, and behaviors (Bonnes and Carrus, 2004; Mercado-Doménech et al., 2017). On the other hand, individuals and social groups leave a footprint on their habitats. The environment is, in some measure, an outcome of human actions (Gifford, 2011).

According to the ecological approach to human development (Bronfenbrenner, 1979), child development occurs in a series of hierarchically organized environmental systems, characterized by specific properties, components, and rules and linked by reciprocal and dynamic relations, and interactions. The social-relational aspects of development and the impact of specific activities for learning and acquisition represent the main research stream in this framework (e.g., Bruner, 1983; Tomasello et al., 1993; Pontecorvo and Pirchio, 2000).

Recently, however, psychologists have shifted their attention toward investigating the relationships among the physical properties of the environment and child development and behavior (Legendre, 2003; Evans, 2006; Carrus et al., 2015).

The articles included in this Research Topic contribute relevant knowledge about “where to raise happy and skilled children” from three different perspectives. In the first perspective, features of home and the school environment are juxtaposed with aspects of children's developmental processes, such as the development of gender stereotypes (Solbes-Canales et al.) and environmental attitudes and behaviors (Durón-Ramos et al.) and with developmental resources such as parental

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involvement in their children's education (Echeverría-Castro et al.). Rural and urban living environments are not only physically different, but foster and constrain the experiences adults and children could have in different ways, and may play a role in their happiness and well-being (Cerina and Fornara, 2011; Kabisch et al., 2017; Maricchiolo et al., 2020) through complex dynamics involving the environmental affordances and the people's behaviors and choices (Carrus et al., 2020). To be able to identify environmental features that play a role in children's development and behaviors certainly contributes to identifying and shaping positive educational environments (Tapia-Fonllem et al.).

A second perspective links six articles that shed light on the connectedness to nature and on the challenges and resources to improve the feeling of connection to nature in children in educational settings. Connectedness to nature is an important factor in environmental education as it is linked to pro-environmental behaviors (Liefänder et al., 2013). There is a robust tradition of environmental education trying to target connectedness to nature to have an impact on pro-environmental behavior (Passafaro et al., 2010; Otto and Pensini, 2017; Varela-Candamio et al., 2018), showing how complex it can be to create long-term effects in children's attitudes and behaviors toward nature and the environment. Although incomplete, preschool children already have a concept of nature (Fraijo-Sing et al.), and they attach their positive and negative emotional responses to nature (Olivos-Jara et al.); moreover, connectedness to nature is related to sustainable behaviors and happiness and related to the child's self-definition (Barrera-Hernández et al.). Given the relevance of the connection to nature for a child's well-being and for the environmental development, interventions aiming to increase connection to nature are important. The mini review by Barrable and Booth analyzes different types of interventions and identifies relevant variables to be considered for further research and for planning interventions, such as

the age of participants and length of the contact with nature. Even if there could be several settings in which connection to nature could be increased, educational institutions, and schools in particular, seem to be the most important. The articles by Pérez-López et al. and van Dijk-Wesselius et al., address the issue of providing preschool and primary school teachers with the knowledge, attitudes, and confidence to implement educational activities involving nature. The research within this perspective highlights the need for more systematic studies on the effect of diverse types of experiences with nature on environmental attitudes and pro-environmental behaviors.

The studies in the third perspective address the cognitive side of the research on the outcomes of contact with nature. Natural environments have a restorative power. Being in contact with nature recharges an individual's cognitive and emotional resources (Kaplan and Kaplan, 1989; Hartig, 2004) in adults (Hartig et al., 2011; Carrus et al., 2017) and children (Hattie et al., 1997; Korpela, 2002; Carrus et al., 2015). Johnson et al. find effects of a nature intervention on children's endogenous attention, and Federico discusses the convergent influence of the natural environment and of social relationships on stress reduction and, consequently, on attentional processes.

Our Research Topic contributes to the study of environmental psychology by accumulating new knowledge about the ways in which physical qualities of educational environments influence children's cognitive functioning and social behavior, assessing instruments to measure relevant factors of child development in different living environments, and in discussing environmental interventions.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

REFERENCES

- Bonnes, M., and Carrus, G. (2004). "Environmental psychology, overview," in *Encyclopedia of Applied Psychology*, Vol. 1, ed C. Spielberger (New York, NY: Academic Press-Elsevier), 801–814.
- Bronfenbrenner, U. (1979). *The Ecology of Human Development*. Cambridge, MA: Harvard University Press.
- Bruner, J. (1983). *Child's Talk. Learning to Use Language*. New York, NY: W.W. Norton.
- Carrus, G., Passiatore, Y., Pirchio, S., and Scopelliti, M. (2015). Contact with nature in educational settings might help cognitive functioning and promote positive social behaviour/El contacto con la naturaleza en los contextos educativos podría mejorar el funcionamiento cognitivo y fomentar el comportamiento social positivo. *Psychology* 6, 191–212. doi: 10.1080/21711976.2015.1026079
- Carrus, G., Pirchio, S., and Tiberio, L. (2020). Transitions to sustainability, lifestyles changes and human well-being: cultural, environmental and political challenges ((Transiciones hacia la sostenibilidad, cambios de estilos de vida y bienestar humano: desafíos culturales, medioambientales y políticos)). *Psychology* 11, 163–169. doi: 10.1080/21711976.2020.1734411
- Carrus, G., Scopelliti, M., Panno, A., Laforzezza, R., Colangelo, G., Pirchio, S., et al. (2017). A different way to stay in touch with 'urban nature': the perceived restorative qualities of botanical gardens. *Front. Psychol.* 8:914. doi: 10.3389/fpsyg.2017.00914
- Cerina, V., and Fornara, F. (2011). The psychological determinants of attitudes toward relocation in the elderly: a survey study in urban and rural environments. *Psychology* 2, 335–348. doi: 10.1174/217119711797877744
- Evans, G. W. (2006). Child development and the physical environment. *Annu. Rev. Psychol.* 57, 423–451. doi: 10.1146/annurev.psych.57.102904.190057
- Gifford, R. (2011). The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *Am. Psychol.* 66:290. doi: 10.1037/a0023566
- Hartig, T. (2004). "Restorative environments," in *Encyclopedia of Applied Psychology*, ed C. Spielberger (New York, NY: Academic Press/Elsevier), 273–279.
- Hartig, T., van den Berg, A. E., Hagerhall, C. M., Tomalak, M., Bauer, N., Hansmann, R., et al. (2011). "Health benefits of nature experience: psychological, social and cultural processes," in *Forests, Trees and Human Health*, eds K. Nilsson, M. Sangster, C. Gallis, T. Hartig, S. de Vries, K. Seeland, et al. (Berlin: Springer Science), 127–168.
- Hattie, J., Marsh, H. W., Neill, J., and Richards, G. (1997). Adventure education and outward bound. *Rev. Educ. Res.* 67, 43–87. doi: 10.3102/00346543067001043
- Hendry, L. B., and Kloep, M. (2002). *Lifespan Development: Resources, Challenges and Risks*. Boston, MA: Cengage Learning EMEA.
- Kabisch, N., van den Bosch, M., and Laforzezza, R. (2017). The health benefits of nature-based solutions to urbanization challenges for children

- and the elderly—A systematic review. *Environ. Res.* 159, 362–373. doi: 10.1016/j.envres.2017.08.004
- Kaplan, R., and Kaplan, S. (1989). *The Experience of Nature: A Psychological Perspective*. New York, NY: Cambridge University Press.
- Korpela, K. (2002). “Children’s environment,” in *Environmental Psychology*, eds R. B. Bechtel and A. Churchman (New York, NY: Wiley), 363–373.
- Legendre, A. (2003). Environmental features influencing toddlers’ biemotional reactions in day care centers. *Environ. Behav.* 35, 523–549. doi: 10.1177/0013916503035004005
- Liefländer, A. K., Fröhlich, G., Bogner, F. X., and Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environ. Educ. Res.* 19, 370–384. doi: 10.1080/13504622.2012.697545
- Maricchiolo, F., Mosca, O., Lauriola, M., and Krysz, K. (2020). The role of urbanization of place of living in the relation between individual features and happiness (El papel del desarrollo urbanístico del lugar de residencia en la relación entre las características individuales y la felicidad). *Psycology* 11, 232–259. doi: 10.1080/21711976.2020.1734399
- Mercado-Doménech, S. J., Carrus, G., Terán-Álvarez-Del-Rey, A., and Pirchio, S. (2017). Valuation theory: an environmental, developmental and evolutionary psychological approach. Implications for the field of environmental education. *J. Educ. Cult. Psychol. Stud.* 16, 77–97. doi: 10.7358/ecps-2017-016-merc
- Otto, S., and Pensini, P. (2017). Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environ. Change* 47, 88–94. doi: 10.1016/j.gloenvcha.2017.09.009
- Passafaro, P., Carrus, G., and Pirchio, S. (2010). *I bambini e l’ecologia: gli aspetti psicologici dell’educazione ambientale*. Rome: Carocci.
- Pontecorvo, C., and Pirchio, S. (2000). A developmental view on children’s arguing: the need of the other. *Hum. Dev.* 43, 361–363. doi: 10.1159/000022696
- Tomasello, M., Kruger, A. C., and Ratner, H. H. (1993). Cultural learning. *Behav. Brain Sci.* 16, 495–511. doi: 10.1017/S0140525X0003123X
- Varela-Candamio, L., Novo-Corti, I., and García-Álvarez, M. T. (2018). The importance of environmental education in the determinants of green behavior: a meta-analysis approach. *J. Clean. Prod.* 170, 1565–1578. doi: 10.1016/j.jclepro.2017.09.214

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Quasi-Randomized Trial of Contact With Nature and Effects on Attention in Children

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Children today spend less time in nature than previous generations and there is concern that this shift negatively impacts children's cognitive abilities, particularly their ability to direct their attention. Theories, such as the Attention Restoration Theory (ART), suggest that contact with nature may replenish endogenous attention (e.g., directed, voluntary attention). There is a lack of rigorous research on how contact with nature is associated with attentional performance in children. This study employed a quasi-experimental design and included a sample of typically developing children to investigate performance on computerized endogenous and exogenous attention tasks before and after exposure to one of two interventions – a 30-min walk in either an urban ($n = 30$) or natural (forested, $n = 30$) environment. The two experimental groups were equivalent with regard to sex ratio, age, IQ, and connectedness to nature. Attention was assessed using the Combined Attention Systems Test (CAST), a state-of-the-art assessment tool designed to evaluate exogenous and endogenous attention characteristics. Bayesian hierarchical modeling of both response time (RT) and error rate (ER) was employed to evaluate the fixed effect of attentional measures and interactions with session and group. Consistent with predictions of ART, results support credible effects of the nature intervention on two measures of endogenous attention: Alerting RT: $d = 0.85$ (95% CI: 0.21–1.8), Orienting ER: $d = 1.45$ (95% CI: 0.17–7.18), but not on any of the measures of exogenous attention.

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INTRODUCTION

Modern lifestyles of children are predominately urban and indoors, disengaged from outdoor experiences with natural environments, and in contrast with psycho-evolutionary theories espousing contact with nature as crucial for healthy physical and cognitive development. Eighty-two percent of North Americans currently reside in urban settings (United Nations, 2014). Thus, even when children spend time outdoors, it is unlikely to be a “natural” environment. More than ever before, people are insulated from regular contact with nature (Maller and Townsend, 2006; The David Suzuki Foundation, 2012).

This modern separation from nature is problematic because many studies with adult samples have indicated that exposure to nature is associated with improved well-being (Ulrich et al., 1991;

Kuo and Faber Taylor, 2004; Staats and Hartig, 2004; Pretty et al., 2005), more positive perceptions of quality of life (Ogunseitan, 2005), and improved self-esteem (Staats and Hartig, 2004). The health-enhancing properties of nature may be mediated through several mechanisms, including recovery from stress (Kuo and Faber Taylor, 2004), facilitation of social contact (Leyden, 2003), physical activity (Pretty et al., 2005), and the restoration of attentional resources (Kaplan and Kaplan, 1989; Hartig et al., 1991). Although research clearly supports positive influences of nature exposure in adults, there has been less research examining how children are affected by exposure to nature. Louv (Louv, 2005) coined the term “nature deficit disorder” to capture the potential cognitive, psychological, and physical problems associated with disconnection from nature in children. Despite growing evidence that nature enhances health and awareness of the potential problems associated with disconnection from nature, there has been little systematic study of how time spent in nature affects children.

One of the major theories regarding the mechanisms through which nature benefits human well-being is the Attention Restoration Theory (ART). This theory is predicated on the notion that attention, particularly directed (i.e., effortful, voluntary) attention, is a finite resource and susceptible to fatigue under conditions of prolonged use (Olmsted, 1968; Kaplan, 1995; Wells, 2000; Kaplan and Berman, 2010). That is, attentional capacities become fatigued due to the many demands placed upon them in our everyday life. This fatigue manifests itself as an inability to concentrate and ignore distracting stimuli, and may lead to irritability and anxiety particularly in children. Time spent in restorative environments can render the need for directed attention temporarily unnecessary and, thus, allow attention to rest and replenish (Kaplan, 1983). Particularly restorative environments are those that engage *soft fascination*. That is, the “attention grabbing stimuli” in these environments must draw gently on our involuntary attention, so as not to overwhelm the attentional system. Thus, nature (e.g., natural parks, forest, the wilderness), which is inherently rich in stimuli that engage *soft fascination* (e.g., ripples on the surface of a lake, rustling leaves, butterflies, song birds), might be particularly restorative (Kaplan, 1995).

Understanding if and how attention in children can be restored is critical, particularly in the context of learning and school performance, as well as associated outcomes including self-esteem, mood, and behavior. Traditional educational approaches provide little time outside of the classroom and minimal opportunity for exposure to nature. The demands on directed attention are high and it is likely that many children experience attentional fatigue during a typical school day. If time outdoors, and specifically time in nature, provides some restorative benefits, this may offer opportunities for educators, parents, and professionals who work with a wide range of children to maximize their learning and other outcomes. Moreover, understanding the links between nature exposure and attention in children is a starting point for uncovering the mechanisms by which exposure to nature positively affects humans.

Over a century ago, William James proposed that there are two types of attention: involuntary attention and voluntary

attention (James, 1892). *Involuntary attention* is automatic, effortless, autonomous, and stimulus driven (Kaplan, 1983; Klein and Lawrence, 2012). It occurs when intriguing stimuli reflexively capture our attention (e.g., when we orient to a bright light in the dark) because at some point in evolution it was adaptive to do so, or because of highly specialized training (Kaplan, 1995). James provided a list of the kinds of stimuli that may involuntarily capture our attention: “strange things, moving things, wild animals, bright things, pretty things, metallic things, words, blows, blood” (p. 88). In contrast, *voluntary attention* is non-reflexive. It is primarily an inhibitory mechanism that requires effortful processing and voluntary cognitive control. It is goal-oriented and contingency-based, occurring when we must focus on tasks that are not, in and of themselves, inherently attention grabbing (e.g., attending to instructions). Henceforth, we will use current terminology, endogenous and exogenous, which are based on current theory (Klein and Lawrence, 2012). Conceptually, these terms are largely consistent with, although not synonymous, voluntary and involuntary, respectively.

Theorists suggest that our relative reliance on endogenous and exogenous modes of attention has evolved over time (Kaplan and Kaplan, 1989). For much of human history, exogenous modes of attention served an important survival function. For example, it was likely adaptive to be drawn to attention-grabbing stimuli (e.g., moving things, wild animals, bright things) for daily living skills such as hunting and personal safety. In the context of urbanization, the demands on endogenous attention have increased for individuals across all age groups, and consequently the adaptiveness of, and our reliance on, exogenous attention has decreased (Kaplan and Berman, 2010). In fact, exogenous attention can often create difficulties for us. We are often rewarded for inhibiting exogenous attention (i.e., ignoring the inherently interesting) in lieu of accomplishing our goals (i.e., the modern day “important”) and staying “on task.” The ability to engage in endogenous attention has become increasingly important and adaptive (Bratman et al., 2012). From classrooms to boardrooms, the demands on our endogenous attention are increasingly prolonged, and success in today’s world is often predicated on our ability to meet these demands. However, endogenous attention is a finite resource and susceptible to depletion. The established role of endogenous attention in many facets of daily functioning underscores the importance of identifying ways to remediate and replenish this critical cognitive ability in the face of inevitable depletion.

Attention is also linked to the notion of soft and hard fascination. *Soft fascination* has been contrasted with *hard fascination*, which involves stimuli that abruptly and harshly grab involuntary attention (Kaplan and Kaplan, 1989; Berman et al., 2008). For example, modern urban environments are thought to be non-restorative, as they are characterized by stimuli that evoke *hard fascination* (e.g., car horns, stoplights). Navigating urban environments frequently requires one to draw on rules and contingencies, the implementation of which frequently evokes directed attention. Previous research corroborates, at least in adult populations, the notion that nature might be more restorative than urban environments

(Herzog et al., 1997; Hartig and Staats, 2006; Gladwell et al., 2012). For example, in studies designed to probe the restorative features of nature, participants rated images of natural environments as more restorative than images of urban environments (Gladwell et al., 2012), and attentionally fatigued participants were more likely to opt for a walk in a forest than a walk through a city center following a mid-afternoon university lecture (Hartig and Staats, 2006).

Research also suggests that time spent in or viewing images of natural and urban environments differentially affects physiological indices. For example, compared to urban scenes, natural scenes more rapidly returned heart rate (Laumann et al., 2003) and blood pressure (Chang et al., 2008) to baseline following stress induction. Also, walks through natural environments, but not walks through built environments, have been shown to decrease noradrenaline levels (Tennessen and Cimprich, 1995), and vagal activity has been shown to increase when viewing images of natural environments (Herzog et al., 1997), effects suggested to index increased relaxation.

The introduction of ART has fostered a growing body of multidisciplinary research seeking to examine the relationship between time spent interacting with natural environments and attention (Kaplan, 1995; Tennessen and Cimprich, 1995) using various methods and populations (i.e., clinical and typical). In a study of the restorative effect of a wilderness vacation on participants' abilities to complete a proofreading task (i.e., an indirect measure of attention), participants were randomly assigned to spend time in a natural environment, urban environment, or to engage in passive relaxation (Hartig et al., 1991). Only individuals who went wilderness backpacking showed improvement on second administration of the proofreading task (post-exposure) compared to the other two conditions.

More recent work using more sophisticated methods has corroborated previous findings using a set of well-designed within-subjects quasi-experimental studies that tested ART in a sample of college students (Berman et al., 2008), and a sample of individuals (mean age = 26 years) with Major Depressive Disorder (Berman et al., 2012). In the first study, college students showed significantly greater improvement on working memory tasks after walking in the natural environment compared to walking in the urban environment. Participants in the second study exhibited significant improvements in memory span after a nature walk relative to a walk in an urban environment. Similar studies of adult samples have subsequently found that even minimal exposure to nature (e.g., a view from a window; or plant-presence in a room) and virtual/simulated nature (Ulrich et al., 1991; Tennessen and Cimprich, 1995) can be restorative (Lohr and Pearson-Mims, 2000). However, outcome measures used in these studies do not map on to current conceptualizations of endogenous attention, but instead likely tap several complex cognitive processes including, but not limited to, endogenous attention.

A study to examine the effect of exposure to projected slides of images of urban or natural environments on attention incorporated a between-subjects, pre-post design (Berto, 2005). Participants (mean age = 23 years) first completed the sustained

attention to response test (Manly et al., 1999), a 5-min response control test. Next, they viewed 25 images of urban or natural environments, which were each presented for 15 s, before completing the attention task for a second time. The results indicated that after viewing the images of natural environments, participants responded significantly faster, were better able to detect the target, and made significantly more correct inhibitory responses. These same improvements were not observed for participants assigned to view urban images. However, at post-image viewing, participants in the urban group did display a significant reduction in the number of incorrect responses.

Previous research has also examined the implications that time spent interacting with nature, or simply in the presence of nature, has on children's attention. Several studies have examined the relationship between school-based nature exposure and school performance. For example, it was found that the amount of nature visible through a school's cafeteria windows, and the objective measure of the amount of vegetation on campus, significantly predicted better performance on standardized testing, higher graduation rates, and higher rate of plans to attend college, even after controlling for socioeconomic status, ethnicity, building age, and the size of a given school (Matsuoka, 2010). Another study employed a quasi-experimental design to examine how children's mood and school behaviors (number of hours of sick leave, record of misbehavior, and academic performance) were affected when classrooms were provided with six medium-sized plants (versus classrooms with no plants) (Han, 2009). The presence of plants in the back of a classroom positively impacted student affect, reduced their number of hours of sick leave, and improved classroom behavior.

Researchers have also sought to examine the relationship between near-home nature and attention in children. A study employing a longitudinal pre-move/post-move design examined the relationship between the naturalness of children's (age range 7–12) homes and parents' ratings of their children's attention (Wells, 2000). Children whose homes improved the most pre-move to post-move on the objective rating of naturalness were rated as having the best levels of attentional functioning. Similar research examined the relationship between parent's ratings of the views of nature from home and objective measures of children's cognitive performance (Taylor et al., 2002). For females, parent-rated near-home nature accounted for 20% of the variance in children's cognitive performance across tasks. Interestingly, no such effect was observed in males. The authors hypothesized that boys do not spend a significant amount of time in the environments around their house.

Consistent with findings indicating relationships between nature exposure and better attention in adults, the majority of child studies drawing on ART highlight the potential benefit of time spent in nature on children's attention. However, the existing studies in children are limited by lack of random assignment to environment, their reliance on subjective parent-report measures of attention, and the use of proxy measures that indirectly assess endogenous and/or exogenous attention (e.g., academic performance) (Kaplan, 1995; Taylor et al., 2002; Wells and Evans, 2003; Kuo and Faber Taylor, 2004). No studies

to date have used an experimental design and objective measures of attention to examine the impact of time spent in natural environments on typically developing children's attention. Moreover, no previous study has explicitly examined both endogenous and exogenous modes of attention in children in contrasting urban and natural environments.

The distinction between endogenous and exogenous attention is central to ART, yet at the time that this study was initiated, there were no tools available to robustly measure both modes of attention in a unified framework. Furthermore, modern perspectives on attention (Klein and Lawrence, 2012) delineate not merely the modes of attention but also their domain, including temporal, spatial, and task. While tests such as the Attention Network Test and its derivatives (ANT-R, ANT-I, and others) are popular in studies that seek to measure attention across its various forms to evaluate specific effects of an intervention, these tests have deficiencies in their design that prompted us to develop an improved test of attention. Specifically, the original ANT failed to achieve orthogonal manipulation of temporal and spatial attention, making it impossible to evaluate their interaction. The original ANT also fully confounded exogenous and endogenous forms of both spatial and temporal attention. The ANT-I is a test that achieved orthogonal manipulation of temporal and spatial attention, and eliminated the confound between exogenous and endogenous spatial attention, but with the latter achieved by focusing on exogenous spatial attention alone, and with no attempt to eliminate the confound between exogenous and endogenous temporal attention.

The Combined Attention Systems Test (CAST) was developed as an improvement on similar tasks, including the Attention Network Test (ANT) and the Attention Network Test-Interaction (ANT-I). The ANT was employed in a prior study that examined nature exposure (although only images presented in a laboratory) and attention (Berman et al., 2008). Like the ANT, the CAST is a computerized measure of the three attentional networks (alerting, orienting, and executive attention), and is a sensitive and theoretically driven measure. The CAST was employed in the current study because it addresses known limitations of the ANT and ANT-I and because it separately measures exogenous and endogenous attention, and executive attention, which are central to examining the Attention Restoration Theory (MacLeod et al., 2010; Lawrence et al., 2011).

The aim of the present study was to test attentional changes, pre- and post-exposure to nature compared to an urban environment in a sample of typically developing children and adolescents, using a quasi-experimental design. Advancements in the area of attention task development were used to more robustly examine how exposure to nature affects both exogenous and endogenous attention performance in children. In order to assess the impact of exposure to nature on both exogenous and endogenous attention, we employed the CAST (Lawrence et al., 2011; Lawrence, 2018) to parse out exogenous and endogenous modes of attention. More specifically, we employed a between-subjects pre/post design, wherein we assessed children's exogenous and endogenous attention performance before and after exposure to either a natural environment or an urban environment. Consistent with ART, we hypothesized that children

who were exposed to natural environments during a 30-min reflective walk would demonstrate specific improvements in endogenous attention, as indexed by change in performance on the CAST. Further, given that ART suggests that the restorative potential of natural environments lies in their ability to engage exogenous attention in lieu of endogenous attention (Kaplan, 1995), we hypothesized that exposure to nature would only improve endogenous attention, and thus did not expect to observe changes in participants' exogenous attention. Finally, consistent with ART and the body of literature which suggests that urban environments are non-restorative (Herzog et al., 1997; MacLeod et al., 2010; Li et al., 2011), we did not expect changes in endogenous or exogenous attention in those children and adolescents assigned to a 30-min reflective walk through an urban environment. The current study is an important first step in exploring exposure to nature as a potential remediation for attentional fatigue in children.

MATERIALS AND METHODS

Participants

Ninety children participants aged 8–15 years were recruited over a 1-year period through community bulletins, newsletters, paid advertisements, and emails distributed to families that had previously participated in studies in our laboratory. The children were initially assessed for eligibility for enrollment in the study and 19 were excluded. Children were required to have an estimated IQ equal or greater than 80, normal or corrected-to-normal vision, no history of psychiatric/psychological diagnoses, no history of severe head injury, and no significant neurological disorders affecting the central nervous system. The study received ethical approval from Dalhousie University's Institutional Research Ethics Board in August 2012. However, registration of the study as a clinical trial occurred retrospectively as there was no determination during ethics review that the study fit the definition of a trial. The authors confirm that all ongoing and related trials for this intervention are registered.

Participants received \$15 as an honorarium for study participation, and parents were entered to win one of two \$50 gift cards to a bookstore as compensation for their time. A total of 71 children were assigned to one of two conditions: an urban walk or nature walk. The logistics of testing outside of a laboratory made true random assignment impossible for this study. However, participants blindly assigned themselves to study condition; participants were informed that there were two possible locations to which they could be assigned and then were asked to select a participation date, following which the testing location prescheduled for that date was revealed.

Thirty-eight children (42% male) participated in the urban condition and 33 children (45% male) participated in the nature condition. Participants were primarily Caucasian (82.6%). One participant in the urban group discontinued the study before completing the second session. Of the 70 participants that completed the study, the CAST data of 10 participants were excluded due to either performing at chance during one of the sessions or failing to respond on more than 30% of trials.

Thus, the analyses for the CAST were conducted on a sample of 60 participants [nature condition, $n = 30$ (15 female); urban condition, $n = 30$ (16 female)] (**Figure 1**). Bayesian regressions indicated that the groups were well-matched (no differences) in terms of key demographic features, study features, and characterization measures (**Table 1**). No significant group differences were evident for level of parental education or household income.

Characterization Measures

A Demographic and History Questionnaire, an IQ test, and the Nature Connectedness Scale (CNS) (Mayer and Frantz, 2004) were administered in order to characterize the participants and facilitate comparison of participants in the two groups. Participants' parents/guardians completed a demographic and

history questionnaire assessing information pertaining to child characteristics (e.g., age, birth date, and ethnicity), family circumstance/composition, child and family psychiatric history, and current medications. The Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999) was administered to provide an estimate of participant's intellectual ability, in order to ensure that participants met inclusion criteria ($IQ \geq 80$). The WASI was not administered to individuals who provided consent for the researchers to obtain the results of IQ testing that had been conducted in another clinical or research setting within the past 2 years. Each child completed a 10-item modified version of the original CNS scale (Mayer and Frantz, 2004) developed by the scale's creators. The child version uses a 7-point scale (strong disagree to strongly agree). Higher scores indicate stronger connectedness to nature (child range = 10–70).

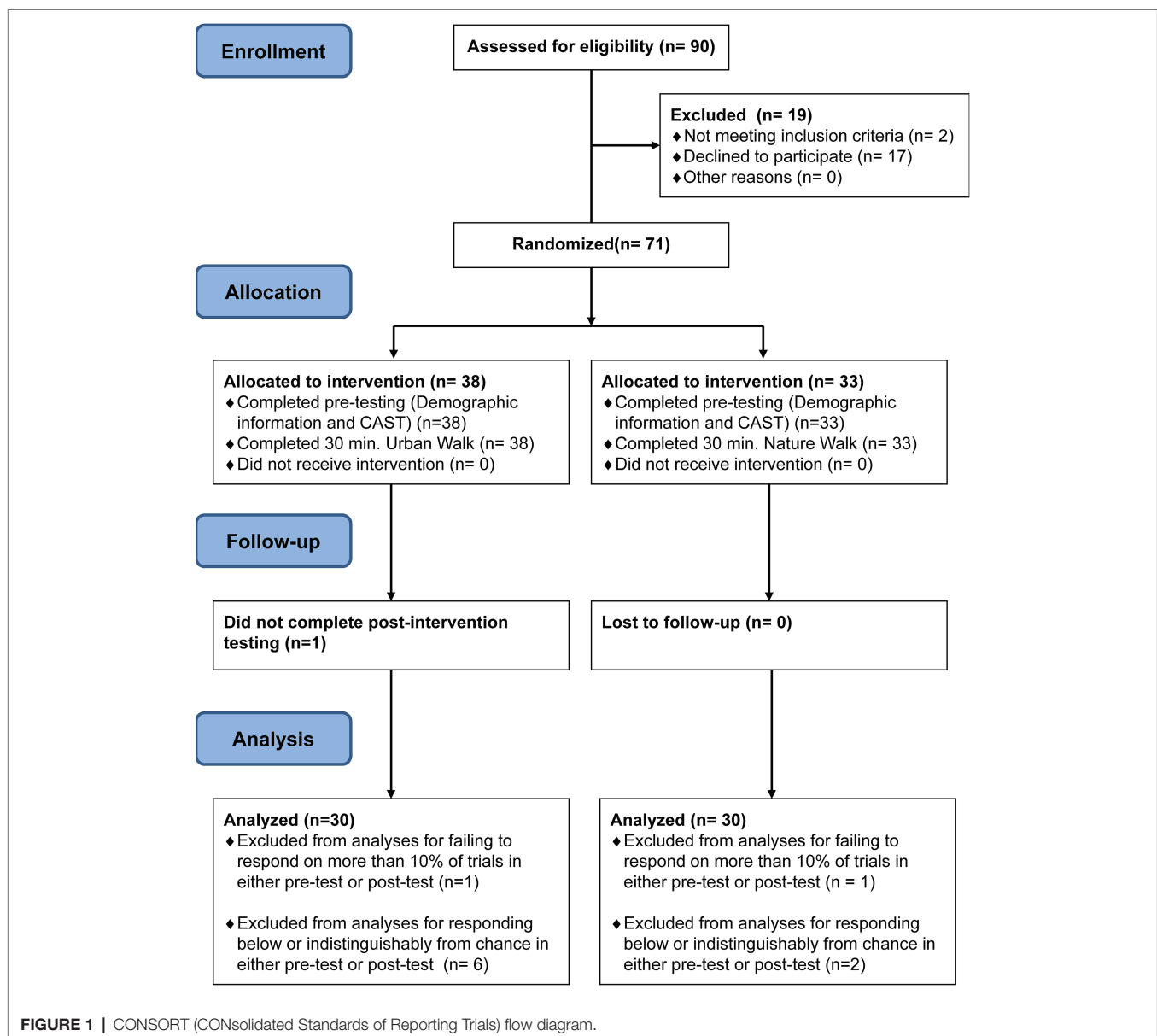


TABLE 1 | Study sample characteristics.

	Overall (n = 60; 29 M/31F)		Nature (n = 30; 15 M/15F)		Urban (n = 30; 14 M/16F)		Difference*
	μ	σ_x	μ	σ_x	μ	σ_x	
Age (years)	11.4	2.3	11.3	2.3	11.5	2.3	0.4 (−0.7–1.5)
WASI Full IQ	115.1	11.7	114.2	10.9	116.0	12.6	1.5 (−4.4–7.7)
CNS	4.9	0.9	4.8	1.0	4.9	0.9	0.1 (−0.4–0.5)

M, male; F, female; WASI, Wechsler Abbreviated Scale of Intelligence, standard scores are reported; CNS, Connectedness to Nature Scale, raw scores are reported. *Difference, posterior median and 95% Credible Interval (CrI).

Combined Attention System Test (CAST) (Lawrence, 2018). The CAST is a game-like computerized measure designed to assess and isolate both endogenous and exogenous attention. Accordingly, the CAST is composed of two separate tasks: the endogenous task and the exogenous task.

Procedure

For the purposes of this study, Shubie Park in Dartmouth, Nova Scotia (geometric center: 44.70°N, −63.55°E) was selected as the location for exposure to a natural environment and a busy section of downtown Halifax, Nova Scotia (geometric center: 44.64°N, −63.57°E) was selected for exposure to an urban environment (**Figure 2**). These locations were chosen due to their proximity to buildings available for the testing phase of the study that provided easy and direct access to urban and natural environments.

Children were placed into groups (between two and four children) and were then led on a 30-min walk through either the nature or the urban exposure environment. The walks consisted of a 2-km (approximately 1.3 mile) route for each exposure condition and the distance was objectively confirmed using a GPS data logger. Pre/post exposure testing took place at indoor locations within 5 min of the walk locations. WASI administration took place in the lab of Dr. Shannon Johnson, during a separate testing session. Walks and corresponding data collection took place between the months of July and November over a 2-year period.

Prior to study participation, a parent/guardian of potential participants completed a brief phone-based screening interview to determine if their child(ren) met preliminary inclusion criteria (note: if cognitive testing had not been conducted previously, it was not possible to determine if participants met IQ cut-off prior to study administration). If preliminary inclusion criteria were met, we explained that participation in this study involved blind assignment to one of the two locations to minimize expectancy biases (i.e., participants were not aware of the specifics regarding the testing location they were not assigned to). The researchers then provided the parent/guardian with several possible testing dates, and asked them to select a date and time during which their child(ren) could complete the study. After the date and time were selected, the parent/guardians were provided with location. Parents were provided with the *demographic and history questionnaire* in advance, and given the option of bringing the completed forms with them on the day of the study, or completing the forms while their child(ren) participated.

Participants completed the study in groups of 1–4 ($M = 3.34$). At least two research assistants were present at all times to provide instructions, address any questions, and monitor for compliance. Upon arrival, research assistants obtained assent for study participation from the children and consent from a parent/guardian. Researchers then administered the *Connectedness to Nature Scale*, followed by the CAST to each participant. All participants completed the questionnaire and attention testing at the same time (i.e., once the researchers provided each child with task instructions, the children were prompted to begin the tests). Accordingly, both testing locations were able to accommodate several workstations. Each child was seated so that they could not see the other participants during the task. Following completion of the CAST, participants were provided with water, and instructions regarding their 30-min walk. They were encouraged to allow the research assistant to set the pace for the walk, to take notice of their surroundings, and to keep social interactions to a minimum. After the walk, participants completed the second administration of the CAST.

In total, the endogenous and exogenous tasks required approximately 26 min to complete. Administrations of the CAST were completed on Macbook laptops, with 28.5-cm screens, running on Lion OS X operating software. Participants sat approximately 64 cm from the screen and were provided with game controllers and audio headphones. The headphones were calibrated using a Class 2 sound level meter to between 60 and 80 decibels for all tones. For both tasks, participants were to indicate, as quickly as possible, the direction that a target fish (subtending 2° of visual angle) is facing by pressing either the right- or left-hand trigger button. Speed of response is emphasized more than accuracy, although both are encouraged as part of the instructions. The target fish appears against a white background, facing left or right, 5° degrees to the left or right of the central fixation. The target fish is presented alone or surrounded by a school of fish (one above, one to the right, one below, one to the left; spaced 0.2° from the target fish) that are facing in either the same or opposite direction of the target fish.

The variables manipulated in the task are target fish direction (left vs. right facing), target fish location (left vs. right), flankers (none, congruent, incongruent), auditory stimuli presented bilaterally (endogenous task: background noise change vs. background noise held constant; exogenous task: background noise volume increase vs. background noise volume held constant), and visual cues (endogenous task: central arrow valid



FIGURE 2 | Photos of the urban and natural exposure environments.

vs. central arrow invalid; exogenous task: valid peripheral black dot vs. invalid peripheral black dot). All possible combinations of these variables yield 72 trial types in the endogenous task, and 48 trial types for exogenous task. For each task, there is a practice block of 24 randomly chosen trials, followed by two experimental blocks, wherein all trial types, respective to each task, are presented at random. Thus, in total participants complete 48 practice trials and 240 experimental trials.

The order of task-presentation was counterbalanced across participants in the urban and nature groups, and there was no group difference for the order of presentation [$\chi^2(1, N = 40) 0.04, p = 0.85$]. The manipulated variables across the two tasks allow for the measurement of a number of dependent variables: (1) exogenous alerting network score, (2) exogenous orienting network score, (3) endogenous alerting network score, (4) endogenous orienting network score, and (5) two measures of the executive network of attention.

Please refer to **Supplementary Material** for a detailed description of the attention measures and CAST procedure.

Data Pre-processing and Modeling

The collected data were pre-processed to remove: all trials on which participants failed to make a response (0.1% of trials); all trials on which responses were made prior to target appearance (0.6% of trials); and all trials on which response times were faster than 200 ms (0.3% of trials). The latter exclusion criterion was determined by prior experience with RT data suggesting that responses faster than 200 ms tend to be anticipatory responses unrelated to target processing, as well as application of a generalized additive model of trial accuracies predicted by trial RTs, showing that only above about 200 ms do responses rise above chance performance.

Bayesian inference was achieved using the Stan (Stan Development Team, 2017) probabilistic programming language *via* the RStan package for R (R Core Team, 2017). Response time and accuracy from both subtests were modeled simultaneously, where trial-by-trial accuracy was modeled as a binomial event and trial-by-trial response time was modeled as having log-normal measurement noise. Within a given participant, the influence of the manipulated variables on accuracy was modeled as affecting the log-odds of error while

their influence on the response time was modeled as affecting the log-mean response time; the scale of the log-normal measurement noise was also modeled for each participant. The full set of coefficients relating a given participant to their trial-level data was modeled as varying across participants through a multivariate normal distribution in a hierarchical model that sought inference on the population-level coefficient means, variabilities, and correlations. Notably, as compared to more traditional approaches to data analysis (e.g., ANOVA) that would employ independent analyses of response time and accuracy data, by modeling the response time and accuracy data in the same model, we achieve more accurate and informed inference on their associated coefficients at both the participant and population level to the degree that there are correlations among them manifest in the population, which is a strong expectation for these measures (for example, slower participants tend to be more accurate; participants with larger flanker effects on response time tend to have larger flanker effects on response accuracy). In the terminology of De Boeck and Minjeong (De Boeck and Jeon, 2019), this is a joint hierarchical model and reflects an approach to the analysis of timed tests that is now relatively common in the psychometric literature (Van Breukelen, 2005; van der Linden, 2007; Loeys et al., 2011) but has yet to see widespread adoption in cognitive psychology (c.f., Molenaar et al., 2015). Independent and weakly informed priors were used for all population-level parameters.

Data, analysis code, and summary tables of response times by task are available online *via* the Open Science Framework (OSF) website (Rainham and Lawrence, 2019).

RESULTS

The results are reported below in two sections. In the first section, we report the main effects of the attentional measures, validate an absence of group differences on these measures at session 1, and report interactions between these measures and session (likely due to learning). In the second section, we test our hypotheses by examining the three-way interactions between group, session, and attention measures. It is amid these three-way interactions that we would expect to find support for the Attention Restoration hypothesis.

Validation of Combined Attention Systems Test, Baseline, and Practice Effects

Validation of Attention Measures

Collapsing across sessions and groups, **Figure 3** and **Table 2** indicate that all attention measures of the CAST are observed with credibly non-zero magnitude except the endogenous and exogenous alerting effects on error rate. These findings indicate that the task manipulations within the CAST yielded the intended effects for both the endogenous and exogenous tasks.

Validation of Absence of Group Differences at Session 1

Figure 4 and **Table 3** show the data from evaluating the effect of group on the attention measures during session 1. Zero falls within the 95% credible interval for all effects, indicating no baseline differences on the CAST between the urban and nature groups for both the endogenous and exogenous tasks.

Attention Measures and Interactions With Session

Figure 5 and **Table 4** show data resulting from the evaluation of the effect of session and its interaction with the attention measures of the CAST. For most effects, zero remains a relatively credible value for the effect of session with the exception of the RT Intercept, reflecting responses that are about 14 ms faster in the second session, and the exogenous orienting effect, reflecting a reduction of about 10 ms in the magnitude of this effect from session 1 to 2. The results demonstrate some minimal practice effects, which is consistent with many cognitive tasks.

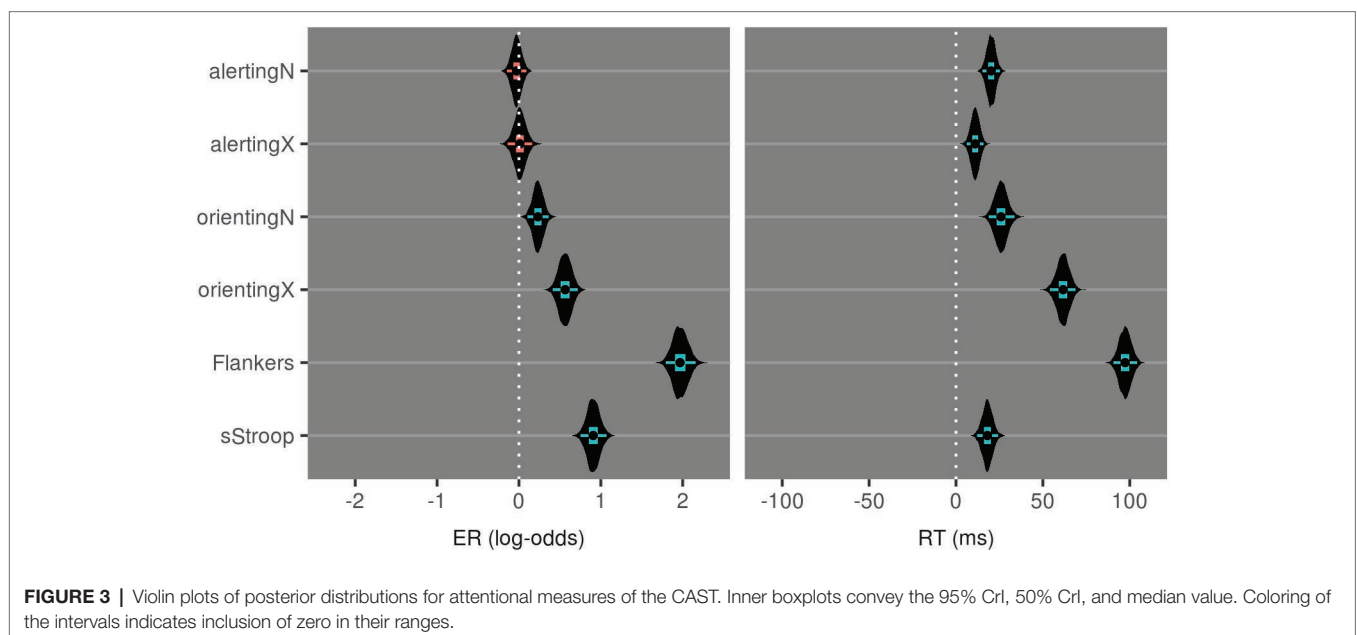
Influence of Exposure Conditions

Figure 6 and **Table 5** show the posterior distributions for the coefficients reflecting the three-way interaction between group, session, and each effect of attention measured by the CAST.

Zero remains a relatively credible value for all except the endogenous alerting effect and the endogenous orienting effect. As shown in **Figure 7**, at baseline, the two groups demonstrated relatively similar endogenous alerting in RT. Compared to baseline, the urban group's endogenous alerting was reduced at session 2, driven by both "high and low" alerting conditions moving toward the mean. In contrast, the nature group's endogenous alerting increased at session 2 compared to baseline, driven primarily by reduction of RT: $d = 0.85$ (95% CI: 0.21–1.8) in the "high alerting" condition. As shown in **Figure 8**, at baseline, the two groups demonstrated relatively similar error rates (ERs) for endogenous orienting. Compared to baseline, the urban group's endogenous orienting was reduced at session 2, driven by an increase in ER in both conditions with a larger increase in the "valid cue" condition. In contrast, the nature group's endogenous orienting increased at session 2 compared to baseline, driven primarily by a reduction of ER: $d = 1.45$ (95% CI: 0.17–7.18), in the "valid cue" condition. These patterns in endogenous alerting and endogenous orienting are consistent with a fatigued endogenous attention system in the urban group and a refreshed (or even enhanced) endogenous attention system in the nature group. In addition to the R code and study data, descriptive statistics (mean and cross-standard deviations) in each condition (urban or nature) for RT, log-RT, and the error rate are provided as **Supplementary Material**.

DISCUSSION

The primary goal of this study was to test the hypotheses set forth by ART, that exposure to nature is restorative to attention, in a sample of typically developing children and adolescents. As hypothesized, we found that children in the nature exposure condition demonstrated slight improvements in endogenous



attention and no change in exogenous attention performance following the walk. Finally, with regard to the third hypothesis, we found that there was no improvement in the urban group, but that counter to our expectations, performance on two endogenous attentional measures worsened following exposure.

We examined the following three hypotheses: (1) Children who were exposed to a natural environment (i.e., path through a forest) during a 30-min reflective walk were expected to demonstrate improvements in endogenous attention, as indexed by change in performance on the CAST. (2) Exposure to nature was not expected to improve participants' performance on the exogenous conditions of the CAST. (3) No changes were expected in endogenous or exogenous attention performance in those children and adolescents assigned to a 30-min reflective walk through an urban environment.

There is some evidence to support our first hypothesis, improvement in the nature group following their walk. However, this was not solely due to better performance in the nature group. We found effects differed between the urban and nature groups for endogenous alerting and orienting, which were due to both improved attentional performance in the nature group and worse performance in the urban group following the interventions.

TABLE 2 | Median and 95%CrI values from posterior distributions for attentional measures of the CAST.

Effect	ER (log-odds)	RT (ms)
alertingN	0.0 (−0.1:0.1)	20 (15:25)
alertingX	0.0 (−0.1:0.2)	11 (6:16)
orientingN	0.2 (0.1:0.4)	26 (18:33)
orientingX	0.6 (0.4:0.7)	62 (54:69)
Flankers	2.0 (1.8:2.2)	97 (91:104)
sStroop	0.9 (0.7:1.1)	18 (12:24)

N, endogenous task; X, exogenous task.

Our findings are consistent with similar experimental studies that interpreted group differences on the ANT executive measure as evidence for improvements for the nature exposure group. Similarly, we found that the urban group demonstrated worse performance post-exposure relative to pre-exposure. Previous studies have also examined and reported significant results on the influence of nature contact on several components of cognitive function (Herzog et al., 2003; Hartig and Staats, 2006; Berman et al., 2008); however, these studies typically employ measures of attention and cognitive function which do not necessarily align with the attentional constructs proposed in ART. That is, previous studies have not been able to tease apart exogenous and endogenous attention, but have instead identified changes in other constructs, such as working memory. Importantly, the current study is the first to differentiate the effects of exposure to nature on exogenous versus endogenous attention.

An important contribution of this study is the application of the CAST, a novel attentional task that has the ability to separate exogenous from endogenous attentional measures. This task allowed us to directly test the core tenets of ART, which previous studies were unable to do given the use of less sophisticated measures of attention. Using the CAST, in conjunction with a data analysis approach that allowed us to model response time and error rates simultaneously, we have identified that not only does nature lead to some improvements in endogenous attentional performance, but importantly spending time in urban environments has a detrimental effect on endogenous attention. This is consistent with ART as urban environments would be expected to lead to attentional fatigue and exposure to nature can serve as a buffer from attentionally fatiguing environments. We replicated the methodology of previous studies, but were able to address specific questions by employing the CAST, and found that the key hypotheses of ART were supported.

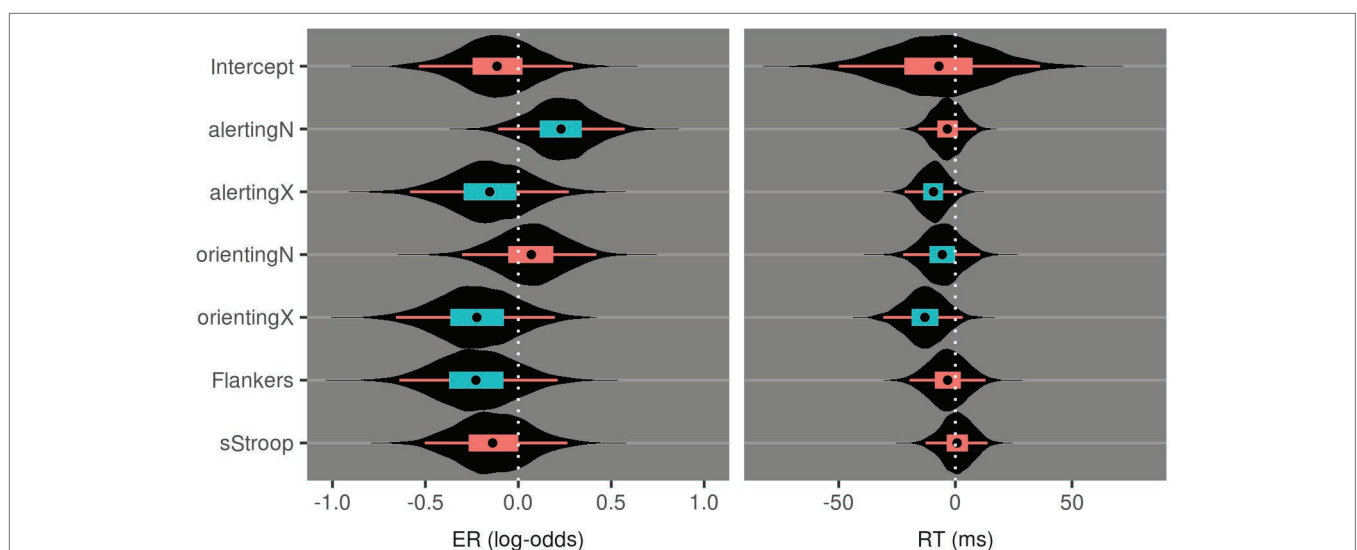


FIGURE 4 | Violin plots of posterior distributions for the effect of Group in Session 1 attention measures of the CAST. Inner boxplots convey the 95% CrI, 50% CrI, and median value. Coloring of the intervals indicates inclusion of zero in their ranges.

However, differences in attention task performance between the nature and urban groups may also have arisen due to inherent features of the study approach. For example, group differences may be due to attenuation of attentional control or performance instability between attention tasks pre- and post-exposure to either the urban or nature conditions. Although not explored here, there is a possibility that improvement in attentional performance arising from restoration (*via* contact with nature) or depletion (from exposure to urban environments) originates from specific locations within the response time distribution, and thus it is the control of attention regulating differences between groups (Kaplan and Berman, 2010). We are unable to exclude the potential influence of attention task position among all tasks during administration of the CAST. Reversing the order of tasks among participants as part of a counterbalanced design may provide additional insight into the importance of task order in administration of the CAST. In addition, we did not conduct sensitivity analyses of the impact of model selection as the priors employed were weakly informed. Readers are welcome to assess stability in intra-individual attentional performance using the study data available from the repository.

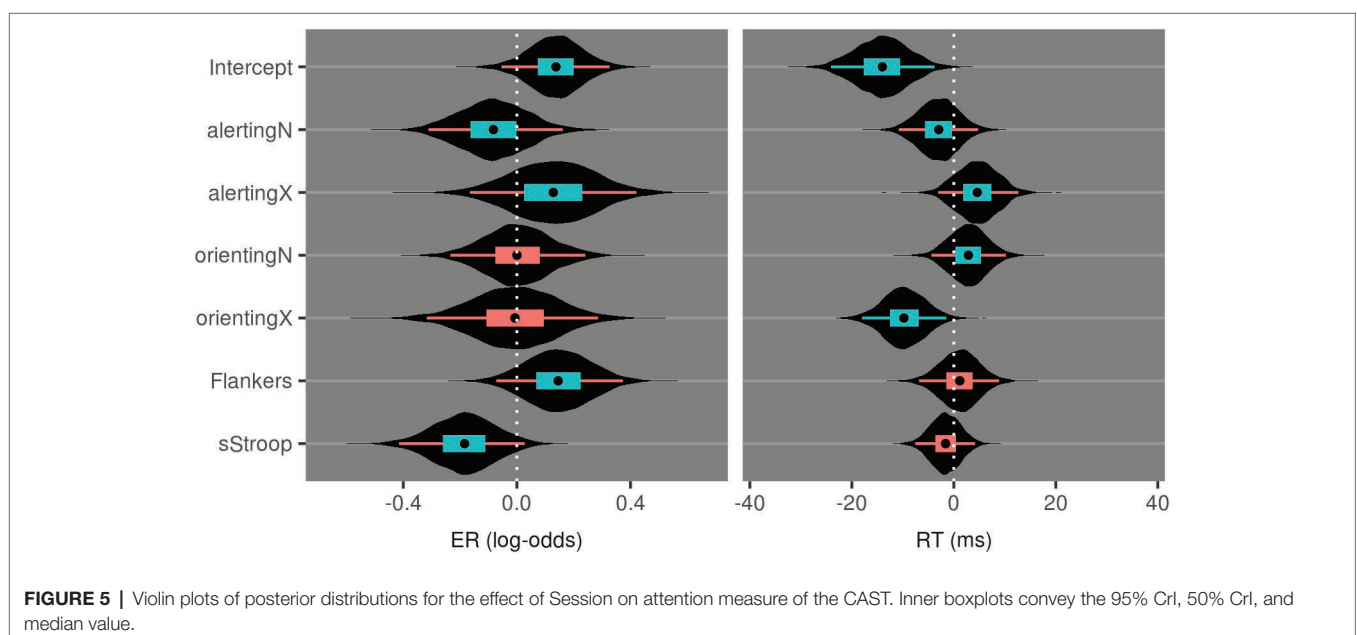
TABLE 3 | Median and 95%CrI values from posterior distributions for group differences at session 1 on attention measures of the CAST.

Effect	ER (log-odds)	RT (ms)
Intercept × Group	−0.1 (−0.5:0.3)	−8 (−51:34)
alertingN × Group	0.2 (−0.1:0.6)	−3 (−16:9)
alertingX × Group	−0.2 (−0.6:0.3)	−9 (−22:3)
orientingN × Group	0.1 (−0.3:0.4)	−6 (−24:11)
orientingX × Group	−0.2 (−0.7:0.2)	−14 (−31:5)
Flankers × Group	−0.2 (−0.6:0.2)	−3 (−20:13)
sStroop × Group	−0.1 (−0.5:0.3)	1 (−12:14)

N, endogenous task; X, exogenous task.

Our findings support the growing body of literature that indicates that spending time in nature is beneficial for children. Correlational studies have suggested improved attentional functioning in children who experience more time in natural settings or in urban settings that include more natural features. The current study provides further evidence for improvements in endogenous attention using a controlled design and a short exposure duration. According to ART, exposure to nature may restore endogenous attention through influence on exogenous attention which can transiently interrupt goal-directed behavior. Exogenous cues in natural environments, such as changes in luminance, the complexity of shapes and patterning (arousing fascination), or peripheral cues arising from the movement of animals, insects, or the movement of vegetation from wind, are components of natural environments that contribute to restoration or arousal *via* interruption of endogenous or intentional, directed attentional resources. Our results indicate that even a relatively short exposure to nature (30–40 min) improves endogenous attention and a relatively short dose of an urban environment taxes endogenous attention in children. Thus, these findings suggest that increasing time in nature, while also considering ways to buffer the detrimental effects of urban exposure, is necessary for maximizing children's attention.

Taken together, the findings of this study offer some important considerations for future studies examining the benefits of nature exposure for children. For example, our analysis reveals only a modest improvement to endogenous attention following exposure to nature. We are reasonably confident that this was not due to the quality of the exposure, nor to the sensitivity of our attention measure. The nature walk, and associated data collection, was completed within a heavily forested urban park that is 40 ha in area with natural walking paths and various natural water features (canal, lakes). We chose this site because there are no features of urban development or other urban stimuli once on the trails. In addition, the CAST is a theoretically driven and



sensitive measure of a variety of exogenous and endogenous attentional processes. Compared to prior studies (e.g., Berman et al., 2008; Bratman et al., 2012), the walk environments and the attention measure were improvements in study design in terms of quality of exposure and measurement of attention.

Although we do not question the quality of the nature exposure, we have reservations about whether the amount of time spent in nature was sufficient to lead to a dramatic improvement in attentional performance in children. Children may require more exposure to obtain similar levels of improvement as adults. The question of how much time children should spend in nature is important. How much time would be enough to invoke a change in attention? It is possible that one experience, regardless of duration, would not be enough. Children may require repeated experiences in order to develop greater familiarity with natural environments, and acquire improved attention as a result of spending time in nature.

When considering the effects of nature exposure on children's attention, it is also important to consider intergenerational differences in nature experience. The idea that historically humans have spent more than 90% of time in nature (Bratman

et al., 2012) provides an evolutionary basis from which to conclude that we are pre-inclined to feel comfortable in and innately connected with nature. However, today's children spend, on average, less than 60 min outdoors each day, usually as part of a trip from one location to another (The David Suzuki Foundation, 2012). As children spend more time indoors, they become increasingly disconnected from nature and the ecology of the outdoors. Perhaps, as a function of becoming more disconnected from nature, children do not experience or perceive nature to be restorative in the way that research suggests adults do (Hartig and Staats, 2006). For adults, spending time in nature creates connections to learned experiences about how they feel in this type of setting. Individuals with existing connections to nature, and who may have already experienced restorative effects, may require a much smaller dose of time in nature to reap benefit. For example, study participants in Berman's study (Berman et al., 2008), with average age of 23 years, may have spent more time developing connections to nature in the late 1980s/early 1990s. In addition to spending much less time in nature, due to significant increases in the allocation of time to indoor activities (e.g., computing, television), children may develop a fear of natural settings (Louv, 2005). If children have become so disconnected from nature that they are afraid of or uncomfortable in nature, it seems unlikely that spending time in nature would provide them with the same rewarding benefits that it provides adults. While this theory points toward compelling empirical questions, to date, there have been few studies of the potential negative impacts of time spent in nature. Regardless, potential generational differences in nature contact may afford an opportunity for additional research focused on the quantity and quality of children's exposure to nature as a determinant of cognitive benefit.

In addition to familiarity with and the time spent in natural environments, the presence of unfamiliar children in the exposure

TABLE 4 | Median and 95%CrI values from posterior distributions for the effect of session on attention measures of the CAST.

Effect	ER (log-odds)	RT (ms)
Intercept × Session	0.1 (−0.1:0.3)	−14 (−24:−4)
alertingN × Session	−0.1 (−0.3:0.2)	−3 (−11:5)
alertingX × Session	0.1 (−0.2:0.4)	5 (−3:13)
orientingN × Session	0.0 (−0.2:0.2)	3 (−5:10)
orientingX × Session	0.0 (−0.3:0.3)	−10 (−18:−1)
Flankers × Session	0.1 (−0.1:0.4)	1 (−7:9)
sStroop × Session	−0.2 (−0.4:0)	−2 (−7:4)

N, endogenous task; X, exogenous task.

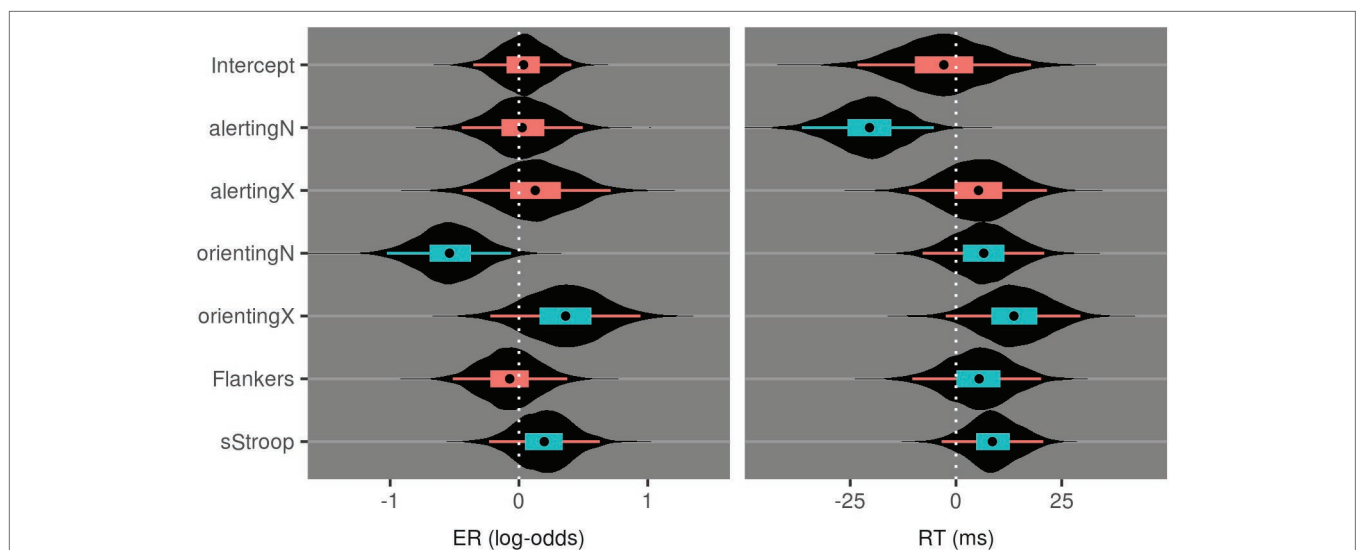


FIGURE 6 | Violin plots of posterior distributions for the effect of the Session-by-Group interaction on attention measures of the CAST. Inner boxplots convey the 95% CrI, 50% CrI, and median value.

TABLE 5 | Median and 95%CrI values from posterior distributions for the effect of the Session-by-Group interaction on phenomena of attention measured by the CAST.

Effect	ER (log-odds)	RT (ms)
Intercept × Session × Group	0.0 (−0.3:0.4)	−3 (−23:18)
alertingN × Session × Group	0.0 (−0.4:0.5)	−20 (−36:−5)
alertingX × Session × Group	0.1 (−0.5:0.7)	5 (−10:21)
orientingN × Session × Group	−0.5 (−1.0:−0.1)	7 (−8:22)
orientingX × Session × Group	0.4 (−0.2:0.9)	14 (−2:30)
Flankers × Session × Group	−0.1 (−0.5:0.4)	5 (−9:20)
sStroop × Session × Group	0.2 (−0.2:0.6)	9 (−3:21)

N, endogenous task; *X*, exogenous task.

conditions and dehydration are additional factors to consider. The design of the current study allocated children to small groups, primarily for practical reasons such as cost associated with space rental and scheduling. In similar studies evaluating nature's restorative potential, participants were exposed and evaluated independently (Berto, 2005; Berman et al., 2008). The presence of unfamiliar children may limit the restorative potential of time spent walking in nature, possibly through stress or the direction of attention to navigating social position and interaction. Potential for the creation of discomfort through socialization stressors in the context of nature may limit the restorative potential of nature contact. We recommend future research designs that include independent nature-based experiences,

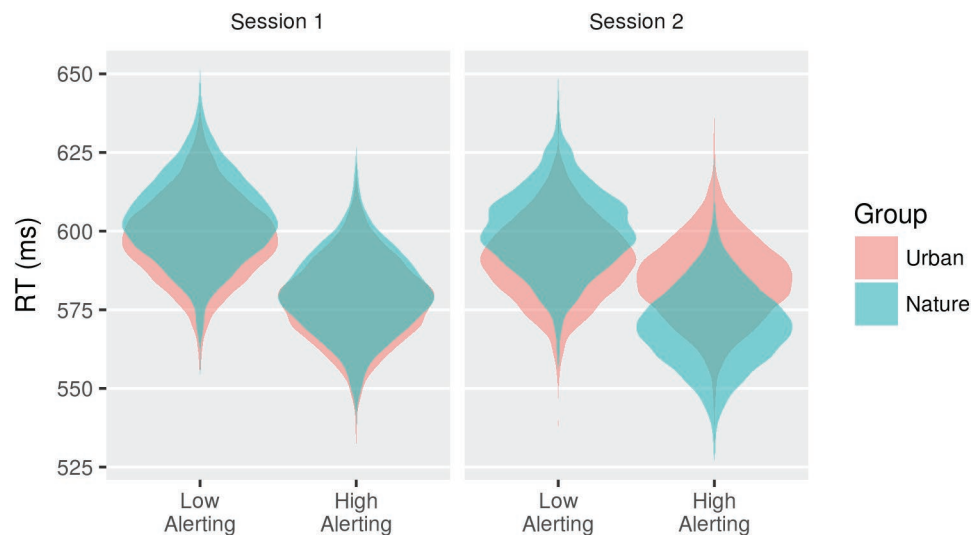


FIGURE 7 | Violin plots of the posterior distributions for the conditions associated with the interaction between Session, Group, and the AlertingN effect on RT.



FIGURE 8 | Violin plots of the posterior distributions for the conditions associated with the interaction between Session, Group, and the OrientingN effect on ER.

possibly with a member of the research team as a guide. Group-based exposure designs should include a component to evaluate relative comfort associated with participation in the group, in addition to feelings associated with immersion in natural environments, as well as the inclusion of participants with existing relationships such as with friends or family. In addition to social influences, research has shown that children can be at risk of mild voluntary dehydration, where changes in hydration status have been linked to cognitive performance (Fadda et al., 2012). Although we did not monitor water consumption, participants' water intake during the study was not different from their usual drinking habits (one glass of water or less). Since participants did not change their nutritional and physical activity habits prior to or during the study, it is unlikely that the amount of water consumed, if any, significantly affected levels of hydration.

Although there is some evidence to support that attention changes following exposure to nature, it is possible that attention is not the ideal outcome measure for studies of nature exposure in children. The ways in which children (particularly children of different ages) and adults experience, interact, and behave in nature are likely quite different. The utility of nature in early childhood (3–6 years of age) is to satisfy a child's own personal material or physical needs, and to provide an environment in which to achieve feelings of control, security, or comfort. Children in early childhood may display affection, indifference, or even anxiety when in contact with natural environments or other species. As children age (from 6–12 years of age), they develop an increased curiosity and capacity for assimilating knowledge and understanding of natural environment. This period of middle childhood integrates the natural world as a place for exploration and discovery and the establishment of self-identity (as different from parents and siblings). Natural environments become a medium that children use to construct their own secret places (e.g., forts, hiding places), where play occurs and stories are created and re-enacted. Nature at this stage may be restorative in the sense of affirming capacity (e.g., self-efficacy) and in the creation of long-term memories or attachments to natural environments and materials.

In adolescence, the concept of nature becomes more abstract, particularly as children learn about ecological function, values, and stewardship. However, nature also becomes a context within which to engage in daring and challenging activities that test and nurture self-confidence and identity. For example, adolescent participants of outdoor camps and leadership schools report that wilderness experiences improve capacity to function in urban settings, and result in greater appreciation for natural environments (Kellert and Derr, 1998). Compared to urban environments, natural environments are inherently unstable, unpredictable, and challenging and require continued alertness and attention. Children's play in and exploration of nature may tax their endogenous attention and increase arousal, all the while increasing other abilities such as creativity and sensory processing. Over repeated exposures, the time children spend in nature would be expected to lead to comfort in and connections with nature that yield the positive benefits consistent with ART. In addition to being more sensitive to the relationship between children's age and the kinds of experiences they may have in nature, it

would seem prudent to explore and measure children's affective responses, behaviors, and connectedness with nature following their time spent in natural environments, as well as longer term outcomes such as learning, creativity, and academic performance.

CONCLUSION

This study investigated whether exposure to nature resulted in improvements to endogenous attention. Using a quasi-experimental design with random assignment, the performance of typically developing children and adolescents on a state-of-the-art attention task was evaluated before and after exposure to a nature or urban condition. We found differences between the exposure groups on two endogenous attentional measures due to both improved performance in the nature group and worse performance in the urban group following exposure. We argue that the unexpected detrimental effects on endogenous attention in the urban group are consistent with ART in that urban exposure fatigues attention. Several explanations are provided as to why the effects in the nature group were less striking than we anticipated, including: immersion time in exposure environments, intergenerational effects, familiarity with nature, the influence of social interaction during exposure, and the sensitivity of attention in children to environmental influences. Exposure to nature in childhood is important for so many reasons other than influences on attention. The results of this work should not only be used to support efforts to increase time children spend in nature, but to also consider ways to buffer the potential negative effects of urban exposure. This is particularly important given the trend toward urbanization. Further research is necessary to address some of the limitations described here, and to understand the effects of exposure to natural settings on children's development in a variety of important domains.

DATA AVAILABILITY STATEMENT

Data, analysis code (STAN) and summary tables of response times by task are available online *via* the Open Science Framework (OSF) website: <https://osf.io/52aqt/>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Social Sciences and Humanities Research Ethics Board, Dalhousie University (2012–2698). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

SJ and DR conceived of the research and the study design, and planned for the acquisition, analysis and interpretation of the data. SS participated in data collection, preliminary

analysis, and early drafts of the manuscript. ML made substantial contributions to the analysis and interpretation of the data and revisions of the manuscript. All authors made substantive contributions to the development and revisions of the manuscript. SJ and DR are accountable for all aspects of the work and are responsible for ensuring accuracy and integrity of the work.

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REFERENCES

- Berman, M. G., Jonides, J., and Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychol. Sci.* 19, 1207–1212. doi: 10.1111/j.1467-9280.2008.02225.x
- Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., et al. (2012). Interacting with nature improves cognition and affect for individuals with depression. *J. Affect. Disord.* 140, 300–305. doi: 10.1016/j.jad.2012.03.012
- Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *J. Environ. Psychol.* 25, 249–259. doi: 10.1016/j.jenvp.2005.07.001
- Bratman, G. N., Hamilton, J. P., and Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health: nature experience, cognitive function, and mental health. *Ann. N. Y. Acad. Sci.* 1249, 118–136. doi: 10.1111/j.1749-6632.2011.06400.x
- Chang, C.-Y., Hammitt, W. E., Chen, P.-K., Machnik, L., and Su, W.-C. (2008). Psychophysiological responses and restorative values of natural environments in Taiwan. *Landsc. Urban Plan.* 85, 79–84. doi: 10.1016/j.landurbplan.2007.09.010
- De Boeck, P., and Jeon, M. (2019). An overview of models for response times and processes in cognitive tests. *Front. Psychol.* 10:102. doi: 10.3389/fpsyg.2019.00102
- Fadda, R., Rapinett, G., Grathwohl, D., Parisi, M., Fanari, R., Calò, C. M., et al. (2012). Effects of drinking supplementary water at school on cognitive performance in children. *Appetite* 59, 730–737. doi: 10.1016/j.appet.2012.07.005
- Gladwell, V. F., Brown, D. K., Barton, J. L., Tarvainen, M. P., Kuoppa, P., Pretty, J., et al. (2012). The effects of views of nature on autonomic control. *Eur. J. Appl. Physiol.* 112, 3379–3386. doi: 10.1007/s00421-012-2318-8
- Han, K.-T. (2009). Influence of limitedly visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environ. Behav.* 41, 658–692. doi: 10.1177/0013916508314476
- Hartig, T., Mang, M., and Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environ. Behav.* 23, 3–26. doi: 10.1177/0013916591231001
- Hartig, T., and Staats, H. (2006). The need for psychological restoration as a determinant of environmental preferences. *J. Environ. Psychol.* 26, 215–226. doi: 10.1016/j.jenvp.2006.07.007
- Herzog, T. R., Black, A. M., Fountaine, K. A., and Knotts, D. J. (1997). Reflection and attentional recovery as distinctive benefits of restorative environments. *J. Environ. Psychol.* 17, 165–170. doi: 10.1006/jenvp.1997.0051
- Herzog, T. R., Colleen Maguire, P., and Nebel, M. B. (2003). Assessing the restorative components of environments. *J. Environ. Psychol.* 23, 159–170. doi: 10.1016/S0272-4944(02)00113-5
- James, W. (1892). *Psychology briefer course*. New York: Henry Holt and Company.
- Kaplan, S. (1983). A model of person-environment compatibility. *Environ. Behav.* 15, 311–332. doi: 10.1177/0013916583153003
- Kaplan, S. (1995). The restorative benefits of nature: toward an integrative framework. *J. Environ. Psychol.* 15, 169–182. doi: 10.1016/0272-4944(95)90001-2
- Kaplan, S., and Berman, M. G. (2010). Directed attention as a common resource for executive functioning and self-regulation. *Perspect. Psychol. Sci.* 5, 43–57. doi: 10.1177/1745691609356784
- Kaplan, R., and Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge, New York: CUP Archive.
- Kellert, S., and Derr, V. (1998). *A national study of outdoor wilderness experience*. New Haven: Yale University School of Forestry and Environmental Studies. Available at: <http://files.eric.ed.gov/fulltext/ED444784.pdf>
- Klein, R., and Lawrence, M. (2012). “On the modes and domains of attention” in *Cognitive neuroscience of attention*. ed. M. I. Posner (New York: Guildford Press), 11–28.
- Kuo, F. E., and Faber Taylor, A. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: evidence from a national study. *Am. J. Public Health* 94, 1580–1586. doi: 10.2105/AJPH.94.9.1580
- Laumann, K., Gärling, T., and Stormark, K. M. (2003). Selective attention and heart rate responses to natural and urban environments. *J. Environ. Psychol.* 23, 125–134. doi: 10.1016/S0272-4944(02)00110-X
- Lawrence, M. A. (2018). Developing and validating a combined attention systems test. Available at: <https://dalspace.library.dal.ca/bitstream/handle/10222/74191/Lawrence-Michael-PhD-PSYO-August-2018.pdf?sequence=3&isAllowed=y> (Accessed March 13, 2019).
- Lawrence, M., Johnson, S., and Klein, R. (2011). The combined systems attention test: Simultaneous measurement of endogenous control of orienting, timing, and filtering. Seattle, WA: Psychonomics Society 52nd Annual Meeting, 125.
- Leyden, K. M. (2003). Social capital and the built environment: the importance of walkable neighborhoods. *Am. J. Public Health* 93, 1546–1551. doi: 10.2105/AJPH.93.9.1546
- Li, Q., Otsuka, T., Kobayashi, M., Wakayama, Y., Inagaki, H., Katsumata, M., et al. (2011). Acute effects of walking in forest environments on cardiovascular and metabolic parameters. *Eur. J. Appl. Physiol.* 111, 2845–2853. doi: 10.1007/s00421-011-1918-z
- Loeys, T., Rosseel, Y., and Baten, K. (2011). A joint modeling approach for reaction time and accuracy in psycholinguistic experiments. *Psychometrika* 76, 487–503. doi: 10.1007/s11336-011-9211-y
- Lohr, V. I., and Pearson-Mims, C. H. (2000). Physical discomfort may be reduced in the presence of interior plants. *HortTechnology* 10, 53–58. doi: 10.21273/HORTTECH.10.1.53
- Louv, R. (2005). *Last child in the woods: Saving our children from nature deficit disorder*. New York: Workman Publishing Company.
- MacLeod, J. W., Lawrence, M. A., McConnell, M. M., Eskes, G. A., Klein, R. M., and Shore, D. I. (2010). Appraising the ANT: psychometric and theoretical considerations of the attention network test. *Neuropsychology* 24, 637–651. doi: 10.1037/a0019803
- Maller, C., and Townsend, M. (2006). Children's mental health and wellbeing and hands-on contact with nature. *Int. J. Learn.* 12, 359–372.
- Manly, T., Robertson, I. H., Galloway, M., and Hawkins, K. (1999). The absent mind: further investigations of sustained attention to response. *Neuropsychologia* 37, 661–670. doi: 10.1016/S0028-3932(98)00127-4
- Matsuoka, R. H. (2010). Student performance and high school landscapes: examining the links. *Landsc. Urban Plan.* 97, 273–282. doi: 10.1016/j.landurbplan.2010.06.011

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SUPPLEMENTARY MATERIAL

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- Mayer, F. S., and Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *J. Environ. Psychol.* 24, 503–515. doi: 10.1016/j.jenvp.2004.10.001
- Molenaar, D., Tuerlinckx, F., and van der Maas, H. L. J. (2015). A bivariate generalized linear item response theory modeling framework to the analysis of responses and response times. *Multivar. Behav. Res.* 50, 56–74. doi: 10.1080/00273171.2014.962684
- Ogunseitan, O. A. (2005). Topophilia and the quality of life. *Environ. Health Perspect.* 113, 143–148. doi: 10.1289/ehp.7467
- Olmsted, F. (1968). "The value and care of parks" in *The American environment: Readings in the history of conservation*. ed. R. Nash (MA: Addison-Wesley), 18–24.
- Pretty, P. J., Peacock, J., Sellens, M., and Griffin, M. (2005). The mental and physical health outcomes of green exercise. *Int. J. Environ. Health Res.* 15, 319–337. doi: 10.1080/09603120500155963
- R Core Team (2017). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Available at: <https://www.R-project.org>
- Rainham, D., and Lawrence, M. (2019). Nature contact and children's attention study data and R files. Open Science Framework (OSF).
- Staats, H., and Hartig, T. (2004). Alone or with a friend: a social context for psychological restoration and environmental preferences. *J. Environ. Psychol.* 24, 199–211. doi: 10.1016/j.jenvp.2003.12.005
- Stan Development Team (2017). RStan: The R interface to Stan. Available at: <http://mc-stan.org>
- Taylor, A., Kuo, F., and Sullivan, W. (2002). Views of nature and self-discipline: evidence from inner city children. *J. Environ. Psychol.* 22, 49–63. doi: 10.1006/jevp.2001.0241
- Tennessen, C. M., and Cimprich, B. (1995). Views to nature: effects on attention. *J. Environ. Psychol.* 15, 77–85. doi: 10.1016/0272-4944(95)90016-0
- The David Suzuki Foundation (2012). *Youth engagement with nature and outdoors; a summary of survey findings*. Vancouver: The David Suzuki Foundation. Available at: <http://www.davidsuzuki.org/publications/reports/> [Accessed July 13, 2016].
- Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., and Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *J. Environ. Psychol.* 11, 201–230. doi: 10.1016/S0272-4944(05)80184-7
- United Nations (2014). *World urbanization prospects: The 2014 revision, highlights*. New York: Department of Economic and Social Affairs, Population Division.
- Van Breukelen, G. J. P. (2005). Psychometric modeling of response speed and accuracy with mixed and conditional regression. *Psychometrika* 70, 359–376. doi: 10.1007/s11336-003-1078-0
- van der Linden, W. J. (2007). A hierarchical framework for modeling speed and accuracy on test items. *Psychometrika* 72:287. doi: 10.1007/s11336-006-1478-z
- Wechsler, D. (1999). *Wechsler abbreviated scale of intelligence*. New York, NY: The Psychological Corporation: Harcourt Brace & Company.
- Wells, N. M. (2000). At home with nature: effects of "greenness" on children's cognitive functioning. *Environ. Behav.* 32, 775–795. doi: 10.1177/00139160021972793
- Wells, N. M., and Evans, G. W. (2003). Nearby nature: a buffer of life stress among rural children. *Environ. Behav.* 35, 311–330. doi: 10.1177/0013916503035003001

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Green Schoolyards as Outdoor Learning Environments: Barriers and Solutions as Experienced by Primary School Teachers

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With a growing number of primary schools around the globe greening their schoolyards, opportunities arise to realize outdoor learning in natural areas on the school's premises. Despite their promising potential, green schoolyards as outdoor learning environments remain mostly unintegrated in teachers' educational practices. In the current study, teachers of five primary schools in Netherlands were followed for two consecutive years during a participatory action research project. Based on their experiences in this project, teachers identified barriers when integrating the green schoolyard as a learning environment and found practice-based solutions to overcome these barriers. Across schools, a total of 20 meetings were organized, with 75 teachers participating in the project. Results revealed four broad themes encompassing barriers and solutions. Teachers feel hindered by outdoor learning having no formal status in their current educational practice, experience barriers related to a lack of confidence in their own outdoor teaching expertise, find it difficult to get started, and experience barriers related to physical constraints. Teachers, professionals, and researchers together found solutions to overcome each specific barrier. These solutions can be translated to general recommendations: just do it, get educated and inspired, engage in real-life experiences, get an outdoor pedagogical mindset, and follow a tailored process. The findings can be used by primary schools and other institutions to develop interventions that support teachers to further integrate the green schoolyard as a learning environment.

Keywords: collaborative action research, experiential learning, outdoor learning, reflective experiences, schoolyard greening, teacher training

INTRODUCTION

Outdoor learning in natural areas can be an enrichment for children, enabling them to learn beyond the borders of their classroom, and has the potential to directly and indirectly strengthen primary schools' educational practice (Rickinson et al., 2004; Blair, 2009; Wistoft, 2013; Goodall, 2016). Most literature regarding outdoor learning is concerned with activities in natural areas

outside the school's premises such as field trips, outdoor adventure activities, forest schools, school gardens, and nature education programs. Despite the promising potential of such extracurricular outdoor learning activities, teachers often feel hindered to facilitate and improve children's access to these types of outdoor learning by factors related to transportation, curriculum requirements, and shortages of time and resources (Rickinson et al., 2004; Edwards-Jones et al., 2018). With a growing number of primary schools re-designing their schoolyards into green schoolyards with natural features such as grass, hills, trees, flowers, bushes, sand, and water, opportunities arise to realize more easy-to-accomplish outdoor learning activities in natural areas on the school's own premises (Danks, 2010; Van Dijk-Wesselius et al., 2018). However, green schoolyards as learning environments remain mostly unintegrated in teachers' educational practices. Amongst other reasons, this may be due to teachers' unfamiliarity with outdoor learning and lack of hands-on experiences (Dyment, 2005; Maynard and Waters, 2007). As part of a two-year collaborative action research project, the current project examined the barriers teachers experience when they actually attempt to realize outdoor learning in the schoolyard, and what solutions they find to be supportive in overcoming these barriers.

The Green Schoolyard as an Outdoor Learning Environment

Green schoolyards and other natural areas such as forests, parks, woodlands, and gardens afford a meaningful context for childhood education, as they provide children with numerous opportunities for both informal and formal learning experiences (Dyment, 2005; Auer, 2008; Ballantyne and Packer, 2009; Sahrakhiz et al., 2018). While playing in a green schoolyard, children are invited to handle, touch, smell, explore, and modify natural features with their entire body. These informal, child-initiated, embodied learning experiences can make important contributions to children's emotional, cognitive, social, and physical development (Dyment and Bell, 2007; Kelz et al., 2013; Chawla and Nasar, 2015; Van Dijk-Wesselius et al., 2018).

Green schoolyards can also be used as an "outdoor classroom" for teaching regular classes in subjects such as reading, writing, mathematics, sciences, art, drama, and environmental education (Rickinson et al., 2004; Dyment, 2005). In this more formal approach to outdoor learning, learning comes alive through a kinesthetic, sensory, and experiential learning style (Lieberman and Hoody, 1998). Teachers become facilitators of learning and guide children through open and flexible real-life, bodily experiences that connect to a child's abilities, needs, and interests (Harris, 2017). In outdoor learning, these hands-on experiences become the foundation for minds-on learning that extends beyond the formal curriculum (Lieberman and Hoody, 1998; Johnson, 2007).

A recurrent finding of research on the benefits of formal types of outdoor learning is that it raises enthusiasm, and increases vitality and motivation for learning (Rickinson et al., 2004; Wistoft, 2013; Waite et al., 2016). In addition, outdoor learning can reduce behavioral and concentration problems, particularly

among children with difficult or mixed temperaments and children that are uninspired in the traditional classroom (Dyment, 2005; Blair, 2009; Fiskum and Jacobsen, 2012; Kuo et al., 2018; Largo-Wight et al., 2018). Other demonstrated advantages of outdoor learning include improved academic achievement, observational capability, and reasoning skills (Lieberman and Hoody, 1998; Ozer, 2007; Bell and Dyment, 2008; Blair, 2009; Becker et al., 2017; Browning and Rigolon, 2019), enhanced self-esteem, independence and feelings of responsibility (Rickinson et al., 2004; Ozer, 2007), improved interpersonal skills, cooperation and social cohesion (Ozer, 2007; Hartmeyer and Mygind, 2016; Waite et al., 2016), and multi-disciplinary learning across subjects (Harris, 2017).

Barriers to Realizing Outdoor Learning in the Green Schoolyard

Despite the potential of green schoolyards as outdoor learning environments, outdoor learning tends to remain largely unrealized in educational practices (Skamp and Bergmann, 2001; Dyment, 2005; Maynard and Waters, 2007; Feille and Nettles, 2017). Surveys among staff and parents of pupils at primary schools in Canada (Dyment, 2005) and the United States (Feille and Nettles, 2017) show that only a small percentage of the teachers use green schoolyards as a learning environment. It is mostly used for physical education and science; most other subjects are rarely or never considered for teaching in the green schoolyard. Teachers express feeling hindered by a low confidence in their outdoor teaching expertise due to a lack of experience and knowledge. They report that curriculum requirements do not endorse or support outdoor learning and require the majority of teaching activities to be placed indoors. In addition, teachers indicate that broader issues within the educational practice and beyond, such as work pressure, overload in responsibilities, and a tiredness of educational changes hinders them from realizing outdoor learning in the green schoolyard.

More information on the barriers teachers experience when actually attempting to engage in outdoor education is provided by interviews amongst teachers from a primary school regarding their use of so called "learnsapes," a concept related to green schoolyards that includes natural and built features designed to be used for outdoor learning activities (Skamp and Bergmann, 2001). Teachers, for instance, found management of children difficult, were uncertain on how to use and incorporate learnsapes, found planning of outdoor learning more complex, and struggled with outdoor learning not being a "real" thing. Furthermore, some teachers were timid about leaving the security of their classroom and the authors suggest that leaving the classroom requires a different "mindset."

Several studies further reflect on outdoor teaching requiring a different mindset, and find that teachers feel hindered by an instrumental, indoor view on learning, and teaching (Dyment and Reid, 2005; Maynard and Waters, 2007; Waite, 2011; Passy, 2014). According to these authors, outdoor learning is considered to be more free and unstructured compared to indoor classroom learning, and is characterized by experiential and child-directed learning. Teachers can feel bound by an

instrumental view on teaching in which they wish to stay in control and to be able to see all children at all times, and for instance, stick to predominantly teacher-directed lessons. It can be difficult for teachers to overcome this conflict within the realities of their ruling educational system. In this light, several studies stress the importance of a fundamental shift to recognize outdoor learning as a legitimate form of learning and an important part of core competencies of teachers (Dyment, 2005; Davies and Hamilton, 2018).

Altogether, findings from previous studies suggest that most teachers are familiar with an indoor pedagogical approach, and realizing outdoor learning in the green schoolyard requires them to discover the pedagogical opportunities of a new learning environment and overcome barriers related to their own didactical competence and demands of the curriculum. However, it remains unknown how teachers can overcome these barriers in their everyday educational practice.

The Current Research

The current research was part of a larger collaborative action research project at five primary schools in The Netherlands. The project, called “becoming an outdoor teacher,” aimed to familiarize primary school teachers with using the green schoolyard as a learning environment and strengthen their didactical competence to realize and integrate outdoor learning in the curriculum. During the project, teachers gained hands-on experience of the barriers they face when trying to integrate the green schoolyard as a learning environment in their educational practice, and were stimulated to seek solutions to overcome these barriers and realize opportunities for outdoor learning at the green schoolyard. The current research aimed to gain more insight into these barriers and solutions, as experienced by teachers while experimenting with outdoor learning in the green schoolyard.

MATERIALS AND METHODS

Context: Collaborative Action Research

The findings presented in this paper were collected in the context of a collaborative action research project. By maintaining the gestalt, the background and context of teachers’ daily practice, this type of project provides useful knowledge that has practical use (Khanlou and Peter, 2005). Collaborative action research is based on the assumption that new skills and knowledge in practices can be acquired when teachers systematically explore their own practice. In the collaborative approach used in the present study, researchers, and professionals support teachers in their systematic reflections and explorations. Through these collaborations, a community of practice emerges in which practice-based and practice-informed knowledge is developed together by teachers, professionals, and researchers. In this approach, the finding of solutions to overcome barriers is placed within the context of teachers’ hands-on experiences. This leads to the identification of solutions that are of direct relevance for teachers’ practices and can also be accumulated and transferred to

other teachers, practices, and the development of theories (Ponte et al., 2004; Ponte, 2005).

The collaborative action research was operationalized through so-called “green schoolyard meetings.” Several of these meetings were held during two consecutive years at each participating school. The cyclic process of collaborative action research is represented by a spiral of steps in each meeting. The meetings started with an evaluation phase. In this part, teachers reflected on the barriers and solutions they encounter in their experiences with outdoor teaching using an evaluation form and group discussion. This was followed by a phase that we labeled “inspiration moment,” consisting of exercises and other activities aimed to educate teachers. These inspiration moments were tailored to teachers’ specific needs. Finally, the last part of each meeting was the planning phase, in which teachers evaluated the inspiration moments and formulated a plan of action using an action planning form and group discussion. In the following meeting, the teachers reflected on the barriers and solutions they experienced while attempting to realize their planned actions, followed by an inspiration moment, and finally developing a new action plan. This ongoing cycle of evaluation, inspiration, and action is illustrated in the left part of **Figure 1**.

Throughout the project each individual teacher is in charge of their own goals, action planning, realization, and evaluation. Teachers directly benefit from their involvement in the project by professionalizing themselves as outdoor teachers. The role of the researchers was to facilitate the green schoolyard meetings and to support teachers in systematically evaluating barriers and solutions to realize their goals. The professionals had experience with outdoor learning in educational settings. Their role was to design and facilitate inspiration moments in collaboration with the researchers.

Schools and Schoolyards

Six primary schools in western parts of The Netherlands participated in the project. A main selection criterion for inclusion of schools was that they should all have a green schoolyard upon entering the project and were located in urbanized areas with limited green play opportunities for children. Another criterion was that the green schoolyard should not yet be an evident part of teachers’ educational practice at the start of the project. School boards of schools that were potentially eligible for inclusion were approached directly by the research team. In a meeting with each potential school we discussed the onset of the project, required investment in time, and commitment of the school to start using the green schoolyard as a learning environment. Ultimately, six primary schools entered the project in two cohorts. Schools that declined to participate mainly declined due to a lack of time.

Three schools started in the first cohort that ran from September 2014 till July 2016, and three schools started in the second cohort that ran from September 2015 till July 2017 (see **Table 1**). In the first cohort, one school quit the project after 1 month, for private reasons unrelated to the project. This school is not included in the present analysis, resulting in a final sample of five schools. Data from the remaining two schools in the first year of the first cohort were excluded from the present analyses,

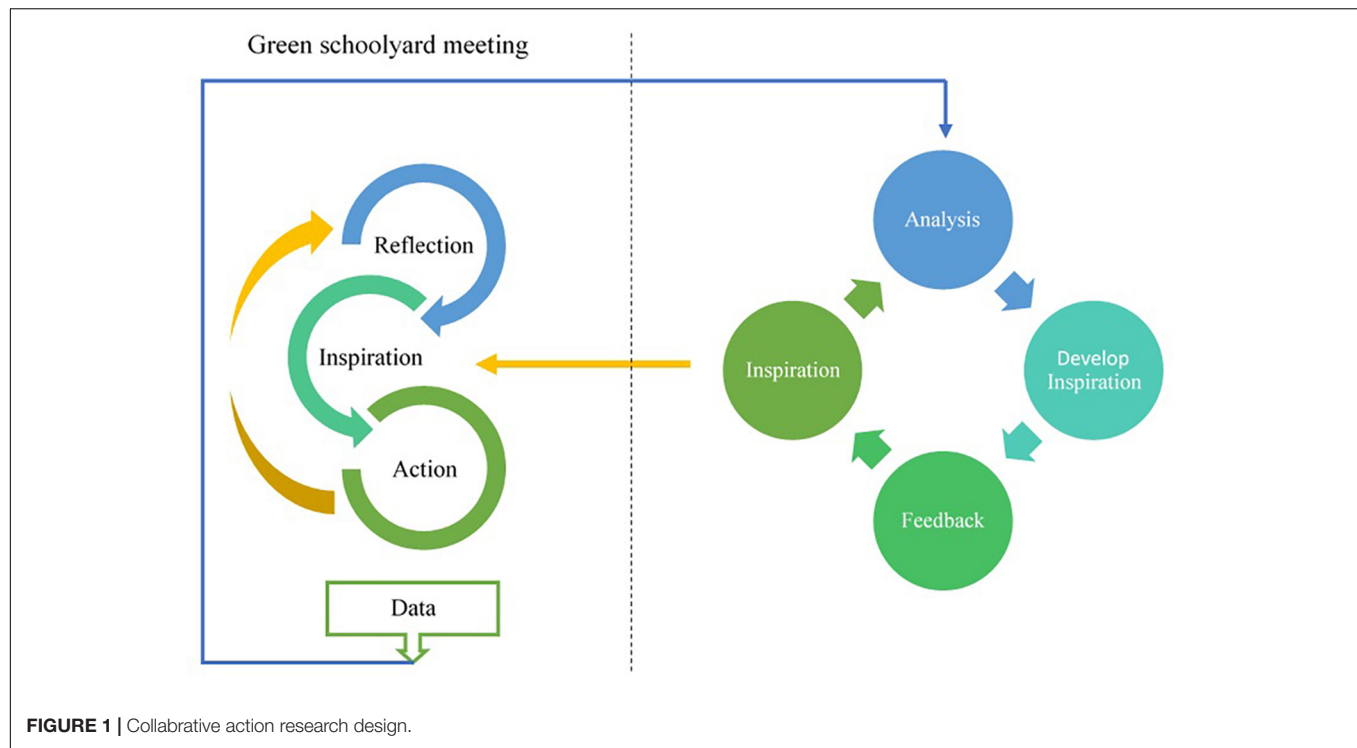


TABLE 1 | Total number of meetings and total number of teachers participating across meetings separate for each school and representation in the total sample in percentages.

	Total number of meetings	Total number of participants across meetings	Total number of different teachers across meetings
Cohort 1			
School 1*	2	19 (10.4%)	14 (18.7%)
School 2*	3	18 (9.9%)	15 (20.0%)
Cohort 2			
School 3	3	22 (12.1%)	9 (12.0%)
School 4	8	65 (35.7%)	16 (21.3%)
School 5	6	58 (31.9%)	21 (28.0%)
Total	20	182 (100%)	75 (100%)

*From the schools in cohort 1 only data of the meetings in the second year are included, data from the first year (five meetings) served as pilot data.

as they served to pilot test the materials. The two schools that remained in the first cohort included a school in an extremely urbanized area (>2500 addresses per square kilometer) and a school in a strongly urbanized area (1500–2500 addresses per square kilometer). Both schoolyards were greened for several years. The second cohort also included a school in an extremely urbanized area, as well as a school in a moderately urbanized area (1000–1500 addresses per square kilometer). In addition, the second cohort included a school for children with special education needs in a moderately urbanized area. The school in the extremely urbanized area had already had a green schoolyard for several years. The schoolyard in the moderately urbanized area had been greened for 1 year when the school entered the

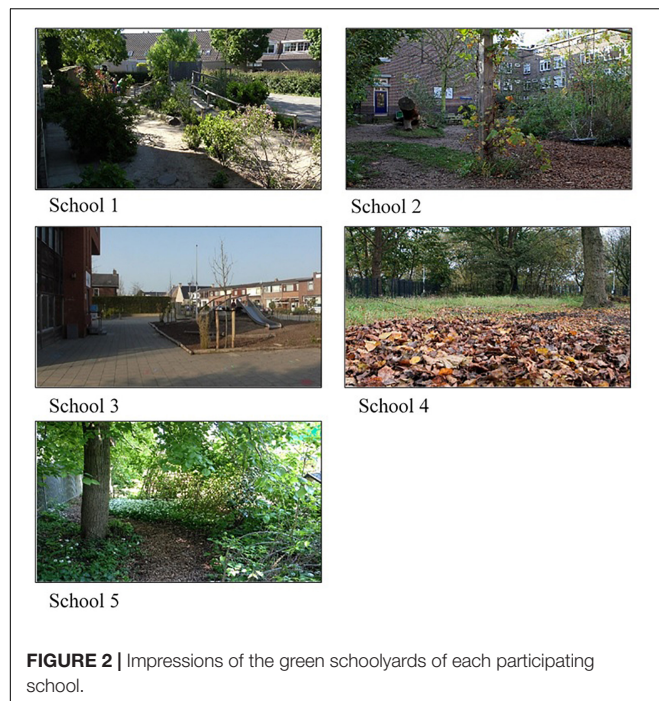
project. The school for children with special needs had a green area in the schoolyard that was destined to be further designed as a green schoolyard during the project. All schoolyards of the participating schools still had some paved parts with play equipment made of non-natural materials and green areas. The green areas in the schoolyards covered mostly features as grassy hills, bushes, trees, tunnels made of tree branches, loose tree branches, water parts, garden-like parts, and vegetable gardens. **Figure 2** gives an impression of the green schoolyards.

Meetings and Participants

At least six meetings were organized at each school across two consecutive years. Each meeting lasted for one and a half hours and was always held in the afternoon, after children were out of school. Due to issues non-related to the project school 3 in cohort 2 had to quit the project in February 2017, so at this school only three meetings were organized. Across the five schools, a total of 75 teachers (93.3% female) participated in a total of 20 meetings. The number of participants per meeting varied per school and per meeting, with a minimum of five in school 2 and a maximum of 13 in school 5 (see **Table 1**). More than two-thirds (69.7%) of the teachers participated in at least two meetings. At each school, teachers representing all grades, from children from the age of 4 till 11, participated. Answers of teachers were anonymized to ensure their privacy.

Materials

During each meeting, teachers filled in two types of forms that asked them to reflect on their experiences with outdoor teaching (evaluation form) and the things that inspired them during the



meeting (action planning form). Altogether, teachers filled in 182 evaluation forms and 182 action planning forms.

Evaluation Form

During the evaluation phase, to get insight into the barriers and solutions teachers experienced in their actions, teachers answered four open-ended questions on the evaluation form: (1) What defines your current experience with outdoor teaching?, (2) What did you enjoy?, (3) What barrier(s) did you experience?, (4) What supported you to overcome these barriers? These questions are based on previous studies using action research as a method to stimulate systematic reflection. This is a process that can allow teachers to increase awareness of their own experiences and stimulate a deeper form of learning beyond first impressions (Ponte, 2005). At the end of each meeting, each reflection form was photographed, so every teacher was able to keep their own reflection form.

Action Planning Form

During the action planning phase teachers filled in three open-ended questions on the action planning form: (1) What inspired you during this meeting?, (2) What implication does this have for your own educational practice?, (3) How are you going to realize this? The current paper only discusses answers to question 1.

Procedure

During the project for each school one researcher was responsible for all communication and organization of the meetings. All researchers were trained by the leading researchers prior to the start of the project to ensure an adequate understanding of the design of the project and the use of the evaluation and planning form. Regular meetings between researchers were organized to

discuss their experiences to increase the reliability and validity of findings. For instance, prior to the first meeting at a school, the researcher visited the school to get acquainted with it and to discuss the planning of meetings. The outcomes of these pre-focus meetings were discussed with all the researchers to ensure similarity in the onset of the projects on each school and minimize differences in data collection. Furthermore, after each meeting at each school researchers discussed their experiences and the analysis of barriers and solutions to increase triangulation of data analysis and the design of inspiration moments. After selecting salient barriers, the researcher together with the professional designed an inspiration moment. The proposed inspiration moment was discussed with the principal of each school to ensure that it focused on the most prominent barrier, and, if needed, the inspiration moment was further adapted to their needs. This process is illustrated in the left part of **Figure 1**.

The materials and procedure were pilot-tested with participants of the first cohort in the first year, and then adapted to better match the project's intentions and reality of the primary schools' daily practice. An important change concerned the implementation of inspiration moments in response to the observed need for education, in relation to the observation that teachers found it difficult to engage in actions due to a lack of familiarity with outdoor learning and ideas on how to get started.

Data Analysis

Data were analyzed using qualitative content analysis (Mayring, 2000). Answers on each open question in the evaluation form and the first question in the action planning form were coded, categorized, and clustered into themes and subthemes by the researchers responsible for a school and the primary investigator. Themes and subthemes encompassed barriers and supportive aspects that teachers experience when facilitating outdoor learning. Analysis started with open, explorative coding of the original data based on similarities and relationships in the data. Answers to each separate question were read and primary codes were addressed in a few words. These codes were then compared in search for umbrella categories and clusters. Using inductive and deductive cycles, data was systematically assigned to these emerging codes, categories, and clusters. First, this procedure was followed for each question individually. Second, the categories and clusters were aggregated across questions. Subsequent data analysis by the primary investigator followed three phases, in which emerging themes and subthemes relating to barriers and solutions were increasingly aggregated from the individual team meetings to school- and supra-school level. After aggregating the inputs from individual researchers responsible for organizing meetings, the final analyses were completed by discussing the themes and subthemes with all researchers.

To increase consistency and saturation of the analyzed categories and clusters in themes and subthemes, a triangulation process was implemented in a few steps. First, separate for each school, after each meeting the responsible researchers transferred the analysis back to the school to ensure validity of the findings. Second, after analyzing the data from each meeting, researchers discussed ongoing analysis to compare categories and clusters between schools. Third, after completing the data collection and

the subsequent meta-analysis across schools, the analysis was transferred back to all researchers and discussed in relation to the accurateness of aggregated themes and subthemes.

RESULTS

As illustrated in **Table 2**, barriers and solutions for using green schoolyards as outdoor learning environments can be summarized in four broad themes and subthemes. The most mentioned barriers relate to outdoor learning having no formal status in teachers' educational practice (46.3%), followed by a lack of teachers' confidence in their own outdoor teaching expertise (32.2%), physical constraints related to a lack of maintenance and weather conditions (13.0%), and finding it difficult to get started (8.5%). During the project, teachers, researchers, and professionals together found solutions to overcome each of these barriers. However, they found it relatively easy to find solutions to overcome a lack of formalization (64.8%) and to make it easier to get started (18.6%), while they found it relatively difficult to find solutions for strengthening teachers' confidence (12.0%).

In the following sections, the barriers and solutions for each of the four themes will be discussed in further detail. Teamwork is found to be supportive across themes, and several aspects of teamwork will be discussed in relation to specific barriers and solutions.

Theme 1: The Lack of a Formal Status of Outdoor Learning in Teachers' Educational Practice

Teachers find it difficult that outdoor learning is not formalized in the current curriculum of their schools' organization. This puts a challenge on teachers to formalize outdoor learning themselves, as they often they have no clear idea on what outdoor learning is and feel hindered by the demands of their existing curriculum. Within this theme, we distinguished three subthemes: unfamiliarity with the value and opportunities of outdoor learning in natural areas and lack of inspiration, lack of time, and lack of communal structure. For each barrier solutions were identified.

Barrier: Unfamiliarity and a Lack of Inspiration

Teachers express the wish to meaningfully integrate outdoor learning within their educational practice but feel hindered by their own unfamiliarity with outdoor learning, and feel that their current didactical skills are inadequate to realize this. A teacher, for instance, expressed as a barrier: *"Both myself and the children are unfamiliar with the green schoolyard and outdoor learning. I need to learn so much myself before I can take the children outside. I have a fear of nature and no knowledge, so I am afraid that children will ask me questions that I cannot answer and I have no clue on what I am allowed and not allowed to do outside (2B1Z)."* Even if teachers already have undertaken some activities, they can still find it difficult to understand what they didactically can do with outdoor learning and how to meaningfully integrate it in their

TABLE 2 | Barriers and solutions experienced by teachers in number of times mentioned and percentages of total.

No formal status outdoor learning		Lack of confidence in outdoor teaching skills		Difficult to get started		Physical constraints	
Barriers							
Unfamiliarity and lack of inspiration	30 (16.9%)	Fear of losing control	31 (14.7%)	Difficult to get started	15 (8.5%)	Lack of design and maintenance	13 (7.3%)
Lack of time	28 (15.8%)	Managing children's behavior	26 (17.5%)			Weather conditions	10 (5.6%)
Lack of communal structure	24 (13.6%)						
Total	82 (46.3%)	Total	57 (32.2%)	Total	15 (8.5%)	Total	23 (12.9%)
Solutions							
Inspiration moments to familiarize with outdoor learning	88 (25.2%)	Teaching attitude	22 (6.3%)	Decisive mind	26 (7.5%)	Prevent child erosion	8 (2.3%)
Inspiration by observing how children react to outdoor learning	34 (9.7%)	Organization and rules	15 (4.3%)	Step by step	17 (4.9%)	Sunny weather	8 (2.3%)
Inspiration through teamwork	33 (9.5%)						
Conscious choice to devote time	25 (7.2%)	Familiarize with outdoor learning	5 (1.4%)	Pioneers	14 (4.0%)		
Develop communal framework	23 (6.6%)			Inspiration	8 (2.3%)		
Teamwork	14 (4.0%)						
Incorporate outdoor learning in the curriculum	9 (2.6%)						
Total	226 (64.8%)	Total	42 (12.0%)	Total	65 (18.7%)	Total	16 (4.6%)

educational practice. As a teacher further exemplifies: *I started with enthusiasm to integrate the green schoolyard. Now I find it difficult, because I do not know exactly what I didactically can do with it (3B2Z)* and another *“How can I integrate outdoors in my lessons? (3B2LA).”*

In response to an unfamiliarity with outdoor learning, some teachers express their need for inspiration and ideas. A teacher for instance wrote down *“I am a plant in need of nutrition (3B2Z).”* Further, after having done a first activity, some teachers feel hindered to continue with formalizing outdoor learning by not having new ideas and finding it difficult to keep generating new activities themselves. Teachers for instance literally wrote down as a barrier: *“What’s next? (5B2LA),”* and another *“To think up activities that are varied (5B5LA).”* Related to this issue, some teachers express that it is difficult to *“To stay motivated (3B1LA)”* and *“To stay enthusiastic and motivated (3B2LA).”*

Solutions to Overcoming Unfamiliarity and a Lack of Inspiration

Inspiration Moments to Familiarize With the Value and Opportunities of Outdoor Learning

Teachers state that it was helpful during green schoolyard meetings to be inspired by an experienced outdoor teacher and to experience outdoor learning activities themselves. After meetings teachers wrote down as inspiring: *“The workshops outside (5B4I)”* and *“The green schoolyard meetings, that function as an example (2B6S).”* Actively participating in outdoor learning activities, such as short activities related to mathematics or language skills, supported teachers with familiarizing themselves with the concept of outdoor learning and lowered the threshold to actually start experimenting with outdoor learning in the green schoolyard themselves. A teacher, for example, described after an inspiration moment: *“I felt my shoulders relaxing, I definitely want to start doing it myself (2B3Z)”* and another, *“The tranquility I experienced by concentrated and with attention feeling the objects with my senses (3B2I).”* Teachers valued the simplicity of outdoor learning activities, and the suggestion to start with small and easy to carry out activities. Teachers wrote down as inspiring: *“The simple things you can do outside (3B3I)”* and *“Small things you are doing can already be big. Unconsciously there are a lot of learning opportunities (1B4I).”* Furthermore, teachers particularly valued activities that were accompanied by theoretical background on the value of outdoor learning. Teachers wrote down as inspiring: *“The activities with Marcel and the information on using your senses (4B5I)”* and *“The information on how a green learning environment inspires learning and fosters children’s ability to concentrate (1B4I)”* and *“Do not let children learn one-dimensional from books, but go outside to experience, move around, to make learning meaningful (3B1L).”* In addition, teachers felt inspired by opportunities to incorporate outdoor learning with existing subjects. A teacher for instance wrote down as inspiring: *“Develop your senses through small exercises in combination with vocabulary (1B1L).”*

After the meetings, we observed teachers integrating the inspiration in their own daily practice. For instance, teachers organized outdoor learning activities that provided children with

experiences to use all their bodily senses, and guided them to further develop their observational skills. As teachers for instance reported on activities: *“A lesson on observing: Look at that tree. It’s color, it’s shape. Look again: tell me what else you see (4B6Z)”* and *“Senses, tasting, feeling, we practiced observing (4B6S).”* In addition, teachers connected exploring and observing natural features to subjects as mathematic and languages. Teachers wrote things down such as: *“Planting bulbs, measuring how deep. How does it feel? They emerge. Feel, smell, look at the earth, the clay and sand (3B2L)”* and *“Chestnuts, pine cones, shells as materials to practice mathematics (4B5Z).”*

Inspiration Through Teamwork

Teachers describe how they can inspire each other to facilitate outdoor learning in their educational practice through collaborating, sharing ideas, and experiences. Teachers, for instance, wrote down as supportive: *“Collaboration (4B7S)”* and *“Sharing ideas with a colleague (2B5S),”* and another teacher wrote down as inspirational: *“The stories and ideas from colleagues (4B4I).”* Realizing outdoor learning together can be a positive contribution to the team. A teacher, for instance, wrote down about her experiences: *“Joint responsibility for developing a focus for outdoor learning is an enrichment for the team (4B8Z).”*

Inspiration by Observing How Children React to Outdoor Learning

In all schools we observed that real-life experiences in teachers’ own daily practice are helpful for further familiarizing them with outdoor teaching. Teachers for instance described as supportive: *“Keep on experimenting (4B8S),”* and *“The day in which I tried out a few activities. Fun, surprising and informative results (5B4L).”* Across all schools and meetings, we observed how teachers are inspired in these real-life experiences by children’s reactions to outdoor learning. We observed an ongoing sense of joy and enthusiasm when teachers described their outdoor learning activities with children. For instance, the words *“Enthusiasm (4B1L)”* and that *“Children were having fun (5B4L)”* were mentioned frequently across all meetings by teachers when asked what they enjoy and what motivates them. Teachers for instance wrote down as inspiring: *“The children! By their enthusiasm (3B3I).”* In addition, teachers describe that they enjoyed observing children being wondered by natural elements, and how it opens up opportunities for learning. A teacher for instance wrote down as motivating: *“When children discovered something and are surprised about it (3B3L)”* and *“Children’s amazement about something (5B4L).”* Other teachers wrote down that they enjoyed: *“To observe how children were enjoying the mathematics assignment, without them really noticing that we were working on mathematics (4B8L)”* and *“Every child chooses for something else, I enjoy to see so many differences. It is really special to see that they choose something that really suits them (4B5L)”* and *“You are getting to know your children in a different way (5B3L).”*

Furthermore, some teachers value that outdoor learning activities can foster group dynamics, by stimulating social cohesion and collaboration amongst children. Teachers for instance wrote down that they enjoyed: *“To observe children collaborating in the schoolyard (5B5L)”* and *“A solid foundation*

for social cohesion in the group. Eating outside together: tranquility and social cohesion (5B3L)” and “Collaboration and discover each other’s strengths (and weaknesses) (4B4Z).” Teachers also observed how outdoor learning fosters environmental awareness and enjoyed teaching children how to take care of the environment, respect nature, and overcome fears of nature. Teachers for instance wrote down that they enjoyed: “Watering the plants (3B1L)” and “Children are getting more involved with nature. Searching for small insects, pretty flowers, and how do you take care of it (3B3L)” and “To observe a change within children. For instance a child that was scared at first for everything that was green and small (insects), and now behaves more comfortable and free and are more daring (4B8L).” Lastly, teachers value the tranquility and space being outdoors literally can give, for instance to allow children to move around and relax: “It meets children’s need to move around (4B7Z)” and “Children can calm down (5B1L).”

These positive experiences with outdoor learning seem to enforce a motivation in teachers to further explore outdoor learning and their own capabilities as an outdoor teacher, and make time for outdoor learning. As they experience outdoor learning to be a valuable contribution, it becomes worthy to devote time to outdoor learning at the cost of something else. As a principal, for example, said during a meeting: “It is the art of letting go. If something like this [ed. outdoor learning] comes in its place. At a certain point you have to do it (2B3Z).” A teacher further explains: “I experienced what it can bring, so it may cost time (2B4Z).” For this particular teacher, lack of time was a main reason not to teach outdoors. However, after she experienced an outdoor learning activity, she was willing to invest time and even became a pioneer in her team.

Barrier: Lack of Time

At the start of the first meeting, a few teachers simply wrote down the word “Time” as a barrier. We observed how important this was across the meetings, as teachers describe how their daily practice follows a tight and set schedule, in which outdoor learning literally has no place yet. Teachers for instance wrote down as barriers: “I have a lot of ideas, but no time to give it a place in my daily practice (5B6Z)” and “I am looking forward to start, but I haven’t had the time to make a plan (5b2Z).” Even if teachers have an idea for an outdoor learning activity, their tight schedule makes it difficult to find a moment to go outside. Teachers for instance reported as barriers: “To schedule in time (4B8L)” and “To place my outdoor activity in my daily practice (3B1LA).” The tight and set schedule of teachers is filled with a full educational program, with responsibilities and tasks that hinder teachers’ ability to invest time in outdoor learning. A teacher, for instance, wrote down as a barrier: “It is difficult to make time besides all the other obligations, like CITO, monitoring learning outcomes, children’s behavior, meetings, etc. (4B8LA).” As another teacher frames it: “There is so much to do and so little time (5B4LA).” A teacher further clarifies how in the ruling educational program finding time for outdoor learning is difficult, as it is becoming something additional, instead of an integrated and valued part of the curriculum. As she wrote down: “It is difficult that there are only things being added to our work, but you also have to account

for what you do. Barriers would be reduced if outdoor learning would be incorporated in our methods. Because: where do I find the time? Every additional thing that I do has to come from somewhere (2B2Z).” Furthermore, within their full and tight daily practice, outdoor learning gets easily lost in other priorities. As teachers illustrate “Our daily practice is too hectic at the moment, to prioritize outdoor learning (5B6LA)” and “Due to other priorities, I had insufficient time to practice with outdoor learning (5B1Z).”

Solutions to Overcoming a Lack of Time

Make a Conscious Decision to Devote Time to Establish Outdoor Learning

First, teachers mentioned it as helpful to consciously put outdoor learning activities on their schedule. Teachers for instance suggest to “Schedule it in (2B4S)” and “Include it in the planning (5B6S)” and “Put what you intend to do on your schedule and execute” (4B8S). Second, teachers suggest making time beforehand to prepare an outdoor learning activity. A teacher, for instance, wrote down: “Preparation in terms of materials, etc.” (4B7S) and another “Preparations!!! (5B2S).” Lastly, some teachers express the importance of creating a routine, and making it a habit to go outside. As teachers, for instance, wrote down: “Repetition (5B3S)” and “Regularity (5B3S).” Furthermore, pioneers in a team can support a conscious decision to devote time to integrate the green schoolyard as a learning environment, by taking responsibility for outdoor learning not getting lost in the hectic daily practice. In one school, for instance, a teacher wrote: “There are two or three pioneers who actively manage the garden and consistently put it on the agenda, which keeps it alive (also in the autumn and winter) (4B8S).” In addition, a few teachers suggest giving outdoor learning more priority by devoting time to the subject together as a team. A teacher for instance wrote down: “The green schoolyard meetings (5B4S),” and another wrote “Put it on the agenda during team meetings (2B6S).”

Incorporate Outdoor Learning in the Curriculum

A few teachers suggested searching for opportunities to connect outdoor learning to existing lessons and subjects to overcome a lack of time. A teacher for instance wrote: “As an expansion after a method lesson on nature (3B1S)” and another “Relate the benefits from real-life learning outside to subject matters indoors (3B1S).” In contrast, a few other teachers did not explicitly connect outdoor learning to a singular lesson, but focused on being aware of spontaneous moments during outdoor time to inspire outdoor learning. A teacher for instance suggested: “Do not schedule an outdoor learning activity, but be aware for spontaneous moments (1B2S).”

Barrier: Lack of Communal Structure

Some teachers felt hindered by not knowing when they can use the green schoolyard. A teacher, for instance, wrote down as a barrier: “For me it was unclear for a long time at what moment my class could go outside in the schoolyard (4B4Z)” and another “I could not do anything, my colleague cleared out the garden before I could start (4B8Z).” Further, a lack of structure on how to use and share the green schoolyard for

outdoor learning can lead to frustrations and uncertainty when teachers do go outside. A teacher wrote down as a barrier: *"Things that children built, were demolished later [ed. by other teachers and children] (4B4L)"* and another experienced *"It was overcrowded due to other classes that were outside (2B6LA)." For other teachers, the lack of structure results in frustrations on sharing materials. As a teacher explains as a barrier: "Keeping materials in line. I borrowed something to a colleague, and that is now in her classroom and I am standing with empty hands (5B4LA)." Lastly, some teachers experience it as a barrier that there is no clear idea on what outdoor learning is and how it should be formalized within their school as an organization. A teacher for instance wrote down as a barrier: "To me it is unclear what we want with it [red. outdoor learning]. It is a blank spot on the horizon, but how do we fill that spot and why in that manner? (5B1Z)."*

Solutions to Overcoming a Lack of Structure Teamwork

Teachers addressed a lack of structure by making rules on using the green schoolyard and organizing materials together as a team. They for instance wrote down: *"We made clear rules (4B4L)"* and *"Organize materials (4B5S)." Teachers also found it helpful to exchange ideas with colleagues, a teacher for instance wrote down as supportive: "Discuss with colleagues: Is a child always allowed to work outside? (5B6S)."*

Develop a Common Framework

In one particular school it was observed how a pioneer with a decisive mind sets in motion the development of a communal structure to establish outdoor learning in the green schoolyard. He wrote down as supportive: *"Lack of structure inspired me to develop a framework myself (5B3S)." In one of the meetings he took the initiative to share his idea on working with so called "outdoor learning cards." These are cards with outdoor learning assignments that are related to subjects in the existing curriculum. Assignments in particular stimulate real-life hands-on experiences in the green schoolyard, for instance related to mathematics, language, or creativity. During free hours, children can choose independently to go outside with a learning card together with another child.*

Inspired by his idea, a group of colleagues took on the responsibility of further developing this framework and motivating colleagues to go outside and experiment with the outdoor learning cards. This seemed to work, as the team responded positively and found the framework supportive to go outside and start realizing outdoor learning. Teachers for instance wrote down as supportive: *"The format of our colleague (5B6S)"* and *"There is a clearer framework to work with (5B6Z)." Teachers also reported enjoying noticing how outdoor learning becomes a more natural part of their daily practice by implementing the outdoor learning cards. A teacher for instance wrote down as motivating: "To see what is all happening. And most of all, what we consider to be normal in outdoor learning (5B6L)" and "Children now can choose to do outdoor learning*

activities (5B6L)." The development of the framework seems to provide a foundation to further integrate the green schoolyard as a learning environment.

Theme 2: Lack of Confidence in One's Own Outdoor Teaching Expertise

A recurrent theme concerns teachers reporting feelings of insecurity related to their own expertise as an outdoor teacher during outdoor learning activities. Within this theme, we distinguished the subthemes: fear of losing control, and difficulties in managing children's behavior. To strengthen confidence in outdoor teaching expertise we observed three common solutions: Familiarize teachers with outdoor learning, organization and rules, and altering one's teaching attitude.

Barrier: Fear of Losing Control and Difficulties Managing Children's Behavior

One aspect that teachers find difficult is how to cope with not being able to see every child at all times during outdoor learning activities in the green schoolyard, which makes it difficult to guard children's safety and manage their behavior. Teachers for instance wrote down as barriers words such as: *"Overview (5B4LA)"* and *"Surveillance (4B6LA),"* and another teacher illustrates *"[red. children] out of your sight. Parents are worried about this (5B4LA)." Teachers are used to an indoor setting in which the rules are clear; outdoors they are faced with a less structured learning environment. Not every teacher immediately feels competent to cope with this learning environment. A teacher for instance expressed as a barrier: "Space and overview is sometimes difficult due to all the different areas (2B4LA)" and another "It is more difficult to address children (5B4LA)." Teachers struggle with not knowing to which extent they can trust children's behavior outside. As teachers illustrate as barriers: *"Measuring the size of the pond. Children are out of my sight, will they stay dry? (5B2L)"* and *"What can you expect from children (5B2LA)?"**

Some teachers struggle with safety and risk issues. They find it difficult to balance between warning and protecting children on one hand, and on the other hand allowing children the space to explore and take risks. A teacher for instance wrote down as a barrier: *"Warning for accidents is like a second nature. I need to learn how to restrain myself. As I often experience that it is not necessary (4B3LA)"* and another teacher admitted to finding it difficult: *"To see how children are taking risks, climbing in trees etc... (4B3LA)"* and another *"Twigs are interesting and fun to play around with, but we also need to be attentive for risk (3B3LA)." In addition, teachers experience that the level of independence you can trust a child with differs between children. As a teacher for instance wrote down as a barrier: "Some children break the rules we have made, some children adhere to the rules (5B6LA)."*

Teachers also find it difficult to manage children's behavior in a way so that all children will be engaged in the outdoor learning activity. Teachers attribute this problem partly to children being unfamiliar with outdoor learning. One teacher for instance wrote: *"I did not do it, my group was not ready yet (4B4Z)." In addition, teachers themselves are unfamiliar with how to guide children*

during outdoor learning activities. A teacher for instance wrote down as a barrier: *"Guiding the children (5B6L)"* and another *"Management of the class. How can I stimulate free situations or invite children to behave free, quiet and motivated? (3B3L)."*

In particular at one school, teachers further reflected on a lack of confidence in their own expertise to generate and hold children's attention during an outdoor learning activity. A teacher described as a barrier: *"Too many children under your guard, difficult to keep children involved (4B7LA)"* and another *"To go outside with the entire class, difficult to divide your attention (4B5LA)."* Furthermore, teachers experience difficulties in coping with children being attracted by the green schoolyard in a way that distracts them from the instructions or lesson they had scheduled as a teacher. A teacher, for example, wrote down as a barrier: *"To give instructions at the schoolyard. There are a lot of distractions for the children (4B7LA)"* and another *"Concentration of the children. This was sometimes diminished because they saw little insects or heard the sounds of for instance an ambulance or cars (4B8LA)"* This further shows how there can be a mismatch between the teachers' intentions, and what triggers children during an outdoor learning activity or what children need to get engaged. As a teacher illustrates: *"It is difficult to stay together as a group. Children were looking for things that caught their interest (4B8LA)"* and another *"For some children an open assignment is too difficult. Running around, behaving crazy or really not being capable to make a choice (4B5LA)."* Furthermore, some teachers first consider it necessary to familiarize with their group indoors, before they can start with outdoor learning. A teacher for instance wrote down as a barrier: *"It is the beginning of the schoolyear, I am still unfamiliar with the children (4B4LA)"* and *"There are also three new children, who do not know each other"(4B4LA).*

Solutions for Strengthening Confidence Expertise as an Outdoor Teacher

Familiarize With Outdoor Learning

Some teachers organized small step activities first that allowed themselves and the children to familiarize with outdoor learning in the green schoolyard. Teachers for instance did an exploratory walk with children around the schoolyard, let children draw their favorite place in the schoolyard, or had a lunch or reading moment outside. A teacher for instance wrote down as supportive: *"We took the period until the fall to familiarize children with the garden (4B4Z)"* and another *"With the children we did a tour in the garden, we explored what there is and how they can deal with the materials (4B4Z)."*

Furthermore, some teachers rely on repetition in order to let children adjust to outdoor learning and let it become ordinary: *"Assure regularity within the activities, so it becomes normal for the children (4B8S)."*

Organization and Rules

Other teachers try to overcome a fear of losing control by making rules and organizing outdoor learning. Teachers, for instance, discuss with children what is allowed and what is not during outdoor learning. As a teacher wrote: *"Discuss with children what surprised them in the schoolyard, but also about what you can and cannot do with loose branches (3B3S)"* and *"Talk about it with*

the children (4B4S)." In addition, teachers find practical solutions to guard children's safety by, for instance, assuring that younger children cannot open the fence. Furthermore, some teachers organize their instructions inside or find a paved, enclosed spot in the schoolyard to hold instructions. A teacher wrote down as supportive: *"Now and then I am in the 'circle' with my children, and I notice that I need this paved spot for instructions (3B3Z)."* Lastly, some teachers organize their outdoor learning in smaller groups of children, or only go outside if they have assistance from a colleague. A teacher for instance wrote down as supportive: *"Intern and teachers outside. One group can play, the other group is in the garden (4B5S) and another 'Smaller group, divide (2B4S)."*

Altering One's Teaching Attitude

Some teachers express how they learned to alter their own teaching attitude. They state that a key to cope with a fear of losing control is to trust on children's independence and own sense of responsibility. A teacher, for instance, wrote down as supportive: *"Trust children that they can independently work outside on an assignment together (5B4S)"* and another *"Let children go, an trust on their own responsibility (4B6S)."* Teachers in this sense find a solution by increasing their own competence and allowing themselves to trust children and reflect on their own actions as a teacher to control and warn for risks. A teacher for example wrote down as a key: *"Be aware of your own actions, so you learn to diminish warning for risks (4B3S)."* During a meeting, a teacher further reflects on this issue of coping with risks by explaining: *"Most children know how far they want to go and stop for example with climbing a tree when they go to high. Risks are mostly in the environment, not in the child (4B4Z)."* Instead of focusing on their own fear to stay in control, these teachers focus on what is beneficial for children to learn outside in regards to risk taking and developing independence. In response, some teachers enjoy and feel motivation from experiencing that they indeed can trust children and observe how children are working on their own outside, as illustrated by remarks that: *"Children adhere to the rules (5B6L)"* and *"Children collect the materials on their own (5B6L)."*

To overcome barriers related to managing children's behavior, some teachers reframed the question "what is distracting children?" to "what is attracting children outside?" They have an open and curious attitude, and become observant of children's experiences in the green schoolyard. A teacher, for example, explains *"I have read with several children in the schoolyard and this helped me to further understand how children experience the outdoor environment. This supports me to further develop and experiment with outdoor education (4B8Z)"* and another teacher wrote down that she has been *"Observing how children experience the garden (4B3Z)."* By actively participating and playing with children, some teachers hope to attract children's attention to an outdoor activity through their own enthusiasm and sense of wondering. As one teacher wrote: *"By being really enthusiast about something, for instance looking at a mushroom with amazement or a yellow leaf, you help the children to get engaged (4B5S)"* and *"Be enthusiastic yourself (4B7S)"* and *"Play along (4B5S)."* In particular, this holds

for children who have more difficulty in getting engaged in an activity themselves. Furthermore, some teachers experience active participation as supportive to directly adjust their teaching style to children's experiences: *"Actively participate myself. This allowed me to address children directly, stimulate them and resulted in interaction (4B3S)."*

Theme 3: Difficult to Get Started

In particular in the beginning, when teachers have little to no experience with outdoor teaching, some teachers experience it as difficult to start with realizing outdoor learning in the green schoolyard. A teacher wrote down as a barrier: *"Getting started is the most difficult part (5B2LA)"* and another teacher described it as difficult *"To actually do it (5B3LA)."* Furthermore, a few teachers found it difficult to get started themselves, they wanted to wait and first experience how colleagues initiated outdoor learning activities. A teacher for instance wrote down: *"I hope to be caught by the enthusiasm of others – of pioneers (5B1Z)"* and another *"First see which way the wind blows (3B1Z)."* In addition, some teachers feel too uninvolved with the concept of outdoor learning to stay engaged in the process of becoming an outdoor teacher. A teacher, for instance, wrote down as a barrier *"Outdoor learning is not on teachers' mind in the higher grades (5B3LA)"* and another *"I cannot adequately empathize with this form of education, so I see almost no development [red. in my own activities] (3B3LA)."*

Solutions to Getting Started

Decisive Mind

Teachers who feel hindered by outdoor learning not being formalized, express that a decisive mind supports them to overcome this barrier. Teachers for example report that *"Do it (5B2S)"* or *"Just start,"* and *"Instead of awaiting, make choices (5B2S)"* enabled them to go for it, to get engaged in first activities, and formalize outdoor learning themselves. A decisive mind is further characterized by *"Enthusiasm (5B2S)," "Feeling convinced (5B2S),"* and *"Perseverance (4B8S)."* This helps teachers to not give up after one activity, but instead continue to formalize outdoor learning despite of barriers they experience.

Step by Step

Teachers suggest taking a first small, demarked, and feasible step, and trust that step by step they will realize outdoor learning, as expressed by remarks to *"Keep it small (4B1S)"* and *"Trust, small steps also make a journey (5B1S)."* In addition, some teachers find it supportive to, as a first step, start indoors with a lesson that is related to the outdoor environment by bringing nature elements into their classroom. Teachers, for example, suggested, *"Walking stick bugs in the classroom (3B2S)," "Starting indoors (2B5S),"* and *"Only indoor sowing and planting (2B6Z)."*

Inspiration

Some teachers report inspiration with ideas on outdoor learning activities as a solution to overcome the hindrances of a lack of pre-structured lessons and methods for outdoor learning. *"A ready-to-use package with bulbs that a parent provided (3B1S)"* and *"Inspiration from other persons (3B3S)"* supported them to

start with a first outdoor learning activity. In a later stage, a teacher mentions how you can get inspired by the environment to formalize outdoor learning, and another that it is important to free time to get inspired.

Pioneers

Previously we observed how in a particular school a pioneer set in chain a reaction of activities in other teachers to formalize outdoor learning. At other schools, teachers also described activities of *"A positive colleague who takes initiative (3B2S)"* and *"The spontaneity with which my colleague is going outside (4B8I)"* as a motivation to get started. The *"Chain reaction (5B2Lk)"* of outdoor learning activities, as one teacher described is, is not only supportive, but teachers also describe it as *"Catching (5B2Lk)."*

Theme 4: Physical Constraints

Teachers report frustrations about the maintenance of the green space, in particular with the rapid deterioration of the green schoolyard. A teacher wrote down as a barrier: *"Quick deterioration of the green play hill (3B1LA)"* and another *"Rapid decay of the green schoolyard (3B3LA)."* Teachers experience it as difficult to protect the green schoolyard from children's behavior. A teacher for instance wrote down: *"I brought a plastic white rose. This symbolizes how I love roses and enjoy looking at them. Our green schoolyard is being trampled and my rose withers (3B2Z)."* Furthermore, some teachers experience that the green schoolyard is not "green enough" for outdoor learning. A teacher, for instance, wrote down as a barrier: *"There are not enough green materials in our schoolyard (3B3LA)."*

Weather conditions are also mentioned as a physical barrier by teachers across all meetings. On most occasions, this concerns teachers who canceled an outdoor activity due to rainfall or stormy weather conditions. As a teacher for instance wrote down as a barrier: *"I brought a drawing of bad weather. This symbolizes the mathematics assignment I postponed. There was too much rain and wind (3B2Z)."* A few teachers mention specifically that certain seasons make outdoor learning more difficult; this was mentioned by teachers during the winter season. A teacher, for instance, wrote down as a barrier: *"The season impedes outdoor learning activities (4B6LA)."*

Solutions to Overcome Physical Constraints

Preventing Child Erosion

To protect green areas against the so-called child-erosion, teachers find a practical solution. For instance, teachers placed: *"A red and white ribbon (3B2S)"* to protect flower bulbs. Furthermore, the team took upon initiatives to green their schoolyard with more natural materials, such as getting *"New plants through sponsoring (3B3S)"* and *"Bring materials myself, for instance 30 pineapples (3B3S)."* The team mentioned commitment to maintenance as important and enjoyed further designing their green schoolyard together.

Dealing With Weather Conditions

Whereas rainfall and stormy weather are mentioned as a barrier, sunny weather is considered inviting and supportive to

go outside. Teachers for instance reported: “Go outside, it is springtime! (5B6Z)” and “Nice weather for the garden (5B1L)” and “Schedule in outdoor lessons, but wait until the weather becomes a bit warmer (4B6S).” Teachers who felt hindered by bad weather conditions, did not report on ways to overcome rainfall and stormy weathers. However, teachers do describe how experiences with seasonal influences in the green schoolyard inspired their outdoor learning activities. A teacher, for instance, observed with her children a chestnut tree across the seasons, as she wrote down “Chestnut tree: we experienced all seasons! Bold, buds, leaves, autumn colors and chestnuts! (3B3Z)” and “Making fat balls for birds in January and February (4B6L).” In another school the children made Christmas trees and decorations in the schoolyard with natural materials during the winter season. Still, fall and spring season seem easiest for teachers to experiment with outdoor learning. Heaps of leaves, chestnuts, and other natural materials in the fall, for instance, inspire creative learning activities, such as “Crafting an autumn wreath with natural materials (4B6Z)” and “An Autumn craft corner (4B5Z).” In springtime, teachers observe with children the emerging and blossoming nature and sow, care, and harvest kitchen gardens. As teachers, for example, wrote down: “A free assignment: What has grown in the last week? (4B3Z)” and “Sowing and transpire. To observe the peas growing (5B6L).” and “Harvesting the grapes and eat them on a nice spot in the sun (2B4S).”

GENERAL DISCUSSION

In this study we present data from a collaborative action research project called ‘Becoming an outdoor teacher’, in which we investigated barriers experienced by primary school teachers preventing them from facilitating outdoor learning in the green schoolyard, and solutions to overcome these barriers, across a period of two consecutive years. Results revealed four broad themes encompassing barriers and solutions. The first theme included three barriers related to outdoor learning having no formal status in teachers’ current educational practice: unfamiliarity and a lack of inspiration, lack of time, and lack of communal structure. The second theme included two, interconnected, barriers related to a lack of confidence of teachers in their own outdoor teaching expertise: fear of losing control, and difficulties managing children’s behavior. The third theme related to the barrier of finding it difficult to get started. The fourth theme related to physical constraints as posed by a lack of maintenance and weather conditions. These barriers are largely similar to those identified in previous studies by, for example, Dymont (2005), and Maynard and Waters (2007). However, a main contribution of the present research is that barriers were identified through a collaborative action approach, in which teachers, professionals, and researchers identified barriers through a process of systematic reflection on teachers’ real-life experiences. Moreover, the collaborative action approach challenged teachers, professionals, and researchers to come up with solutions to overcome barriers and realize outdoor learning in the green

schoolyard. This provides meaningful data that are grounded in teachers’ daily educational practice.

To conquer the “daunting task” [as it was previously called by Dymont and Reid (2005)] of realizing outdoor learning in the green schoolyard we identified several solutions that could support teachers in overcoming the barriers related to each specific theme. With respect to the lack of formal status of outdoor learning (theme 1), as a solution to the barrier of unfamiliarity and a lack of inspirations, teachers found support in the organized inspirations moments, working together with colleagues, and engaging in real-life experiences and observing children’s positive reactions to outdoor learning. Teachers experienced that the barrier of a lack of time can be overcome by making a conscious decision to make time for outdoor learning, and to connect outdoor learning to existing lessons in the curriculum. To overcome a lack of communal structure, teachers also found teamwork helpful, as well as the bottom-up development of a common framework for outdoor learning. With respect to the lack of confidence of teachers in their own outdoor teaching experience (theme 2), teachers experienced that fear of losing control and difficulties managing children’s behavior can be overcome by familiarizing children with outdoor learning, making rules and organizing outdoor learning, and altering one’s own attitude as a teacher. To overcome difficulties in getting started (theme 3), a step by step approach, inspiration, a decisive spirit, and teamwork were found to be supportive. Finally, to deal with adverse physical conditions related to maintenance and weather (theme 4), teachers found support in practical solutions to prevent child erosion of the greenspace. Although teachers did not experience a solution to overcome rainfall and stormy weather conditions, they did find support in sunny weather, and found inspiration for outdoor learning in experiences with seasonal influences.

GENERAL RECOMMENDATIONS

In addition to the specific barriers and solutions, some general recommendations for what is needed to realize outdoor learning in a green schoolyard can be derived from the present research.

Just Do It

First, previous studies that theorized on what teachers need to realize outdoor learning mostly suggest the idea that teachers need to adopt a new pedagogical outdoor mindset (Dymont and Reid, 2005; Maynard and Waters, 2007; Waite, 2011; Passy, 2014). Although this sounds obvious, changing a mindset is difficult and costs time, which is scarce in current educational practices. Alternatively, the present research suggests that, when outdoor learning is yet another additional thing on the workload, the simple answer might be: just do it. There is a certain aspect of a decisive mind in some of the teachers. Despite all the barriers, despite the lack of time, despite the realities of their educational practice, they take a first step and go for it. Sometimes teachers

were even surprised by their own actions. They did it, against their own odds. Scheduling it in, preparing, connecting outdoor learning to an existing subject, and collaborating with colleagues are some aspects that support this decisive mind. This mindset corresponds to a previous study in which ten primary school teachers in Scandinavia who gained some experience in the so called “udeskole” (teaching outside the classroom) were interviewed. Results showed that teaching outside can stimulate a feeling of regaining one’s professionalism (Barfod, 2017). However, the freedom and autonomy also create a double-edge sword as it puts a challenge on one’s professional judgment as a teacher. We also observed how teachers can enjoy using their skills and knowledge as a teacher to create outdoor learning, and at the same time can feel hindered by feelings of incompetence in regards to their unfamiliarity with outdoor learning and a lack of confidence in their outdoor teaching skill. In general, deciding that outdoor learning is a worthy part of one’s educational practice and just doing it can be a helpful strategy in realizing outdoor learning, but this also sets in motion a professional developmental process that brings to light doubts about one’s own competence and skills.

Get Educated and Inspired

Second, we observed how inspiration moments and guided hands-on experiences can support teachers familiarizing themselves with the concept of outdoor learning, and opens up their awareness of opportunities to incorporate outdoor learning in the green schoolyard in their educational practice. In this sense, it seems of particular importance not to limit inspiration moments to ready-to-use lessons, but to combine theoretical background and real-life experiences aimed to stimulate a carry-over effect to teachers generating their own pedagogical ideas and meaningfully incorporate the green schoolyard as an outdoor learning environment in their educational practice. Only handing out concrete ideas for outdoor lessons can lead to a one-dimensional use of the green schoolyard and a failure to strengthen teachers’ professional judgment and competence. This can lead teachers to simply asking “what’s next,” and outdoor learning will risk to cease to exist when the inspiration flow stops, or all the lessons are carried out. This adds to a previous study that explored strategies that are effective in facilitating learning in a natural environment and stress the importance of teachers’ understanding the reason for visiting an outdoor location and having appropriate exercises to guide children in a meaningful learning process (Ballantyne and Packer, 2009). Without insight in the value and background of outdoor learning, time spent in the green schoolyard will be no more than a change of scenery instead of an enrichment of children’s learning experiences.

Engage in Real-Life Experiences

Third, the importance of learning and inspiration goes hand in hand with the importance of real-life experiences in teachers’ educational practice and reflection on these experiences. Simply stated: teachers do not realize outdoor learning by staying indoors. They need to be stimulated to go outside,

to experiment, to incorporate the green schoolyard as a learning environment through hands-on learning themselves. This builds upon previous research by Hickman and Stokes (2016) who evaluated outdoor leader education and training, and suggest the importance of reflecting on experiences in teachers’ daily practice to further professionalize and develop outdoor education skills. Experiencing outdoor learning for themselves meant barriers became more vivid compared to the barriers they had previously just imagined. Teachers sometimes experienced fears that they held that turned out to be different in reality, and vice versa. In addition, hands-on learning goes beyond acquiring physical and technical skills and supports the development of broader and holistic skills. In this there is a similarity between the characteristics of outdoor learning and what supports teachers to become an outdoor teacher. Through experiences outdoor education becomes alive, and teachers’ understanding and competence can be shaped and strengthened through practice. This is in line with previous research that discusses how outdoor learning can re-awaken joy in teachers (Waite, 2011).

Get an Outdoor Pedagogical Mindset

Fourth, we observed that, although a controlling mindset based on fear of losing control and managing children’s behavior can be successful to a certain extent, it also entails a risk of a negative impact on the educational process. Stan and Humberstone (2011) observed in an ethnographic study teachers’ behavior during outdoor education and found that a controlling approach in order to manage risks during outdoor education limited learning opportunities for children. A different approach, in which teachers become observant to what attracts children in the green schoolyard, actively participated with the children, and aimed to understand the value of their (risky) behavior and guide learning activities, seemed to open up learning situations for the children. This builds upon previous studies, which suggest the need to develop a different attitude in which teachers loosen their indoor need for structure, and are open and curious to the opportunities of the unstructured green schoolyard (Dyment, 2005; Sahrakhiz, 2017a). Still, it remains somewhat unclear as to why some teachers embrace a more open mindset and other teachers hold on to indoor controlling strategies. One explanation could lie in teachers’ and schools’ vision on education and the school culture in this regard (Passy, 2014). Future research could extend our collaborative action research approach by observing and measuring the impact of teachers’ outdoor activities and behavior during these activities, and in reflections discuss these experiences in the context of their vision. This could further untangle what defines an outdoor pedagogical mindset, what supports teachers to develop this, and how their behavior can be grounded in a vision on (outdoor) learning.

Follow a Tailored Process

Lastly, although most barriers are observed across schools, not every teacher has to experience or go through every barrier, and they may experience different barriers in different orders or phases. There can be differences between schools,

but also differences within teachers at the same school. For instance, in one school the emphasis was on developing a communal structure for outdoor learning, while at another school managing children's behavior was a major concern. In addition, while some teachers have ideas but find it difficult to make time for outdoor learning, others can struggle mostly with feelings of didactical incompetence. This reveals that becoming an outdoor teacher refers to a certain extent to a personal and organizational development. This implies that supporting teachers to facilitate outdoor learning in the green schoolyard requires a tailored process and there is no one-size-fits-all solution. This further builds on previous research that discusses differences between teachers in their willingness and capabilities to teach outdoors (Passy, 2014; Waite, 2011). Apparently to some teachers it becomes more natural to use the green schoolyard as a learning environment, while others are more hesitant to go outdoors. Interestingly, in a team it can become a strength that some teachers more naturally dare to get started and undertake outdoor learning activities in the green schoolyard. When sharing and making their activities visible to their colleagues, they can inspire and enthuse them to do the same. Furthermore, developing outdoor learning in the green schoolyard together as a team can be a valuable contribution to the school as an organization (Sahrakhiz, 2017b).

Strengths and Limitations

To our knowledge, this is the first project that aimed to identify solutions that support teachers in overcoming barriers and realizing outdoor learning in the green schoolyard, and in which teachers were followed for two consecutive years. The collaborative action research design stimulated the development of hands-on knowledge of which teachers participating in the project directly benefited, and that can be extended to other primary schools on a national and international level. However, the research is not without its limitations.

First, primary schools participating in the project were open to devoting time to facilitate outdoor learning in the green schoolyard. This could have led to a self-selection bias, in which outcomes could be different in more reluctant schools. However, barriers observed are similar to those in previous studies in different countries. Furthermore, participating in the green schoolyard meetings was not without struggles. Despite a decision to participate in the project, teachers were often faced with other responsibilities that required their attention. In some occasions this led principals to decide to cancel meetings or to, in one situation, prematurely abandon the project. Although disappointing, this reflects a realistic situation of circumstances in which teachers need to establish outdoor learning.

Second, schools differ in the number of meetings and teachers participating in every meeting, and the designs of their schoolyards. In particular at one school, the type of greening and maintenance formed a barrier to realize outdoor learning. However, in qualitative research it is not about the quantity of measurements, but the content. Still, to account

for differences between schools, we first aggregated findings within schools, and then triangulated our findings across schools. As shown, similar themes arose, but also differences between schools. These differences suggest a tailored process of becoming an outdoor teacher. Future research could devote attention to differences between schools and explore, for instance, whether these differences find their origin in the type of education, personality of teachers, or design of the schoolyard. For example, selection of schools based on systematic variations in school type and design or a procedure of co-analysis with teachers could account for these aspects.

Third, despite the fact that we observed teachers overcoming barriers and, in all schools, outdoor learning activities emerged, the project is not solely a success story. During and after the project barriers continued to exist, and teachers kept struggling with outdoor learning having no formal status and their own feelings of incompetence. However, a change has been set into motion and it is up to teachers to further rely on and strengthen their professional judgment. The supportive aspects found in the project can help teachers to continue their process. In addition, future research could support teachers by further investigating the impact of outdoor learning activities in the green schoolyard on children's development and what constitutes a beneficial outdoor learning experience. As insight into the evidential value of outdoor learning can support teachers and institutions to acknowledge the green schoolyard as an outdoor learning environment and empower the formal status of outdoor learning.

CONCLUSION

As a first project to explore what teachers need to facilitate outdoor learning in the green schoolyard, we hope to have set the stage for future research in unraveling the professional qualities of an outdoor teacher and the characteristics and value of outdoor learning in green schoolyards. Altogether, our research suggests that trusting on one's professional judgment, taking the time and just doing it, getting educated and inspired, embracing an outdoor pedagogical mindset, engaging in real-life experiences, and reflecting on these experiences can support teachers to establish outdoor learning in the green schoolyard. Furthermore, our findings imply the importance of understanding why outdoor learning should be facilitated and stress the importance of teamwork.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation

and institutional requirements. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

JD-W and DH contributed to the conception and design of the study. JD-W organized the database, performed the qualitative content analysis, and wrote the first draft of the manuscript. DH and JM contributed to finalizing the data analysis and manuscript revision. AB revised the manuscript critically for important intellectual content. All authors approved the submitted version of the manuscript.

REFERENCES

- Auer, M. R. (2008). Sensory perception, rationalism and outdoor environmental education. *Int. Res. Geogr. Environ. Educ.* 17, 6–12. doi: 10.2167/irgee225.0
- Ballantyne, R., and Packer, J. (2009). Introducing a fifth pedagogy: experience-based strategies for facilitating learning in natural environments. *Environ. Educ. Res.* 15, 243–262. doi: 10.1080/13504620802711282
- Barfod, K. S. (2017). Maintaining mastery but feeling professionally isolated: experienced teachers' perceptions of teaching outside the classroom. *J. Advent. Educ. Outdoor Learn.* 18, 201–213. doi: 10.1080/14729679.2017.1409643
- Becker, C., Lauterbach, G., Spengler, S., Dettweiler, U., and Mess, F. (2017). Effects of regular classes in outdoor education settings: a systematic review on students' learning, social and health dimensions. *Int. J. Environ. Res. Public Health* 14:E485.
- Bell, A. C., and Dymont, J. E. (2008). Grounds for health: the intersection of green school grounds and health-promoting schools. *Environ. Educ. Res.* 14, 77–90. doi: 10.1080/13504620701843426
- Blair, D. (2009). The child in the garden: an evaluative review of the benefits of school gardening. *J. Environ. Educ.* 40, 15–38. doi: 10.3200/JOEE.40.2.15-38
- Browning, M. H., and Rigolon, A. (2019). School green space and its impact on academic performance: a systematic literature review. *Int. J. Environ. Res. Public Health* 16:E429. doi: 10.3390/ijerph16030429
- Chawla, L., and Nasar, J. L. (2015). Benefits of nature contact for children. *CPL Bibliogr.* 30, 433–452. doi: 10.1177/0885412215595441
- Danks, S. G. (2010). *Asphalt to Ecosystems: Design Ideas for Schoolyard Transformation*. Oakland, CA: New Village Press.
- Davies, R., and Hamilton, P. (2018). Assessing learning in the early years' outdoor classroom: examining challenges in practice. *Education* 46, 117–129. doi: 10.1080/03004279.2016.1194448
- Dymont, J. E. (2005). Green school grounds as sites for outdoor learning: barriers and opportunities. *Int. Res. Geogr. Environ. Educ.* 14, 28–45. doi: 10.1080/09500790508668328
- Dymont, J. E., and Bell, A. C. (2007). Grounds for movement: green school grounds as sites for promoting physical activity. *Health Educ. Res.* 23, 952–962. doi: 10.1093/her/cym059
- Dymont, J. E., and Reid, A. (2005). Breaking new ground? Reflections on greening school grounds as sites of ecological, pedagogical, and social transformation. *Can. J. Environ. Educ.* 10, 286–301.
- Edwards-Jones, A., Waite, S., and Passy, R. (2018). Falling into LINE: school strategies for overcoming challenges associated with learning in natural environments (LINE). *Education* 46, 49–63. doi: 10.1080/03004279.2016.1176066
- Feille, K., and Nettles, J. (2017). Permission as support: teacher perceptions of schoolyard pedagogy. *Electron. J. Sci. Educ.* 23, 1–31.
- Fiskum, T. A., and Jacobsen, K. (2012). Individual differences and possible effects from outdoor education: long time and short time benefits. *World J. Educ.* 2, 20–33.
- Goodall, J. S. (2016). Technology and school-home communication. *Int. J. Pedagog. Learn.* 11, 118–131. doi: 10.1080/22040552.2016.1227252
- Harris, F. (2017). The nature of learning at forest school: practitioners' perspectives. *Education* 45, 272–291. doi: 10.1080/03004279.2015.1078833
- Hartmeyer, R., and Mygind, E. (2016). A retrospective study of social relations in a Danish primary school class taught in 'u deskole'. *J. Advent. Educ. Outdoor Learn.* 16, 78–89. doi: 10.1080/14729679.2015.1086659
- Hickman, M., and Stokes, P. (2016). Beyond learning by doing: an exploration of critical incidents in outdoor leadership education. *J. Advent. Educ. Outdoor Learn.* 16, 63–77. doi: 10.1080/14729679.2015.1051564
- Johnson, P. (2007). Growing physical, social and cognitive capacity: engaging with natural environments. *Int. Educ. J.* 8, 293–303.
- Kelz, C., Evans, G. W., and Röderer, K. (2013). The restorative effects of redesigning the schoolyard. *Environ. Behav.* 47, 119–139. doi: 10.1177/0013916513510528
- Khanlou, N., and Peter, E. (2005). Participatory action research: considerations for ethical review. *Soc. Sci. Med.* 60, 2333–2340. doi: 10.1016/j.socscimed.2004.10.004
- Kuo, M., Browning, M. H., and Penner, M. L. (2018). Do lessons in nature boost subsequent classroom engagement? Refueling students in flight. *Front. Psychol.* 8:2253. doi: 10.3389/fpsyg.2017.02253
- Largo-Wight, E., Guardino, C., Wludyka, P. S., Hall, K. W., Wight, J. T., and Merten, J. W. (2018). Nature contact at school: the impact of an outdoor classroom on children's well-being. *Int. J. Environ. Health Res.* 28, 653–666. doi: 10.1080/09603123.2018.1502415
- Lieberman, G. A., and Hoody, L. L. (1998). *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*. San Diego: State Education and Environment Roundtable.
- Maynard, T., and Waters, J. (2007). Learning in the outdoor environment: a missed opportunity? *Early Years* 27, 255–265. doi: 10.1080/09575140701594400
- Mayring, P. (2000). Qualitative content analysis. *Forum Qual. Soc. Res.* 1:20.
- Ozer, E. J. (2007). The effects of school gardens on students and schools: conceptualization and considerations for maximizing healthy development. *Health Educ. Behav.* 34, 846–863. doi: 10.1177/1090198106289002
- Passy, R. (2014). School gardens: teaching and learning outside the front door. *Education* 42, 23–38. doi: 10.1080/03004279.2011.636371
- Ponte, P. (2005). A Critically constructed concept of action research as a tool for the professional development of teachers. *J. Serv. Educ.* 31, 273–296. doi: 10.1080/13674580500200279
- Ponte, P., Ax, J., Beijgaard, D., and Wubbels, T. (2004). Teachers' development of professional knowledge through action research and the facilitation of this by teacher educators. *Teach. Teach. Educ.* 20, 571–588. doi: 10.1016/j.tate.2004.06.003
- Rickinson, M., Dillon, J., Teamey, K., Choi, M. Y., and Benefield, P. (2004). *A Review of Research on Outdoor Learning*.

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- Sahrakhiz, S. (2017a). Immediacy and distance in teacher talk—A comparative case study in German elementary- and outdoor school-teaching. *Cogent Educ.* 4:1291175. doi: 10.1080/2331186X.2017.1291175
- Sahrakhiz, S. (2017b). The 'outdoor school' as a school improvement process: empirical results from the perspective of teachers in Germany. *Education* 3-13, 1–13. doi: 10.1080/03004279.2017.1371202
- Sahrakhiz, S., Harring, M., and Witte, M. D. (2018). Learning opportunities in the outdoor school—empirical findings on outdoor school in Germany from the children's perspective. *J. Advent. Educ. Outdoor Learn.* 18, 214–226. doi: 10.1080/14729679.2017.1413404
- Skamp, K., and Bergmann, I. (2001). Facilitating learnscape development, maintenance and use: teachers' perceptions and self-reported practices. *Environ. Educ. Res.* 7, 333–358. doi: 10.1080/13504620120081241
- Stan, I., and Humberstone, B. (2011). An ethnography of the outdoor classroom – how teachers manage risk in the outdoors. *Ethnogr. Educ.* 6, 213–228. doi: 10.1080/17457823.2011.587360
- Van Dijk-Wesselius, J. E., Maas, J., Hovinga, D., Van Vugt, M., and Van den Berg, A. E. (2018). The impact of greening schoolyards on the appreciation, and physical, cognitive and social-emotional well-being of schoolchildren: a prospective intervention study. *Landsc. Urban Plan.* 180, 15–26. doi: 10.1016/j.landurbplan.2018.08.003
- Waite, S. (2011). Teaching and learning outside the classroom: personal values, alternative pedagogies and standards. *Education* 39, 65–82. doi: 10.1080/03004270903206141
- Waite, S., Bølling, M., and Bentsen, P. (2016). Comparing apples and pears?: a conceptual framework for understanding forms of outdoor learning through comparison of English Forest Schools and Danish udeskole. *Environ. Educ. Res.* 22, 868–892. doi: 10.1080/13504622.2015.1075193
- Wistoft, K. (2013). The desire to learn as a kind of love: gardening, cooking, and passion in outdoor education. *J. Advent. Educ. Outdoor Learn.* 13, 125–141. doi: 10.1080/14729679.2012.738011

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Connectedness to Nature: Its Impact on Sustainable Behaviors and Happiness in Children

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Given the environmental problems humanity is currently facing, and considering that the future of the planet lies in the hands of children and their actions, research on the determinants of sustainable behaviors in children has become more relevant; nonetheless, studies on this topic focusing on children are scarce. Previous research on adults suggests, in an isolated manner, the relationship between connectedness to nature, the development of behaviors in favor of the environment, and positive results derived from them, such as happiness and well-being. In the present research, connectedness to nature was considered as a determinant of sustainable behaviors, and happiness was considered as a positive consequence of the latter. This research aimed to demonstrate the relationship between these variables in children. Two hundred and ninety-six children with an average age of 10.42 years old participated in the study, in which they responded to a research instrument that measured connectedness to nature, sustainable behaviors (*pro-ecological behavior, frugality, altruism, and equity*), and happiness. To analyze the relationships between these variables, a model of structural equations was specified and tested. The results revealed a significant relationship between connectedness to nature and sustainable behaviors, which, in turn, impact happiness. This suggests that children who perceive themselves as more connected to nature tend to perform more sustainable behaviors; also, the more pro-ecological, frugal, altruistic, and equitable the children are, the greater their perceived happiness will be. The implications for studying and promoting sustainable behaviors are discussed within the framework of positive psychology.

Keywords: connectedness to nature, sustainable behavior, children, happiness, nature

INTRODUCTION

Environmental problems represent one of the most significant challenges humanity is currently facing, and, in such a scenario, children are important agents who could mitigate some of these environmental challenges; in their actions and in the relationship they have with the natural environment lays the opportunity to solve those problems. Hence the relevance of carrying out studies focused on this population.

This article is framed within *environmental psychology* (EP), which aims to study the relationships between behavior and the environment (Aragonés and Amérigo, 2010). Corral (2011) proposes that there are two aspects within EP: architectural psychology, which is interested in investigating the effects of the natural or built environment on behavior and its dispositions, and environmental conservation psychology, which is dedicated to studying the effects of human behavior on the environment. Olivos and Clayton (2017) point out that, although studies regarding the effects of the built environment and the *self* have a long tradition in EP, research focused on the role of nature in people's construction of *self* and well-being were barely developed during the two first decades of the 21st century.

As environmental problems become worse, researchers are starting to focus their attention on the relationships between humans and nature and their effects on environmentally *sustainable behavior* (SB; Nisbet and Zelenski, 2013). Nisbet et al. (2009) draw attention to the fact that disconnection from the natural world may contribute to the destruction of the planet. Recently, the term *nature-deficit disorder* has been used to describe the lack of connectedness that children feel about the natural world; this concept is used to evoke a lack of a bond with other living beings (Howard, 2013). Authors like Zylstra et al. (2014) state that this disconnection from nature is mainly a consciousness problem, one that is fundamental among and for the convergent socio-ecological crises. This is of main importance for researchers and professionals concerned with environmental changes and degradation, since they see the solution to that problem as a way to develop environmental care and concern (Bruni et al., 2017).

Specialized literature offers different definitions for connectedness to nature. Mayer and Frantz (2004) conceptualize it as a trait of individuals that enables them to feel emotionally connected to the natural world. Nisbet et al. (2009) suggest the term *nature relatedness*, which they define as a relatively stable characteristic throughout time and all situations. This encompasses the appreciation and understanding of the interconnection between human beings and other living organisms and is more than love for nature or the enjoyment of its superficial facets: it includes an understanding of the importance of all of nature's aspects, even those that are not esthetically attractive. Zylstra et al. (2014) define connectedness to nature as a stable state that includes cognitive, affective, and experiential symbiotic traits that reflect, through consistent attitudes and behaviors, sustained awareness of the interrelation between oneself and the rest of nature, which is in a continuum that includes both information and experience.

There are antecedents in the literature that have identified several benefits of connectedness to nature, including well-being (Mayer and Frantz, 2004; Nisbet and Zelenski, 2013; Zylstra et al., 2014; Olivos and Clayton, 2017), health (Nisbet and Zelenski, 2013), happiness (Nisbet and Zelenski, 2013; Zylstra et al., 2014), and a satisfying and meaningful life (Zylstra et al., 2014). Furthermore, Olivos and Clayton (2017) remark that connections with the natural environment can also have an indirect effect on well-being through pro-environmental behavior; on this matter,

several studies expound that behaviors with a low environmental impact are related to happiness or satisfaction.

Several investigations reveal significant relationships between connectedness to nature and pro-ecological behaviors among the adult population (Olivos et al., 2013; Geng et al., 2015; Bruni et al., 2017). On the other hand, some researchers suggest that connectedness to nature is also related to pro-social behaviors. García et al. (2016) explain that people with a strong sense of connectedness to nature carry out a greater number of pro-ecological, frugal, fair, and altruistic behaviors, which altogether compose SB. Corral (2011) define SB as a series of actions aimed at the preservation of natural resources considering the integrity of plant and animal species, as well as the individual and social well-being of present and future generations.

Likewise, there are investigations that report a link between SB and happiness, finding a significant association between the two psychological factors and concluding that the more pro-ecological, frugal, altruistic, and equitable a person is, the more he or she experiences happiness (Corral-Verdugo et al., 2011; Tapia-Fonllem et al., 2013).

The amount of research and literature related to children's pro-ecological attitudes and behaviors has no comparison to the number of works on the adult population, with most of the studies on this subject centered on adults (García et al., 2017). Fraijo et al. (2012) assert that it is important to arouse research interest in early age environmental education, since they consider it necessary to start aiming research efforts also at this population. Moreover, some authors point out that there are few assessments of children's levels of connectedness to nature (Bragg et al., 2013). García et al. (2017) emphasize that studies on children could have greater effects on reducing environmental problems and increasing pro-ecological behaviors because early awareness can have better and long-lasting results.

One of the studies carried out on this topic on children is that of García et al. (2017), which expounds a relationship between connectedness to nature and pro-ecological behaviors; likewise, Collado et al. (2013) report a significant association between emotional affinity toward nature and ecological behaviors; finally, Capaldi et al. (2019) indicate that when children are in greater contact with nature, they report a greater willingness to protect it and be more pro-social.

Although previous studies have explored the relationship between connectedness to nature and pro-ecological behavior (Nisbet and Zelenski, 2013; Geng et al., 2015; Bruni et al., 2017), no studies have been conducted to address the association with the determinants of sustainable behavior except for the one performed on adults and conducted by García et al. (2016). Furthermore, despite the presence of research that has analyzed the association between sustainable behavior and happiness (Corral-Verdugo et al., 2011; Tapia-Fonllem et al., 2013), no studies were found that have proven the direct and indirect relationships between children's connectedness to nature and their sustainable behavior and the impact of the latter on their perceived happiness.

Therefore, the present research aimed to demonstrate the relationship between connectedness to nature and sustainable

behaviors, as well as the impact of these two factors on the perceived happiness of children.

MATERIALS AND METHODS

Participants

Two hundred and ninety-six children from a northwestern Mexican city participated in this study: 175 girls and 121 boys whose ages ranged from 9 to 12 years ($M = 10.42$ years, $DE = 1.00$); 35.8% were 11 years old, 26.0% were 10 years old, 23.3% were 9 years old, and 14.9% were 12 years old. The children were enrolled in different education grades: fourth (38.5%), fifth (21.6%), and sixth (39.9%).

Instruments

Data collection was carried out through the application of three instruments: the first was a scale to measure *connectedness to nature* (Cheng and Monroe, 2012), which consists of 16 items in the Likert scale referring to the pleasure of seeing wildflowers and wild animals, hearing sounds of nature, touching animals and plants, and considering that human beings are part of the natural world, among other rates; the scale contains five response options (from 1 = strongly disagree to 5 = totally agree).

Measurement of *sustainable behaviors* (*altruism*, *equity*, *frugality*, and *pro-ecological behavior*) was performed by adapting the scales of Fraijo et al. (2012). To assess *altruism* actions, the scale consisted of nine items that describe selfless help behaviors to other people, such as giving away used clothing, giving money to the Red Cross, helping those who fall or are hurt, among others, with five options for answering (from 1 = never to 5 = always). *Equity* was measured through seven statements that pose equality between sexes, ages, socioeconomic conditions, and races, among others; in it, participants determine their degree of agreement using a response scale (from 1 = strongly disagree to 5 = strongly agree). *Frugality* was measured by using five negative items on a Likert-type scale, which state behaviors such as using money to buy sweets, buying more food than I am going to eat, buying shoes to combine with all clothes, and so on; there were five response options (from 1 = never to 5 = always). *Pro-ecological behavior* was measured by using 11 items on the Likert scale, where participants reported the frequency (from 1 = never to 5 = always) of behaviors bound to care for the natural environment (recycling, object reuse, saving water, and separating garbage).

Happiness was measured by three items of the Subjective Happiness Scale (SHS; Lyubomirsky and Lepper, 1999), which measures the perception of happiness experienced by means of statements that refer to considering oneself happy in general, compared to most peers, and enjoying life regardless of what happens, with a range of answers from 1 = not very happy to 7 = very happy.

Procedure

The instrument was self-administrated in the participants' classroom with prior approval of the principals, teachers, and parents. Collaboration was requested from the children,

explaining the purpose of the investigation to them and indicating that their participation was voluntary. The administration of the scales took about 20 min.

Data Analysis

The results were analyzed using univariate statistics (mean, standard deviation, maximum, and minimum values); for each scale, one indicator of internal consistency was computed (Cronbach's alpha). A matrix of correlation between the analyzed variables (connectedness to nature, altruism, equity, frugality, pro-ecological behavior, and happiness) was also obtained.

To analyze the direct and indirect relationships between these variables, a structural equation model (SEM) utilizing the EQS statistical package was specified (Bentler, 2006). The authors assumed a previous understanding of the nature and dimensionality of the items for all scales, and due to the fact that parcels can be used to optimize the measurement structure (see Little et al., 2002), the scales were parceled into three indicators for each tested construct. In order to form the parcels, the authors randomly distributed the total number of items corresponding to each factor into the indicators. The exception was happiness, wherein all three items were considered without parceling. For this study, six first-order factors were pre-specified: (1) connectedness to nature, (2) happiness, (3) altruism, (4) equity, (5) frugality, and (6) pro-ecological behavior; where the last four formed a second-order factor called "sustainable behavior." The specified model hypothesized that the connectedness to nature factor would affect the second-order factor "sustainable behavior," while this would positively influence happiness.

RESULTS

Table 1 shows the univariate statistics of the scales, as well as their internal consistency. The mean values obtained were 4.32 in connectedness to nature, 4.25 in equity, 3.54 in pro-ecological behaviors, 3.40 in altruism, and 3.15 in frugality; scales ranged from 1 to 5, representing moderate levels in pro-ecological, altruistic and frugal behaviors, and higher scores in connectedness to nature and equity. In addition, the happiness scale mean was 5.8; in this scale, the scores range from 1 to 7, which indicates that children report a high level of happiness. The Cronbach's alpha values of the scales varied from 0.68 to 0.81, indicating an adequate level of internal consistency. The items with the highest means in *connectedness to nature* were: picking up trash from the ground can help the environment, taking care of animals is important, and human beings are part of the natural world. Regarding *altruistic behavior*, the most self-reported were: I help someone who falls or gets hurt, and I give away used clothes to the poor. On *equity*, children reported a greater degree of agreement with the statements: men and women have the same right to make decisions, boys and girls have the same opportunity to study as far as they want, and I treat poor and rich people in the same way. The most common *frugal behaviors* were: not buying more food than I am going to eat and not spending money on games and toys – on this scale, it is necessary to keep in mind that, although children have power

TABLE 1 | Univariate statistics and reliabilities of the used scales.

	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>Sd</i>	<i>Alpha</i>
<i>Connectedness to nature</i>	2.25	5.00	4.32	0.520	0.81
1. I like to hear different sounds of nature.	1	5	4.22	1.08	
2. I like to see wildflowers in nature.	1	5	4.40	0.90	
3. When I feel sad, I like to go outside and enjoy nature.	1	5	4.14	1.04	
4. Being in the natural environment makes me feel peaceful.	1	5	4.37	0.89	
5. I like to garden.	1	5	4.45	0.86	
6. Collecting rocks and shells is fun.	1	5	3.85	1.20	
7. Being outdoors makes me happy.	1	5	4.41	0.88	
8. I feel sad when wild animals are hurt.	1	5	4.43	1.02	
9. I like to see wild animals living in a clean environment.	1	5	4.58	0.81	
10. I enjoy touching animals and plants.	1	5	4.53	0.82	
11. Taking care of animals is important to me.	2	5	4.70	0.62	
12. Humans are part of the natural world.	1	5	4.59	0.80	
13. People cannot live without plants or animals.	1	5	4.55	0.93	
14. My actions will make the natural world different.	1	5	4.09	1.12	
15. Picking up trash from the ground can help the environment.	1	5	4.73	0.70	
16. People do not have the right to change the natural environment.	1	5	3.61	1.68	
<i>Sustainable behavior</i>	2.10	5.00	3.60	0.511	
<i>Altruism</i>	1.00	5.00	3.40	0.827	0.80
1. I give away clothes that I no longer use.	1	5	4.00	1.31	
2. I help someone who falls or gets hurt.	1	5	4.18	1.06	
3. I give money to the Red Cross.	1	5	3.64	1.24	
4. I visit sick people at the hospital.	1	5	2.50	1.40	
5. I help older or handicapped persons to cross the street.	1	5	3.02	1.44	
6. I help people to find an address.	1	5	3.38	1.37	
7. I give money to homeless people (street-living poor people).	1	5	3.49	1.37	
8. I participate in events to obtain money (fundraise) for civil organizations (firefighters, Red Cross).	1	5	2.71	1.47	
9. I explain or help schoolmates with their homework or tasks they do not understand.	1	5	3.86	1.17	
<i>Equity</i>	2.00	5.00	4.25	0.641	0.72
1. Men and women have the same right to make decisions about anything.	1	5	4.66	0.80	
2. I treat all my classmates as my equals.	1	5	3.99	1.11	
3. In my house, children have the same right as adults to make important decisions for the family.	1	5	3.46	1.30	
4. In my family, men and women have the same obligations in house cleaning.	1	5	4.28	1.13	
5. I treat native people in the same way as people who are not.	1	5	4.34	1.07	
6. I treat poor and rich people in the same way.	1	5	4.47	0.91	
7. In my family, girls have the same opportunity to study as boys (as far as they want).	1	5	4.64	0.86	
<i>Frugality</i>	1.25	4.75	3.15	0.693	0.72
1. I use my money to buy candy.	1	5	3.07	1.23	
2. I buy enough shoes and tennis to match my clothes.	1	5	2.59	1.38	
3. I buy more food than I am going to eat.	1	5	3.60	1.41	
4. At home, a lot of food is bought.	1	5	2.75	1.24	
5. I spend my money on games and toys.	1	5	3.45	1.41	
<i>Pro-Ecological Behavior</i>	1.27	5.00	3.54	0.720	0.78
1. I save and recycle used paper.	1	5	3.01	1.26	
2. I separate empty bottles to recycle.	1	5	3.01	1.25	
3. I tell people when their actions damage the environment.	1	5	3.74	1.23	
4. I read about nature.	1	5	3.08	1.27	

(Continued)

TABLE 1 | Continued

	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>Sd</i>	<i>Alpha</i>
5. I look for a way to reuse things.	1	5	3.55	1.27	
6. I encourage my friends and family to recycle.	1	5	3.07	1.35	
7. When I go to nearby places, I walk or cycle.	1	5	3.77	1.34	
8. I turn off the lights in rooms where they are not being used.	1	5	4.44	1.00	
9. I shut off the water faucet while brushing my teeth.	1	5	4.53	0.99	
10. I leave the fridge door open for a long time while choosing food.	1	5	3.87	1.38	
11. I watch environmental videos or programs.	1	5	3.10	1.31	
<i>Happiness</i>	<i>1.00</i>	<i>7.00</i>	<i>5.81</i>	<i>1.22</i>	<i>0.68</i>
1. In general, I consider myself:	1	7	6.02	1.40	
2. Compared to most of the people around me, I consider myself:	1	7	5.84	1.59	
3. Some people tend to be very happy. They enjoy life in spite of what happens, facing most things. To what extent do you consider yourself such a person?	1	7	5.82	1.49	

italics values are indicates minimum, maximum, mean, standard deviation, Cronbach Alpha.

in making family consumption decisions, parents are directly responsible for these behaviors. The most frequent *pro-ecological behaviors* were: shutting off the water faucet while brushing teeth and turning off the lights in rooms where they are not being used. Regarding the values of the responses of the happiness items, they did not differ from each other.

Table 2 exhibits the correlations between connectedness to nature, happiness, and the determinants of sustainable behavior (altruism, equity, frugality, and pro-ecological behavior). The highest correlation with happiness occurred between this factor and connectedness to nature, followed by those with altruism, pro-ecological behavior, equity, and frugality. The lowest association occurred between frugality and happiness.

Figure 1 exhibits the results of the structural model evaluating the relationship between connectedness to nature, sustainable behavior, and happiness. The factor loadings that connected the first-order factors with their corresponding indicators were high and significant ($p < 0.05$), revealing convergent construct validity for the used measures. Furthermore, the first-order factors (pro-ecological behavior, altruism, frugality, and equity) correlated significantly with their corresponding second-order factor (sustainable behavior), as revealed by the value and statistical significance ($p < 0.05$) of their factorial loadings. In the model of structural equations, it was found that connectedness

to nature (structural coefficient = 0.66; $p < 0.05$) influences sustainable behavior, and in turn, as expected, this positively affects happiness (structural coefficient = 0.38; $p < 0.05$). Having said that, although the chi-square value ($X^2 = 203.26$, 125 *df*) associated to this model was significant ($p < 0.0001$), the values of the practical indices Bentler Bonett Normed Fit Index (BBNFI; = 0.90), Bentler Bonnet Non-normed Fit Index (BBNNFI; = 0.94), Comparative Fit Index (CFI; = 0.95), as well as RMSEA (0.04), support the pertinence of this interrelations model.

DISCUSSION

The present study is framed within the positive sustainability psychology line of research, which studies the antecedents and positive consequences of pro-environmental or sustainable behaviors (Corral-Verdugo et al., 2011); according to Adams and Savahl (2017), there is a tendency to merge the theories of EP, sustainability, and positive psychology, emphasizing the importance that the natural environment commitment has in people's well-being.

As previous research and our results show, there is a relationship between feeling connected to nature and carrying out sustainable behaviors (García et al., 2016) and also between carrying out sustainable behaviors and the happiness of individuals (Corral-Verdugo et al., 2011), and this also applies to children. In addition to the above, the most remarkable findings of the study reported here include the associations between connectedness to nature, the four determinants of sustainable behavior (altruism, equity, frugality, and pro-ecological behavior), and happiness. A possible exception to this conclusion is the relationship between frugality and happiness. Although frugal behaviors were correlated to the rest of the sustainable behavior indicators, and this aggregate of actions significantly predicted happiness, the matrix correlation revealed that frugality and happiness presented an almost-zero correlation. These findings agree with the results reported by previous research (Corral-Verdugo et al., 2011). One explanation

TABLE 2 | Correlations between variables.

	CNAT	ALT	EQU	FRU	PEB	SB	HAP
Connectedness to nature	1						
Altruism	0.43**	1					
Equity	0.39**	0.26**	1				
Frugality	0.18**	0.09	0.15**	1			
Pro-ecological behavior	0.49**	0.61**	0.34**	0.26**	1		
Sustainable behavior	0.54**	0.76**	0.61**	0.53**	0.82**	1	
Happiness	0.31**	0.25**	0.10	−0.05	0.19**	0.19**	1

** $p < 0.001$. CNAT, connectedness to nature; ALT, altruism; EQU, Equity; FRU, Frugality; PEB, pro-ecological behavior; SB, sustainable behavior; HAP, happiness.

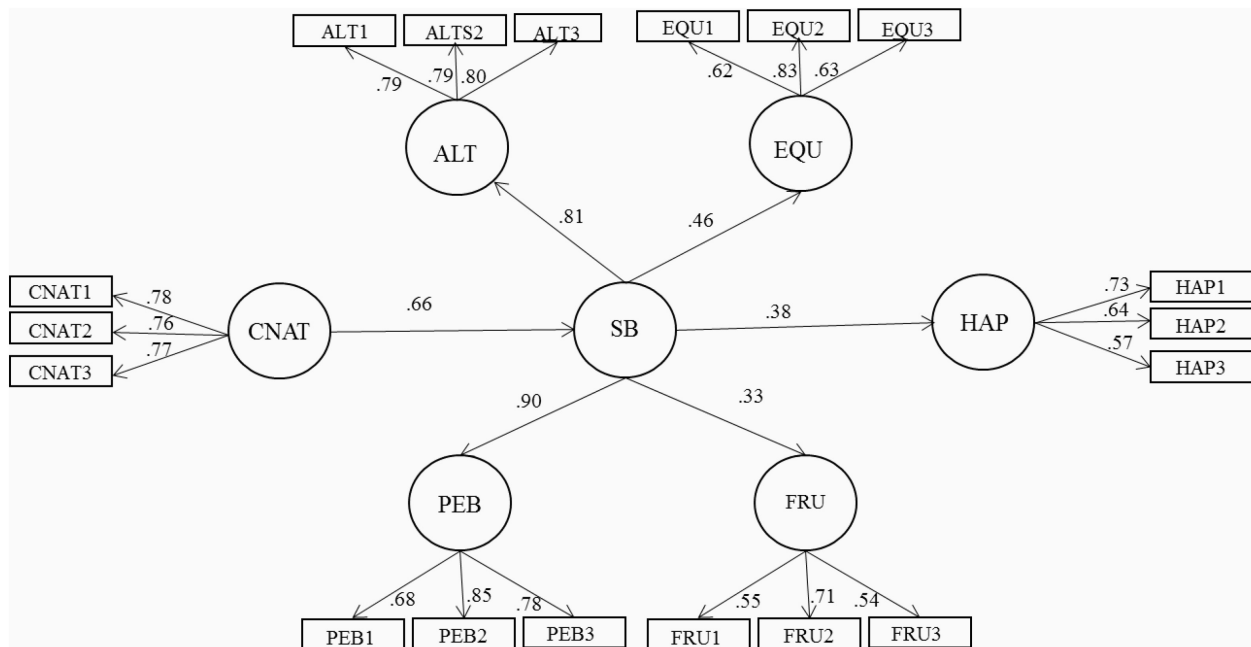


FIGURE 1 | Structural model of sustainable behavior and happiness, predicted by connectedness to nature. Goodness of fit: $\chi^2 = 203.26$ (125 d.f.) $p = 0.000$, $BBNFI = 0.90$, $BBNNFI = 0.94$, $CFI = 0.95$, $RMSEA = 0.04$; R^2 Sustainable behavior = 0.42; R^2 Happiness = 0.14.

for the lack of relationship between frugality and happiness could be that frugality may not have been voluntary, because although children influence consumption decisions, parents make the ultimate choice in these matters. Future studies may investigate this relationship by contrasting the correlations between happiness and voluntary frugality across age samples.

The findings of the model tested revealed that connectedness to nature impacts sustainable behaviors and that these result in happiness. This suggests that children who perceive themselves as more connected to nature tend to perform more sustainable behaviors, and the more pro-ecological, altruistic, frugal, and equitable the child is, the greater his or her perceived happiness will be. These results confirm findings presented in previous research carried out with adults, in the sense that connectedness to nature leads to performing protective behaviors for the sake of the physical (Nisbet and Zelenski, 2013; Geng et al., 2015; Bruni et al., 2017) and social environments (García et al., 2016, 2017), which in turn generate happiness (Corral-Verdugo et al., 2011; Tapia-Fonllem et al., 2013). However, none of those studies were focused on investigating these variables and the relationship between them in children; so, part of the purpose of this study was to contribute to fixing that gap in the specialized literature.

It is necessary to mention several limitations of this study: the number of participants, their age, and the fact that they lived in the same city; altogether, this makes it impossible to conclude that the sample is representative of the Mexican population aged 9 to 12 years. Besides, in spite of differences that may exist between socio-demographic data such as sex, age, and school grade, the results were not compared based on those characteristics. Furthermore, the use of self-report scales in the measurement

of variables presents disadvantages compared to other, more objective data-collection techniques (e.g. observations, third-party reports, behavioral traces). In addition, in the measurement of frugality, although children have the power to make family consumption decisions, parents are directly responsible for these behaviors. Finally, the correlational research design could also be considered as a limitation, given its restrictions compared with experimental studies.

Despite these limitations, the findings of this study provide an advance in the knowledge about the positive psychology of sustainability in children, deepening it into the relationships between connectedness to nature, sustainable behaviors, and happiness. Fraijo et al. (2012) highlight the intention to look after future generations and not only for the present one, which should be taken into consideration in the study of sustainable behaviors. This study was focused on children, because the need to foster love for nature in them is increasingly being recognized nowadays, as children will be the future caretakers of natural places, and because it is from the love to nature that arises the need to protect it (Bragg et al., 2013).

Future research could solve the limitations of the present study, replicate the findings, and address what was proposed by Otto and Pensini (2017), who suggest further investigation of nature-based environmental education to promote ecological motivation in people, connectedness to nature, and environmental knowledge as complementary factors of ecological behavior. In addition, the development of research focused on educational and recreational interventions based on nature, including long-term follow-up (Bragg et al., 2013), should be considered, as should the

documentation of tangible actions to move toward reconnection with nature, in order to collect evidence that supports and encourages these lines of research (Ives et al., 2018).

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

This study was reviewed and approved by the ethical board of Instituto Tecnológico de Sonora. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

REFERENCES

- Adams, S., and Savahl, S. (2017). Children's discourses of natural spaces: considerations for children's subjective well-being. *Child Indic. Res.* 10, 423–446. doi: 10.1007/s12187-016-9374-2
- Aragónés, T. J., and Américo, M. (2010). *Psicología Ambiental*. Madrid: Ediciones Pirámide.
- Bentler, P. M. (2006). *EQS, Structural Equations Program Manual*. Encino, CA: Multivariate Software Inc.
- Bragg, R., Wood, C., Barton, J., and Pretty, J. (2013). *Measuring Connection to Nature in Children Aged 8-12: A Robust Methodology for the RSPB*. Colchester: University of Essex.
- Bruni, C. M., Winter, P. L., Schultz, P. W., Omoto, A. M., and Tabanico, J. J. (2017). Getting to know nature: evaluating the effects of the get to know program on children's connectedness with nature. *Environ. Educ. Res.* 23, 43–62. doi: 10.1080/13504622.2015.1074659
- Capaldi, C., Dopko, R., and Zelenski, J. (2019). The psychological and social benefits of a nature experience for children: a preliminary investigation. *J. Environ. Psychol.* 63, 134–138. doi: 10.1016/j.jenvp.2019.05.002
- Cheng, J. C. H., and Monroe, M. C. (2012). Connection to nature: children's affective attitude toward nature. *Environ. Behav.* 44, 31–49. doi: 10.1177/0013916510385082
- Collado, S., Staats, H., and Corraliza, J. A. (2013). Experiencing nature in children's summer camps: affective, cognitive and behavioural consequences. *J. Environ. Psychol.* 33, 34–37. doi: 10.1016/j.jenvp.2012.08.002
- Corral, V. V. (2011). "Glosario de términos psicoambientales," in *Diccionario Temático De Psicología*, ed. C. García, (México: Trillas), 67–78.
- Corral-Verdugo, V., Mireles-Acosta, J. F., Tapia-Fonlle, C. O., and Fraijo-Sing, B. S. (2011). Happiness as correlate of sustainable behavior: a study of pro-ecological, frugal, equitable and altruistic actions that promote subjective wellbeing. *Hum. Ecol. Rev.* 18, 95–104.
- Fraijo, B. S., Corral, V. V., Tapia, C. F., and García, F. V. (2012). Adaptación y prueba de una escala de orientación hacia la sustentabilidad en niños de sexto año de educación básica. *Rev. Mexic. Invest. Educ.* 17, 1091–1117.
- García, F. V., Bello, M. E., and Ruvalcaba, J. M. (2017). Relaciones entre conductas pro-ecológicas, conectividad con la naturaleza, eco-afinidad y eco-conciencia en niños de primaria. *Trabajo Presentado en el XIV Congreso Nacional de Investigación Educativa*, San Luis Potosí.
- García, F. V., Durón, M. R., and Corral, V. V. (2016). Conectividad con la naturaleza y conducta sustentable: una vía hacia las conductas pro-sociales y pro-ambientales. *Rev. PSICUMEX* 6, 81–96. doi: 10.36793/psicumex.v6i2.289
- Geng, L., Xu, J., Ye, L., Zhou, W., and Zhou, K. (2015). Connections with nature and environmental behaviors. *PLoS One* 10:127247. doi: 10.1371/journal.pone.0127247
- Howard, B. C. (2013). *Connecting With Nature Boosts Creativity and Health*. Washington, D.C.: National Geographic.

AUTHOR CONTRIBUTIONS

CT-F and LB-H designed the project and supervised the findings of this study. MS-C and LB-H performed the data collection and analyzed the data. LB-H and SE-C wrote the manuscript with input from all other authors.

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- Ives, C. D., Abson, D. J., von Wehrden, H., Dorninger, C., Klaniecki, K., and Fischer, J. (2018). Reconnecting with nature for sustainability. *Sustainabil. Sci.* 13, 1389–1397. doi: 10.1007/s11625-018-0542-9
- Little, T., Cunningham, W., Shahar, G., and Widaman, K. (2002). To parcel or not parcel: exploring the question, weighing the merits. *Struct. Equ. Model.* 9, 151–173. doi: 10.1207/s15328007sem0902_1
- Lyubomirsky, S., and Lepper, H. (1999). A measure of subjective happiness: preliminary reliability and construct validation. *Soc. Indic. Res.* 46, 137–155. doi: 10.1023/A:1006824100041
- Mayer, F. S., and Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *J. Environ. Psychol.* 24, 503–515. doi: 10.1016/j.jenvp.2004.10.001
- Nisbet, E. K., and Zelenski, J. M. (2013). The NR-6: a new brief measure of nature relatedness. *Front. Psychol.* 4:813. doi: 10.3389/fpsyg.2013.00813
- Nisbet, E. K., Zelenski, J. M., and Murphy, S. A. (2009). The nature relatedness scale: linking individuals' connection with nature to environmental concern and behavior. *Environ. Behav.* 41, 715–740. doi: 10.1177/0013916508318748
- Olivos, P., Aragónés, J. I., and Navarro, O. (2013). Educación ambiental: itinerario en la naturaleza y su relación con conectividad, preocupaciones ambientales y conducta. *Rev. Latinoam. Psicol.* 45, 501–511.
- Olivos, P., and Clayton, S. (2017). "Self, nature and well-being: sense of connectedness and environmental identity for quality of life," in *Handbook of Environmental Psychology and Quality of Life Research*, eds G. Fleury-Bahi, and E. Pol, (Cham: Springer), 107–126. doi: 10.1007/978-3-319-31416-7_6
- Otto, S., and Pensini, P. (2017). Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behavior. *Glob. Environ. Change* 47, 88–94. doi: 10.1016/j.gloenvcha.2017.09.009
- Tapia-Fonlle, C. O., Corral-Verdugo, V. V., Fraijo-Sing, B. S., and Durón-Ramos, M. F. (2013). Assessing sustainable behavior and its correlates: a measure of pro-ecological, frugal, altruistic and equitable actions. *Sustainability* 5, 711–723. doi: 10.3390/su5020711
- Zylstra, M. J., Knight, A. T., Esler, K. J., and Le Grange, L. L. (2014). Connectedness as a core conservation concern: an interdisciplinary review of theory and a call for practice. *Springer Sci. Rev.* 2, 119–143. doi: 10.1007/s40362-014-0021-3

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Organic Learning Gardens in Higher Education: Do They Improve Kindergarten Pre-service Teachers' Connectedness to and Conception of Nature?

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Studies have shed light on the idea that people who have experiences in natural settings might be more aware of the environment. Learning gardens, as outdoor contexts, might contribute to the development of students' affective relations toward nature, pro-environmental attitudes, and protective actions; nevertheless, these aspects begging to be explored. This preliminary research investigates the impact that the use of organic gardens to teach natural sciences at university has on kindergarten pre-service teachers' (KPST) connectedness to and conceptions of nature. The research follows a pre-/post-design and it uses a mixed methods approach. A total of 74 students completed four quantitative scales (INS, CCC, LCN, and NR-6), and 66 of them an open question about the concept of nature. After the garden experience, students scored higher in all the scales, nevertheless the change was significant only for INS and CCC. The phenomenographic analysis evidenced an initial predominant static and non-social concept of nature, biased toward the most obvious biological elements. After the garden-based learning experience, more informed conceptions of nature – including notions of complexity and systemic character – increased from 7 to 19%; however, statistical comparison was not significant. In spite of the absence of concluding results, further research is required to assess the role that learning gardens may play regarding connectedness to nature and pro-environmental behaviors.

Keywords: nature, organic learning gardens, environmental concerns, pre-service teachers, connectedness to nature, phenomenography

INTRODUCTION

The existence of a global environmental crisis is scientifically established (Lewis and Maslin, 2015); if current world's population truly cares about future generations, the preservation of the planet appears as an obligation (Röckstrom and Karlberg, 2010). Thus, environmental education and sustainability education play a fundamental role in training citizens that are more aware of global change, and more environmentally responsible (Novo, 2017). Research supports that experiences in nature relate to the development of affective relations toward

nature, pro-environmental attitudes, and protective actions (Chawla, 2009; Collado et al., 2013; Zelenski et al., 2015; Evans et al., 2018). However, contact with nature is becoming more infrequent in an increasingly urbanized world where most of the population is urban (World Watch Institute [WWI], 2016), in such a way that access to natural settings is not always possible, particularly for young people (International Union for Conservation of Nature [IUCN], 2016). The loss of human–nature interactions was reported 20 years ago and it is increasing, resulting in both the diminution of a range of benefits related to health and wellbeing, and in positive emotions, attitudes, and behaviors toward the environment (Soga and Gaston, 2016).

Since “direct experience of nature plays a significant, vital, and perhaps irreplaceable role in affective, cognitive, and evaluative development” (Kahn and Kellert, 2002, p.139), the need to increase education in nature or to naturalize school environments has been emphasized by International Union for Conservation of Nature [IUCN] (2016). There is empirical evidence of how outdoor classrooms increases wellbeing and boost subsequent classroom engagement (Kuo et al., 2018; Largo-Wight et al., 2018), and on the impacts of greening schoolyards on children’s health and wellbeing (Dyment and Reid, 2005; Johnson, 2007; Kelz et al., 2013; Dijk-Wesselius et al., 2018). Similarly, learning gardens are expected to allow children gaining outdoor learning experiences (Williams and Dixon, 2013; Sanders et al., 2018; Zelenika et al., 2018), and an incipient research shows their impacts on health (Dyg and Wistoft, 2018), including university students (Retzlaff-Fürst, 2016).

In Spain, the number of learning gardens is growing at primary and middle schools, and they are also being used as a context for natural sciences teaching in Higher Education, particularly for initial teacher training. Thus, University Organic Learning Gardens (UOLGs) allow students to experience sustainable land practices and encourage them to become aware of the need for nature conservation from cognitive, procedural, and affective dimensions (Eugenio and Aragón, 2016; Eugenio et al., 2018; Eugenio-Gozalbo et al., 2020). Pre-service teachers might become a key to spread knowledge and transfer pro-environmental values and skills to forthcoming generations, since whenever teachers perceive that implementing outdoor experiences result in school improvement (Sahrakhiz, 2017) and that support is given to them to further integrate the green schoolyard as a learning environment (Dijk-Wesselius et al., 2020).

Regarding the cognitive dimension, *Nature*, this is a widely used concept in both academic and daily languages, which has gained complexity over the time (Sharma and Buxton, 2018). Research highlights that students at different educational stages treat *nature* as synonymous of *environment*, and hold a range of *conceptions of nature*, from very simplistic (place for animals and plants to live), to more complex (dynamic domain with a diversity of biotic and abiotic elements, including humans, in relationships of mutual interdependence) (Loughland et al., 2002; Payne et al., 2014). In spite of this, students develop distinct perceptions, attitudes, and values about the natural world and the role people play in it, and they show inclination to protect and treat it with respect (Sharma and Buxton, 2018).

In this preliminary research, we aim to assess whether or not the use of UOLGs as learning contexts from where teaching natural sciences may influence cognitive and emotional dimensions of students’ relation with nature. Concretely, we will evaluate effects of compulsory natural sciences programs on connectedness to and the concept of nature in kindergarten pre-service teachers (KPST).

MATERIALS AND METHODS

Participants

A total of 74 KPST participated in this study enrolled in one of the two compulsory natural sciences programs that took place during a semester and used an UOLG as a main setting for practical science lectures. The two programs corresponded to two equivalent subjects of the Degrees in Pre-School Teacher Training in two universities. Both subjects met the official scientific curriculum for pre-school education and use an university garden that constitutes living laboratory where learning and experimenting with living beings and processes. Garden facilities are similar and conformed by a cultivate area, a tool house, and composting drawers. Students at both programs work in groups on gardening tasks for 2-h sessions a total of about six or seven times during the course. In class sessions, a total 44 participants took part in Program 1 (University of the Basque Country) and 30 enrolled in Program 2 (University of Valladolid). From all participants, 67 were female and 7 were male ($M_{\text{age}} = 22$ years; $SD = 2.1$).

Measures

This research follows a mixed methodology to explore connections with the natural environment among KPST. As Creswell (2014) suggests, this procedure enables to deeper understand research question; in this regard, quantitative data would be better explained with qualitative ones. In this study, participants completed a questionnaire composed of several Likert scales aiming to measure cognitive, emotional, and attitudinal aspects of their connection to nature. Concretely, the whole sample filled up seven-point Likert scales: *Inclusion of Nature in Self-Scale* (INS) (Schultz, 2001), the *Love and Care for Nature Scale* (LCN) (Perkins, 2010), the *Nature Relatedness* (NR-6 Spanish version) (Pasca García, 2019), and a five-point Likert three-item scale about Climate Change Concerns (CCC)¹. Additionally, an open question was used to explore the cognitive dimension: *Imagine you are the teacher of Year-9 class and you need to explain what nature is. Please write down the way you would explain it to your students*. All measures were completed at the beginning and at the end of the science programs.

Data Analysis

Firstly, several mean comparison analyses were conducted with SPSS 20.0 software for all the quantitative scales ($N = 74$). Secondly, the open question was analyzed basing on a

¹CCC’s items: Item 1, *Climate change is real*; Item 2, *Climate change impacts my daily life*; and Item 3, *Usually, I behave pro-environmentally*.

phenomenographic approach (Marton, 1988, 2015) ($N = 66$ due to missing values). A final system of nine hierarchic categories of growing complexity was defined enclosing the whole range of KPST's *conceptions of Nature*. The degree of agreement reached between two researchers regarding allocation of each nature definition (Cohen's Kappa reliability coefficient average 0.92) fell within the suggested range. A detailed description of the phenomenographic procedure is enclosed in the **Supplementary Material**. Finally, using the nine categories, a Wilcoxon signed ranks test was done to compare the complexity of the definitions before and after the intervention.

RESULTS

Quantitative Data Analyses: Connectedness to Nature

For all the scales, participants considerably agreed, and higher values are found on the CCC scale (Tables 1, 2). The reliability analyses showed good adequacy for LCN and NR-6: Cronbach's alpha was >0.8 , meaning that these two scales have high consistency and they are adequate to measure connectedness to nature. Nevertheless, the reliability analysis for the CCC scale showed a Cronbach's α of 0.66, indicating that the instrument is acceptable (Nunnally and Bernstein, 1994). Additional, several factor analyses were run resulting in one dimension scales (Tables 1, 2).

In order to identify differences between programs, an ANOVA was conducted, and non-significant differences were

TABLE 1 | Statistics, internal consistency for the four scales, and total variance explained for pre-test measures ($N = 74$).

Scale	Number of items	Pre-test				Total variance explained
		<i>M</i>	<i>SD</i>	Cronbach's α		
INS	1	4.82	1.502	–	–	–
LCN	14	5.44	0.929	0.97		67.9
NR-6	6	5.03	0.988	0.88		62.6
CCC	3	4.23	0.555	0.66		60.3

INS, Inclusion of Nature in Self scale; LCN, Love and Care for Nature scale; NR-6, Nature Relatedness scale; CCC, five-point Likert three-item scale about Climate Change Concerns.

TABLE 2 | Statistics, internal consistency for the four scales, and total variance explained for post-test measures ($N = 74$).

Scale	Number of items	Pre-test				Total variance explained
		<i>M</i>	<i>SD</i>	Cronbach's α		
INS	1	5.30	1.331	–	–	–
LCN	14	5.51	0.918	0.97		69.2
NR-6	6	5.13	1.040	0.92		72.2
CCC	3	4.38	0.482	0.62		58.5

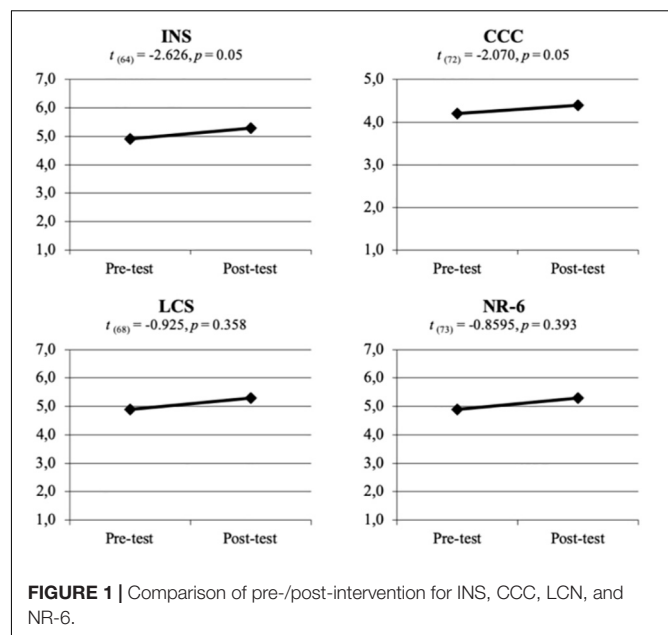


FIGURE 1 | Comparison of pre-/post-intervention for INS, CCC, LCN, and NR-6.

found. Therefore, the comparisons before and after the intervention using OLGs was conducted with then whole sample. Comparisons pre/post showed significant differences for the INS ($t_{(64)} = -2.626, p = 0.05$) and the CCC ($t_{(72)} = -2.070, p = 0.05$) scales, but not for the LCN and NR-6 scales (Figure 1).

Qualitative Data Analyses: Conceptions of Nature

Kindergarten pre-service teachers' *conceptions of nature* were classified into nine categories corresponding to qualitatively different visions. Such categories were arranged to show the most important qualitative differences between conceptions, and from the least to the most inclusive and informed view (Table 3).

Kindergarten pre-service teachers who described *nature* using *conceptions 1 to 5* understand it as a *static entity*, exclusively enlisting various bio and/or physical elements. From these static conceptions, some referred to *nature* as untouched or unmodified by humans (*static pristine conceptions of nature*: C1 and C2), while others did not explicitly acknowledge this aspect (*static non-pristine conceptions*: C3–C5). Finally, some of these students acknowledged the change and diversity of nature (C5).

Kindergarten pre-service teacher who described *nature* using *conceptions 6 to 9* go beyond and describe it as a *dynamic entity*. From these dynamic conceptions, some focused exclusively on value-oriented human to nature interactions (*utilitarian-C6, preservation-C7, or utilitarian + preservation-C8*), whereas others showed a more informed ecological view (*systemic-C9*).

Kindergarten pre-service teacher who showed the most comprehensive *conception of nature* (C9) consider it as a series of relations between different earth systems, beyond the human-to-nature interactions. This view was systemic and complex, at least partially, and it is the most aligned with contemporary *scientific conceptions*.

TABLE 3 | Categorization of the main KPST's conceptions about nature that were unveiled by means of phenomenographic analyses.

			Pre % (n)	Post % (n)
Static	Pristine		19.7 (13)	21.2 (14)
		C1-Bio(or)Physical pristine	9.1 (6)	4.5 (3)
	Non-pristine	C2-Biophysical pristine	10.6 (7)	16.7 (11)
			42.4 (28)	37.9 (25)
		C3-Bio(or)Physical	18.2 (12)	21.2 (14)
		C4-Biophysical	13.6 (9)	10.6 (7)
Dynamic	Only human-nature interactions	C5-Biophysical diverse	10.6 (7)	6.1 (4)
			30.3 (20)	21.2 (14)
		C6-Utilitarian	10.6 (7)	7.6 (5)
		C7-Preservation	6.1 (4)	6.1 (4)
	Interactions among components of a complex system	C8-Utilitarian + preservation	13.6 (9)	7.6 (5)
			7.6 (5)	19.7 (13)
		C9-Systemic	7.6 (5)	19.7 (13)

KPSTs, kindergarten pre-service teachers. Bold values represent subcategories totals.

A detailed description of the categories and examples of each are provided as **Supplementary Material**.

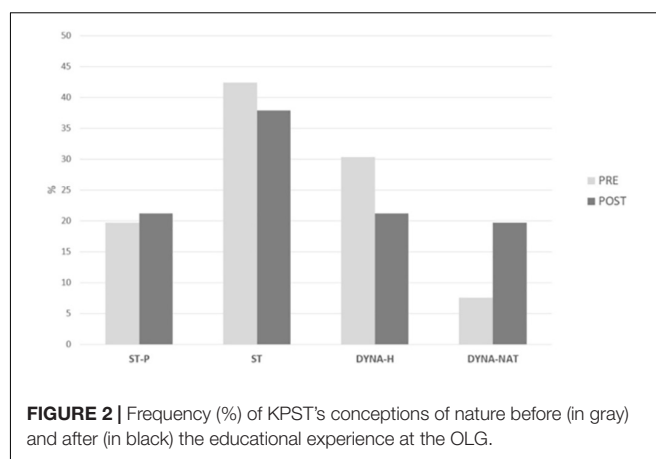
Initial results outline a predominant *conception of nature* which was not only static (62.1%), but also non-social and biased toward the most obvious elements. Concretely, only around 14% of KPST explicitly enclose humans into *nature*. The elements that are mentioned mainly correspond to the biosphere (“plants and animals”), while those corresponding to other earth systems are anecdotal, such as the references to the hydrosphere, the geosphere, or the atmosphere. Final results showed some changes, therefore, whereas the percentage of static views reduced the dynamic views increased ($\pm 3\%$). Outstandingly, the frequency of the most comprehensive *conception of nature* (C9) increased in 2.6 times.

In order to compare the conceptions of nature before and after the intervention, a Wilcoxon signed ranks test revealed non-significant differences pre/post when considering the complete system of nine categories ($z = -0.734$, $p = 0.463$).

Figure 2 shows the frequency of KPST's *conceptions of nature* as grouped according to four main categories: *Static pristine* (ST-P) (C1 and C2); *static non-pristine* (ST) (C3–C5); *dynamic only human–nature interactions* (DYNA-H) (C6–C8); and finally, *dynamic interactions among components of a complex system* (DYN-NAT) (C9).

DISCUSSION

This preliminary study aims to assess the impact that using UOLGs for practical science lessons may have on the emotional and cognitive dimensions of KPST's relation

**FIGURE 2 |** Frequency (%) of KPST's conceptions of nature before (in gray) and after (in black) the educational experience at the OLG.

with nature. Research studying educational experiences in natural environments uses quantitative (Kuo et al., 2018; Largo-Wight et al., 2018) or qualitative methods (Williams and Dixon, 2013), we follow a mixed methods approach, including quantitative analyses and a phenomenographic exploration to better understand the impact of the interventions. Regarding connectedness to nature, KPST considered themselves as relatively connected to nature, and their score values placed around five, higher than those found in other studies with Spanish undergraduates (Olivos and Aragonés, 2011; Amérigo et al., 2012). After taking part in the program, scores for the four scales increased, nonetheless significant differences were only identified for the INS and the CCC scales. Two ideas underline this result: one related to measure design and another linked to evaluated aspects. Firstly, KPST might be more willing to complete simple and graphic scales, such as the INS (Martin and Czellar, 2016), hence the drawing representation of *nature* and *self* might facilitate them to consider how much connected to the environment they feel, and such connection significantly increased. Secondly, in comparison to LCN and NR-6, INS and CCC measure more cognitive than emotional and attitudinal aspects; and significant differences were only shown for the cognitive dimension. This fact might indicate that, after the experience in the OLG, participants were more conscious on their connection to the natural environment but not more affectively connected.

The significant differences found in quantitative measures relate somehow with the *conceptions of nature* held by KPST. The predominant initial *conception of nature* was mainly static, simplistic, non-social, and biased toward the most obvious natural elements. These results are similar to those reported in previous studies with students from different educational levels (Loughland et al., 2002; Payne et al., 2014), including KPST (Flogaitis and Agelidou, 2003). Similarly, previous research indicates that most students encountered difficulties with understanding nature as a complex and dynamic Earth system (Eilam, 2012; Sharma and Buxton, 2018). In our study, a previously reported tendency of students to exclude humans from their conception of the natural world (Shepardson et al., 2007; Li and Ernst, 2015) was also identified. The existence of a conceptual dichotomy between “nature” and “culture,” also

named “human–nature binary,” has been widely discussed and considered characteristic of a western worldview in the modern era (Castree, 2013), but not universal (Descola, 2013). This is closely related to the *utilitarian* view that was shown by part of the students, which had also been identified in Sharma and Buxton’s (2018) research. Nevertheless, Li and Ernst (2015) reported that students could simultaneously show the inclination to protect and treat nature with respect, as it was the case for the students in C8.

After the garden experience, changes occurred mostly from conceptions included in the groups *static non-pristine* (C3–C5) and *dynamic only human–nature interactions* (C6–C8), in such a way that the number of definitions allocated into C9 (*Systemic*) increased from 7 to 19% of the total students. Relevant concepts of Ecology and Environmental Sciences, such as “cycles,” “ecosystem,” “global,” “interdependence,” or “biodiversity” appeared in the final KPTS’ definitions of nature, in line with previous findings on the use of UOLGs in Education for Sustainability (Eugenio et al., 2018). Albeit this increase, when the whole category system was quantitatively evaluated, non-statistically significant differences appeared.

CONCLUSION

Overall, KPST showed connection to nature, more related to cognitive than to emotional or attitudinal aspects, and their conceptions of nature seem to be predominantly simplistic. This might indicate that even though participants reported to be connected to nature, their idea about nature does not include a complex relation between all the living and non-living things and the processes and interactions occurring. Considering this idea, it seems that more research in OLG should be done to promote attachment, care, and love toward the environment, since attitudinal and emotional aspects of the environment link to pro-environmental behaviors (Schultz, 2001; Zelenski et al., 2015). From the point of view of science education, it is relevant to promote the evolution of students’ *conceptions of nature* toward a global, systemic, and multidimensional view. Flogaitis and Agelidou (2003) found that environmental education programs were not able to influence KPST’s *conceptions of nature*. It is known that learners’ conceptions are rooted systems of persistent ideas, which result difficult to change and thus remain even through different educational stages, coexisting in children and young of varying ages (Taber, 2015). Further efforts to better teach the complex, comprehensive, and macroscale aspects of the nature concept are undoubtedly necessary and valuable, particularly for initial teacher training. Additionally, research

in the area should be conducted to understand the intricate relations between experience the natural environment and the connectedness and conception of nature.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ME-G and RP-L designed the study. Data were collected by ME-G, RP-L, and DZ. The data were analyzed by RP-L, DZ, and AR-G. All authors wrote the manuscript.

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SUPPLEMENTARY MATERIAL

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REFERENCES

- Américo, M., Aragonés, J. I., and García, J. A. (2012). Explorando las dimensiones de la preocupación ambiental. Una propuesta integradora. *Psycology* 3, 299–311. doi: 10.1174/217119712802845705
- Castree, N. (2013). *Making Sense of Nature*. New York, NY: Routledge.
- Chawla, L. (2009). Growing up green: becoming an agent of care for the natural world. *J. Dev. Process.* 4, 6–23.
- Collado, S., Staats, H., and Corraliza, J. A. (2013). Experiencing nature in children’s summer camps: affective, cognitive and behavioural consequences. *J. Environ. Psychol.* 33, 37–44. doi: 10.1016/j.jenvp.2012.08.002
- Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 4th Edn. Thousand Oaks, CA: Sage.
- Descola, P. (2013). *Beyond nature and Culture*. Chicago, IL: University of Chicago Press.

- Dijk-Wesselius, J. E., Berg, A. E., van den Maas, J., and Hovinga, D. (2020). Green schoolyards as outdoor learning environments: barriers and solutions as experiences by primary school teachers. *Front. Psychol.* 10:2919. doi: 10.3389/fpsyg.2019.02919
- Dijk-Wesselius, J. E., van Maas, J., Hovinga, D., Vugt, M., and van Berg, A. E. (2018). The impact of greening schoolyards on the appreciation, and physical, cognitive and socio-emotional well-being of schoolchildren: a prospective intervention study. *Landsc. Urban Plan.* 180, 15–26. doi: 10.1016/j.landurbplan.2018.08.003
- Dyg, P. M., and Wistoft, K. (2018). Wellbeing in school-gardens – the case of the Garden for Bellies food and environmental education program. *Environ. Educ. Res.* 24, 1177–1191. doi: 10.1080/13504622.2018.1434869
- Dymont, J. E., and Reid, A. L. (2005). Breaking new ground? reflections on greening school grounds as sites of ecological, pedagogical, and social transformation. *Can. J. Environ. Educ.* 10, 286–301.
- Eilam, B. (2012). System thinking and feeding relations: learning with a live ecosystem model. *Instr. Sci.* 40, 213–239. doi: 10.1007/s11251-011-9175-4
- Eugenio, M., and Aragón, L. (2016). Experiencias en torno al huerto ecológico como recurso didáctico y contexto de aprendizaje en la formación inicial de maestros de Infantil. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias* 13, 667–679. doi: 10.25267/Rev_Eureka_ensen_divulg_cienc.2016.v13.i3.11
- Eugenio, M., Zuazagoitia, D., and Ruiz-González, A. (2018). Huertos EcoDidácticos y Educación para la Sostenibilidad. *Experiencias educativas para el desarrollo de competencias del profesorado en formación inicial. Revista Eureka sobre Enseñanza y Divulgación de las Ciencias* 15, 1501. doi: 10.25267/Rev_Eureka_ensen_divulg_cienc.2018.v15.i1.1501
- Eugenio-Gozalbo, M., Pérez-López, R., and Tójar-Hurtado, J. C. (2020). Identifying key issues for university garden-based learning practitioners in Spain. *J. Environ. Educ.*
- Evans, G. W., Otto, S., and Kaiser, F. G. (2018). Childhood origins of young adult environmental behavior. *Psychol. Sci.* 29, 679–687. doi: 10.1177/0956797617741894
- Flogaitis, E., and Agelidou, E. (2003). Kindergarten teachers' conceptions about nature and the environment. *Environ. Educ. Res.* 9, 461–478. doi: 10.1080/1350462032000126113
- International Union for Conservation of Nature [IUCN]. (2016). *Navigating Island Earth: The Hawaii's Commitments*. Available online at: <https://www.hawaiiconservation.org/our-work/iucn-hawaii-commitments/>
- Johnson, P. (2007). Growing physical, social, and cognitive capacity: engaging with natural environments. *Int. Educ. J.* 8, 293–303.
- Kahn, P. H., and Kellert, S. I. R. I. (eds) (2002). *Children and Nature: Psychological, Sociocultural, and Evolutionary investigations*. Cambridge, MA: MIT press.
- Kelz, C., Evans, G. W., and Röderer, K. (2013). The restorative effects of redesigning the schoolyard: a multi-methodological, quasi-experimental, study in rural Austrian middle schools. *Environ. Behav.* 47, 119–139. doi: 10.1177/0013916513510528
- Kuo, M., Browning, M. H. E. M., and Penner, M. L. (2018). Do lessons in nature boost subsequent classroom engagement? refueling students in flight. *Front. Psychol.* 8:2253. doi: 10.3389/fpsyg.2017.02253
- Largo-Wight, E., Guardino, C., Wludyka, P. S., Hall, K., Wight, J. T., and Merten, J. W. (2018). Nature contact at school: the impact of an outdoor classroom on children's well-being. *Int. J. Environ. Health Res.* 28, 653–666. doi: 10.1080/09603123.2018.1502415
- Lewis, S. L., and Maslin, M. A. (2015). Defining the anthropocene. *Nature* 519, 171–180. doi: 10.1038/nature14258
- Li, J., and Ernst, J. (2015). Exploring value orientations toward the human-nature: a comparison of urban youth in Minnesota, USA and Guangdong, China. *Environ. Educ. Res.* 21, 556–585. doi: 10.1080/13504622.2014.910499
- Loughland, T., Reid, A., and Petocz, P. (2002). Young people's conceptions of environment: a phenomenographic analysis. *Environ. Educ. Res.* 8, 187–197. doi: 10.1080/13504620220128248
- Martin, C., and Czellar, S. (2016). The extended inclusion of nature in self scale. *J. Environ. Psychol.* 47, 181–194. doi: 10.1016/j.jenvp.2016.05.006
- Marton, F. (1988). Phenomenography: a research approach to investigating different understandings of reality. *Q. Res. Educ.* 21, 143–161. doi: 10.1177/104973299129121794
- Marton, F. (2015). *Necessary Conditions of Learning*. New York, NY: Routledge.
- Novo, M. (2017). *La Educación Ambiental: Bases Éticas, Conceptuales y Metodológicas*. Madrid: Editorial Universitas.
- Nunnally, J. C., and Bernstein, I. H. (1994). *Psychometric theory*, 3rd Edn. New York, NY: McGraw-Hill.
- Olivos, P., and Aragón, J. I. (2011). Propiedades psicométricas de la Escala de Identidad Ambiental (EID). *Psychology* 2, 65–74. doi: 10.1174/217119711794394653
- Pasca García, L. (2019). *Naturaleza, Conectividad y bienestar*. Doctoral dissertation. E-prints Complutense (ID Code: 55335).
- Payne, P., Cutter-Mackenzie, A., Gough, A., Gough, N., and Whitehouse, H. (2014). Children's conceptions of nature. *Austr. J. Environ. Educ.* 30:68. doi: 10.1017/ae.2014.26
- Perkins, H. E. (2010). Measuring love and care for nature. *J. Environ. Psychol.* 30, 455–463. doi: 10.1177/0146167298243005
- Retzlaff-Fürst, C. (2016). Biology education & health education: a school garden as a location of learning & well-being. *Univ. J. Educ. Res.* 4, 1848–1857.
- Röckstrom, J., and Karlberg, L. (2010). The quadruple squeeze: defining the safe operating space for freshwater use to achieve a triply green revolution in the Anthropocene. *AMBIO* 39, 257–265. doi: 10.1007/s13280-010-0033-4
- Sahrakhiz, S. (2017). The 'outdoor school' as a school improvement process: empirical results from the perspective of teachers in Germany. *Int. J. Prim. Elem. Early Years Educ.* 46, 3–13.
- Sanders, D. L., Ryken, A. E., and Stewart, K. (2018). Navigating nature, culture and education in contemporary botanic gardens. *Environ. Educ. Res.* 24, 1077–1084. doi: 10.1080/13504622.2018.1477122
- Schultz, P. W. (2001). The structure of environmental concern: concern for self, other people, and the biosphere. *J. Environ. Psychol.* 21, 327–339. doi: 10.1006/jevp.2001.0227
- Sharma, A., and Buxton, C. (2018). "The received curriculum: nature as understood by students," in *The Natural World and Science Education in the United States*, eds A. Sharma, and C. Buxtons, (London: Palgrave Macmillan), 149–167. doi: 10.1007/978-3-319-76186-2_6
- Shepardson, D. P., Wee, B., Priddy, M., and Harbor, J. (2007). Students' mental models of the environment. *J. Res. Sci. Teach.* 44, 327–348. doi: 10.1002/tea.20161
- Soga, M., and Gaston, K. J. (2016). Extinction of the experience: the loss of human-nature interactions. *Front. Ecol. Environ.* 14:94–101. doi: 10.1002/fee.1225
- Taber, K. S. (2015). "Alternative conceptions/frameworks/misconceptions," in *Encyclopedia of Science Education*, ed. R. Gunstone, (Dordrecht: Springer), 37–41. doi: 10.1007/978-94-007-2150-0_88
- Williams, D. R., and Dixon, P. S. (2013). Impact of garden-based learning on academic outcomes in schools: synthesis of research between 1990 and 2010. *Rev. Educ. Res.* 83, 211–235. doi: 10.3102/0034654313475824
- World Watch Institute [WWI], (2016). *La Situación del Mundo 2016: Nuestro Futuro Urbano. Informe Anual del Worldwatch Institute sobre el Progreso Hacia una Sociedad Sostenible*. Icaria: Barcelona.
- Zelenika, I., Moreau, T., Lane, O., and Zhao, J. (2018). Sustainability education in a botanical garden promotes environmental knowledge, attitudes and willingness to act. *Environ. Educ. Res.* 24, 1581–1596. doi: 10.1080/13504622.2018.1492705
- Zelenski, J. M., Dopko, R. L., and Capaldi, C. A. (2015). Cooperation in our nature: nature exposure may promote cooperative and environmentally sustainable behavior. *J. Environ. Psychol.* 42, 24–31. doi: 10.1016/j.jenvp.2015.01.005

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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School Environments and Elementary School Children's Well-Being in Northwestern Mexico

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School environment refers to the set of relationships that occur among members of a school community that are determined by structural, personal, and functional factors of the educational institution, which provide distinctiveness to schools. The school environment is an important factor when evaluating student well-being. Previous findings have shown that variables such as physical, academic, and social dimensions influence school environments. This research seeks to explain the relationship between school environment and the well-being of primary education students. To carry out this research, a total of 405 students from four public elementary schools in northwestern Mexico were selected to participate. The instrument used to measure the variables and the relationship of school environment and well-being is based on the three dimensions of school environment proposed by Kutsyuruba et al. (2015): Physical, social, and academic. Statistical analyses were carried out to determine the reliability and validity of the measurement scales using SPSS V20 and EQS software. Confirmatory factor analysis models were tested to determine the construct validity of each scale; then, an analysis via structural equation modeling was made to form an explanatory model obtaining acceptable practical and statistical indicators. Among the relationships in this study, our research identified the variable of school environments as an outcome determined by physical, academic, and social factors. School environment and student well-being variables were also found to be correlated.

Keywords: school environment, well-being, positive school, children, elementary school

INTRODUCTION

The study of the physical, social, and academic (curricular) conditions of the environment and the administrative organization of schools have been related to school environments and the well-being of students (Corral-Verdugo et al., 2015). Nowadays, it has become more common to find empirical studies that identify the impact of school environments on student well-being. For example, safe school environments and student well-being have been found to be significantly and strongly interrelated variables on research of various kinds of students' needs (Kutsyuruba et al., 2015).

Primarily, research of positive school environment is focused on physical conditions: density, privacy, activity areas, open spaces, and, even, green areas. Some of the most researched effects from physical elements have been the ones resulting from noise, lighting and colors, temperature and humidity, decoration, and furniture, since they contain properties that have effects on people's behavior; nevertheless, despite having found evidence of these effects, the results are not considered entirely conclusive (Olivos and Amérigo, 2010). The quality of these conditions in

school infrastructure can have direct effects on the behavior and cognitive, social, and emotional development of children (Prescott and David, 1976; Wohlwill and Heft, 1987; Moore et al., 2003). In other words, the school space is considered a didactic agent that helps to offer optimal physical conditions for the development of the teaching-learning process. Likewise, it allows for the creation of an adequate environment for the development of students' abilities, fostering their autonomy as well as teacher motivation.

Romaña (1994) focused on the role that the environment takes as an object of attention for learning. There are three ideas about how it has been addressed: (a) conceiving the environment as an educator: the nature of physical elements of the environment as socializing agents themselves; (b) considering it as an educational object for the valuation and conservation of the environment, and (c) and conceiving it as an educational or didactic resource; in other words, as a pedagogical utility factor.

Olivos and Américo (2010) performed a historical review and background check on the study of the connection between environment and education and identified that it had been studied in the fields of pedagogy, where it had been called "environmental pedagogy" (Göttler, 1955) or "mesological pedagogy" (Zaniewski, 1952); and psychology, under the term "classroom ecology" (Sommer, 1967; Weinstein, 1979). Other authors have also underlined how the emotional dimension is an important component in the development of evaluation competences, such as for example, the aesthetic evaluation experience, and we argue that this component could also be relevant for the evaluation of school environments (e.g., Mastandrea, 2014; Mastandrea and Crano, 2019).

At the end of the 20th century, environmental psychology focused its attention on the study of school environments, specifically on aspects of practical conditions such as ergonomics and architecture, considering particular physical aspects of the school environment and its role in the process of teaching learning and even associating it with academic performance (Holahan, 1986; Gump, 1987; Bell et al., 1990; Gifford, 2007; Amedeo et al., 2008).

However, there are always challenges for the design and management of educational spaces and they overcome the traditional difficulties of improving the teaching-learning process in conflictful conditions resulting from social interaction within school environments. A wide range of studies has found a reduction of negative or violent behaviors that are usually present in schools are due to management changes in physical environments (Bosworth et al., 2011; Steffgen et al., 2013; Cornell et al., 2015). Current trends in educational intervention consider the promotion of positive personal interactions as a priority and as a cause or consequence of harmonious activities of the school with its environment, putting integration into practice (Corral-Verdugo et al., 2015).

It is in the second decade of the 21st century when special attention was paid to the study of school environments (Bernardes and Vergara, 2017), school climate (Wang and Degol, 2016; Maxwell et al., 2017) and its connection with student well-being (Bird and Markle, 2012; Borkar, 2016).

Currently, research on physical aspects in school environments has gained attention as a result of the theoretical

relevance of the human-environment link, the new conceptions about the importance of social interactions in the educational environment, and questions about the objectives of education in the modern world (Aldridge and McChesney, 2018; Lundberg and Abdelzadeh, 2019).

In existing literature, this has been an extensively investigated subject in an attempt to depict a complete model of school environments. We have not only taken into consideration the contributions of Thapa et al. (2013), who identify five dimensions that converge in security, social relations, teaching/learning, institutional environment (both physical and administrative), and process of school improvement; but also the ones from Bradshaw et al. (2014), who suggested that there are three elements that affect the formation of safe and supportive school models, including the variables of commitment, safety, and environment. Both reflect the evolution of research in this area; and, despite their success in the identification of some relevant dimensions of school environment, they still suffer from a lack of variables to consider.

Particularly, as a basis for this study, we reference the contributions of Kutsyuruba et al. (2015) which, as a result from an exhaustive review of published empirical evidence, conclude in a common axis categorization of the school environment named "dimensions of the school climate" that consists of three main categories: (a) physical, refers to the condition of school facilities, the environmental quality of schools, and their relationship with the educational performance and behavior of students; (b) academic, where it is mentioned that the personal skills and characteristics of teachers serve as factors for the development of their students; and finally, (c) social, this specific category suggests that the quality of relationships between members of the school community is fundamental in the configuration of the school climate. These categories shape a conceptual framework that can be regarded as a multidimensional construction of the components and conditions of a positive or safe school environment (Kutsyuruba et al., 2015).

Our study incorporates and integrates these three dimensions into a variable called school environment and evaluates its impact on student well-being. The participating population consists of children from fifth and sixth grade of primary education in Hermosillo, Mexico. **Figure 1** shows the hypothetical model of variable correlations under study, where we propose that the physical dimension comprises the classroom, playground, and library elements; that the academic dimension consists of variables related to students, teaching methodology, didactic strategies, and evaluation; and the social dimension is constituted by justice, sustainability, and social behavior.

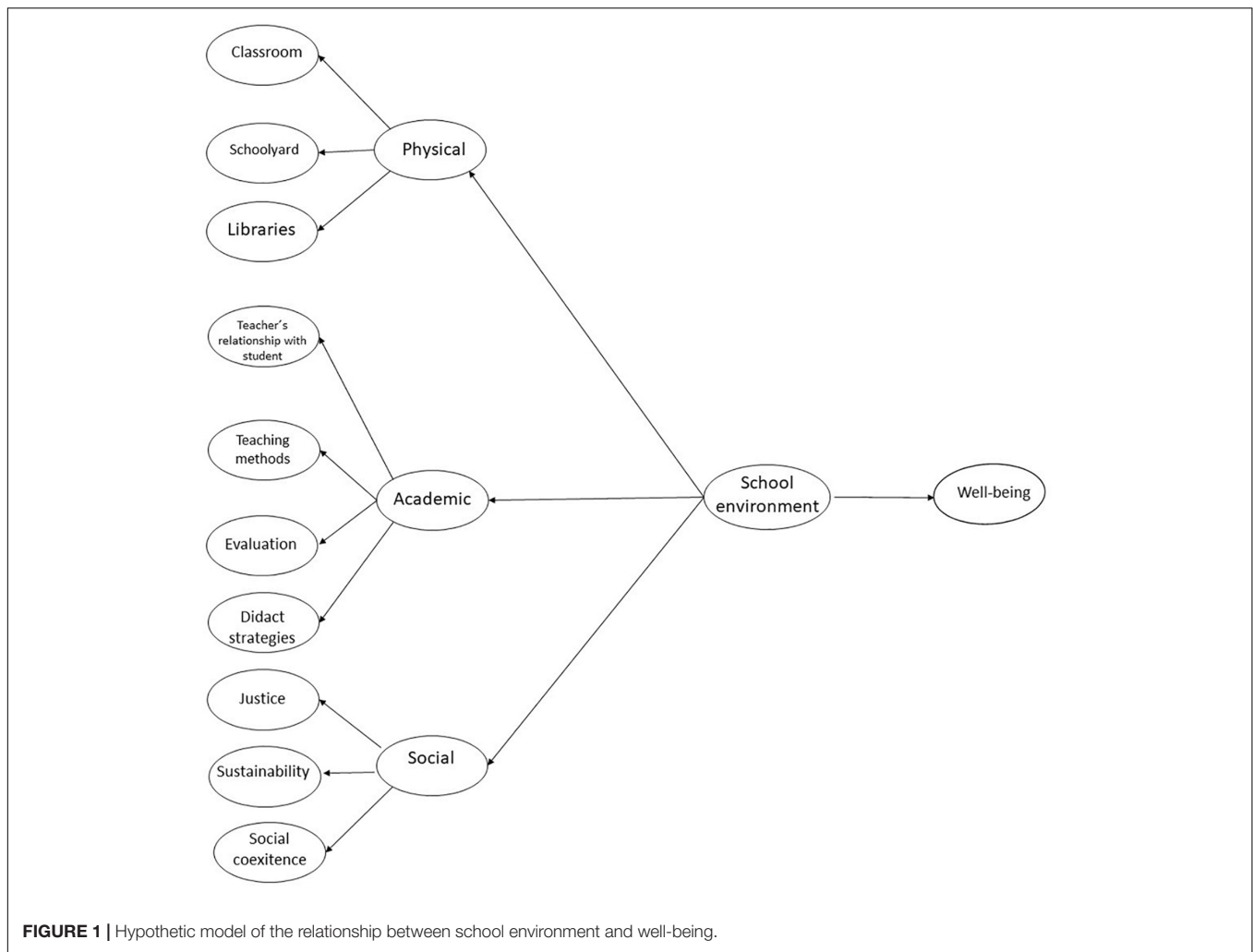
CONCEPTUALIZATION OF CATEGORIES IN THE STUDY

School Environment

Physical

Classroom

Space for the delivery of materials that correspond to the areas of basic knowledge where students and teachers interact with



furniture that enables individual or group work. Recently it has been mentioned that specific characteristics of the classroom's physical environment are related to student satisfaction, attitudes, and evaluation of the quality of the course (Fraser, 2015; Han et al., 2019).

School yard

Spaces in which students perform educational, civic, recreational, and food-related activities. In a recent study, Dilbil and Basaran (2017) argue that playgrounds positively affected cognitive development and levels of attachment of children to school.

Libraries

Space that is well-conditioned to read, learn, and consult a bibliographic collection belonging to the school community where students can interact and work. Schultz-Jones (2011) conducted a study to explain how an evaluation of the learning environment of the school library can be used to demonstrate a positive impact on student performance.

Student relationship

In the educational context, the teacher–student relationship is one of the most outstanding academic interactions at the core of the teaching–learning process. Even though this interaction is

composed by many other elements, this relationship is the one that plays the most important role when it comes to meeting educational objectives (Bertoglia, 2008). Affective teacher–student communication and interaction plays an important role in building a teacher–student support relationship and a positive classroom environment (Roorda et al., 2011; Poulou, 2014).

Teaching methods

The didactic methods are part of the methodological aptitudes that a trainer must have. This means that these types of methods will influence the degree of intervention of the trainer on the student (Calvo, 2006). Teachers' classroom management practices have a direct impact on the probability of success of their students (Gage et al., 2018). Classroom management and methods are a major challenge for teachers and school administrators, often qualified as the main area of concern for teachers and the most common reason why many choose to leave their profession. Recently, academic research on emotional health, especially during the early years of childhood, has had a greater interest in social and emotional learning and its relationship with the improvement of student behavior (Caldarella et al., 2012).

Evaluation

For Bordas and Cabrera (2001), an evaluation system within the classroom will be convenient as long as the students feel like active agents; learn to value their actions and learning, know and understand the curricular objectives; as well as understand the aspects of evaluation in certain tasks. Since the data that teachers receive from their evaluation serve as references for the future, it is necessary to think more deeply about the content of these evaluations, in addition to how we can create conditions for teachers to use this evaluation to inform their instructional methods (Datnow and Hubbard, 2015).

Teaching strategies

The term strategy implies reflexive planning to do something by applying any general model used in the classroom (Orlich et al., 2012). Previous studies have concluded that teachers in primary education use different teaching strategies as students gain knowledge through experience, participation in education, express their opinion, and solve problems (Hus and Grmek, 2011).

Social

Justice

Konow (2003) refers to justice as a virtue that is attached to what is morally correct, concerning the ethics, rationality, natural law, equity, or religion in which they base their foundations.

Sustainability

Regarding sustainability, it is important to mention that there are two studies that have prioritized the analysis of sustainable or environmental education. These are "Literature on Environmental Education" (De Castro, 2010) and "Education for Sustainability" by Corral (2010) which required this component to focus more on environmental protection behaviors, forgetting the point that students can obtain various types of benefits when practicing sustainable behaviors (Corral-Verdugo et al., 2015).

Social coexistence

Refers to the way students relate with others and how those relationships have important consequences in his/her personal development. Ponferrada-Arteaga and Carrasco-Pons (2010) explain that the emotional expectations that students have about their own school and the degree of recognition and legitimization of the differences manifested by the practices of the school institution influence how students deal with each other at school. A study made by Tian et al. (2016) shows that social support experienced in school is significantly related to subjective well-being.

Well-Being

Well-being is often interpreted as growth and human satisfaction; it is deeply influenced by the surrounding contexts of people's lives and, as such, the opportunities for self-realization (Ryff and Singer, 2008). Well-being incorporates the challenges that individuals face in their attempts to fully function and realize their potential (Keyes, 2006; Medina-Calvillo et al., 2013).

One of the reasons why this topic was chosen is because literature that analyzes the conditions of school environments at

the basic level requires empiric evidence that proves its impact in children well-being.

MATERIALS AND METHODS

The main objective of the study was to test a model where the variable "school environment" is determined by physical, academic, and social dimensions. Our variables were "school environment" and "well-being." The aim of the study focused on a correlational methodology with the purpose of measuring the degree of relationship between the variables mentioned above (Sampieri et al., 1998). It also has a non-experimental design, since the phenomenon was experienced and measured as it occurred in its natural context. We employed an instrument consisting of different scales that evaluate each of the variables and constructions of the model (**Supplementary Data Sheet 1**).

Participants

Four primary schools at the primary level were evaluated, two of them public and two private, all in the city of Hermosillo, Mexico. A total of 405 students were surveyed, 212 females and 193 males, aged between 10 and 12. At the time of the study, the students were in the fifth and sixth grade of primary school.

Measurements

After deciding on what type of data needed to be collected, the instrument chosen was a survey that consisted of four variables divided in 11 subscales for a total of 63 items. In addition, the survey also included a brief questionnaire inquiring about certain demographic variables related to gender, grade, age, and school.

Physical Dimension

This scale assessed the educational spaces such as the classroom, the school yards, and the library. It comprised 15 items and was a semantic differential type scale, where two opposing adjectives are presented and the response is selected from six intermediate values.

Academic Dimension

A 24-item scale divided into four subscales: teacher's relationship with students, teaching methodology, evaluation, and teaching strategies. All subscales were structured with Likert questions, where the response options were "never," "almost never," "almost always," and "always." In relationship with other students, they were presented with a scale consisting of eight items; the didactic methodology scale has 10 items; the evaluation scale with four items; and, finally, the scale of teaching strategies which includes four items.

Social Dimension

Contained three subscales with 11 items, the first one, referring to justice, included four semantic differential type items. The next section, sustainability, was composed of four items also elaborated in Likert scales with four response options going from "never" to "always." Finally, the social coexistence scale (Fraijo-Sing et al., 2014) evaluated three groups of social interaction, two

corresponding to school and one from home, was a Likert scale about satisfaction with five response options ranging from “very unsatisfied” to “very satisfied.”

Well-Being

An adaptation for children of the Van Dierendonck (2004) version of Ryff's (1989) psychological well-being scale (psychological well-being scales, SPWB), from which 13 items were selected, corresponding to the categories of self-acceptance, personal growth, and purpose with life.

Except for the social coexistence and well-being scale, the rest were specifically developed for the purpose of this study and were tested in a regional context (Northern Mexico).

Procedure

First, a non-random sample was selected; that is, there was a process by which data were extracted to be analyzed, where the universe consists of elementary school students from the city of Hermosillo, Mexico. In the next phase, there was a request for authorization from the directors of the educational institutions to proceed with the application of the instrument. This was carried out in a period of 2 weeks, when students were surveyed in groups in their respective classrooms, without teacher intervention but with their approval.

It is important to emphasize that this instrument was tested as reliable and valid by comparing the magnitude of the different variables and indicators. Once the surveys were answered and the numerical valuations of variables were made, we obtained ranges of values for the responses, as well as the different trends obtained. Through this data analysis, we transformed the data into information that was used to answer our research questions by using the Statistical Package for Social Sciences (SPSS v21.0). Using this, we analyzed the psychometric properties and construct validity through exploratory factor analysis, reliability through Cronbach's alpha, analysis of descriptive data of each of the scales, and correlation coefficients between the scales (Supplementary Table 1).

Subsequently, we tested the structural model using the statistical program EQS. First, we analyzed the measurement models of each of the variables. Then, we performed a structural model analysis to test the model of school environments using procedures in first instance plot development (sets of two variables). Likewise, first and second order variables were formed.

RESULTS

Table 1 shows the correlation matrix of the measured variables of scholar environment and their internal consistencies. The Cronbach's alpha values in all used scales turned out to be appropriate, indicating an acceptable reliability coefficient of the instruments. Overall, the correlations go from moderate, but statistically significant, to strongly correlated.

Structural Model

Figure 2 shows the structural model that illustrates the relationship between the variables “school environment”

TABLE 1 | Univariate statistics and their relationship to school environment and well-being.

	\bar{X}	σ	Alpha	PH	AC	SO	WB
PH	3.7	0.66	0.79	1			
AC	3.1	0.44	0.88	0.407**	1		
SO	3.5	0.60	0.74	0.606**	0.647**	1	
WB	1.9	0.67	0.67	0.342**	0.284**	0.344**	1

$n = 411$; \bar{X} = mean; σ = standard deviation; PH = physical dimension; AC = academic dimension; SO = social dimension; WB = well-being. Pearson * $p < 0.05$. ** $p < 0.001$.

(composed of physical, academic, and social factors) and “well-being.” In reference to model fitting and its interpretation, researchers use numerous goodness-of-fit indicators to assess a model. Some common fit indexes are the normed fit index (NFI), non-normed fit index (NNFI), and comparative fit index (CFI) (Hu and Bentler, 1999). Absolute fit indexes were also employed to evaluate the degree to which the model proposed and how the actual data variance-covariance matrices compare. Some absolute fit indexes include the chi-square statistic and the standardized root-mean-square residual (Bentler, 1995). We can verify that the indicators of goodness of statistical adjustment ($\chi^2 = 570.99$, 307 df, $p = 0.000$) were not significant, so there are no apparent reasons, in mathematical matter (Corral-Verdugo, 1995), to discard this model and the relationships that are illustrated in it. On the other hand, it should also be noted that the goodness of fit indexes adjustments (BBNFI = 0.90, BBNFI = 0.91, CFI = 0.93, RMSEA = 0.04.) show that the structural model is supported by the amount of data that was presented in this sample, since all values are equal to or greater than 0.90 (Bentler, 1990).

DISCUSSION

Our research was presented with the chance to provide additional empirical evidence to the conclusions of the work of Kutsyruba et al. (2015), who determined integrative categories associated with studies on school climate and proposed a three-dimensional model: physical, academic, and social. Other studies have offered a conceptual framework derived from a multidimensional construction of components and conditions of a positive school environment (Wang and Degol, 2016). In addition to confirming the relevance of this theoretical-conceptual approach, we recognized a causal relationship between the school environment and the well-being of elementary education students who participated in the study (Aldridge and McChesney, 2018).

The hypothetical model that guided this research was confirmed by the structural model's second order factor called “school environment” which was shaped by the three dimensions suggested by Kutsyruba et al. (2015): physical, academic, and social. In turn, the “school environment” had an effect on the “well-being” variable (Ryff and Singer, 2008), which also allowed us to verify the relevance of the suggestions made by Corral-Verdugo et al. (2015) in their review and conceptualization of a “positive school.”

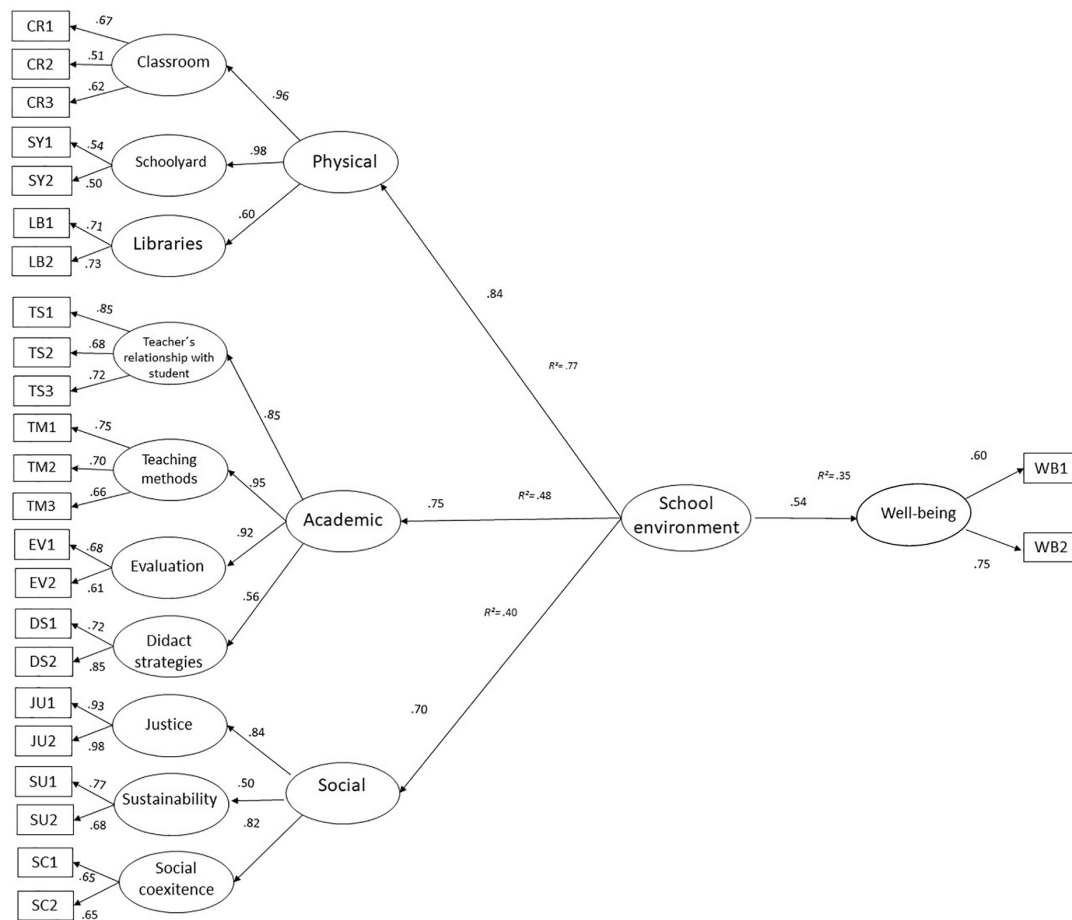


FIGURE 2 | Structural model of the relationship between school environment and well-being. Goodness of fit: $\chi^2 = 570.99$ (307 df), $p = 0.000$, $BBNFI = 0.90$, $BBNNFI = 0.91$, $CFI = 0.93$, $RMSEA = 0.04$. Well-being $R^2 = 0.35$.

Hypothesized first-order factors were also conformed by their respective measures and by the nesting of their variables. Confirming these relationships leads us to conclude that the present estimation and evaluation of the school environment dimension model was measured in a valid and pertinent manner for this construct. Results obtained by this model support the ideas of the three-dimensional construct of Kutsyuruba et al. (2015) and confirm this theoretical model in the reality of children of fifth and sixth grade of basic education in Hermosillo, Mexico.

Such remarks allow for some reassurance that we have established some of the variables that could influence a positive school climate (Bosworth et al., 2011; Aldridge and McChesney, 2018). In the three dimensions proposed by the model, we can also identify the actions required in order to impact on well-being and its relationship with the academic achievement of the students (Maxwell et al., 2017), their ways of relating to teachers (Roorda et al., 2011), and the relationships they establish with peers and others in their environment (Tian et al., 2016).

In other regards, this work suffers from limitations notably related to methodological aspects and the means used to collect data. Even when speaking about the validity of the instruments

and statistical procedures that account for their reliability, the surveys used for this analysis were specifically developed for the purpose of this study on a non-random sample, which may compromise the generalizability of our findings, despite obtaining acceptable goodness of fit indexes. Therefore, we recommend future research should therefore seek to address this issue by devising a specific method for gathering data on random samples by the means of surveys.

A key strength of this research lies within the integration of the three aspects considered in our model. Some studies have discussed variables related to well-being. For instance, how the physical design of space affects learning and the well-being of children (Martin, 2016); how teacher support and the ways it is perceived by students impacts well-being (Reddy et al., 2003); and also, the way social relationships with companions and peers may serve as a protective factor for well-being (Lindberg and Swanberg, 2006). However, gathering all of these variables into a single model can be considered to be a significant step forward in the study of student well-being, as well as which variables should be considered in order to design and promote the implementation of programs concerning well-being in school environments.

CONCLUSION

The posture of a school environment factor constituted by physical, social, and academic components was verified and adequately supported by the data gathered in our study and the structural model obtained in **Figure 2**. The school environment factor also correlated significantly with a measure of well-being as proposed by our hypothetic model. Moreover, our measure of school environment was found to be a valid one given regarding internal consistency where all factors have a reasonable level of reliability; we can see that all the variables show acceptable correlation values as we also consider the goodness of fit indexes obtained.

Our model confirmed that, in order to promote subjective well-being, schools must facilitate the optimal development of people by accepting that all students possess differentiated strengths, recognize its students' abilities, and offer school environments that imply positivity in aspects concerning the physical, social, and didactic spheres of school life. Insights into these aspects are expected to contribute to a better understanding of how they correspond harmoniously with the abilities and expectations of the students (Corral-Verdugo et al., 2015; Maxwell et al., 2017). The potential implementation of these findings has been widely described in literature. A school should aim its goals toward the promotion of the subjective well-being of its students, without neglecting the purposes of developing academic and cognitive skills (Huebner et al., 2009).

In order to design an accurate system, knowledge of the factors that contribute to well-being in school environments is necessary. The application of these research findings should be focused on the advocacy of curricula that embodies these factors, in such a manner that may comprise better practices in school environments (Bird and Markle, 2012). A more interesting and practical scenario would be if findings such as the ones found in this study could be oriented toward the outlining or amelioration

of public education programs dedicated to student's prosperity, learning, and well-being.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comité de ética en Investigación de la Universidad de Sonora. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

CT-F and BF-S contributed by writing, reviewing, and editing. CT-F and VC-V contributed with conceptualization and design of this study. GG-T ran formal analysis and organized databases. CT-F contributed by supervising this study and its methodological tasks (methodology) were designed by CT-F and BF-S. GG-T and MM-B provided the writing of the original draft. All authors contributed to manuscript revision and read and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00510/full#supplementary-material>

REFERENCES

- Aldridge, J. M., and McChesney, K. (2018). The relationships between school climate and adolescent mental health and wellbeing: a systematic literature review. *Int. J. Educ. Res.* 88, 121–145. doi: 10.1016/j.ijer.2018.01.012
- Amedeo, D., Golledge, R. G., and Stimson, R. J. (2008). *Person-Environment-Behavior Research: Investigating Activities and Experiences in Spaces and Environments*. New York: Guilford Press.
- Bell, P. A., Fisher, J. D., Baum, A. Y., and Greene, T. E. (1990). *Environmental Psychology*, 3a Edn. Holt: Rinehart y Winston.
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychol. Bull.* 107:238. doi: 10.1037/0033-2909.107.2.238
- Bentler, P. M. (1995). *EQS Structural Equations Program Manual*. Encino, CA: Multivariate Software.
- Bernardes, M., and Vergara, L. G. L. (2017). Aprendiendo entre la naturaleza: una revisión de los beneficios de los espacios verdes en el ambiente escolar. *Arquit. Del Sur*. 35, 96–103. doi: 10.22320/07196466.2017.35.052.09
- Bertoglia, R. L. (2008). La interacción profesor-alumno. Una visión desde los procesos atribucionales. *Psicoperspect. Individ. Soc.* 4, 57–73.
- Bird, J. M., and Markle, R. S. (2012). Subjective well-being in school environments: promoting positive youth development through evidence-based assessment and intervention. *Am. J. Orthopsychiatry* 82:61. doi: 10.1111/j.1939-0025.2011.01127.x
- Bordas, M. I., and Cabrera, F. (2001). Estrategias de evaluación de los aprendizajes centrados en el proceso. *Rev. Esp. Pedagog.* 218, 25–48.
- Borkar, V. N. (2016). Positive school climate and positive education: impact on students well-being. *Indian J. Health Wellbe.* 7, 861–862.
- Bosworth, K., Ford, L., and Hernandez, D. (2011). School climate factors contributing to student and faculty perceptions of safety in select Arizona schools. *J. Sch. Health* 81, 194–201. doi: 10.1111/j.1746-1561.2010.00579.x
- Bradshaw, C. P., Waasdorp, T. E., Debnam, K. J., and Johnson, S. L. (2014). Measuring school climate in high schools: a focus on safety, engagement, and the environment. *J. Sch. Health* 84, 593–604. doi: 10.1111/josh.12186
- Caldarella, P., Page, N. W., and Gunter, L. (2012). Early childhood educators' perceptions of conscious discipline. *Education* 132, 597–599.
- Calvo, M. (2006). Introducción a la metodología didáctica. *Sevilla MAD* 26, 54–55.
- Cornell, D., Shukla, K., and Konold, T. (2015). Peer victimization and authoritative school climate: a multilevel approach. *J. Educ. Psychol.* 107:1186. doi: 10.1037/edu0000038
- Corral, V. (2010). *Psicología de la Sustentabilidad. Un Análisis de lo que Nos Hace Proecológicos y Prosociales*. México: Editorial Trillas.
- Corral-Verdugo, V. (1995). Modelos de variables latentes para la investigación conductual. *Acta Comportament.* 3, 171–190.
- Corral-Verdugo, V., Frías, M., Gaxiola, J., Tapia, C., Fraijo, B., and Corral, N. (2015). *Ambientes positivos* [Positive environments].
- Datnow, A., and Hubbard, L. (2015). Teachers' use of assessment data to inform instruction: lessons from the past and prospects for the future. *Teachers Coll. Rec.* 117.
- De Castro, R. (2010). "Educación ambiental," in *Psicología Ambiental*, eds J. I. Aragonés y, and M. Américo, (Madrid: Pirámide).

- Dilbil, A., and Basaran, Z. (2017). Effect of school yard playgrounds on development and school attachment levels of children. *Univ. J. Educ. Res.* 5, 144–151. doi: 10.13189/ujer.2017.051321
- Fraijo-Sing, B., Tapia-Fonllem, C., Corral-Verdugo, V., and Echeverría-Castro, S. (2014). “Participación en democracia y convivencia prosocial: componentes de una escuela positiva,” in *en Ambientes de Aprendizaje y Contextos de Desarrollo Social*, Vol. 1, (London: PEARSON), 9.
- Fraser, B. (2015). “Classroom learning environments,” in *Encyclopedia of Science Education*, ed. R. Gunstone, (Dordrecht: Springer), 154–157.
- Gage, N. A., Scott, T., Hirn, R., and MacSuga-Gage, A. S. (2018). The relationship between teachers’ implementation of classroom management practices and student behavior in elementary school. *Behav. Disord.* 43, 302–315. doi: 10.1177/0198742917714809
- Gifford, R. (2007). “The physical environment and the development of the child,” in *Environmental Psychology*, 3a Edn, ed. W. A. Colville (Colville, WA: Optimal Books).
- Göttler, J. (1955). *Pedagogía Sistemática*. Barcelona: Herder.
- Gump, P. V. (1987). “School and classroom environments,” in *Handbok of Environmental Psychology*, Vol. 1, eds E. D. Stokols, and E. I. Altman, (New York, NY: John Wiley & Sons), 691–732.
- Han, H., Moon, H., and Lee, H. (2019). Physical classroom environment affects students’ satisfaction: attitude and quality as mediators. *Soc. Behav. Pers. Int. J.* 47, 1–10. doi: 10.2224/sbp.7961
- Holahan, C. J. (1986). *Environmental Psychology*. Nueva York, NY: Random House.
- Hu, L. T., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equat. Model.* 6, 1–55. doi: 10.1080/10705519909540118
- Huebner, E. S., Gilman, R., Reschly, A. L., and Hall, R. (2009). “Positive schools,” in *Oxford Library of Psychology. Oxford Handbook of Positive Psychology*, eds S. J. Lopez, and C. R. Snyder (New York: Oxford University Press), 561–568.
- Hus, V., and Grmek, M. I. (2011). Didactic strategies in early science teaching. *Educ. Stud.* 37, 159–169. doi: 10.1080/03055698.2010.506336
- Keyes, C. L. (2006). The subjective well-being of America’s youth: toward a comprehensive assessment. *Adoles. Fam. Health* 4, 3–11.
- Konow, J. (2003). Which is the fairest one of all? A positive analysis of Justice Theories. *J. Econ. Literat.* 61, 1188–1239. doi: 10.1257/002205103771800013
- Kutsyuruba, B., Klinger, D. A., and Hussain, A. (2015). Relationships among school climate, school safety, and student achievement and well-being: a review of the literature. *Rev. Educ.* 3, 103–135. doi: 10.1002/rev3.3043
- Lindberg, L., and Swanberg, I. (2006). Well-being of 12-year-old children related to interpersonal relations, health habits and mental distress. *Scand. J. Car. Sci.* 20, 274–281. doi: 10.1111/j.1471-6712.2006.00405.x
- Lundberg, E., and Abdelzadeh, A. (2019). The role of school climate in explaining changes in social trust over time. *Scand. J. Educ. Res.* 63, 712–724. doi: 10.1080/00313831.2018.1434824
- Martin, C. S. (2016). Exploring the impact of the design of the physical classroom environment on young children with autism spectrum disorder (ASD). *J. Res. Spec. Educat. Needs* 16, 280–298. doi: 10.1111/1471-3802.12092
- Mastandrea, S. (2014). “How emotions shape aesthetic experiences,” in *The Cambridge Handbook of the Psychology of Aesthetics and the Arts (Cambridge Handbooks in Psychology)*, P. Tinio, and J. Smith (Cambridge: Cambridge University Press), 500–518. doi: 10.1017/CBO9781139207058.024
- Mastandrea, S., and Crano, W. (2019). Peripheral factors affecting the evaluation of artworks. *Empir. Stud. Arts* 37, 82–91. doi: 10.1177/0276237418790916
- Maxwell, S., Reynolds, K. J., Lee, E., Subasic, E., and Bromhead, D. (2017). The impact of school climate and school identification on academic achievement: multilevel modeling with student and teacher data. *Front. Psychol.* 8:2069. doi: 10.3389/fpsyg.2017.02069
- Medina-Calvillo, M. A., Gutiérrez-Hernández, C. Y., and Padrós-Blázquez, F. E. R. A. N. (2013). Propiedades psicométricas de la escala de bienestar psicológico de Ryff en población mexicana. *Rev. Educ. Desarrollo* 27, 25–30.
- Moore, G. T., O’Donnell, L., and Sugiyama, T. (2003). “Children’s physical environments rating scale” in *Children: The Core of Society, Proceedings of the Australian Early Childhood Association biennial conference (CD-ROM)*, ed. R. Cornish, (Canberra: Australian Early Childhood Association).
- Olivos, P. J., and Américo, M. (2010). *Psicología Ambiental*. Madrid: Pirámide.
- Orlich, D. C., Harder, R. J., Callahan, R. C., Trevisan, M. S., and Brown, A. H. (2012). *Teaching Strategies: A Guide to Effective Instruction*. Boston, MA: Cengage Learning.
- Ponferrada-Arteaga, M., and Carrasco-Pons, S. (2010). Togetherness, coexistence or confrontation—the impact of school climate and culture on peer-to-peer social relations in catalonia, Spain. *Mediterr. J. Educ. Stud.* 15, 87–107.
- Poulou, M. (2014). The effects on students’ emotional and behavioural difficulties of teacher–student interactions, students’ social skills and classroom context. *Br. Educ. Res. J.* 40, 986–1004. doi: 10.1002/berj.3131
- Prescott, E., and David, T. G. (1976). *Concept Paper on the Effects of the Physical Environment on Day Care*. Pasadena, CA: Pacific Oaks College. Unpublished paper.
- Reddy, R., Rhodes, J., and Mulhall, P. (2003). The influence of teacher support on student adjustment in the middle school years: a latent growth curve study. *Dev. Psychopathol.* 15, 119–138. doi: 10.1017/s0954579403000075
- Romañá, T. (1994). *Entorno Físico y Educación. Reflexiones Pedagógicas*. Barcelona: PPU SA.
- Roorda, D. L., Koomen, H. M., Spilt, J. L., and Oort, F. J. (2011). The influence of affective teacher–student relationships on students’ school engagement and achievement: a meta-analytic approach. *Rev. Educ. Res.* 81, 493–529. doi: 10.3102/0034654311421793
- Ryff, C. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological wellbeing. *J. Pers. Soc. Psychol.* 57, 1069–1081. doi: 10.1037/0022-3514.57.6.1069
- Ryff, C. D., and Singer, B. H. (2008). Know thyself and become what you are: a eudaimonic approach to psychological well-being. *J. Happiness Stud.* 9, 13–39. doi: 10.1007/s10902-006-9019-0
- Sampieri, R. H., Collado, C. F., Lucio, P. B., and Pérez, M. D. L. L. C. (1998). *Metodología de la Investigación*, Vol. 1. New York, NY: McGraw-Hill.
- Schultz-Jones, B. (2011). “Assessing school library learning environments,” in *Global Perspectives on School Libraries: Projects and Practices*, eds L. Marquardt, and D. Oberg, (Berlin: Walter de Gruyter), 71–82.
- Sommer, R. (1967). Classroom ecology. *J. Appl. Behav. Sci.* 3, 489–503.
- Steffgen, G., Recchia, S., and Viechtbauer, W. (2013). The link between school climate and violence in school: a meta-analytic review. *Aggress. Violent Behav.* 18:300309.
- Thapa, A., Cohen, J., Guffey, S., and Higgins-D’Alessandro, A. (2013). A review of school climate research. *Rev. Educ. Res.* 83, 357–385. doi: 10.3102/0034654313483907
- Tian, L., Tian, Q., and Huebner, E. S. (2016). School-related social support and adolescents’ school-related subjective well-being: the mediating role of basic psychological needs satisfaction at school. *Soc. Indic. Res.* 128, 105–129. doi: 10.1007/s11205-015-1021-7
- Van Dierendonck, D. (2004). The construct validity of Ryff’s scales of psychological well-being and its extension with spiritual well-being. *Pers. Ind. Diff.* 36, 629–643. doi: 10.1016/s0191-8869(03)00122-3
- Wang, M. T., and Degol, J. L. (2016). School climate: a review of the construct, measurement, and impact on student outcomes. *Educ. Psychol. Rev.* 28, 315–352. doi: 10.1007/s10648-015-9319-1
- Weinstein, C. S. (1979). The physical environment of the school: a review of the research. *Rev. Educ. Res.* 49, 577–610. doi: 10.3102/00346543049004577
- Wohlwill, J. F., and Heft, H. (1987). “The physical environment and the development of the child,” in *Handbook of Environmental Psychology*, eds E. D. Stokols, and I. Altman, (New York, NY: Wiley), 281–328.
- Zaniewski, R. (1952). *Les Theories Du Milieu et la Pédagogie Mésologique*. Paris: Casterman.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Increasing Nature Connection in Children: A Mini Review of Interventions

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Half of the world's population live in the urban environment. Lifestyle changes in the 20th century have led to spending more time indoors and less in nature. Due to safety concerns, longer hours in formal education, as well as lack of suitable outdoor environments, children in particular have been found to spend very little time outdoors. We have an opportunity, both timely and unique to have our children (re)connect with nature. Nature connection is a subjective state and trait that encompasses affective, cognitive, and experiential aspects in addition to being positively associated with wellbeing, and strong predictor of pro-environmental attitudes and behaviors. This mini-review brings together recent studies that report on interventions to increase nature connection in children. Fourteen studies were identified through electronic searches of Web of Science, Scopus, PsychInfo, ERIC, and Google Scholar. The review aims to offer an overview of the interventions identified, provide a snapshot of the current state of the literature, briefly present themes and trends in the studies identified in relation to nature connection in young people, and propose potential guidelines for future work.

Keywords: nature connection, children, intervention, environmental education, sustainability

INTRODUCTION

In the 21st century, numerous voices have been calling for children and adults to (re)connect with nature, both as a wellbeing intervention for humans, but also for environmental sustainability (Miller, 2006; Barker, 2007; Louv, 2008; Capaldi et al., 2015; Díaz et al., 2015). Nature connection, the concept that describes the human–nature relationship, has been described in numerous ways. These related, but not identical constructs have at different times been defined as inclusion of nature in self (Schultz, 2002), nature relatedness (Nisbet et al., 2009), emotional affinity toward nature (Müller et al., 2009), and nature connectedness (Mayer and Frantz, 2004). Despite the subtle differences in these constructs, as well as different instruments to measure them, the underlying construct is very similar and it refers to our perceived and subjective connection to the non-human natural world (Capaldi et al., 2014). A review exploring the similarities and differences between the constructs and measures found that not only do the measures correlated strongly with each other, but that they also shared similar correlations with measures of wellbeing, and ecological beliefs and behaviors (Tam, 2013). For this reason, this paper will include all the constructs mentioned above, and use the umbrella term “nature connection” for ease.

Several studies have found nature connection is positively associated with wellbeing in adults and children (Mayer and Frantz, 2004; Howell et al., 2011; Nisbet and Zelenski, 2013; Capaldi et al., 2014; Zelenski and Nisbet, 2014; RSPB, 2015). Moreover, feeling close to the natural world has been found to correlate positively with pro-environmental attitudes and ecological behaviors (Mayer and Frantz, 2004; Leary et al., 2008; Nisbet et al., 2009; Frantz and Mayer, 2014). In fact, nature connectedness is a stronger predictor of ecological behaviors in children, than environmental knowledge (Otto and Pensini, 2017). For these reasons, nature connection has been identified as a suitable focus for assessing environmental education (EE) programs (Frantz and Mayer, 2014), as well as a distinct goal for early years' environmental and outdoor education (Otto and Pensini, 2017; Barrable and Arvanitis, 2018; Barrable, 2019a,b).

Childhood is often seen as a time of development for values and beliefs (Wigfield and Eccles, 2002). There is also evidence to suggest that adult nature connection and environmental stewardship may have their roots in childhood (Wells and Lekies, 2006; Andrejewski et al., 2011). Therefore, this current mini-review focuses on activities and interventions that aim to promote nature connection in children. More specifically, the review aims to identify and summarize the key points of interventions that promote a connection to nature in people <18 years of age, and provide some guidelines for future research.

MATERIALS AND METHODS

Inclusion Criteria

In order to find interventions that promote nature connection the author conducted a literature search adopting the following inclusion criteria. The articles identified had to (i) be published in peer-reviewed journals; (ii) be in the English language; (iii) have used experimental or quasi-experimental design, including randomized controlled trials (RCTs), pre- and post-testing with or without control groups, and included both between- and within-subjects testing; (iv) have nature connection as a dependent variable; (v) have used a validated instrument for that age group to measure nature connection; and finally (vi) majority of participants were under the age of 18 years.

Data Sources and Search Strategy

In order to gain a comprehensive coverage of the literature, the following three-fold strategy was used.

- (1) Keyword searches were undertaken in the following scientific databases: Web of Science, Scopus, PsychInfo, ERIC, and Google Scholar. The terms used were "nature relatedness," "connection to nature," and "nature connect*," in combination with "intervention," "measure," and "testing."
- (2) Specific appropriate journals (such as *Journal of Environmental Psychology*, *Environment and Behavior*, *Ecopsychology*, and others) were targeted and searched using the same terms as above.

- (3) Finally, by using Google Scholar the first author manually looked through all publications that cited any of the articles of validation of nature connection measures.

The following information was extracted from each of the publications: age and number of participants, length and type of intervention, design, nature connection measure used, and finally effect size, if reported.

RESULTS

A total of 3794 articles were initially identified, with 635 remained after duplicates were removed. Those were then screened by title and abstract. Forty-three full articles were read and finally 14 articles were identified as meeting all inclusion criteria.

The ages of participants in the studies ranged from 6 years of age (Bruni et al., 2017) to 19 (Sellmann and Bogner, 2013). All of the studies included pre- and post-intervention measurements, while five also included a control group. The length of activities reported on varied widely, from a short, two-hour field trip reported in Boeve-de Pauw et al. (2019) to programs that lasted several weeks and included regular weekly classes (e.g., Hignett et al., 2018). Environments were also diverse, ranging from the South African bush to the Scottish Highlands, and included urban and wild nature, indoor environments, and coastal areas. Nine of the studies describe activities that were characterized by the authors as EE, while the rest were a mixture of outdoor leisure activities, camps, expeditions, and other educational activities. Several scales were used, which are reported in **Table 1**.

SUMMARY OF KEY THEMES

Participant Age as an Influencing Factor

Some studies looked at the effect of age and reported significant findings. Braun and Dierkes (2017) found that there were significant age-based differences between the samples tested for baseline nature connection, with younger children (10–12) having higher nature connection compared to the older (13–15) group. During analysis, for the 5-day programs 7–9-year olds exhibited the largest shift, while for the 1-day intervention, it was the 17–19-year-old group that showed the greatest positive shift. Finally, looking at follow up after 6 weeks, these two groups (10–12 and 17–19) exhibited highest retention of nature connection, with 13–15 showing the biggest decline. Liefänder et al. (2013) reported a marked difference in baseline nature connection levels between younger (9–10-year-old) and older (11–13-year-old) pupils. While both groups showed an increase in levels immediately post intervention, only the younger group (9–10) sustained this at the four-week follow up, indicating perhaps that changes in nature connection in younger children are more likely to be permanent.

Length, Type of Intervention, and Environment

In studies that compared similar interventions with differing lengths, the longer interventions seemed to have a greater impact

TABLE 1 | Interventions to increase nature connection as identified in review.

Article	Age of participants (years)	Length of intervention	Type of intervention	Type of environment	Design	Control	Number of participants	Instrument used	Effect size (Cohen's <i>d</i>)
Barton et al., 2016	11–18	5–11 days	Wildlife expeditions	Bush/highlands	Pre–post	No	130	CNS	≈0.96
Boeve-de Pauw et al., 2019	10–11	2 h	Field trip (EE)	Heathland	Pre–post	No	560	INS	≈0.26
Braun and Dierkes, 2017	7–18	1-day, 5-day	1-day field trip 5-day residential (EE)	Rainforest	Pre–post	Yes	601	INS	≈0.21
Bruni et al., 2017	6–16	Varied (30 days – activity 1 to 30–45 min)	<i>Get to know program</i> three studies for three activities (1) The Creative Arts Contest, (2) the Natural Treasure Adventure, and (3) Virtual Hikes	Urban nature	Pre–post	No	(1) 168 (2) 35 (3) 50	IAT nature (FlexiTwins)	≈0.37
Bruni et al., 2018	6–15	Day visit	Visit to natural history museum	Museum	Pre–post	No	238 (across two locations)	IAT nature (FlexiT wins)	≈0.15
Collado et al., 2013	Approx. 7–15	1–2 weeks	Summer camps	Mountain camp	Pre–post	Yes (urban camp)	397 (four different camps)	EAN	≈0.89
Ernst and Theimer, 2011	8–14	Seven different programs all which included sustained contact with nature	EE programs	Urban nature	Pre–post	Yes	Total 385	CNI	0
Hignett et al., 2018	13–16	12 weekly lessons	Surfing and EE program for “at risk” youth	Coast	Pre–post	No	58	INS	0
Kossack and Bogner, 2012	Approx. 10–16	1 day	Indoor and outdoor EE program	Woodland	Pre–post and follow up	Yes	123 (and 116 control) = 239	INS	≈0.42–0.71
Liefländer et al., 2013	9–13	4-days	EE program on water	Woodland	Pre–post and follow up	Yes	264	INS	≈0.3–0.65
Mullenbach et al., 2018	10–11	4-day	Residential outdoor EE program	Urban nature	Pre–post	Yes	163	Adapted CNS	≈0.11–0.25
San Jose and Nelson, 2017	9–11	4-day	4-day outdoor program	Woodland	Pre- and post and follow up	No	177	CNI	≈0.53
Schneider and Schaal, 2017	Approx. 10–16	1-day 5-day	EE program with use of geogames/treasure hunt game	Woodland	Pre–post	No	339	INS (and DCN)	≈0.2
Sellmann and Bogner, 2013	15–19	1-day	EE program	Urban nature	Pre–post, and follow up	Yes	114	INS	≈0.77

on nature connection (e.g., Sellmann and Bogner, 2013; Braun and Dierkes, 2017). As this trend is observed only within studies, it is impossible to determine whether it is the type, density, or length of the activity that has the effect.

Most of the activities reported on in the studies included in this review were knowledge-rich, with a distinct EE element. Kossack and Bogner (2012) report a negative effect of high information content, while Collado et al. (2013) suggest that enjoyment and play may have a positive effect on nature connection in children. Bruni et al. (2017) found that only the activity in which children engaged artistically with the natural world, such as narrative writing, art work, and photography, created a positive shift in nature connection. Immersive experiences and free outdoor play were seen as a positive feature by Mullenbach et al. (2018) as well as Schneider and Schaal (2017). There was heterogeneity in the types of environments reported, and these environments were idiosyncratic to the location of the study. As such it is difficult to draw any conclusions. A breakdown of different environments can be seen in Table 1, and in relation to effect size of intervention in Figure 1C.

Baseline Connection to Nature and Ceiling Effect

Overall participants with lower nature connection during pre-testing seemed to make the biggest gain in most studies (Braun and Dierkes, 2017; Schneider and Schaal, 2017; Bruni et al., 2018;

Boeve-de Pauw et al., 2019). This could be attributed to a number of potential factors, including a larger observed effect on children who had not previously had contact with natural environments, due to novelty. Additionally, this could be seen to support the Biophilia hypothesis (Kellert and Wilson, 1995) that describes an innate tendency of humans to seek connection to nature. Potential methodological reasons may relate to the ceiling effect, explored below. Ceiling effects were reported in several studies (Ernst and Theimer, 2011; Kossack and Bogner, 2012; Barton et al., 2016) which may present a limitation of the instruments used to measure nature connection in young people, with the instrument technically only capable of measuring variation across 50% of its range of values. It may also be an interesting general property shared across many participants (i.e. an innate, above-average connection to nature).

Analytic Issues and Implications Study Design

The response of the measure to an intervention may not be linear in nature (Figure 1A). For example, it may be that a hypothetical response to an intervention could rise quickly to a set level (asymptotic); have a threshold value resulting in a sharp increase to a leveling off point (logistic); have a constant rate of increase (exponential); or even in some rare cases the response could be linear. There is some tantalizing evidence that such non-linear relationships may exist, particularly when contrasting the

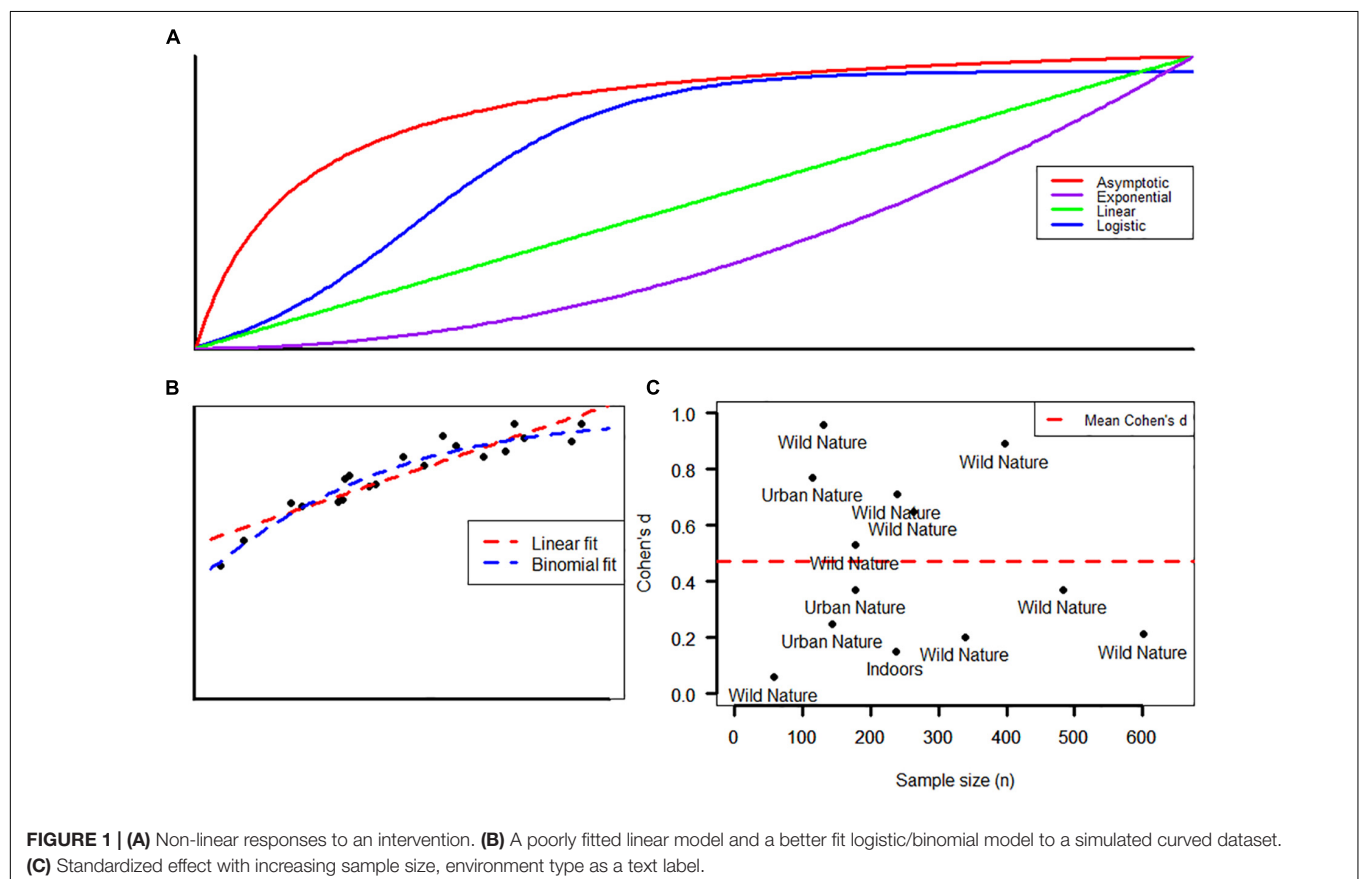


FIGURE 1 | (A) Non-linear responses to an intervention. **(B)** A poorly fitted linear model and a better fit logistic/binomial model to a simulated curved dataset. **(C)** Standardized effect with increasing sample size, environment type as a text label.

effect of interventions in children at either end of the age range, or who start with different baseline nature connectedness scores (Braun and Dierkes, 2017).

Measurements from all but one of the instruments (IAT) have a second property that confounds their analysis using simple statistical tests. Variables from these instruments tend to be bounded (e.g., between one and five) with a great opportunity for variance at the center of a scale, and none at either extreme value. These mean–variance relationships tend not to conform well with linear regression, *t*-testing, and analysis of variance (ANOVA). This has been recognized by statisticians for some time (Nelder and Wedderburn, 1972) resulting in the development of generalized linear models (GLMs). Such models have matured with statistical computing and can explore the effect of independent variables and covariates on a plethora of measured outcomes. Beta, binomial, or quasibinomial GLMs are better suited to handling instruments with bounded outcomes, particularly when a ceiling or floor effect may be present (Figure 1B), and as such study design should take this into account to avoid poorly fitted models (Furr, 2011).

Recommendations for Further Research

Using CEBM guidelines to evaluate evidence, we noted that most papers would be classified as level 3, i.e., non-randomized comparisons, with a single level 2 study, i.e., a RCT (Braun and Dierkes, 2017) and several level 4 studies, i.e., case series, or pre- and post-studies (Howick et al., 2011). We discuss our evaluation below, ending with recommendations for the field to move forward. There is an aphorism in science of “no controls, no conclusions” (Crawley, 2014, p. 8). Five of the 14 studies incorporated a form of control, with even fewer contrasting their intervention with that of a control set. While pre-post measurements do mitigate this issue somewhat, it is still impossible to discount the possibility of a confounding variable running alongside the intervention, inducing the change (Pearl, 2009). A creative approach would be to incorporate a wait-list control. Recruitment should employ some element of randomization (including cluster randomization) to remove the possibility of systematic confounding variables.

Sample sizes varied over two orders of magnitude ($n = 58$ to $n = 601$) and it is conspicuous that the largest studies also reported some of the smallest effects (Figure 1C). Large effects in underpowered experiments are common, due to the conflated false discovery rate (Friston, 2012). Related to this, statistical power ($1-\beta$) as estimated through a *post hoc* power analysis (Cohen, 1988) revealed a range of values from the lowest of 0.06 through to the highest of 1.0. This may point toward a likelihood of false negatives in the literature, though it should be noted that half of the studies generally met the conventional threshold of statistical power equaling 0.8 for hypothesis tests. In order to protect against false negatives, we suggest the following as a general guide for minimum sample size, based on effect sizes observed in the most robustly conducted piece of work (Braun and Dierkes, 2017). Assuming an effect size of Cohen's $d \approx 0.2$ a sample size of $n = 400$ for unpaired, and $n = 200$ for paired (pre-post) comparisons should be able to detect an effect.

We noted the array of statistical approaches employed throughout the literature, from a simple comparison of means (with no standard deviations) through to thorough mixed-model analysis of co-variance (ANCOVA). Two of the 14 employed omnibus tests with *post hoc* pairwise comparisons, the remainder conducted multiple pairwise comparisons without some form of correction to minimize the multiple comparisons problem. The problem in its simplest form is that every pairwise comparison carries a type I error rate for m hypotheses ($\alpha = 1-0.95^m$). A single comparison yields a rate of 0.05, five comparisons is 0.23, and 10 comparisons is 0.4. In this set of studies, the most extreme example found conducted 63 pairwise comparisons across a single dataset, yielding an α of 0.96 and meaning that there almost certainly would be false positive observations. This inflation of error can be corrected to mitigate this issue somewhat, through a variety of approaches, the simplest of which being the Bonferroni correction (Dunnett, 1955; Aickin and Gensler, 1996).

To that end we suggest that as a minimum, researchers should clearly report means and standard deviations for each level or group in their study; and for summary statistics a minimum of test statistic, degrees of freedom, *p*-values, and effect sizes. Where the raw data of the experiment require extensive manipulation it is advised to make the dataset publicly available in an anonymized fashion.

General guidelines from the open science framework (OSF) could be used to improve the reliability, reproducibility, and generalizability of studies in this field of environmental and educational psychology (Munafò et al., 2017). We have covered design and analysis above, but other cultural practices could be adopted, such as pre-registration (van't Veer and Giner-Sorolla, 2016), reporting of null results and more transparency in the sharing of data and the analytical workflow.

CONCLUSION

Throughout this review of studies that evaluate nature connection before and after different interventions, there is a notable absence of evaluations of different type of programs, for example nature kindergartens, forest schools, etc. An exception to this is the study by McCree et al. (2018) which evaluates several aspects of a forest school program in younger children. Part of the difficulty in making such evaluations is the fact that the majority of participants in such programs tend to be younger children (Knight, 2013), while at the same time no self-report instrument to measure nature connection in the early years' age group currently exists (Barrable, 2019b). Finally, the hypothesis of a “critical period” for nature connection could be put to the test in future experimental research.

The majority of studies presented in this review explore EE programs, within a school or other educational context. However, new research suggests that the way to connect to nature is not necessarily through knowledge, but through beauty, emotion, and sustained contact (Lumber et al., 2017). More emphasis could be placed on measuring alternative activities

that bring children in sustained or condensed contact with nature, such as forest schools, nature kindergartens, adventure activities, and wildlife expeditions.

Further research could include more non-educational interventions that look at the interaction between play or mindfulness, and nature connection (such as ones focused on adults, see Unsworth et al., 2016). Finally, being clear about our intention to facilitate nature connection in children and differentiating between simply providing children with opportunities to be in nature and fostering and nurturing connectedness could further help to identify and highlight which activities are most suited to increasing a child's connection to the natural world.

The review identifies some points of note: One relates to age, and is in accordance with previous literature that highlight the importance of early emotional connection to nature (Wells and Lekies, 2006; Jalongo, 2014). Moreover, earlier studies have found that length of time, as well as time spent in nature during childhood are the two most significant predictors of emotional affinity toward the natural world (Kals et al., 1999; Andrejewski et al., 2011). This review reinforces this and further highlights the fact that changes in nature connection in younger children may be more resistant to change over time.

The second point relates to the way we measure nature connection and possible limitations of our current instruments. This includes limitations in the age-range of validated measures, no self-report measures currently exist for children under 8 years of age (Barrable, 2019a), as well as the fact that current measures may impose an artificial ceiling effect that prevents us from measuring changes in highly connected individuals.

Finally, the last point raised in this review relates to the design, recruitment, and consistency of reporting, which makes the quality of the evidence weaker than it could be, given the amount of effort and relative ease with which they could be rectified. To that effect, we propose the above guidelines for future research and reporting in this field.

AUTHOR CONTRIBUTIONS

AB conceived, designed, and undertook the review. DB reviewed the search results, assisted in compiling the table, and undertook the statistical analysis, reporting, and visualizations. AB drafted the final report. AB and DB contributed and approved the final version of the manuscript.

REFERENCES

- Aickin, M., and Gensler, H. (1996). Adjusting for multiple testing when reporting research results: the Bonferroni vs Holm methods. *Am. J. Public Health* 86, 726–728. doi: 10.2105/ajph.86.5.726
- Andrejewski, R., Mowen, A. J., and Kerstetter, D. L. (2011). *An Examination of Children's Outdoor Time, Nature Connection, and Environmental Stewardship*. Available online at: <https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1001&context=nerr> (accessed March 11, 2019).
- Barker, S. (2007). Reconnecting with nature. *J. Biol. Educ.* 41, 147–149. doi: 10.1080/00219266.2007.9656089
- Barrable, A. (2019a). Refocusing environmental education in the early years: a brief introduction to a pedagogy for connection. *Educ. Sci.* 9:61. doi: 10.3390/educsci9010061
- Barrable, A. (2019b). The case for nature connectedness as a distinct goal of early childhood education. *Int. J. Early Child. Environ. Educ.* 6, 59–70.
- Barrable, A., and Arvanitis, A. (2018). Flourishing in the forest: looking at Forest School through a self-determination theory lens. *J. Outdoor Environ. Educ.* 22, 39–55. doi: 10.1007/s42322-018-0018-5
- *Barton, J., Bragg, R., Pretty, J., Roberts, J., and Wood, C. (2016). The wilderness expedition: an effective life course intervention to improve young people's well-being and connectedness to nature. *J. Exp. Educ.* 39, 59–72. doi: 10.1177/1053825915626933
- *Boeve-de Pauw, J., Van Hoof, J., and Van Petegem, P. (2019). Effective field trips in nature: the interplay between novelty and learning. *J. Biol. Educ.* 53, 21–33. doi: 10.1080/00219266.2017.1418760
- *Braun, T., and Dierkes, P. (2017). Connecting students to nature—how intensity of nature experience and student age influence the success of outdoor education programs. *Environ. Educ. Res.* 23, 937–949. doi: 10.1080/13504622.2016.1214866
- *Bruni, C. M., Ballew, M. T., Winter, P. L., and Omoto, A. M. (2018). Natural history museums may enhance youth's implicit connectedness with nature. *Ecopsychology* 10, 280–288. doi: 10.1089/eco.2018.0025
- *Bruni, C. M., Winter, P. L., Schultz, P. W., Omoto, A. M., and Tabanico, J. J. (2017). Getting to know nature: evaluating the effects of the get to know program on children's connectedness with nature. *Environ. Educ. Res.* 23, 43–62. doi: 10.1080/13504622.2015.1074659
- *References that have an asterisk are studies included in the review.
- Capaldi, C. A., Dopko, R. L., and Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: a meta-analysis. *Front. Psychol.* 5:976. doi: 10.3389/fpsyg.2014.00976
- Capaldi, C. A., Passmore, H. A., Nisbet, E. K., Zelenski, J. M., and Dopko, R. L. (2015). Flourishing in nature: a review of the benefits of connecting with nature and its application as a wellbeing intervention. *Int. J. Wellbeing* 5, 1–16. doi: 10.5502/ijw.v5i4.1
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*, 2nd Edn. Hillsdale, NJ: Lawrence Erlbaum Associates.
- *Collado, S., Staats, H., and Corraliza, J. A. (2013). Experiencing nature in children's summer camps: affective, cognitive and behavioural consequences. *J. Environ. Psychol.* 33, 37–44. doi: 10.1016/j.jenvp.2012.08.002
- Crawley, M. J. (2014). *Statistics: An Introduction Using R*, 2nd Edn. Chichester: Wiley & Sons.
- Diaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., et al. (2015). The IPBES conceptual framework—connecting nature and people. *Curr. Opin. Environ. Sustain.* 14, 1–16. doi: 10.1371/journal.pbio.102040
- Dunnett, C. W. (1955). A multiple comparison procedure for comparing several treatments with a control. *J. Am. Stat. Assoc.* 50, 1096–1121. doi: 10.1080/01621459.1955.10501294
- Ernst, J., and Theimer, S. (2011). Evaluating the effects of environmental education programming on connectedness to nature. *Environ. Educ. Res.* 17, 577–598. doi: 10.1080/13504622.2011.565119
- Frantz, C. M., and Mayer, F. S. (2014). The importance of connection to nature in assessing environmental education programs. *Stud. Educ. Eval.* 41, 85–89. doi: 10.1016/j.stueduc.2013.10.001
- Friston, K. (2012). Ten ironic rules for non-statistical reviewers. *NeuroImage* 61, 1300–1310. doi: 10.1016/j.neuroimage.2012.04.018
- Furr, M. (2011). *Scale Construction and Psychometrics for Social and Personality Psychology*. Thousand Oaks, CA: SAGE Publications Ltd.
- *Hignett, A., White, M. P., Pahl, S., Jenkin, R., and Froy, M. L. (2018). Evaluation of a surfing programme designed to increase personal well-being and connectedness to the natural environment among 'at risk' young people. *J. Adventure Educ. Outdoor Learn.* 18, 53–69. doi: 10.1080/14729679.2017.1326829
- Howell, A. J., Dopko, R. L., Passmore, H. A., and Buro, K. (2011). Nature connectedness: associations with well-being and mindfulness. *Pers. Individ. Dif.* 51, 166–171. doi: 10.1016/j.paid.2011.03.037

- Howick, J., Phillips, B., Ball, C., Sackett, D., Badenoch, D., Straus, S., et al. (2011). *Oxford Centre for Evidence-Based Medicine—Levels of Evidence (March 2009). Centre for Evidence Based Medicine*. Available online at: <https://www.cebm.net/wp-content/uploads/2014/06/CEBM-Levels-of-Evidence-2.1.pdf> (accessed January, 2020).
- Jalongo, M. R. (2014). *Teaching Compassion: Humane Education in Early Childhood*. Dordrecht: Springer.
- Kals, E., Schumacher, D., and Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environ. Behav.* 31, 178–202. doi: 10.1177/00139169921972056
- Kellert, S. R., and Wilson, E. O. (eds) (1995). *The Biophilia Hypothesis*. Washington, DC: Island Press.
- Knight, S. (2013). *Forest School and Outdoor Learning in the Early Years*. London: Sage.
- *Kossack, A., and Bogner, F. X. (2012). How does a one-day environmental education programme support individual connectedness with nature? *J. Biol. Educ.* 46, 180–187. doi: 10.1080/00219266.2011.634016
- Leary, M. R., Tipsord, J. M., and Tate, E. B. (2008). “Allo-inclusive identity: incorporating the social and natural worlds into one’s sense of self,” in *Transcending Self-Interest: Psychological Explorations of the Quiet Ego*, eds H. A. Wayment and J. J. Bauer (Washington, DC: American Psychological Association), 137–147. doi: 10.1037/11771-013
- *Liefänder, A. K., Fröhlich, G., Bogner, F. X., and Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environ. Educ. Res.* 19, 370–384. doi: 10.1080/13504622.2012.697545
- Louv, R. (2008). *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*. Chapel Hill, NC: Algonquin books.
- Lumber, R., Richardson, M., and Sheffield, D. (2017). Beyond knowing nature: contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *PLoS One* 12:e0177186. doi: 10.1371/journal.pone.0177186
- Mayer, F. S., and Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals’ feeling in community with nature. *J. Environ. Psychol.* 24, 503–515. doi: 10.1016/j.jenvp.2004.10.001
- McCree, M., Cutting, R., and Sherwin, D. (2018). The Hare and the Tortoise go to Forest School: TAKIng the scenic route to academic attainment via emotional wellbeing outdoors. *Early Child Dev. Care* 188, 980–996. doi: 10.1080/03004430.2018.1446430
- Miller, J. R. (2006). Restoration, reconciliation, and reconnecting with nature nearby. *Biol. Conserv.* 127, 356–361. doi: 10.1016/j.biocon.2005.07.021
- *Mullenbach, L. E., Andrejewski, R. G., and Mowen, A. J. (2018). Connecting children to nature through residential outdoor environmental education. *Environ. Educ. Res.* 25, 365–374. doi: 10.1080/13504622.2018.1458215
- Müller, M. M., Kals, E., and Pansa, R. (2009). Adolescents’ emotional affinity toward nature: a cross- societal study. *J. Dev. Process.* 4, 59–69.
- Munafò, M. R., Nosek, B. A., Bishop, D. V., Button, K. S., Chambers, C. D., Du Sert, N. P., et al. (2017). A manifesto for reproducible science. *Nat. Hum. Behav.* 1:0021. doi: 10.12688/f1000research.5686.2
- Nelder, J. A., and Wedderburn, R. W. (1972). Generalized linear models. *J. R. Stat. Soc. Ser. A* 135, 370–384.
- Nisbet, E. K., and Zelenski, J. M. (2013). The NR-6: a new brief measure of nature relatedness. *Front. Psychol.* 4:813. doi: 10.3389/fpsyg.2013.00813
- Nisbet, E. K., Zelenski, J. M., and Murphy, S. A. (2009). The nature relatedness scale: linking individuals’ connection with nature to environmental concern and behaviour. *Environ. Behav.* 41, 715–740. doi: 10.1177/0013916508318748
- Otto, S., and Pensini, P. (2017). Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Glob. Environ. Change* 47, 88–94. doi: 10.1016/j.gloenvcha.2017.09.009
- Pearl, J. (2009). *Simpso’s Paradox, Confounding, and Collapsibility in Causality: Models, Reasoning and Inference*, 2nd Edn. New York, NY: Cambridge University Press.
- RSPB (2015). *The Impact of Children’s Connection to Nature: A Report for the Royal Society for the Protection of Birds (RSPB)*. Available online at: <https://www.rspb.org.uk/globalassets/downloads/documents/positions/education/the-impact-of-childrens-connection-to-nature.pdf> (accessed March 11, 2019).
- *San Jose, A. L., and Nelson, K. E. (2017). Increasing children’s positive connection to, orientation toward, and knowledge of nature through nature camp experiences. *Int. J. Environ. Sci. Educ.* 12, 933–944.
- *Schneider, J., and Schaal, S. (2017). Location-based smartphone games in the context of environmental education and education for sustainable development: fostering connectedness to nature with Geogames. *Environ. Educ. Res.* 24, 1597–1610. doi: 10.1080/13504622.2017.1383360
- Schultz, P. W. (2002). “Inclusion with nature: the psychology of human-nature relations,” in *Psychology of Sustainable Development*, eds P. Schmuck and W. P. Schultz (Boston, MA: Springer), 61–78. doi: 10.1007/978-1-4615-0995-0_4
- *Sellmann, D., and Bogner, F. X. (2013). Effects of a 1-day environmental education intervention on environmental attitudes and connectedness with nature. *Eur. J. Psychol. Educ.* 28, 1077–1086. doi: 10.1007/s10212-012-0155-0
- Tam, K. (2013). Concepts and measures related to connection to nature: similarities and differences. *J. Environ. Psychol.* 34, 64–78. doi: 10.1016/j.jenvp.2013.01.004
- Unsworth, S., Palicki, S. K., and Lustig, J. (2016). The impact of mindful meditation in nature on self- nature interconnectedness. *Mindfulness* 7, 1052–1060. doi: 10.1007/s12671-016-0542-8
- van’t Veer, A. E., and Giner-Sorolla, R. (2016). Pre-registration in social psychology—a discussion and suggested template. *J. Exp. Soc. Psychol.* 67, 2–12. doi: 10.1016/j.jesp.2016.03.004
- Wells, N. M., and Lekies, K. S. (2006). Nature and the life course: pathways from childhood nature experiences to adult environmentalism. *Child. Youth Environ.* 16, 1–24.
- Wigfield, A., and Eccles, J. S. (2002). “The development of competence beliefs, expectancies for success, and achievement values from childhood through adolescence,” in *Development of Achievement Motivation*, eds A. Wigfield and J. S. Eccles (London: Academic Press), 91–120. doi: 10.1016/b978-012750053-9/50006-1
- Zelenski, J. M., and Nisbet, E. K. (2014). Happiness and feeling connected: the distinct role of nature relatedness. *Environ. Behav.* 46, 3–23. doi: 10.1177/0013916512451901

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The Role of Urban/Rural Environments on Mexican Children's Connection to Nature and Pro-environmental Behavior

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Living in rural areas has been described a driver for behaving in a pro-environmental way, mainly due to the more frequent contact with nature that people from rural areas have. However, the processes that link living in a rural area and behaving in a more ecological manner have not been systematically studied. Moreover, most studies have focused on adults living in developed countries. Given the importance that the actions conducted by people in developing countries have for the future of the environment, as well as the relevance of children's pro-environmentalism for nature conservation, we present a brief research report examining the relationship between Mexican children's place of residence and self-reported pro-environmental behavior (PEB). Participants were 200 children from Mexican rural areas (<1,000 inhabitants) and 200 from a Mexican urban city (>150,000 inhabitants). Children were between 9 and 12 years old. Children's connection to nature was considered as a mediator in the relationship between children's place of residence and PEB. Our findings revealed that rural children hold a stronger sense of connection to nature and behave in a more pro-environmental way than urban children. In addition, place of residence was directly and positively linked to their PEBs, and this relationship was mediated by children's connection to nature. The relationship between connection to nature and PEB was stronger for girls than for boys. The model explained 45% of the variance of children's self-reported PEBs.

Keywords: connection, nature, pro-environmental behavior, urban, rural

INTRODUCTION

Human actions negatively affect the health of our planet (Milfont and Schultz, 2016; Evans, 2019). Environmental psychologists have long tried to find ways to mitigate the negative consequences that human behavior has on nature, mainly through the promotion of a sustainable way of living (Schutte and Bhullar, 2017; Rosa et al., 2018). One way of doing this is through instilling pro-environmental behaviors (PEBs). PEB have been described as deliberate and effective behaviors that protect the natural environment (Corral, 2010).

Most of the studies of PEB have been conducted with adults. The role played by children in the protection of nature has been largely overlooked (Collado and Sorrel, 2019). Moreover, the majority of knowledge gained about the drivers of PEB relates to people living in developed countries. This ignores those living in developing countries who, according to the World Trade Organization (World Trade Organization [WTO], 2014), have an increasing impact on the health of the planet. Given this, we believe it is relevant to examine the factors and processes leading to the PEB of children from developing countries.

According to previous studies, some of the drivers of children's PEB include frequent contact with nature (Evans et al., 2018; Collado and Evans, 2019; Otto et al., 2019), pro-environmental attitudes (Cheng and Monroe, 2012; Larson et al., 2015), social norms (Casaló and Escario, 2016; Evans et al., 2018), and perceived restorativeness (Collado and Corraliza, 2015). To the best of our knowledge, there has been little research done on the role played by the child's environment on their PEB, especially in developing countries. In the current study, we investigate whether Mexican children's place of residence (urban/rural) is linked to their PEB, and if this relationship is mediated by children's sense of emotional connection to nature (Mayer and Frantz, 2004).

Place of Residence, Connection to Nature, and PEB

Rural residents spend more time in nature than their urban counterparts (Gifford and Nilsson, 2014), and tend to recall experiences in the natural environment as positive (Chawla and Derr, 2012). This pattern holds both for adults and children (Lekies and Brensinger, 2017). In line with previous researchers (Hinds and Sparks, 2008; Gifford and Nilsson, 2014), this study assumes that children living in rural areas have more frequent contact with nature than those living in urban ones. Pleasant experiences in nature lead to increased environmental responsibility (Berenguer et al., 2005; Evans et al., 2018) and connection to nature (Rosa et al., 2019). However, the pathways to this relation are unknown, especially among children from developing countries (Bratman et al., 2019). The present study considers connection to nature as a possible mediator of the relationship between those living in an urban and those in a rural context as well as PEB in Mexican children.

A greater connection to nature often leads to higher interest in taking care of the natural resources (Nisbet et al., 2008) and more frequent PEB (Schultz, 2001; Mayer and Frantz, 2004; Olivos et al., 2013). Of interest to the current study, Hinds and Sparks (2008) found that living in a rural area as a child promotes connection to nature which, in turn, leads to more frequent PEB in adulthood. Collado et al. (2015) concluded that children who live in rural areas show stronger environmental attitudes and connection to nature which, in turn, lead to children's PEB. The relationship between children's environmental attitudes and PEB differed according to children's place of residence, which determined the amount of time children spent in nature. Similarly, De Dominicis et al. (2017) found that the effect of participating in an environmental education program organized

in a natural environment on children's PEB differed according to children's place of residence. According to the authors, rural children spend more time in nature than urban ones. This leads rural children to behave in a more pro-environmental way, and might be the reason why the environmental education program is less effective for them.

The Present Study

Given the scarcity of studies of the determinants of children's PEB, especially in developing countries, we focus on the study of the relationship between urban/rural residency of Mexican children and their PEB. We also evaluate whether connection to nature mediates the relationship between children's place of residence and PEB. This specific sample was chosen for two primary reasons. First, Mexico is a developing country and has a large biodiversity within its territory, which needs to be preserved (Calderon-Aguilera et al., 2012). Second, in contrast to children from urban areas, rural children in Mexico live in direct contact with nature (Vargas, 2010).

We expect the children's place of residence (urban/rural) to be linked to their PEB. Specifically, children from rural areas are expected to show stronger PEB than those from urban ones (Hypothesis 1, H1). Children's CN is expected to mediate the relation between children's place of residence and PEB (Hypothesis 2, H2). Women (Gifford and Nilsson, 2014) and girls (Duarte et al., 2017) tend to report higher PEBs than men and boys. One reason for this is that females endorse higher environmental attitudes (Duerden and Witt, 2010) and emotional empathy (Arnocky and Stroink, 2010) than men, which usually lead to more frequent PEB. Additionally, findings from previous studies suggest that the association between PEB and its determinants varies from boys to girls (Collado et al., 2015). Considering this, we explored the possible variations in the direct and indirect associations between the place of residence and PEB according to gender (i.e., moderating role of gender), without any specific hypothesis in mind.

MATERIALS AND METHODS

Participants

Four hundred children from 9 to 12 years old ($M = 10$, $SD = 0.73$) participated in the study. Half of them lived in rural and indigenous communities (i.e., <1,000 inhabitants) in Northern Mexico. The rest lived in an urban area with >150,000 inhabitants. Fifty-four percent of the participants were girls.

Measures

Place of Residence

Place of residence was coded as 1 (urban) and 2 (rural).

Self-Reported PEB

Pro-environmental behavior was recorded using the general ecological behavior scale of Kaiser (1998), adapted for use with children by Fraijo et al. (2012). This instrument includes 15 items related to PEB, such as reuse, recycle, as well as energy conservation. For example, "When performing a school project,

TABLE 1 | Descriptive statistics and correlation matrix.

	Descriptive statistics				Descriptive statistics				Correlation matrix		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Place of residence	Connection to nature	PEB
	Urban		Rural		Girls		Boys		1		
Connection to nature	4.25	0.56	4.45	0.40	4.51	0.40	4.12	0.56	0.20**	1	
PEB	1.53	0.52	2.18	0.48	1.98	0.56	1.57	0.63	0.55**	0.46**	1

** $p < 0.01$; PEB, pro-environmental behavior.

I try to reuse material.” Responses were rated using a scale from 0 (never) to 3 (always). $\alpha = 0.78$.

Connection to Nature

Connection to nature was registered using the children’s affective attitude toward nature scale (Cheng and Monroe, 2012). This instrument is formed by 17 items (e.g., “Humans are part of the natural world”) and responses used a scale from 1 (strongly disagree) to 5 (strongly agree). $\alpha = 0.84$.

Gender

Gender was coded as 1 (boys) and 2 (girls).

Procedure

The study was approved by the Technological Institute of Sonora (Mexico). Fifty schools were invited to participate and 12 of them agreed. Participations were restricted to children with a written authorization from their parents. Paper-and-pencil questionnaires were completed individually at school with assurance of anonymity. Data collection took about 30 min.

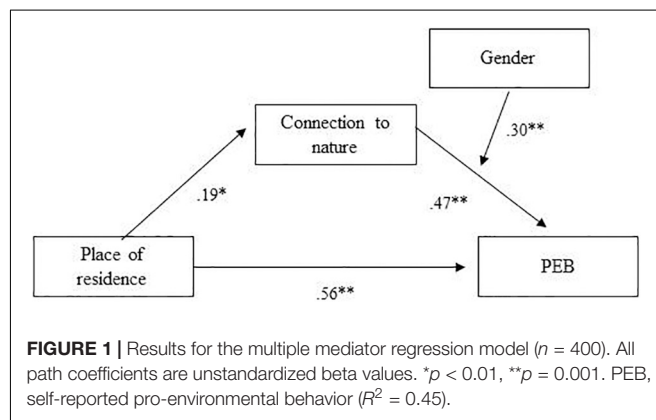
Data Analysis

First, descriptive, correlational, and t -tests analyses were conducted. Then, a mediational model was carried out using PROCESS (Hayes, 2018), model 14.¹ This particular model provides the direct relation between place of residence (urban/rural) and PEB (H1). It also estimates the indirect effect on the dependent variable (PEB) through the connection to nature (H2), as well as the possible moderating role of gender.

RESULTS

Children from both urban and rural places of residence show a high sense of connection to nature, being higher for those living in rural areas ($t = 360.76$, $p < 0.00$). However, they report a low frequency of conducting PEB, with urban children reporting a lower frequency than rural children ($t = 395.13$, $p < 0.00$). Girls reported more connection to nature ($t = 358.60$, $p < 0.00$) than boys, while PEB is very similar for both genders. We found a

¹This specific model was chosen (compared to other models, such as number 59) because preliminary regression analyses suggested that gender only affected the relation between connection to nature and PEB.



moderate positive correlation (Cohen, 1988) between children’s place of residence and PEB, as well as between connection to nature and PEB (Table 1).

The mediating model shows a positive, direct link between place of residence (urban/rural) and children’s PEB [$\beta = 0.56$, 95% CI (0.47, 0.65)]. We also found an indirect relationship between place of residence and PEB mediated by connection to nature [$\beta = 0.19$, 95% CI (0.09, 0.28)]. Gender (boy/girl) was found to moderate the link between connection to nature and PEB [$\beta = 0.30$, 95% CI (0.12, 0.48)], with the relation between connection to nature and PEB being stronger for girls than for boys. R^2 for PEB was 0.45 (Figure 1).

DISCUSSION

The growing visibility of environmental damage has led to an increase of environmental concern (Arı and Yılmaz, 2016). Consequently, the number of studies examining the factors and processes leading to PEB has also increased. However, little is known about the pathways to children’s pro-environmentalism (Otto et al., 2019), especially in developing countries. To fill this gap in the literature, we evaluated the role that place of residence (urban/rural) plays in Mexican children’s PEB. We also checked whether connection to nature is behind the link between place of residence and PEB, and explored the possible moderating role of gender.

According to our results, living in rural areas seems to be positively linked with children’s frequency of PEB (H1). This is in line with previous studies (Cheng and Monroe, 2012; Rosa

et al., 2019) which demonstrate that time spent in rural areas, and hence in contact with nature (Gifford and Nilsson, 2014), is one of the main determinants of people's PEB. In contrast to previous studies conducted in developed countries (Cheng and Monroe, 2012), our study shows that Mexican children report a low frequency of PEB. These findings align with previous studies conducted in Latin America (Juárez-Lugo, 2014; Díaz-Marín and Geiger, 2019), in which participants reported low to medium PEB. There might be cultural reasons behind these results. For instance, Milfont and Schultz (2016) found that culture influences the relationship between humans and nature. This might, in turn, lead to differences in the way people behave toward the natural environment. The possible cultural differences behind children's PEB require further attention.

As expected (H2), connection to nature seems to be partly responsible for the higher PEB found in children living in rural areas. The associations found suggest that the stronger the connection children feel with the natural world, the more likely they are to behave in a pro-environmental way. This result is also in consonance with the findings of previous studies (Olivos et al., 2013; Whitburn et al., 2019), suggesting that connection to nature is linked to PEB both in developed and developing countries.

In line with the pattern often described in previous studies, girls report being slightly more connected to nature than boys (Duarte et al., 2017). In addition, the current study adds to the literature on gender differences in pro-environmentalism by demonstrating variation in the relationship between connection to nature and PEB, being this association stronger for girls than for boys. The reasons for this may be that females are usually socialized to consider the needs of others (Dietz et al., 2002). This might imply that girls are socialized to show more altruistic values and helping behavior toward others, including nature and natural elements, than boys (McCright, 2010). This might, in turn, strengthen the link between girls' emotional connection to nature (i.e., connection to nature) and their behavior (i.e., PEB). Close examinations of these possibilities remain for future studies.

Our findings point in the same direction as those of previous researchers (Otto and Pensini, 2017; Rosa et al., 2019), suggesting that contact with nature can be a way of promoting children's pro-environmentalism. Other factors involved in experiences with nature should also be considered when trying to explain children's PEB, such as the type of nature in which children spend their time (Collado et al., 2015) and the perception of aesthetic qualities in natural areas (Lumber et al., 2017). Living close to nature is not always possible and other ways of providing opportunities for children's contact with nature should be considered. For example, schoolyards could play an important role in enhancing urban children's time spent in natural areas (Amicone et al., 2018). Introducing nature in the classroom, such as wall gardens, can also be an effective way for children to experience nature in their daily live (van den Berg et al., 2017). Another strategy that can help to bring children close to nature is incorporating technology into the classroom. Presenting a video or images from natural areas has benefits such as increased positive emotions (Zelenski et al., 2015) and a sense of wellbeing (Capaldi et al., 2015). Being exposed to nature

through videos/images in the classroom could be complementary to direct contact with nature.

Because environmental education programs have a stronger effect when conducted on young children than on adults (Liefänder and Bogner, 2014), and because most programs are aimed at children, we encourage the organization of environmental programs to be carried out in rural areas and include direct contact with nature (De Dominicis et al., 2017; Otto and Pensini, 2017). This might lead, in turn, to a stronger connection to nature and PEB. Given the differences found between urban/rural regarding their connection to nature and PEB, we believe that environmental education programs should be designed taking into consideration children's place of residence and their frequency of contact with nature. We hope the findings of this cross-sectional study serve as an inspiration for testing out interventions, as this will most likely help establish a causal link between exposure to nature and pro-environmentalism.

Despite the contributions described above, some limitations should be noted when interpreting the results. First, this is a cross-sectional study and the effects found cannot be taken in a strictly causal sense. Nevertheless, our results are in line with previous studies highlighting the importance of the physical context (Hinds and Sparks, 2008; Collado et al., 2015) and connection to nature (Cheng and Monroe, 2012) when examining the factors leading to PEB. We believe they serve as a starting point for further experimental research. Second, it should be noted that the results of this brief research report only apply to a specific context: the Northern part of Mexico. The findings are consistent with previous studies conducted in developed countries (Evans et al., 2018), but further research in various developing countries is needed to generalize our results. A third limitation is that our study explains 45% of the variance from self-reported PEB. This percentage is similar to the one found in previous studies with children (Collado and Evans, 2019), but other variables such as social norms (Casaló and Escario, 2016) and perceived restorativeness (Collado and Corraliza, 2015) might help us obtain a deeper understanding of children's PEB.

Limitations aside, from a theoretical point of view this study shows the relevance of place of the residence (urban/rural) for Mexican children's PEB, as well as the mediating role of connection to nature in the place of residence-PEB relationship. We believe it is essential to expand the findings of this brief research report by studying the possible influence that living in places with a variety of physical characteristics (e.g., the beach, the mountains, and the city) can have in people's PEB. Given that children will be the ones taking care of the natural environment in the near future, the inclusion of children from developing countries in such research seems essential.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Comité de Ética Institucional del Instituto Tecnológico de Sonora. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MD-R and FG-V conceived and designed the study. MB-E collected the data. MD-R, SC, and FG-V analyzed the data and

wrote an initial draft based on the results. SC critically revised the draft manuscript and made important changes in the content.

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REFERENCES

- Amicone, G., Petrucci, I., De Dominicis, S., Gherardini, A., Costantino, V., Perucchini, P., et al. (2018). Green breaks: the restorative effect of the school environment's green areas on children's cognitive performance. *Front. Psychol.* 9:1579. doi: 10.3389/fpsyg.2018.01579
- Ari, E., and Yilmaz, V. (2016). Effects of environmental illiteracy and environmental awareness among middle school students on environmental behavior. *Environ. Dev. Sustain.* 19, 1779–1793. doi: 10.1007/s10668-016-9826-3
- Arnocky, S., and Stroink, M. (2010). Gender differences in environmentalism: the mediating role of emotional empathy. *Curr. Res. Soc. Psychol.* 16, 1–14.
- Berenguer, J., Corraliza, J. A., and Martin, R. (2005). Rural-urban differences in environmental concern, attitudes, and actions. *Eur. J. Psychol. Assess.* 21, 128–138. doi: 10.1027/1015-5759.21.2.128
- Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S., Flanders, J., et al. (2019). Nature and mental health: an eco system service perspective. *Sci. Adv.* 5:eaa0903. doi: 10.1126/sciadv.aax0903
- Calderon-Aguilera, L. E., Rivera-Monroy, V. H., Porter-Bolland, L., Martínez-Yrizar, A., Ladah, L. B., Martínez-Ramos, M., et al. (2012). An assessment of natural and human disturbance effects on Mexican ecosystems: current trends and research gaps. *Biodivers. Conserv.* 21, 589–617. doi: 10.1007/s10531-011-0218-6
- Capaldi, C. A., Passmore, H.-A., Nisbet, E. K., Zelenski, J. M., and Dopko, R. L. (2015). Flourishing in nature: a review of the benefits of connecting with nature and its application as a wellbeing intervention. *Int. J. Wellbeing* 5, 1–16. doi: 10.5502/ijw.v5i4.449
- Casaló, L., and Escario, J. J. (2016). Intergenerational association of environmental concern: evidence of parents' and children's concern. *J. Environ. Psychol.* 48, 65–74. doi: 10.1016/j.jenvp.2016.09.001
- Chawla, L., and Derr, V. (2012). "The development of conservation behaviors in childhood and youth," in *The Oxford Handbook of Environmental and Conservation Psychology*, ed. S. Clayton (New York: Oxford University Press) 527–555.
- Cheng, J. C. H., and Monroe, M. C. (2012). Connection to nature: children's affective attitude toward nature. *Environ. Behav.* 44, 31–49. doi: 10.1177/0013916510385082
- Cohen, J. (1988). Set correlation and contingency tables. *Appl. Psychol. Meas.* 12, 425–434. doi: 10.1177/014662168801200410
- Collado, S., and Corraliza, J. A. (2015). Children's restorative experiences and self-reported pro-environmental behaviors. *Environ. Behav.* 47, 38–56. doi: 10.1177/0013916513492417
- Collado, S., Corraliza, J. A., Staats, H., and Ruiz, M. A. (2015). Effect of frequency and mode of contact with nature on children's self-reported ecological behaviors. *J. Environ. Psychol.* 41, 65–73. doi: 10.1016/j.jenvp.2014.11.001
- Collado, S., and Evans, G. (2019). Outcome expectancy: a key factor to understanding childhood exposure to nature and children's pro-environmental behavior. *J. Environ. Psychol.* 61, 30–36. doi: 10.1016/j.jenvp.2018.12.001
- Collado, S., and Sorrel, M. A. (2019). Children's environmental moral judgments: variations according to type of victim and exposure to nature. *J. Environ. Psychol.* 62, 42–48. doi: 10.1016/j.jenvp.2019.02.005
- Corral, V. (2010). *Psicología de la Sustentabilidad: un Análisis de lo que nos hace pro Ecológicos y pro Sociales [Sustainability Psychology: an Analysis of What Makes us Pro Ecological and Pro Social]*. México: Trillas.
- De Dominicis, S., Bonaiuto, M., Carrus, G., Passafaro, P., Perucchini, P., and Bonnes, M. (2017). Evaluating the role of protected natural areas for environmental education in Italy. *Appl. Environ. Educ. Commun.* 16, 171–185. doi: 10.1080/1533015X.2017.1322014
- Díaz-Marín, J. S., and Geiger, S. M. (2019). Comportamiento proambiental: actitudes y valores en una muestra poblacional colombiana [Proenvironmental Behavior: attitudes and values in a Colombian population sample]. *Rev. Iberoam. Psicol.* 12, 33–40. doi: 10.33881/2027-1786.rip.1210
- Dietz, T., Kalof, L., and Stern, P. C. (2002). Gender, values, and environmentalism. *Soc. Sci. Q.* 83, 353–364. doi: 10.1111/1540-6237.00088
- Duarte, R., Escario, J. J., and Sanagustín, M. V. (2017). The influence of the family, the school, and the group on the environmental attitudes of European students. *Environ. Educ. Res.* 23, 23–42. doi: 10.1080/13504622.2015.1074660
- Duerden, M. D., and Witt, P. A. (2010). The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *J. Environ. Psychol.* 30, 379–392. doi: 10.1016/j.jenvp.2010.03.007
- Evans, G. W. (2019). Projected behavioral impacts of global climate change. *Annu. Rev. Psychol.* 70, 449–474. doi: 10.1146/annurev-psych-010418-103023
- Evans, G. W., Otto, S., and Kaiser, F. G. (2018). Childhood origins of young adult environmental behavior. *Psychol. Sci.* 47, 88–94. doi: 10.1177/0956797617741894
- Fraijo, B., Corral, V., Tapia, C., and García, F. (2012). Adaptación y prueba de una escala de orientación hacia la sustentabilidad en niños de sexto año de educación básica [Adaptation and testing of a scale of orientation towards sustainability in children in sixth year of basic Education]. *RMIE* 17, 1091–1117.
- Gifford, R., and Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: a review. *Int. J. of Psychol.* 49, 141–157. doi: 10.1002/ijop.12034
- Hayes, A. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: a Regression-Based Approach*. New York, NY: The Guilford Press.
- Hinds, J., and Sparks, P. (2008). Engaging with the natural environment: the role of affective connection and identity. *J. Environ. Psychol.* 28, 109–120. doi: 10.1016/j.jenvp.2007.11.001
- Juárez-Lugo, C. S. (2014). Predictores del comportamiento de reciclaje en alumnos de educación primaria en México [Predictors of recycling behavior in elementary school students in Mexico]. *Psycology* 1, 25–37. doi: 10.1174/217119710790709568
- Kaiser, F. (1998). A general measure of ecological behavior. *J. Appl. Soc. Psychol.* 28, 395–442. doi: 10.1111/j.1559-1816.1998.tb01712.x
- Larson, L. R., Stedman, R. C., Cooper, C. B., and Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *J. Environ. Psychol.* 43, 112–124. doi: 10.1016/j.jenvp.2015.06.004
- Lekies, K. S., and Brensing, J. D. (2017). "Childhood nature experiences across residential settings: Rural, suburban, and urban," in *Risk, Protection, Provision and Policy. Geographies of Children and Young People*, Vol. 12, eds C. Freeman, P. Tranter, and T. Skelton (Singapore: Springer), 67–86. doi: 10.1007/978-981-287-035-3_22

- Liefländer, A. K., and Bogner, F. X. (2014). The effects of children's age and sex on acquiring pro-environmental attitudes through environmental education. *J. Environ. Educ.* 45, 105–117. doi: 10.1080/00958964.2013.875511
- Lumber, R., Richardson, M., and Sheffield, D. (2017). Beyond knowing nature: contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *Plos. One* 12:e0177186. doi: 10.1371/journal.pone.0177186
- Mayer, S. F., and Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *J. Environ. Psychol.* 24, 505–515. doi: 10.1016/j.jenvp.2004.10.001
- McCright, A. M. (2010). The effects of gender on climate change knowledge and concern in the American public. *Popul. Environ.* 32, 66–87. doi: 10.1007/s11111-010-0113-1
- Milfont, T. L., and Schultz, P. W. (2016). Culture and the natural environment. *Curr. Opin. Psychol.* 8, 194–199. doi: 10.1016/j.copsyc.2015.09.009
- Nisbet, E., Zelenski, J., and Murphy, S. (2008). The nature relatedness scale: linking individuals' connection with nature to environmental concern and behavior. *Environ. Behav.* 41, 715–740. doi: 10.1177/0013916508318748
- Olivos, P., Aragonés, J. I., and Navarro-Carrascal, O. (2013). Educación ambiental: itinerario en la naturaleza y su relación con conectividad, preocupaciones ambientales y conducta [Environmental education: itinerary in nature and its relationship with connectivity, environmental concerns and behavior]. *Rev. Lat. Am. Psicol.* 45, 503–513. doi: 10.14349/rlp.v45i3.1490
- Otto, S., Evans, G. W., Moon, M. J., and Kaiser, F. G. (2019). The development of children's environmental attitude and behavior. *Global. Environ. Chang.* 58:101947. doi: 10.1016/j.gloenvcha.2019.101947
- Otto, S., and Pensini, P. (2017). Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global. Environ. Chang.* 47, 88–94. doi: 10.1016/j.gloenvcha.2017.09.009
- Rosa, C. D., Collado, S., Profice, C. C., and Larson, L. R. (2019). Nature-based recreation associated with connectedness to nature and leisure satisfaction among students in Brazil. *Leisure Stud.* 38, 682–691. doi: 10.1080/02614367.2019.1620842
- Rosa, C. D., Profice, C. C., and Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: the role of connectedness to nature and childhood nature experiences. *Front. Psychol.* 9:1055. doi: 10.3389/fpsyg.2018.01055
- Schultz, P. W. (2001). The structure of environmental concern: concern for self, other people, and the biosphere. *J. Environ. Psychol.* 21, 327–339. doi: 10.1006/jevp.2001.0227
- Schutte, N. S., and Bhullar, N. (2017). Approaching environmental sustainability: perceptions of self-efficacy and changeability. *J. Psychol.* 151, 321–333. doi: 10.1080/00223980.2017.1289144
- van den Berg, A. E., Wesselijs, J. E., Maas, J., and Tanja-Dijkstra, K. (2017). Green walls for a restorative classroom environment: a controlled evaluation study. *Environ. Behav.* 49, 791–813. doi: 10.1177/0013916516667976
- Vargas, G. (2010). “La cosmovisión de los pueblos indígenas” [The worldview of indigenous peoples], in *Patrimonio Cultural [Cultural heritage]*, ed. R. Córdova (Veracruz: Universidad Veracruzana), 105–126.
- Whitburn, J., Linklater, W., and Abrahamse, W. (2019). Meta-analysis of human connection to nature and proenvironmental behavior. *Conserv. Biol.* 0, 1–14. doi: 10.1111/cobi.13381
- World Trade Organization [WTO] (2014). *World Trade Report*. Available at: https://www.wto.org/English/res_e/publications_e/wtr14_e.htm (Accessed June 5, 2019).
- Zelenski, J. M., Dopko, R. L., and Capaldi, C. A. (2015). Cooperation is in our nature: nature exposure may promote cooperative and environmentally sustainable behavior. *J. Environ. Psychol.* 42, 24–31. doi: 10.1016/j.jenvp.2015.01.005

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Biophilia and Biophobia as Emotional Attribution to Nature in Children of 5 Years Old

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Introduction: Connectedness to nature is a concept that reflects the emotional relationship between the self and the natural environment, based on the theory of biophilia, the innate predisposition to the natural environment. However, the biophobic component has largely been ignored, despite, given its adaptive functional role, being an essential part of the construct. If there is a phylogenetic component underlying nature connectedness, biophilic, and/or biophobic, there should be evidence of this record from early childhood. The main aim of this study is therefore to describe the emotional attributions identified in 5 years old.

Methodology: Two studies were conducted. In the first, 94 children expressed their concept of nature and made basic emotional attributions to a set of 30 images of natural, using a software designed for the study. In the second, 39 children repeated the procedure and provided explanations for their responses.

Results: The main results show that, in general, children use both positive and negative emotions, which may be related to a three-dimensional model of emotional attributions to nature. The most widely attributed emotion is happiness. However, fear is the second most common attribution. The role of happiness could be explained by a feeling of security and familiarity, while the importance of fear in nature could show an adaptive response of the fear of wild nature in children. This interpretation could be confirmed when analyzing specifically the emotional attributions, classifying the images according to biological and ecosystemic criteria. Thus, for example, more emotional attributions are explained by the “pleasantness” attributed to primary producers and landscapes (e.g., flora), versus attributions of “harm” to the images of secondary and tertiary consumers (e.g., hunters).

Conclusion: These results provide evidence in favor of a didactic procedure to study emotional attributions to images of nature in preschool children. They suggest the incorporation of biophobia as an important adaptive factor in connectedness to nature and a tripartite emotional hypothesis based on the valences of the attributed emotions.

Keywords: biophilia, biophobia, connectedness, nature, emotion, emoji, children

INTRODUCTION

Since Clayton (2003) and Mayer and Frantz (2004) proposed the concepts of environmental identity and connectedness to nature, several studies have highlighted the link between the environment and people through self or identity. These concepts include the self-perceived affective relationship of the interconnection between the self and the natural environment. However, unlike environmental identity, the original approach to connectedness (Mayer and Frantz, 2004; Schultz et al., 2004) was founded on phylogenetic arguments, drawing on the theory of Biophilia. Originally proposed by Wilson (1984), this refers to an innate and positive human predisposition of affiliation to the natural environment, which allows the human being to experience benefits that, according to its author, facilitated the development, adaptation and survival of human beings. However, the biophobic component of connectedness with nature has largely been ignored, despite, given its adaptive functional role, being an essential part of the construct. This lack in the conceptual field faces the present study.

Although many alternative measures have been developed to the connectedness to nature scale originally proposed by Mayer and Frantz (e.g., Kals et al., 1999; Schultz, 2001; Dutcher et al., 2007; Davis et al., 2009; Nisbet et al., 2009; Pasca et al., 2017), this construct remains one of the most widely used in studies on the relationship between self and nature, with these works always adopting a biophilic perspective (Brügger et al., 2011; Tam, 2013; Olivos and Clayton, 2017). Another important characteristic of connectedness is its emotional component (Kals et al., 1999; Mayer et al., 2009; Howell et al., 2011; Cervinka et al., 2012), which has been studied in relation to subjective well-being (Gillis and Gatersleben, 2015; Olivos and Clayton, 2017).

Some authors, such as Perrin and Benassi (2009) have argued that the connectedness to nature scale fails to measure an emotional component. However, the study of well-being in relation to the environment has a solid empirical basis, which has been approached from different conceptualizations. The most frequent approach to connectedness has been the study of hedonic well-being – also called subjective or emotional well-being – based on the registration of positive emotions as a result of direct contact with natural stimuli (Saraglou et al., 2008; Weinstein et al., 2009; Nisbet et al., 2011). The results usually point to the experience of positive sensations after direct exposure to nature (Mayer et al., 2009), to residence near green environments (Astell-Burt et al., 2014; Fattorini et al., 2017), even after mere exposure to images (Falsten, 2014; Mena et al., 2020) or the evocation of natural landscapes (Hinds and Sparks, 2011). Some of these studies show the mediating role of connectedness between environmental stimuli and well-being, in such a way that nature has a buffering effect for stress reduction, improves attention tasks, promotes positive social behaviors, pro-environmental behaviors, connectedness to nature, and in short, improves quality of life (Mayer et al., 2009; Corraliza and Collado, 2011; Hoot and Riedman, 2011; Nisbet and Zelenski, 2011; Carrus et al., 2012; Myers, 2012; Howell et al., 2013; Collado and Corraliza, 2016; Collado and Staats, 2016). However, other authors have observed that an adequate prior

connectedness feature is not required to be effective in improving emotional well-being through experiences of contact with natural environments (Passmore and Howell, 2014).

Considering, then, the emotional content of biophilia, connectedness with nature would act as a kind of phylogenetically oriented guide, favoring the search for the individual, material and emotional benefits, through contact with the environment. Therefore, if the phylogenetic relationship of human beings with their environment must be resolved favorably toward survival, then a negative phylogenetic disposition, of a biophobic type, must be expected, consisting of emotions that allow an alert, safe reaction to certain threats present in nature.

Biophobia has been considered by other authors, who describe it as the feeling of fear or rejection of natural elements with an adaptive purpose (Ulrich, 1993; Orians, 1998). It produces emotional reactions of negative valence in reaction to certain natural stimuli (such as a dangerous animal or a natural catastrophe) with the aim of promoting protective, rejection or withdrawal behaviors to avoid harm (Koole and Van den Berg, 2005). In this line, Hand et al. (2017) point out that children do not behave as predicted by the biophilic hypothesis, because, in some cases, they avoid biodiverse spaces due to their producing negative emotions.

Although biophobia is an unexplored field in Environmental Psychology, due to the bias imposed by positive psychology on the study of well-being (Brown et al., 2018; Olivos and Ernst, 2018), some studies have highlighted affective ambivalence effects, such as anxiety or isolation responses, after contact with certain natural environments (Hinds and Sparks, 2011; Davis and Gatersleben, 2013; Gatersleben and Andrews, 2013). Biophobia may activate other phylogenetic components of connectedness and, like biophilia, may also be subject to processes of sociocultural symbolization and epigenetic adaptation.

The scientific literature lacks instruments to measure negative affectivity as a dimension with positive adaptive effects for individuals. There exist a few scales developed *ad hoc* to record negative emotions (Hinds and Sparks, 2011; Davis and Gatersleben, 2013), and other scales that measure negative emotions versus positive emotions in the well-being concept (for example, PANAS, Watson et al., 1988; SPANE, Diener et al., 2010; ZIPERS, Zuckerman, 1977) but their interpretation is usually negatively stigmatized as undesirable response. There is, therefore, a need to develop a procedure for positive and negative emotion measurement, according to the effects that the perception of nature may cause, conceived for the description of biophilia and biophobia, interpretable as adaptive mechanisms.

CHILDREN, EMOTION, AND NATURE

Studies on experiences of contact with nature in young and adult populations have shown the importance of childhood memories in the impressions evoked by these experiences (Thomashow, 1995; Schroeder, 2007; Bartos, 2013; Olivos et al., 2013; Mena et al., 2020). The results suggest that the significance of the environment depends on the emotional impact of a person's early experiences. Thus, it is of key importance to determine how

children interact with the environment and the emotions evoked by contact with natural stimuli.

However, most studies to assess children's pro-environmental attitudes and behaviors, on contact with nature, have been conducted as part of structured environmental education programs, with samples of children aged above 8 years. Most of the studies were conducted using pencil-and-paper questionnaires (e.g., Kanh and Kellert, 2002; Kals and Ittner, 2003; Wells and Evans, 2003; Wells and Lekies, 2006; Maller, 2009; Bruni and Schultz, 2010; Van den Berg and Van den Berg, 2010; Carrus et al., 2012; Collado et al., 2013; Corraliza et al., 2013; Collado and Corraliza, 2016).

One approach to the biophilic and biophobic principles of nature connectedness consists of observing the emotional components it induces in early childhood, due to children's lower exposure to socialized symbolic content compared to adolescents, young persons and adults.

During the first year of life, children experience primary emotions and dichotomous models of relational interaction (laughing or crying, happiness or sadness), mainly associated with internal physiological states (hunger, sleepiness, etc.). Happiness and anger are emotions that infants can recognize in others after just 1 month of life. However, it is from the age of 4–8 months when they begin to differentiate between them, improving their expressive capacity, and adding reactions of surprise. It is after this stage that infants begin to distinguish between positive and negative emotions and expressions of fear and guilt emerge (Sprung et al., 2015). Between the first and third year of life, empathy begins to develop and basic emotions are consolidated, which infants are now able to imitate (Jones and Mize, 2016). At 4 years, due to language development resulting from the linguistic and conceptual acquisition of graphic expression (Remplein, 1966; Bomfim, 2003; Myers, 2012), their conceptual repertoire increases, being able to recognize and name emotions (Segura and Arcas, 2004; Cejudo, 2015). Hence, emotional awareness develops (understanding what you feel and why), although this is still a stage of extremes (great sadness or joy). Emotion regulation begins between 4 and 5 years of age, bolstered by emergence of symbolic play. Nonetheless, the predomination of egocentricity continues until 6 years, when contact and understanding of the social world is enhanced (Sprung et al., 2015).

Children aged between 2 and 5 years begin to have a sense of self and control of their identity, forming an initial sense of connection to the world, which, if developed securely, creates a bond generating well-being and emotional attachment to the natural world (Barraza, 1998; Myers, 2012; Green et al., 2016; Tugurian and Carrier, 2017). Furthermore, at this age, children have not initiated the formal learning of reading and writing skills, which constitutes one of the most powerful socializing influences on the structure of thought (Vygotsky, 1934; Habermas, 1984; Langer and Applebee, 1985; Palinscar, 1998). As the process of representing emotions begins before the acquisition of written expression, images, at an early age, offer the opportunity for greater expression of emotions and feelings, being a more favorable means of expression for children, even for those with reduced social interaction skills (Bomfim, 2003;

Ulker, 2012). Hence, it is possible to study the recognition of basic emotions in children using photos (Nelson and Rusell, 2016; Brechet, 2017), drawings (Brechet, 2017), and storytelling (Widen et al., 2015). Some studies have reported better effects of these resources in 5 years old than in older children (Brechet, 2017).

In light of the above, it is important to study connectedness to nature based on emotional attributions toward natural environments in early childhood, in order to delve into the biophilic and biophobic components related to the characteristic elements of the natural world. The aim, then, of the present study is to describe the emotional attributions toward environmental stimuli made by 5 years old boys and girls.

METHODOLOGY

This work involved conducting two studies, the methodological characteristics of which are described below.

STUDY 1

Participants

Initially, 98 participants aged under 6 years were selected using convenience sampling. These were all enrolled in the 5 years old pre-school classes at Benjamín Palencia and Cristóbal Colón Public Infant and Primary Schools in the city of Albacete, Spain. Of these 98 children, 41.2% were girls. A small number of the children had special educational needs in the form of language difficulties and impaired cognitive development and understanding and were consequently excluded from the sample analyzed, which finally comprised 94 children ($M = 5.7$ years; $SD = 0.6$).

Instrument and Procedure

Taking into account the aims and hypotheses and the differences in the stages of cognitive and moral development compared to older children (Mestre et al., 2011; Lemos, 2013), a measurement procedure was designed to assess the 5 years old emotional attributions toward natural environments.

As the emotion attribution procedure was to be conducted based on exposure to images, the first step was to select such images (**Figure 1**). We worked with the images of natural environments used in the Environmental Preference Scale (EPS) designed by Sánchez et al. (2012). We choose those images because they formed part of an implicit association test (IAT), which procedure includes a strict prior evaluation (valence, familiarity, activation) as IAT studies demand (De Houwer, 2003; Ruiz and Ortiz, 2006; Verges and Duffy, 2010; Olivos and Aragonés, 2013).

The stimuli were presented in random order, and trial images were included at the beginning to check for correct identification of the icons representing the emotions.

We first conducted a pilot test with the participation of 10 children, 70% boys, with a mean age of 4.5 years ($SD = 0.47$), to check images were identified correctly and the response procedure was understood. The children evaluated the images



FIGURE 1 | Some of the images of natural environments used in the emotional attribution test (Sánchez et al., 2012).

using emoticons to attribute four basic emotions posited in the literature (Harris, 1994; Davidson, 2006): happiness, sadness, anger and fear. Emoticons are increasingly being used as response protocols in satisfaction evaluations in different settings (shopping malls, airports, public services, etc.) and studies (e.g., Gallo et al., 2017; Schouteten et al., 2018), while also being a common element of communication systems in both children and adults. The results of this trial indicated that, despite appropriately using the emoticons to attribute emotions to the images, the children's explanations during the attributional process suggested they were able to use at least another emotion within their repertoire.

Taking the above into account and the fact there exists no consensus on the predominant set of basic emotions in early childhood, in this first study, we decided to follow the basic emotions theory espoused by Ekman (1999), and used five emoticons (**Figure 2**): happiness, sadness, anger, fear, and disgust.

To validate the emoticons, an inter-rater reliability analysis, with three expert judges, was conducted to determine whether the emoticons adequately represented the associated emotions. The mean Kappa coefficient was 0.350, equivalent to “correct” (Dubé, 2008). Moreover, 90% of the children correctly associated the emotions represented in the trial images with the corresponding emoticons.

To present the images and record the responses, we developed a web-based application using HTML language, with PHP server language. To run the application, an Apache server was used as well as an MySQL database to store the information generated, which was subsequently exported to an Excel spreadsheet. The applications were partly developed by a trained survey expert, who used a Lenovo Yoga laptop computer, with Windows 10 business edition, Intel Core i5 de 1.60 GHz processor and a touch screen (**Figure 3**).

We contacted the school principals and the class teachers of the groups of 5 years old, with whom we subsequently held an informational meeting. Once they agreed to collaborate, we distributed authorization letters to parents and guardians, with an informed consent form and a short family questionnaire to collect sociodemographic data.

The procedure was administered individually, with each session lasting an average of 22 min. The first thing the children did was to answer an open question on what nature meant to them. The next stage was conducted in front of the computer (game), and was divided into three parts. In the first part, the children were required to associate the name of each emotion

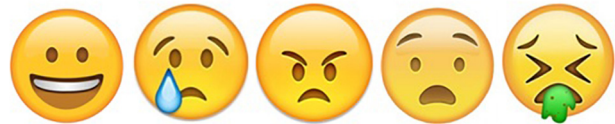


FIGURE 2 | Emoticons from the response scale, emoticons reflecting happiness, sadness, anger, fear and disgust, in that order.



FIGURE 3 | Images of a boy and a girl using the application on the touch screen laptop (written informed consent for publishing images available).

with its corresponding emoticon. This served to check the validity of the emotional pictographic scale and for the children to become acquainted with the response protocol. The second part was composed of five trial images, and the third consisted of the presentation of the images included in the study.

A lexicographic analysis was conducted on the open responses on the concept of nature using the “open coding” procedure (Strauss and Corbin, 1994), to identify the children's ideas on the concept of nature. This technique has been used in other environmental psychology studies (Schroeder, 2007; Mena et al., 2020). It involves the quantitative analysis of certain word patterns within a comprehensive documentary corpus, organized into categories (labels).

The data analysis was conducted using SPSS24 software, with frequency and simple correspondence analysis to describe the relationships between the nominal variables in a correspondence table in a low-dimensional space, to describe the new dimensional categories build from the weighed intersected position between those variables. For the adequate interpretation of the correspondence analyses, we used both quantitative and qualitative criteria. First, to retain the number

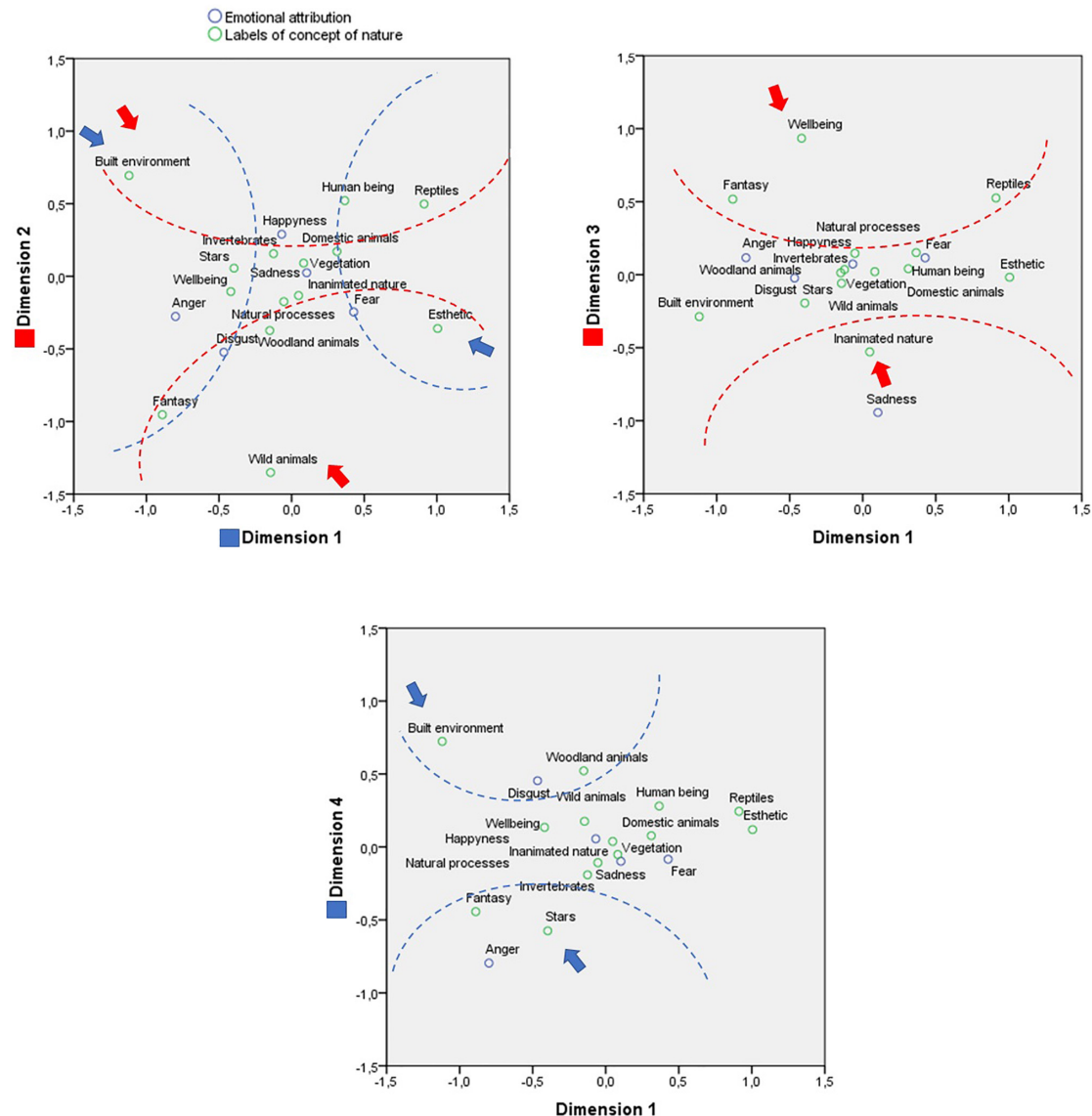


FIGURE 4 | Correspondence analysis between concept of nature and emotional attribution in images of a natural environment.

of dimensions resulted we used the more common rules which recommend that their added inertia represents as a minimum of 70% (Higgs, 1991). Additionally, we retain dimensions with eigenvalues over 10% (Nagpaul, 1999). After that, we analyze them taking in to account theoretical assumptions and objectives, following a whole comprehension of the dimensions and the axis resulted from the extremes contents involve.

Results

Concept of Nature

The analysis of the responses on the concept of nature resulted in a table with 14 labels from a total corpus of 316 words. The largest category was “vegetation,” accounting for 31.28% of mentions, with the words including flowers and trees. The

next largest category was “animals,” which included 32.29% of the mentions. This category, however, was subdivided into “invertebrates” (16.76%), “domestic animals” (9.50%), “woodland animals” (2.52%), “wild animals” (2.24%), and “reptiles” (1.27%).

The next category was “natural processes” (10.42%), including seasons, such as spring; expressions, such as cycles; and actions, such as living or coming out, referring to flowers, the sun, butterflies, etc.

The following label was “inanimate nature” (6.34%, e.g., water, rainbow), followed by “celestial bodies” (4.10%, e.g., star, moon, sun) and “built environment” (2.87%, e.g., cars, schools, motorbikes). These last two categories are interesting in the children’s concept of nature, as the first refers to indirectly experienced natural elements, and the second to non-natural elements.

TABLE 1 | Symmetrical normalization of row and column points of the correspondence analysis between concept of nature and emotional attribution in images of a natural environment.

	Mass					Inertia	Contribution									
	Score in dimension						Of point to inertia of dimension				Of dimension to inertia of point					
	1	2	3	4			1	2	3	4		1	2	3	4	Total
Overview row points: labels of concept of nature																
Vegetation	0.257	0.082	0.091	0.021	−0.052	0.000	0.015	0.023	0.001	0.011	0.448	0.436	0.019	0.098	1.0	
Inanimated nature	0.113	0.048	−0.133	−0.528	0.038	0.003	0.002	0.022	0.423	0.003	0.011	0.070	0.915	0.004	1.0	
Stars	0.050	−0.397	0.056	−0.195	−0.575	0.002	0.069	0.002	0.025	0.266	0.432	0.007	0.068	0.493	1.0	
Natural processes	0.113	−0.053	−0.174	0.146	−0.108	0.001	0.003	0.038	0.032	0.021	0.060	0.512	0.295	0.133	1.0	
Domestic animals	0.108	0.312	0.171	0.041	0.077	0.002	0.093	0.035	0.002	0.010	0.778	0.187	0.009	0.026	1.0	
Wild animals	0.018	−0.145	−1.351	−0.059	0.175	0.003	0.003	0.363	0.001	0.009	0.014	0.973	0.002	0.011	1.0	
Country animals	0.063	−0.151	−0.373	0.013	0.522	0.002	0.013	0.097	0.000	0.279	0.080	0.395	0.000	0.524	1.0	
Invertebrates	0.145	−0.125	0.156	0.035	−0.191	0.001	0.020	0.039	0.002	0.085	0.279	0.350	0.014	0.356	1.0	
Reptiles	0.014	0.912	0.498	0.525	0.244	0.002	0.099	0.037	0.050	0.013	0.669	0.159	0.146	0.026	1.0	
Esthetic	0.027	1.005	−0.360	−0.018	0.119	0.003	0.241	0.039	0.000	0.006	0.901	0.092	0.000	0.007	1.0	
Wellbeing	0.034	−0.418	−0.105	0.934	0.134	0.003	0.052	0.004	0.393	0.010	0.228	0.012	0.747	0.013	1.0	
Human being	0.023	0.366	0.521	0.151	0.280	0.001	0.027	0.068	0.007	0.029	0.327	0.531	0.037	0.105	1.0	
Built environment	0.027	−1.119	0.694	−0.287	0.723	0.006	0.299	0.144	0.030	0.230	0.634	0.195	0.027	0.144	1.0	
Fantasy	0.009	−0.890	−0.953	0.517	−0.443	0.002	0.063	0.090	0.032	0.029	0.439	0.404	0.098	0.059	1.0	
Overview column points: emotional attribution																
Happyness	0.480	−0.068	0.289	0.073	0.055	0.004	0.020	0.442	0.035	0.024	0.060	0.872	0.046	0.022	1.0	
Sadness	0.076	0.104	0.024	−0.944	−0.099	0.005	0.007	0.000	0.905	0.012	0.018	0.001	0.973	0.009	1.0	
Anger	0.056	−0.799	−0.276	0.116	−0.796	0.007	0.315	0.047	0.010	0.572	0.606	0.058	0.008	0.327	1.0	
Fear	0.280	0.427	−0.245	0.115	−0.084	0.008	0.451	0.186	0.050	0.032	0.750	0.198	0.036	0.016	1.0	
Disgust	0.108	−0.467	−0.523	−0.023	0.454	0.007	0.207	0.325	0.001	0.359	0.397	0.399	0.001	0.204	1.0	

Finally, accounting for lower percentages, are the labels of “well-being” (3.18%, e.g., happy, peaceful, having a good time), “esthetic emotion” (2.89%, e.g., pretty, cool, smell good), “human beings” (1.59%, e.g., humans, people), and “fantasy” (0.64%, e.g., dinosaur, vampire).

Emotional Attributions

We then performed a frequency analysis on the number of times each emoticon was selected. Happiness was also the most popular choice of emotion for the natural environment images (47.27%), when they featured fish, penguins and landscapes of fields with yellow flowers. Fear was the second most frequently chosen emotion for natural environments (27.62%), in response to images of a shark and a snake. The third most frequently elicited emotion for nature environments was disgust (11.10%), elicited by images of insects. The fourth most frequently chosen emotion was sadness (8.30%), in response to images of a cactus and a scorpion. Finally, anger (5.71%) was the lowest ranked emotion, in response to a cactus and a forest with smoke.

Next, a simple correspondence analysis was conducted between the emotional attributions and the labels of the concept of nature, according to the environment type (Figure 4). We obtained statistically significant coefficients in the observation of both the row points ($\chi^2 = 202.482$; $p < 0.001$), referring to the labels of the concept of nature, and the column points, referring to the emotions. This reflects

the existence of a relationship between the frequency of the nature labels and the emotions attributed to the images of nature environment.

To interpret theses data, it is advisable to take into account the categories of content and emotions with the greatest explanatory power, as there are few truly clear associations. The analysis of the relative contributions to the examination of the row points, for the attributions toward both types of environment, reveals high representativeness, with most of the values close to one (> 0.800) in the dimensions.

In the attributions (Table 1), four dimensions were identified that together explain 100% of the variance. The first dimension explains 42.2%. In one extreme of the first dimension we find “built environment,” “fantasy,” “well-being,” and “celestial bodies,” associated with anger; and in the other extreme, we find the labels of “esthetic emotion,” “reptiles,” “human beings,” and “domestic animals,” associated with fear. In other words, the first dimension discriminates between predominately subjective elements with negative emotional valence and living beings associated with fear.

The second dimension explains 27.1% of the variance. At one extreme are situated “wild animals,” “fantasy,” “woodland animals,” and “esthetic emotion,” associated with disgust; and at the other extreme “built environment,” “human beings,” and “reptiles,” which, although they have no defined weighting, are close to happiness. This implies that the second dimension discriminates between a threatening natural environment, and

living beings in an urban environment (as pets) with a positive emotional valence.

The third dimension explains 18.2% of the variance. At one extreme we find only “inanimate nature” associated with sadness; and at the other “well-being,” “reptiles,” and “fantasy” but without a clear association with any emotions. In other words, the third dimension discriminates between a subjective component without a defined emotional attribution and an inanimate natural environment associated with sadness.

The fourth dimension explains 12.5% of the variance. At one extreme are situated “celestial bodies” and “fantasy,” associated with anger; and at the other extreme “built environment” and “woodland animals,” associated with disgust. This implies that the fourth dimension discriminates between an urban environment with animals associated with disgust and an imaginary environment associated with anger.

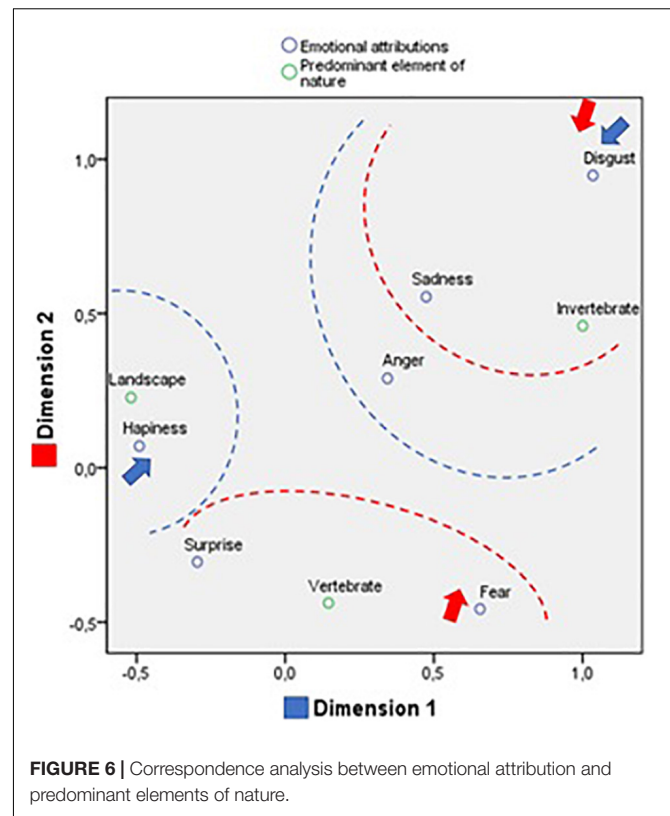
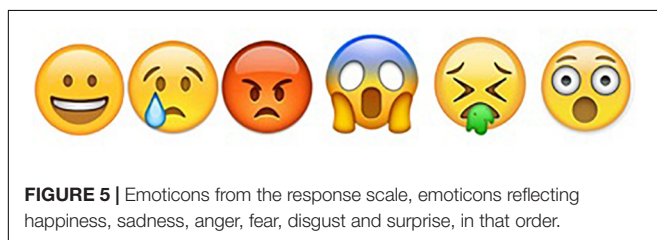
STUDY 2

The mental maps generated by experience, which individuals draw on to understand reality, are not exempt from changes. A large body of literature claims that surprise arises as an emotional response to the perception of a strong stimulus, which, due to its perceptive magnitude and the necessity of accommodation it triggers, overwhelms our established mental maps (Lazarus, 1991). A positive correlation has been reported between the experience of awe, paying attention and preparing to confront unexpected occurrences (Marina, 2006; Faber and Hall, 2007). Furthermore, despite surprise being a complex emotion, it has been observed that children are able to recognize it from around the age of 6 years (Doan et al., 2018). The study of awe and surprise is increasingly forming part of research on environmental psychology (e.g., Lazarus, 1991; Keltner and Haidt, 2003; Shiota et al., 2007; Nasar and Cubukcu, 2011; Joye and Dewitte, 2016; Ballew and Omoto, 2018; Collado and Manrique, 2019).

Methodology

Participants

Once we had excluded participants that had not presented their parents' or guardians' informed consent and two students with special educational needs, the sample comprised 39 children enrolled in the 5 years old pre-school classes at the Benjamín Palencia Infant and Primary School in Albacete, Spain, none of whom had participated in Study 1. Of these, 48.7% were girls and the mean age was 4.86 years ($SD = 0.41$).



Instrument and Procedure

To study the emotional attributions, the same procedure was followed as in Study 1, with images of natural environments, of which 56.7% were images of animals and insects and 43.3% were of landscapes. Specifically, and drawing on a first level classification, 20% of the images corresponded to the label of mammals, 10% birds, 6.7% fish, 3.3% reptiles, 16.7% arthropods, 3.3% cold landscapes, 10% forest landscapes, 10% landscapes with water, 10% dry landscapes, and 10% landscapes of flowers. As in the first study, the images were presented randomly.

For the emotional attribution procedure, on this occasion, we used a response scale with six emoticons representing the previously used five basic emotions proposed by Ekman (1999), happiness, sadness, anger, fear and disgust, plus a sixth emotion, that of surprise (Figure 5), improving the scale from the study 1. This emotion was included due to its significance in studies on the environment, and because some of the children's explanations in Study 1 could have been classified as expressions of surprise, but as it was not a choice among the five basic emotions, some of the children exhibited doubts when expressing a response.

The validity of the emoticons was once more submitted to inter-rater analysis. Two expert professionals from the field of preschool education completed a questionnaire in which they were required to rate three possible emoticons on a three-point scale (Appropriate = 1, Inappropriate = 2, Needs modifying = 3). Fleiss' Kappa was .317, indicating a correct level of agreement (Dubé, 2008). The emoticons chosen were signaled correctly by the children in 92% of the cases.

TABLE 2 | Symmetrical normalization of row and column points in the correspondence analysis between emotional attribution and predominant elements of nature.

	Mass	Inertia			Contribution				
					Of point to inertia of dimension		Of dimension to inertia of point		
		Score in dimension						Total	
		1	2	1	2	1	2		
Overview row points: predominant element of nature									
Vertebrate	0.400	0.145	−0.438	0.013	0.029	0.571	0.193	0.807	1.0
Invertebrate	0.167	1.000	0.460	0.053	0.571	0.262	0.911	0.089	1.0
Landscape	0.433	−0.519	0.228	0.037	0.400	0.167	0.919	0.081	1.0
Overview column points: emotional attributions									
Happiness	0.453	−0.491	0.070	0.032	0.373	0.017	0.991	0.009	1.0
Sadness	0.098	0.474	0.554	0.011	0.076	0.224	0.614	0.386	1.0
Anger	0.054	0.344	0.290	0.002	0.022	0.034	0.754	0.246	1.0
Fear	0.228	0.655	−0.457	0.035	0.336	0.355	0.817	0.183	1.0
Disgust	0.043	1.035	0.948	0.018	0.156	0.284	0.721	0.279	1.0
Surprise	0.124	−0.296	−0.305	0.005	0.037	0.086	0.671	0.329	1.0

We repeated the same contact, information and consent procedures with the school authorities and the children's parents or guardians. The tests were administered individually in specially prepared rooms in the school during normal class time. The mean time taken to administer the test was around 30 min, but on this occasion, we recorded the children's explanations for their attributions.

All the responses were recorded on an Excel spreadsheet. The data were analyzed using PSS24 for the descriptive analysis, χ^2 (chi squared) and simple correspondence analysis, as well as the same procedure as study 1 to retain the number of dimensions and their interpretation; and we used Open Coding (Strauss and Corbin, 1994) for the qualitative analysis of explanations.

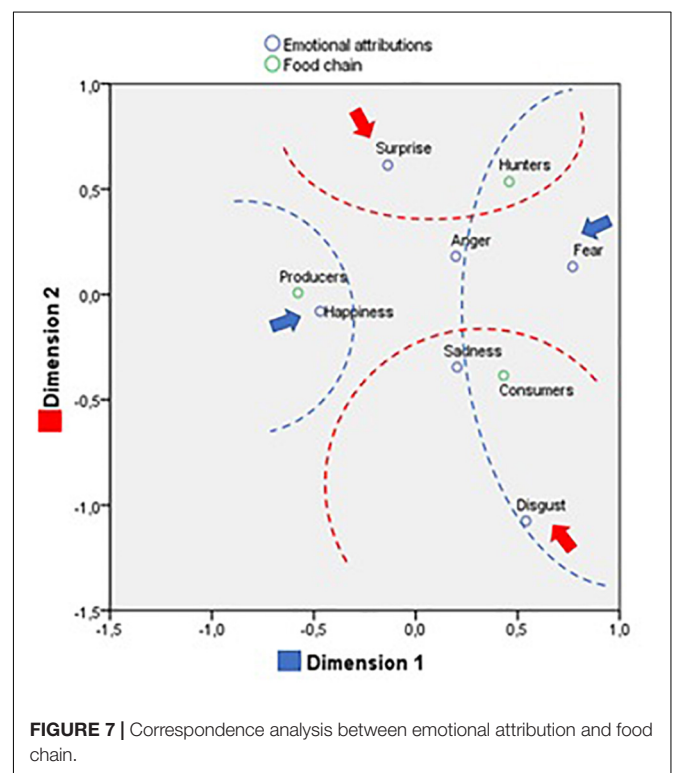
Results

Emotional Attributions

To examine the emotional attributions, we conducted an analysis of frequency distribution on the emotions attributed to the images. The results revealed happiness was the emotion most frequently attributed (45.1%) and fear the second (23%).

With the assistance of experts in environmental sciences and biology, the images of natural environments were twice classified, according to their predominant elements and according to the food chain to which they belonged. The first classification distinguished between “vertebrates” “invertebrates” and “general landscape.” The frequency distribution of the emotional attributions according to these labels was significant ($\chi^2 = 123.942$; $p < 0.001$; $\eta = 0.16$). In the vertebrate category, happiness was the most frequently attributed emotion (40.6%), followed by fear (29.6%). In the invertebrate category, the most common emotion was fear (33%), followed by happiness (24.5%). Finally, in the landscape category, the most frequently attributed emotion was happiness (57.5%), followed by surprise (13.5%).

The correspondence analysis between the classification of the natural environment images according to their predominant natural elements (invertebrates, vertebrates and landscapes)



and the emotional attributions revealed two dimensions ($\chi^2 = 123.942$; $p = 0.000$), which together explain 100% of the variance (see Figure 6 and Table 2).

The first dimension explains 82.5% of the variance. At one extreme of the first dimension we find only happiness, although surprise falls near, together with the label “landscapes.” At the other extreme, are located the emotions of disgust, fear, sadness, and anger, which appear close to “invertebrates.” This means that the first dimensions distinguishes between landscapes eliciting positive emotions and living beings, which generate negatively emotions.

TABLE 3 | Symmetrical normalization of row and column points in the correspondence analysis between emotional attribution and food chain.

Mass		Inertia			Contribution						
					Score in dimension		Of point to inertia of dimension		Of dimension to inertia of point		
									1	2	1
Overview row points: emotional attributions											
Happiness	0.453	−0.469	−0.080	0.026	0.389	0.025	0.987	0.013	1.0		
Sadness	0.098	0.203	−0.346	0.002	0.016	0.101	0.431	0.569	1.0		
Anger	0.054	0.197	0.180	0.001	0.008	0.015	0.724	0.276	1.0		
Fear	0.228	0.770	0.131	0.035	0.529	0.034	0.987	0.013	1.0		
Disgust	0.043	0.541	−1.076	0.009	0.049	0.423	0.357	0.643	1.0		
Surprise	0.124	−0.137	0.614	0.006	0.009	0.402	0.099	0.901	1.0		
Overview column points: food chain											
Consumers	0.333	0.431	−0.385	0.022	0.242	0.425	0.734	0.266	1.0		
Hunters	0.233	0.459	0.535	0.020	0.192	0.575	0.618	0.382	1.0		
Producers	0.433	−0.578	0.008	0.037	0.566	0.000	1.000	0.000	1.0		

TABLE 4 | Descriptive and frequency analysis of the 21 explanatory labels of the reasons for the emotional attributions given to the natural environments images.

Categories	Happiness	Sadness	Anger	Fear	Disgust	Surprise	Total	Percentages (%)
Activity	42	8	0	4	0	36	90	6.00
Association	26	0	2	18	1	21	68	4.53
Beauty	35	0	0	0	0	27	62	4.13
Characteristic	32	0	6	24	9	17	88	5.86
Quality	13	3	1	8	0	11	36	2.40
Taking care	11	8	0	0	0	9	28	1.87
Harm	3	71	30	15	6	11	272	18.12
Emotion	18	20	8	13	9	3	71	4.73
Season	2	0	0	0	0	1	3	0.20
Liking	320	0	0	0	0	39	367	24.45
Insects	0	2	0	6	28	0	36	2.40
Meteorology	7	2	2	5	1	3	20	1.33
No beauty	0	1	0	4	18	0	23	1.53
Disliking	0	11	25	35	20	2	93	6.20
No danger	12	0	0	0	0	6	18	1.20
Novelty	17	1	0	0	0	47	63	4.20
Danger	0	9	13	52	0	6	80	5.33
Worry	2	4	1	5	0	2	14	0.93
Overcoming fear	2	0	0	0	0	0	2	0.13
Tautology	8	2	1	4	1	6	22	1.47
Experience	34	2	0	3	1	5	45	3.00

The second dimension explains 17.5%. At one extreme we find fear and surprise, together with the label “vertebrates,” while at the other, we find disgust and sadness, together with “invertebrates.” This suggests that the second dimensions distinguishes fear and surprise associated with vertebrates and disgust and sadness elicited by invertebrates.

The second classification of the images, according to food chain, differentiated between “consumers” (primary consumers, such as scorpion, centipede, bee, tarantula, fish, insect, or parrot), “hunters” (secondary consumers, such as a bat, penguin, snake, fox, leopard, vulture, shark, tiger, or sea lion) and “producers” (primary producers, corresponding to images of landscapes, flowers and fungi). The frequency distribution for the emotional

attributions made according to these categories was significant ($\chi^2 = 94.772$; $p < 0.001$; $\eta = 0.17$). “Hunters” were mainly associated with fear (60%), “producers” with happiness (78.5%) and “consumers” showed similar percentages for happiness and fear (50%).

The correspondence analysis for the classification of the natural environment images according to food chain and emotional attribution confirmed this trend, revealing two dimensions ($\chi^2 = 94.772$; $p < 0.001$), which together explain 100% of the variance (see **Figure 7** and **Table 3**).

The first dimension explains 82.9%. At one extreme is situated happiness together with the “producers” category, while at the other extreme, we find fear and disgust, with “hunters” and

“consumers.” This suggests the first dimension distinguishes between landscapes associated with happiness and insects and certain animals associated with a negative emotional valence.

The second dimension explains 17.1%. At one extreme are situated the emotions of disgust and sadness, together with the category of “consumers,” while at the other, we find only surprise close to the “hunters” category. Thus, we can observe a distinction between animals causing a certain degree of repulsion and hunters that produce surprise.

Explanations for the Emotional Attributions

We performed a qualitative lexicographic analysis (Open Coding) on the explanations provided by the participants for their attributions to each of the 30 natural environment images, where the units of analysis were the entire sentences so as to avoid loss of semantic quality (Strauss and Corbin, 1994). A corpus of 2695 sentences was obtained, of which 1501 referred to the natural environment. We then drew up 21 categories to define the classification and facilitate the analysis. We then described the frequency of the emotional attributions made to each one (Table 4).

The most frequent explanations referred to liking (24.45%) and harm (18.12%). Liking was more frequently associated with happiness (21.31%) and surprise (2.59%). Within this category, we found content that better explained why the children had made this attribution, referring to their liking of animals, vegetation, landscape, water, etc. Examples included: *“I like it because the trees are really big”*; *“because I like fish”*; *“because I love nature and all the bugs.”*

After liking, activity (6%), beauty (4.53%), and experience (3%) are the labels most frequently associated with the positively valenced emotional attributions (happiness and surprise).

Harm is the most common category in the emotional attributions of fear (10.06%). When harm was associated with fear or sadness, the explanations alluded to internal harm, directly suffered by the children. Examples include: *“it scares me because it might sting me and I’d cry”*; *“because it could eat me”*; or *“because it bites.”*

The categories of overcoming fear (0.13%), season (0.20%), and worry (0.93%) were the least frequently mentioned. Nonetheless, overcoming fear was associated with happiness, season with happiness and surprise, and worry with all the emotions except disgust.

DISCUSSION AND CONCLUSION

Following the biophilia theory (Wilson, 1984), the relationship between human beings and the environment from the perspective of connectedness to nature (Mayer and Frantz, 2004) presupposes a connection based on an innate, positive predisposition. There is an extensive body of literature drawing on empirical studies on the benefits for well-being of contact with nature, measured in terms of positive physiological indicators of feelings of restoration. However, despite the evidence, the literature tends to ignore the possible adaptive function of negative emotional reactions, as part of a construct we might call biophobia. This

is arguably due to a stigmatization of the negative hedonic tone and the methodological difficulties of studying the phenomenon in child populations.

The present study provides a valid measurement procedure to study the emotional attributions of 5 years old in response to images of natural environments. The inter-rater validation, the patterns of the participants’ correct responses for the trial images, and the results obtained in our two studies with different samples appear to confirm the validity of the procedure. The participants recognized and attributed emotions to the images in a spontaneous and immediate manner, and the initial instructions for the procedure were rapidly assimilated. The six-emotion protocol is the most appropriate, given that, in Study 1, the participants spontaneously identified surprise among the emotions generated by the images, while, in addition, this emotion is corroborated in the literature (Gosselin and Simard, 1999; Liu and Fang, 2007; Sauter et al., 2015).

Regarding the concept of “nature” as mentioned by the children and addressed in Study 1, similarities were found with the findings of previous studies (Collado et al., 2016). For example, the distinction appears between natural and non-natural elements, a description extended in the present study by the use of categories, such as “vegetation,” “natural environment,” and different types of “animals.” In addition, the human-nature interaction and emotional experiences associated with nature were identified in expressions used by the children in reference to the concept, and which can be observed in labels such as “human beings,” “esthetic emotion,” “well-being,” or “natural processes.”

Coinciding with the findings of previous studies (Fägerstam, 2012; Gilberston, 2012), happiness is the emotion most frequently attributed to the images of natural environments (landscapes). The higher frequency of attributions of happiness may be the result of feelings of agreeableness generated by the recall of previous experiences in similar settings, which reinforces, as posited in the theory of connectedness to nature, the importance of contact with nature for the development of positive emotional traits (Mayer and Frantz, 2004; Schultz and Tabanico, 2007; Mayer et al., 2009; Olivos and Clayton, 2017; Mena et al., 2020).

Nonetheless, fear, as a response to unpleasant or threatening images, such as those of factories, traffic jams, sharks or snakes, is the second most frequently attributed emotion. The results of the correspondence analysis between the concept of nature and the emotional attributions are in a similar line, as they suggest that children associate nature with happiness, when the images refer to landscapes, places with other people or animals that might be thought of as pets, but they also see nature as a threatening, hostile environment, related to emotions of disgust and fear.

The second study allowed us to confirm that happiness is the emotion most commonly associated with natural environments, and fear the second. Detailed analysis of the correspondences between the emotional attributions and the natural environment revealed relationships between fear, sadness and anger, mainly in response to images of wild animals, insects or natural landscapes that might involve a certain level of danger.

The classification of the images by both predominant elements and by food chain also revealed similar findings. The results of the analysis according to predominant elements

suggest the attributions can be interpreted across two axes, where surprise plays a dual role. That is, the first axis would run from awe (happiness and surprise) attributed to landscapes, to threat or harm (rest of negatively valenced emotions) associated with living beings. The second axis would distinguish between living beings, associating a state of alert (surprise and fear) in response to vertebrates and a reaction to harm (disgust, sadness and anger) associated with invertebrates. The categorization of the images by food chain suggests a distinction between animals that generate a certain feeling of repulsion (e.g., bats and snakes) and hunters, which elicit surprise, associated here with the activation of a state of alert.

Study 2 shows the importance of including surprise as a possible emotional response in children, despite being a complex emotion that may, on some occasions, be accompanied by fear and on others by happiness. It has been reported that a reaction of surprise or awe is primarily a response to positive stimuli (Keltner and Haidt, 2003). However, it has also been shown that in the face of sudden, unexpected situations, individuals focus and prepare themselves for unanticipated scenarios (Marina, 2006), an example being the reflex to fight or flee, which facilitates a rapid but short-term cognitive and physiological activity that displaces other emotions. Studies in emotional psychology have shown that fear and surprise trigger initially similar facial expressions but a few seconds later differences emerge when either fear or surprise is fully expressed (Jack et al., 2014). Although happiness and surprise both appear in response to positively valenced stimuli, the difference lies in that stimuli that generate happiness induce self-focused attention, while awe focuses attention on the perception and interpretation of a situation in relation to oneself (Salovey, 1992; Silvia and Abele, 2002), facilitating other adaptive associations.

The findings of our analyses of emotional explanations provides information in favor of our interpretations. Expressions of happiness are typically associated with explanations based on the esthetic value of natural environments and their elements, or environments that present a challenge where fear must be overcome. Instead negative emotions appear associated with a perception of nature as a source of displeasure, danger or physical harm. Finally, such attributions also draw on a series of disagreeable natural elements and environments associated with disgust.

Thus, in light of our findings, two main conclusions may be drawn. The first is a tripartite hypothesis based on the valences of the attributed emotions, where we observe that potentially threatening animals are associated with surprise and fear, insects and certain consumers are associated with disgust, and other elements of nature identified as producers or landscapes are associated with happiness. The second conclusion is that these emotional attributions coincide with the findings of other authors on the importance of biophobic content in connectedness to nature (Orr, 1994; Freire, 2011), whereby negative emotions offer a valuable adaptive function.

Finally, the present study provides empirical evidence and procedures for the study of environmental psychology in 5 years

old. The natural environment is regarded as key for the successful development of coming generations. Hence, it is of importance to reflect on the link between today's children and the environment, to address questions on their concept of nature, and to develop emotional training with regard to the natural environment in an educational context where positive psychology and emotional intelligence have enabled a partial perspective on nature.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The study was carried out under the ethical conditions of the UCLM Department of Psychology and the University Vice-Rectorate of Research, which is requested for not an experimental study; authorization was requested from those responsible for the participating institutions, as well as the informed consent of the parents. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

PO-J: substantial contributions to the conception or design of the work; analysis and interpretation of data for the work; drafting the work; providing approval for publication of the content. RS-F: substantial contributions to the acquisition, analysis or interpretation of data for the work; drafting the work; providing approval for publication of the content. CR-P: substantial contributions to the acquisition, analysis or interpretation of data for the work; providing approval for publication of the content. BF-G: substantial contributions to the acquisition of data for the work; providing approval for publication of the content.

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REFERENCES

- Astell-Burt, T., Mitchell, R., and Hartig, T. (2014). The association between green space and mental health varies across the lifecourse. *A longitudinal study. J. Epidemiol. Commun. Health* 68, 578–583. doi: 10.1136/jech-2013-203767
- Ballew, M. T., and Omoto, A. M. (2018). Absorption: how nature experiences promote awe and other positive emotions. *Ecopsychology* 10, 26–35. doi: 10.1089/eco.2017.0044
- Barraza, L. (1998). Conservación y medio ambiente para niños menores de 5 años. *Especies* 7, 19–23.
- Bartos, A. (2013). Children sensing place. *Emot. Space Soc.* 9, 89–98. doi: 10.1016/j.jemospa.2013.02.008
- Bomfim, Z. C. (2003). *Ciudad y Afectividad: Estima y Construcción de los Mapas Afectivos de Barcelona y Sao Paulo*. Fortaleza: Ediciones UFC.
- Brechet, C. (2017). Children's recognition of emotional facial expressions through photographs and drawings. *J. Genet. Psychol.* 178, 1–8. doi: 10.1080/00221325.2017.1286630
- Brown, N., Lomas, T., and Eiroá-Orosa, F. J. (2018). *International Handbook of Critical Positive Psychology—a Synthesis for Social Change*. Abingdon: Routledge.
- Brügger, A., Kaiser, F. G., and Roczen, N. (2011). One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *Eur. Psychol.* 16, 324–333. doi: 10.1027/1016-9040/a000032
- Bruni, C. M., and Schultz, P. W. (2010). Implicit beliefs about self and nature: evidence from an IAT game. *J. Environ. Psychol.* 30, 95–102. doi: 10.1016/j.jenvp.2009.10.004
- Carrus, G., Pirchio, S., Passiatore, Y., Mastandrea, S., Scopelliti, M., and Bartolini, G. (2012). Contact with nature and children's wellbeing in educational settings. *J. Soc. Sci.* 8, 304–309. doi: 10.3844/jssp.2012.304.309
- Cejudo, M. J. (2015). “Recomendaciones para el diseño, desarrollo y evaluación de programas de evaluación emocional,” in *Manual de Orientación y Tutoría*, eds M. Álvarez, and R. Bisquerra, (Spain: Wolters Kluwer), 1–14. doi: 10.2307/j.ctvdmwxbw.3
- Cervinka, R., Röderer, K., and Hefler, E. (2012). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *J. Health Psychol.* 17, 379–388. doi: 10.1177/1359105311416873
- Clayton, S. (2003). “Environmental identity: a conceptual and an operational definition,” in *Identity and the Natural Environment. The Psychological Significance of Nature*, eds S. Clayton, and S. Opatow, (Cambridge: The MIT Press), 45–65.
- Collado, S., and Corraliza, J. A. (2016). “Conciencia ecológica y well-being en la infancia,” in *Efectos de la Relación Con la Naturaleza*, Madrid: CCS.
- Collado, S., Iñiguez-Rueda, L., and Corraliza, J. A. (2016). Experiencing nature and children's conceptualizations of the natural world. *Child. Geograph.* 14, 716–730. doi: 10.1080/14733285.2016.1190812
- Collado, S., and Manrique, H. M. (2019). Exposure to awe-evoking natural and built scenes has positive effects on cognitive performance and affect. *Environ. Behav.* 21, doi: 10.1177/0013916519868733
- Collado, S., and Staats, H. (2016). Contact with nature and children's restorative experiences: an eye to the future. *Front. Psychol.* 7:1885. doi: 10.3389/fpsyg.2016.01885
- Collado, S., Staats, H., and Corraliza, J. A. (2013). Experiencing nature in children's summer camps: affective, cognitive and behavioural consequences. *J. Environ. Psychol.* 33, 37–44. doi: 10.1016/j.jenvp.2012.08.002
- Corraliza, J. A., and Collado, S. (2011). La naturaleza cercana como moderadora del estrés infantil. *Psicothema* 23, 221–226.
- Corraliza, J. A., Collado, S., and Bethelmy, L. (2013). Spanish version of the new ecological paradigm scale for children. *Spanish J. Psychol.* 16, 1–8. doi: 10.1017/sjp.2013.46
- Davidson, D. (2006). The role of basic, self-conscious and self-conscious evaluative emotions in children's memory and understanding of emotion. *Motivat.Emot.* 30, 237–247. doi: 10.1007/s11031-006-9037-6
- Davis, J. L., Green, J. D., and Reed, A. (2009). Interdependence with the environment: commitment, interconnectedness, and environmental behavior. *J. Environ. Psychol.* 29, 173–180. doi: 10.1016/j.jenvp.2008.11.001
- Davis, N., and Gatersleben, B. (2013). Transcendent experiences in wild and manicured settings: the influence of the trait connectedness to nature. *Ecopsychology* 5, 92–102. doi: 10.1089/eco.2013.0016
- De Houwer, J. (2003). “A structural analysis of indirect measures of attitudes,” in *The Psychology of Evaluation: Affective Processes in Cognition and Emotion*, eds J. Musch, and K. C. Klauer, (Mahwah, NJ: Lawrence Erlbaum), 219–244.
- Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D. W., Oishi, S., et al. (2010). New well-being measures: short scales to assess flourishing and positive and negative feelings. *Soc. Indic. Res.* 97, 143–156. doi: 10.1007/s11205-009-9493-y
- Doan, T., Friedman, O., and Denison, S. (2018). Beyond belief: the probability-based notion of surprise in children. *Emotion* 18, 1163–1173. doi: 10.1037/emo0000394
- Dubé, J. É. (2008). Evaluación del acuerdo Interjueces en Investigación Clínica,” in Breve Introducción a la Confiabilidad Interjueces. *Rev. Argent. Clín. Psicol.* 17, 75–80.
- Dutcher, D., Finley, J. C., Luloff, A. E., and Johnson, J. B. (2007). Connectivity with nature as a measure of environmental values. *Environ. Behav.* 30, 474–493. doi: 10.1177/0013916506298794
- Ekman, P. (1999). “Basic Emotions”. in *Handbook of Cognition and Emotion*, ed T. Dalgleish, and M. J. Power, 45–60. New York, NY: John Wiley & Sons Ltd.
- Faber, M., and Hall, T. (2007). Emotion and environment: visitors' extraordinary experiences along the Dalton Highway in Alaska. *J. Leisure Res.* 39, 248–270. doi: 10.1080/00222216.2007.11950107
- Fägerstam, E. (2012). Children and young people's experience of the natural world: teachers' perceptions and observations. *Austr. J. Environ. Educ.* 28, 1–16. doi: 10.1017/ae.2012.2
- Falsten, G. (2014). Personality predicts perceived potential for attention restoration of natural and urban scenes. *Psychology* 5, 37–57. doi: 10.1080/21711976.2014.881663
- Fattorini, S., Gabriel, R., Arroz, A. M., Amorin, I. R., Borges, P. A. V., et al. (2017). Children's preferences for less diverse greenspaces do not disprove biophilia. *Proc. Natl. Acad. Sci. U.S.A.* 114:35. doi: 10.1073/pnas.1711505114
- Freire, H. (2011). *Educación Verde. Ideas Para Acercar a Niños y Niñas a la Naturaleza*. Graó: Barcelona.
- Gallo, K. E., Swaney-Stueve, M., and Chambers, D. H. (2017). A focus group approach to understanding food-related emotions with children using words and emojis. *J. Sens. Stud.* 32:e12264. doi: 10.1111/joss.12264
- Gatersleben, B., and Andrews, M. (2013). When walking in nature is not restorative—The role of prospect and refuge. *Health Place* 20, 91–101. doi: 10.1016/j.healthplace.2013.01.001
- Gilberston, E. (2012). *When Nature Speaks: Evoking Connectedness With Nature in Children Through Role-Play in Outdoor Programming*. Edmonton, AB: University of Alberta. PhD diss.
- Gillis, K., and Gatersleben, B. (2015). A review of psychological literature on the health and wellbeing benefits of biophilic design. *Buildings* 5, 948–963. doi: 10.3390/buildings5030948
- Gosselin, P., and Simard, J. (1999). Children's knowledge of facial expressions of emotions: distinguishing fear and surprise. *J. Genet. Psychol.* 160, 181–193. doi: 10.1080/00221329909595391
- Green, C., Kalvaitis, D., and Worster, A. (2016). Recontextualizing psychosocial development in young children: a model of environmental identity development. *Environ. Educ. Res.* 22, 1025–1048. doi: 10.1080/13504622.2015.1072136
- Habermas, J. (1984). *Theory of Communicative Action*. Translated by Thomas A. McCarthy. Boston, Mass: Beacon Press.
- Hand, K. L., Freeman, C., Seddon, P., Recio, M. R., and Heezik, Y. (2017). Reply to fattorini children's selected avoidance of wild greenspace is driven by more than cultural factors. *Proc. Natl. Acad. Sci. U.S.A.* 144:35. doi: 10.1073/pnas.1712175114
- Harris, P. L. (1994). The child's understanding of emotion: developmental change and the family environment. *J. Child Psychol. Psychiatry* 35, 3–28. doi: 10.1111/j.1469-7610.1994.tb01131.x
- Higgs, N. T. (1991). Practical and innovative uses of correspondence analysis. *Statistician* 40, 183–194.
- Hinds, J., and Sparks, P. (2011). The affective quality of human-natural environment relationships. *Evol. Psychol.* 9, 451–469. doi: 10.1177/147470491100900314
- Hoot, R. E., and Riedman, H. (2011). Connectedness and environmental behavior: sense of interconnectedness and pro-environmental behavior. *Int. J. Transpers. Stud.* 30, 89–100.

- Howell, A. J., Dopko, R. L., Passmore, H.-A., and Buro, K. (2011). Nature connectedness: associations with well-being and mindfulness. *Personal. Individ. Differ.* 51, 166–171. doi: 10.1016/j.paid.2011.03.037
- Howell, A. J., Passmore, H.-A., and Buro, K. (2013). Meaning in nature: meaning in life as a mediator of the relationship between nature connectedness and wellbeing. *J. Happiness Stud.* 14, 1681–1696. doi: 10.1007/s10902-012-9403-x
- Jack, R. E., Garrod, O. G., and Schuns, P. G. (2014). Dynamic facial expressions of emotion transmit an evolving hierarchy of signals over time. *Curr. Biol.* 24, 187–192. doi: 10.1016/j.cub.2013.11.064
- Jones, N. A., and Mize, K. D. (2016). Introduction to the special issue: psychophysiology and psychobiology in emotion development. *J. Exp. Child Psychol.* 142, 239–244. doi: 10.1016/j.jecp.2016.05.001
- Joye, Y., and Dewitte, S. (2016). Up speeds you down. Awe-evoking monumental buildings trigger behavioral and perceived freezing. *J. Environ. Psychol.* 47, 112–125. doi: 10.1016/j.jenvp.2016.05.001
- Kals, E., and Ittner, H. (2003). “Children’s environmental identity: Indicators and behavioral impacts,” in *Identity and the Natural Environment*, eds S. Clayton and S. Opatow, (Cambridge, MA: MIT Press), 135–157.
- Kals, E., Schumacher, D., and Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environ. Behav.* 31, 178–202. doi: 10.1177/00139169921972056
- Kanh, P. H., and Kellert, S. R. (2002). *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, MA: MIT Press.
- Keltner, D., and Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cogn. Emot.* 17, 297–314. doi: 10.1080/02699930302297
- Koole, S., and Van den Berg, A. E. (2005). Lost in the wilderness: terror management, action orientation, and nature evaluation. *J. Personal. Soc. Psychol.* 88, 1014–1028. doi: 10.1037/0022-3514.88.6.1014
- Langer, J. A., and Applebee, A. N. (1985). Learning to write: learning to think. *Educ. Horizons* 64, 36–38.
- Lazarus, R. S. (1991). “Goal congruent (positive) and problematic emotions,” in *Emotion and Adaptation*, ed. R. S. Lazarus, (New York, NY: Oxford University Press).
- Lemos, V. (2013). La operacionalización de constructos psicológicos en la infancia: dificultades y propuestas de superación. *Anu. Psicol.* 43, 189–199.
- Liu, G., and Fang, F. (2007). Development of preschoolers’ emotion cognition concerning belief-based surprise. *Acta Psychol. Sin.* 39, 662–667.
- Maller, C. J. (2009). Promoting children’s mental, emotional and a social health through contact with nature: a model. *Health Educ.* 109, 522–543. doi: 10.1108/09654280911001185
- Marina, J. A. (2006). Anatomía del miedo: un tratado sobre la valentía. *Anagrama*. 6, 2019.
- Mayer, F. S., and Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals’ feeling in community with nature. *J. Environ. Psychol.* 24, 503–515. doi: 10.1016/j.jenvp.2004.10.001
- Mayer, F. S., Frantz, C. M., Bruehlman-Sencal, E., and Dolliver, K. (2009). Why Is nature beneficial? the role of connectedness to nature. *Environ. Behav.* 41, 607–643. doi: 10.1177/0013916508319745
- Mena, A., Olivos, P., Loureiro, A., and Navarro, O. (2020). Effects of contact with nature on connectedness, environmental identity and evoked contents. *Psychology* 11, 21–36. doi: 10.1080/21711976.2019.1643663
- Mestre, J. M., Guil, R., Martínez-Cabañas, F., Larrán, C., and González, G. (2011). Validación de una prueba para evaluar la capacidad de percibir, expresar y valorar emociones en niños de la etapa infantil. *Rev. Electrón. Int. Form. Profesorado* 14, 37–54.
- Myers, O. E. (2012). “Children and nature,” in *The Oxford Handbook of Environmental and Conservation Psychology*, ed S. Clayton, (New York, NY: Oxford University Press), 113–127.
- Nagpaul, P. S. (1999). *Correspondence Analysis. Guide to Advanced data Analysis Using IDAMS Software*. New Delhi: United Nations Educational, Scientific and Cultural Organization.
- Nasar, J. L., and Cubukcu, E. (2011). Evaluative appraisals of environmental mystery and surprise. *Environ. and Behav.* 43, 387–414. doi: 10.1177/0013916510364500
- Nelson, N. L., and Russell, J. A. (2016). Preschoolers’ use of dynamic facial, bodily, and vocal cues to emotion. *J. Exp. Child Psychol.* 110, 52–61. doi: 10.1016/j.jecp.2011.03.014
- Nisbet, E. K. L., and Zelenski, J. M. (2011). Underestimating nearby nature: affective forecasting errors obscure the happy path to sustainability. *Psychol. Sci.* 22, 1101–1106. doi: 10.1177/0956797611418527
- Nisbet, E. K. L., Zelenski, J. M., and Murphy, S. A. (2009). The nature relatedness scale: linking individuals’ connection with nature to environmental concern and behavior. *Environ. Behav.* 41, 715–740. doi: 10.1177/0013916508318748
- Nisbet, E. K. L., Zelenski, J. M., and Murphy, S. A. (2011). Happiness is in our nature: exploring nature relatedness as a contributor to subjective well-being. *J. Happiness Stud.* 12, 303–322. doi: 10.1007/s10902-010-9197-7
- Olivos, P., and Aragonés, J. I. (2013). Test de Asociaciones Implícitas con la Naturaleza: aplicación en España del IAT-Nature. *Rev. Psicol. Soc.* 28, 237–245. doi: 10.1174/021347413806196672
- Olivos, P., Aragonés, J. I., and Navarro, O. (2013). Educación ambiental: itinerario en la naturaleza y su relación con conectividad, preocupaciones ambientales y conducta. *Rev. Latinoam. Psicol.* 45, 501–511. doi: 10.14349/rp.v45i3.1490
- Olivos, P., and Clayton, S. (2017). “Self, nature and wellbeing: sense of connectedness and environmental identity for quality of life,” in *Handbook of Environmental Psychology and QOL Research*, eds G. Fleury-Bahi, E. Pol, and O. Navarro, (Switzerland: Springer), 107–126. doi: 10.1007/978-3-319-31416-7_6
- Olivos, P., and Ernst, R. (2018). “To feel good or to be happy: distinctions between emotions and development in the environmental psychology research of Wellbeing,” in *International Handbook of Critical Positive Psychology—a Synthesis for Social Change*, eds S. N. Brown, T. Lomas, and F. J. Eiroa-Orosa, (Abingdon: Routledge), 546–564.
- Orians, G. H. (1998). Human behavioral ecology: 140 years without Darwin is too long. *Bull. Ecol. Soc. Am.* 79, 15–28. doi: 10.2307/20168201
- Orr, D. W. (1994). *Earth in Mind: On Education, Environment, and the Human Prospect*. Washington, DC: Island Press.
- Palinscar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annu. Rev. Psychol.* 49, 345–375. doi: 10.1146/annurev.psych.49.1.345
- Pasca, L., Aragonés, J. I., and Coello, M. T. (2017). An analysis of the connectedness to nature scale based on item response theory. *Front., Psychol.* 8:1330. doi: 10.3389/fpsyg.2017.01330
- Passmore, H.-A., and Howell, A. J. (2014). Eco-existential positive psychology: experiences in nature, existential anxieties, and wellbeing. *Hum. Psychol.* 42, 370–388. doi: 10.1080/08873267.2014.920335
- Perrin, J. L., and Benassi, V. A. (2009). The connectedness to nature scale: a measure of emotional connection to nature? *J. Environ. Psychol.* 29, 434–440. doi: 10.1016/j.jenvp.2009.03.003
- Remplein, H. (1966). *Tratado de Psicología Evolutiva*. Madrid: Editorial Labor.
- Ruiz, M., and Ortiz, M. (2006). ¿Puede la valencia estimular alterar la asociación entre conceptos en el IAT? *Rev. Psicol. Soc.* 21, 211–222.
- Salovey, P. (1992). Mood-induced self-focused attention. *J. Personal. Soc. Psychol.* 61, 699–707. doi: 10.1037/0022-3514.62.4.699
- Sánchez, M. P., De la Garza, A., López, E. O., and Morales, G. E. (2012). Escala de Preferencia Ambiental (EPA): una propuesta para medir la relación entre individuos y su ambiente. *Int. J. Psychol. Res.* 5, 66–76.
- Saraglou, V., Buxant, C., and Tilquin, J. (2008). Positive emotions as leading to religion and spirituality. *J. Posit. Psychol.* 3, 165–173. doi: 10.1080/17439760801998737
- Sauter, D. A., Eisner, F., Ekman, P., and Scott, S. K. (2015). Emotional vocalizations are recognized across cultures regardless of the valence of distractors. *Psychol. Sci.* 26, 354–356. doi: 10.1177/0956797614560771
- Schouteten, J. J., Verwaeren, J., Lagast, S., Gellynck, X., and De Steur, H. (2018). Emoji as a tool for measuring children’s emotions when tasting food. *Food Q. Prefer.* 68, 322–331. doi: 10.1016/j.foodqual.2018.03.005
- Schroeder, H. W. (2007). Place experience, gestalt, and the human-nature relationship. *J. Environ. mental Psychol.* 27, 293–309. doi: 10.1016/j.jenvp.2007.07.001
- Schultz, P., Shriver, C., Tabanico, J., and Khazian, A. (2004). Implicit connections with nature. *J. Environ. Psychol.* 24, 31–42. doi: 10.1016/S0272-4944(03)0022-7
- Schultz, P., and Tabanico, J. (2007). Self, identity, and the natural environment: exploring implicit connections with nature. *J. Appl. Soc. Psychol.* 37, 1219–1247. doi: 10.1111/j.1559-1816.2007.00210.x
- Schultz, P. W. (2001). The structure of environmental concern: concern for self, other people, and the biosphere. *J. Environ. Psychol.* 21, 327–339. doi: 10.1006/jenvp.2001.0227

- Segura, M., and Arcas, M. (2004). *Relacionarnos Bien*. Madrid: Editorial Narcea.
- Shiota, M., Keltner, D., and Mossman, A. (2007). The nature of awe: elicitors appraisals, and effects on self-concept. *Cogn., Emot.* 2, 944–963. doi: 10.1080/02699930600923668
- Silvia, P. J., and Abele, A. E. (2002). Can positive affect induce self-focused attention? Methodological and measurement issues. *Cogn. Emot.* 16, 845–853. doi: 10.1080/02699930143000671
- Sprung, M., Much, H., Harris, P., Ebesutani, C., and Hofmann, S. (2015). Children's emotion understanding: a meta-analysis of training studies. *Dev. Rev.* 37, 41–65. doi: 10.1016/j.dr.2015.05.001
- Strauss, A., and Corbin, J. (1994). in *Grounded Theory Methodology*, eds N. K. Denzin, and Y. S. Lincoln, (Thousand Oaks, CA: Sage Publications), 217–285.
- Tam, K. P. (2013). Concepts and measures related to connection to nature: similarities and differences. *J. Environ., Psychol.* 34, 64–78. doi: 10.1016/j.jenvp.2013.01.004
- Thomashow, M. (1995). *Ecological Identity, Becoming a Reflective Environmentalist*. London: MIT Press.
- Tugurian, L. P., and Carrier, S. J. (2017). Children's environmental identity and the elementary science classroom. *J. Environ. Educ.* 48, 143–153. doi: 10.1080/00958964.2016.1191415
- Ulker, R. (2012). Turkish children's drawing of nature in a certain way: range of mountains in the back, the sun, couple of clouds, a river rising from the mountains. *Educ. Sci.* 12, 3173–3180.
- Ulrich, R. (1993). "Biophilia, biophobia, and natural landscapes," in *The Biophilia Hypothesis*, eds S. R. Kellert, and E. O. Wilson, (Washington, DC: Island Press), 73–137.
- Van den Berg, E., and Van den Berg, C. G. (2010). A comparison of children with ADHD in a natural and built setting. *Child* 37, 430–439. doi: 10.1111/j.1365-2214.2010.01172.x
- Verges, M., and Duffy, S. (2010). Connected to birds but not bees: valence moderates implicit associations with nature. *Environ. Behav.* 42, 625–642. doi: 10.1177/0013916508330210
- Vygotsky, L. (1934). *Thought and Language*. Translated by Alex Kozulin. Barcelona: Paidós.
- Watson, D., Clark, L. A., and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS Scales. *J. Personal. Soc. Psychol.* 54, 1063–1070. doi: 10.1037/0022-3514.54.6.1063
- Weinstein, N., Przybylski, A. K., and Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personal. Soc. Psychol. Bull.* 35, 1315–1329. doi: 10.1177/0146167209341649
- Wells, N. M., and Evans, G. W. (2003). Nearby nature: a buffer of life stress among rural children. *Environ., Behav.* 35, 311–330. doi: 10.1177/0013916503035003001
- Wells, N. M., and Lekies, K. S. (2006). Nature and the life course: pathways from childhood nature experiences to adult environmentalism. *Child. Youth Environ.* 16, 1–24.
- Widen, S. C., Pochedly, J. T., and Russell, J. A. (2015). The development of emotion concepts: a story superiority effect in older children and adolescents. *J. Exp. Child Psychol.* 131, 186–192. doi: 10.1016/j.jecp.2014.10.009
- Wilson, E. O. (1984). *Biophilia*. Cambridge: Harvard University press.
- Zuckerman, M. (1977). The development of a situation-specific trait-state test for the prediction and measurement of affective responses. *J. Cons. Clin. Psychol.* 45, 513–523. doi: 10.1037/0022-006X.45.4.513

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Pictographic Representations of the Word “Nature” in Preschool Education Children

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The relevance of preschool children’s understanding of nature, its elements, how it affects the behavior of human beings, and how human beings influence it, is a two-purpose task. First, it helps to identify the necessary elements for the design of programs that have a significant impact in the development of environmental identity. Second, it also assists in the implementation of environmental education in the school curriculum in Mexico, in order to develop attitudes to preserve the environment from an early age. Based on this logic, the objective of this study was to identify the components of the concept of nature and its relationship with environmental identity, from drawings made by preschool children in a desert environment through a visual discursive analysis. The sample consisted of 118 preschool students whose ages ranged between 5 and 6 years. Participants were selected from four different schools in Hermosillo, Mexico: three located in the urban area and one on the coastal area of the State of Sonora. Participants were asked to draw the first thing that came to their minds when they heard the word nature. As a result, all the drawings presented categories such as plants, animals, waterbodies, celestial bodies, abiotic factors, natural locations, locations made by man, and others. Finally, the analysis showed that a general idea of what nature represents to children includes elements of known flora and fauna; however, they did not capture elements of the desert region in which they live. In addition, most participants’ self-definition contained environmental identity.

Keywords: nature concept, kids drawings, preschool children, representations, physical environment

INTRODUCTION

The research of environmental psychology focuses on the study of the activity of the individual in their physical and social context in order to find logic on the connections between human beings and their environment. On one hand, it analyzes perceptions, attitudes, environmental assessments, and representations, and, on the other hand, environmental behavior (Moser, 2014). The environment also plays an important role in defining and expressing the identity of individuals, which is mediated through a complex pattern of beliefs, values, feelings, expectations, and preferences relevant to the physical world (Proshansky et al., 1983). An individual gives meaning to these environments according to the emotional impact that affects their cognitive, evaluative, and

behavioral activity. These factors determine the level and the ways the subject is involved in each of these spaces.

This way, the physical space where an individual develops becomes a significant factor in the process of person-environment interaction, where an analysis of the psychological processes and environmental factors that participate in them is indispensable (Corraliza and Berenguer, 2000). Furthermore, attitudes toward the environment, such as concerns, also influence and reflect different values such as egoistic, altruistic, and biospheric attitudes. Given that the individual reflects their concerns on themselves, toward other people, or toward all living beings and ecosystems, these attitudes are reflected in the perception and behaviors toward the environment (Schultz, 2002).

Environmental studies in children are an adaptation of the studies carried out by adults; therefore, it is necessary to also consider the youngest population in order to know their first thoughts about environmental issues. These issues are highly related to environmental identity, for the way we perceive our environment, and especially how we act on it or from it, can provide insight into the phenomenon of understanding our identity and our immediate natural space. These concepts are constructed from spatial, sociocultural, temporal, and community bases on cognitive, evaluative, and behavioral processes (Zimmermann, 2010). These identity behaviors are formed from the first stages of development and within cultural, historical, and dynamic patterns, where relatively permanent meanings and representations are configured and reinforced during the following years (Delval, 2004; Rojas, 2004). Thus, it is important to explore environmental perceptions in children and obtain a starting point to, eventually, influence them through their school classes on issues about care and protection of the environment, as well as to generate attention, evaluation, and action in programs of environmental education (Clayton, 2012). As an example, Olivos et al. (2014) studied connectivity with nature, environmental identity, and pro-environmental behavior, where they found patterns of positive behaviors related to identity and connectivity with nature.

The study of the relationship of children with nature entails values at this stage of human life that relate to the characteristics of the natural environment (Myers, 2012). In children, development is intrinsically connected with the basic areas of psychology that include sensation and perception, spatial cognition, and, in some cases, nature-related psychopathologies such as phobias of animals (Clayton and Myers, 2015). According to the theory of human development formulated by Piaget (1964), it is in the preoperative stage where children begin to develop the ability to represent and perceive their physical environment, which makes them able to recognize their environment and act on it (Delval, 2004). The first years of life and the beginning of formal education is a relevant stage in the development of opportunities to act freely and learn to be responsible from an early age, which has been linked to prosocial behavior and cooperation. Furthermore, contact with natural environments is associated with well-being and connection with nature (Zhang et al., 2014; Zelenski et al., 2015; Sobko et al., 2018), which fosters the concern for the preservation of their environments.

Moreover, environmental knowledge of preschool children can provide a new perspective that stimulates reflection on the individual's relationship with nature and the active construction of new understandings (Selin, 2013). Finally, it is considered fundamental to use drawings to study preschool children's representation of nature, because drawing helps children to express themselves about the real world that surrounds them (Wright, 2010).

CHILDREN'S DRAWINGS

Children can represent reality through different forms, and drawing is one of them, since it is an important cognitive component that aids children on reflecting about what they understand as reality, their spatial representation, and how they conceive things. Drawing is also considered a form of communication (Coates and Coates, 2011; Vivaldi and Salsa, 2017) and conveys an affective aspect (Delval, 2004). According to developmental theorists, said representations begin to take place from the age of two. This relates to the beginning of children's primary socialization, either by their family environment or their school environment; therefore, drawings are a concrete and effective act that helps children record their perception from the world around them (Fox and Lee, 2013). This way, drawing has been used in various studies to collect information about perceptions and ideas in participants of different ages and in different themes. Additionally, drawing is also considered as a type of language in children, and, as Callaghan (2013) states, representations of children are a sign of the development process regarding the intention to communicate with other people.

Language, both oral and written, is a system of symbols. In oral language, the speaker must relate the oral symbol to a meaning or idea, both in reality and according to the perception of each individual. The same happens in written language, and, as children begin to write, they develop their relational principles because they must relate them to their own ideas, concepts, or meanings. Pictographic writing is children's first approach to writing in an attempt to represent written language, objects, meanings, or conceptualizations (Brandt, 2015; Baroutsis et al., 2019).

Studies have shown that drawing is an appropriate strategy to gather information about how children perceive certain places, processes, or events. Some examples of studies utilizing this strategy are Baroutsis et al. (2019), where children were asked to draw how they explain the process of learning to write; Highet et al. (2019) measured the social impact of *H. pylori* in children through drawings, and also Moragón and Martínez (2016), who conducted a study to describe the way in which primary school children represent children's play through drawings. The results concluded that drawings are a representation of the reality that children perceive, and the majority presented real elements about the research topic. However, it was also found that through drawing, children expressed their feelings and attitudes.

Moreover, other studies were found where it was intended to examine the perception of the natural environment, such as Günindi (2012) and Özsoy (2012), who conducted studies to

examine the perception of the environment in preschool children through their drawings and the explanation that students gave about them. This was performed with the purpose of knowing how children build their thoughts and concepts. As a result, it was found that at least 81% of the children see a clean environment and 60% included people in their drawings, which shows that some children consider people as part of the environment. While the rest do not share this consideration of people, they do consider other living beings. Similar studies also evaluated how children perceived the environment in present and future times. In these cases, most of the students drew polluted technological environments using elements such as the sun, trees, humans, cars, and houses; some even showed robots and spaceships. Additionally, it was found that perception changed depending on the context where children were raised, and participants represented a greater number of favorable environmental elements other than the increase of temperature in the future and deteriorated forest and rivers (Pellier et al., 2014; Özsoy and Ahi, 2014).

On the other hand, Yilmaz and Kahraman (2015) and Yilmaz et al. (2012) analyzed the graphic productions of Turkish elementary students to determine how they reflect what they know about science and nature. The results showed that the words "science" and "nature" have some similar concepts as "environment." However, science is explained with "laboratory environment," while nature with "clean environment." Another thing in common is that both words are related to living beings that are classified as "animals" and "plants," but "human being" is excluded in both categories. Other than those already mentioned, the drawing technique was also used in a study related to the playground environment in a school (Sali et al., 2014), where children were asked to draw their dream playground and the one they had at the moment. It was found that children drew their ideal playground with movable and more interactive games. Macdonald (2009) mentions that the drawings and their previous oral description by the participants favor the holistic approach in research with children. Similarly, Angell et al. (2015) mention that graphic representations along with their oral description have been a central tool for researchers working with participants in the childhood stage due to the apparent simplicity, attractiveness, and disposition of the resources.

In this study, we focused on finding out how preschoolers represented what the word nature meant to them through drawing by emphasizing the objects and figures that children illustrate from their perception of nature, so that we could describe the relation with environmental identity. Considering that, in formal education in Mexico, there are few activities that present environmental education programs from the first school years, it is not considered as a variable that could affect student perception of environment. Conversely, other variables of the context such as the place of residence and family are.

METHOD

Sample

The sample size included 118 children aged between 5 and 6 at the time of the study, 59 females and 59 males, all enrolled

in four different preschools. One of them was a private school, while the rest of them were public. The first school was located on the coast of the municipality of Hermosillo. From this school, 48 students participated, and the conditions of the classroom let the students work individually. The second school was a private school with a bilingual education system. From this school, 34 students participated, and the researchers worked in a hallway outside of the classroom to prevent participants from seeing their classmates' work. The last two schools had the same dynamics; both were state-funded public schools with only one teacher for each class, located in an urban area. There were 16 participants from one school and 20 from the other. One was located at the south of the city, while the other one was up north. In them, work was done inside the classroom and only two tables and two chairs were available. The tables were placed as far away as possible from each other, and students were asked for their collaboration in the study. The students who accepted continued to carry out with their drawings, while their descriptions and annotations were written by the researcher.

The schools located in the urban area have limited vegetation, while the one located on the coast has very particular vegetation and fauna that predominate the landscape, such as saguaros, mesquites, trees, bushes, and a nearby beach. This region of Mexico is characterized by being desertic and having temperatures that exceed 45°C during the summer, while in winter temperatures can reach approximately 15°C or less.

Survey and Data Analysis

Following the aforementioned logic, drawings were used as the main form of collecting information. Participants received white sheets, pencils, and colored crayons. They were subsequently asked, "What do you understand by nature?", before being instructed to draw their answer on the sheet in front of them. The drawings were made individually so that there was no interference or influence by the responses of other classmates. Each student described their drawing while making it or after the fact, and no questions were made by the researcher or teachers. Then, the researcher wrote the descriptions down on a separate sheet of paper that was stapled to the drawing and then numbered (Nic Gabhainn and Kelleher, 2002).

Drawings, graphic representations, pictographs, or permanent products are a means to access the ideas, feelings, and experiences of children where the objects form part of a message regarding their understanding of the world (Macdonald, 2009; Fisher et al., 2014; Bland, 2015). In order to obtain relevant data in an investigation carried out with drawings, it is necessary to identify the components that capture the participant's understanding of the specific topic through a content analysis (Krippendorff, 2013; Linder et al., 2017; Flores et al., 2018). The use of drawings and their keywords as tools allow the participants to understand the activity that they are asked to carry out despite of possible limitations in the stroke. In this fashion, they can express their thoughts in relation to a topic (Macdonald, 2009; Angell et al., 2015; Linder et al., 2017).

Along these lines, and after analyzing each drawing, the elements were codified, categorized, and described according to their components, which resulted in six different categories that appeared frequently in each of the drawings. It is worth

noting that there were also drawings that did not fit into any category. The categorization presents an intra-coding reliability since the coding was carried out at first when classifying the elements according to their values and a second time after reviewing the literature to compare them with previous studies. In the same way, an intercoding was performed, since the categories were verified by experts in the subject and relevant changes were suggested for better results. For the content analysis, the words were classified into different thematic categories using the bottom-up strategy, so the categories were not previously established. The definition of common thematic categories is useful for comparisons between different case studies because it provides a systematic way of classifying perceptions (Maneja-Zaragoza et al., 2013).

Likewise, we used the visual discourse analysis of Albers (2007). This mentions that drawings are made up of support systems that indicate how they should be read considering the spatial elements and the distribution previously discussed by Zabulis and Orphanoudakis (2001) and Kress and Van Leeuwen (2007). The authors explain that each graphic composition has a visual attention center that does not necessarily correspond to the center of the paper, so they propose to divide it in quadrants to identify the elements with greater emphasis following the directionality provided by the text itself, which also does not correspond necessarily to the conventional directionality of writing. Thus, after obtaining the frequencies of the presented objects, the support systems were identified using both the children's discourse and drawings, subsequently identifying the intention of the drawing and its central component. According to Albers (2007), the support systems are the ones available for reading the exchange of meanings between the creator and the interpreter based on the semantics of the text by means of the symbols used to represent the phenomenon within the cultural canons. Hence, visual representations are loaded with properties and cannot be reduced only to substitutions of the object in real life (Banks and Zeitlyn, 2015), so they present complementary properties that can be categorized into sets that reflect social processes and have a certain intention behind them.

RESULTS

The drawings generated by the participants showed symbols that referred to elements of nature; most of them were understandable and corresponded to the skills and knowledge expected in this stage of development. However, the rest of the works were rather abstract for the interpreters, so the oral descriptions made by the participants became an essential part in their categorization. In the collected drawings, there was a total of 133 elements obtained that derived in nine categories according to their similarity and mutually exclusive logic. Subsequently, another encoding was performed to enable a second analysis of the data obtained with this technique. Six different categories were found: locations, plants, animals, abiotic elements, bodies of water, and people (see **Table 1**).

They found that the "animals" category had the highest frequency, since it was present 171 times in the 118 drawings. Particularly, the referred animals were butterflies, birds, dogs, lions, fish, rabbits, snakes, and giraffes; it is worth noting that some of the depicted animals are not typical of the participants' own region. On the other hand, as can be seen in **Table 2**, bodies of water were only observed 29 times, with places such as seas, rivers, lakes, and ponds; however, only two participants from the coast area drew the sea. As for the location category, there were places that, like animals, are not typical in the region where the study was conducted, such as forests and jungles. Finally, the human factor was the second less frequent element presented (40 times), in which the participants referred to themselves, their parents, or other children.

As for the drawings themselves, there were some where it was possible to encode different categories, such as plants, animals, and abiotic elements, where each of them could be clearly spotted (see **Figure 1**). However, there were some drawings that could not be classified in any category, since they were too abstract and did not have a specific shape, only color. **Figure 2** shows a symbolic representation of elements recognizable by existing literature and correspond to elements of nature, in addition to making a correct spatial representation. Oppositely, other drawings (see **Figure 3**) do not contain a spatial representation that is attached to reality, even though they do include biotic elements.

TABLE 1 | Coding scheme and description of the study categories.

Categories	Description	Category elements
Location	Place or environment in which the elements referred to the given task	Forest, beach, jungle, house, Hermosillo, zoo, island, city, land, jungle, hospital, school and garden.
Plants	Flora and vegetation specifically originated in the location.	Trees, flowers grass/grass, palm/palm, shrub, leaves, apples, pines, pineapple, bushes, algae, bananas, coconuts, seeds, corn and pumpkin.
Animals	Wildlife identified in the location	Butterfly, bird, dog, lion, fish, rabbit, snake, giraffe, monkeys, bears, elephant, tiger, duck, cat, wolf, bees, owl, squirrel, spiders, eagle, frog, gorilla, shark, jellyfish, bird, horse, jaguar, puma, leopard, kangaroo.
Abiotic Elements	Spatial arrangement between heaven and earth or other elements of the category.	Sun, sky, clouds, earth, rocks, world, mountains, sand, mud, air, moon, stars, rainbows, nest, rain and moth.
Water Bodies	Bodies of water in a similar spatial arrangement with elements related to the category.	Sea, river, lake, pond, water that sells from a tube, puddle and water to water plants.
People	Representations of themselves, identical people.	Himself, mom, boy/girl, dad, person, grandfather, cousins, grandmother, humans, hunters.

TABLE 2 | Number of drawings coded in each category.

Category	Frequency of referred elements	Most frequently referred category elements	Total of drawings
Location	41	Beach, forest, jungle and home.	118
Plants	134	Trees, flowers, grass and palms.	
Animals	171	Butterfly, bird, dog, lion, fish, rabbit, snake and giraffe.	
Abiotic elements	105	Sun, sky, clouds and earth.	
Water bodies	29	Sea, river, lake and pond.	
People	40	Me (the participant) mom, children and dad.	

Most of the graphic texts made by the participants show support systems that can be interpreted mostly in an easy way, as they represent objects from the outside world expressed in a realistic way according to their developmental stage, such as those presented in **Figure 4**. In this way, many of the symbols are understandable without need for interpretation by the participant; also, some texts as a whole are easily recognizable and decipherable by the reader.

The drawings also showed that children drew facial expressions on some natural elements (**Figure 4**). Whenever this happened, they were always smiling faces, even on animals. It should be noted that the symbols that represent human beings are found in the lower quadrants, which represent the position where terrestrial beings move and live, whereas the superior quadrants are used either for extensions of large terrestrial elements such as trees or mountains, or for the location of birds, celestial bodies, and abiotic elements such as clouds.

Furthermore, in the graphic representations, 13 participants drew people, representing themselves or other relatives as part of nature. However, when questioned if they felt part of nature, 81 participants answered positively, which indicates that participants include an environmental identity as a part of their self-definition, despite most not expressing it in their drawings.

DISCUSSION

The study was based on a discursive analysis of the drawings produced by preschool children with the purpose of observing the elements that make up their understanding of nature.

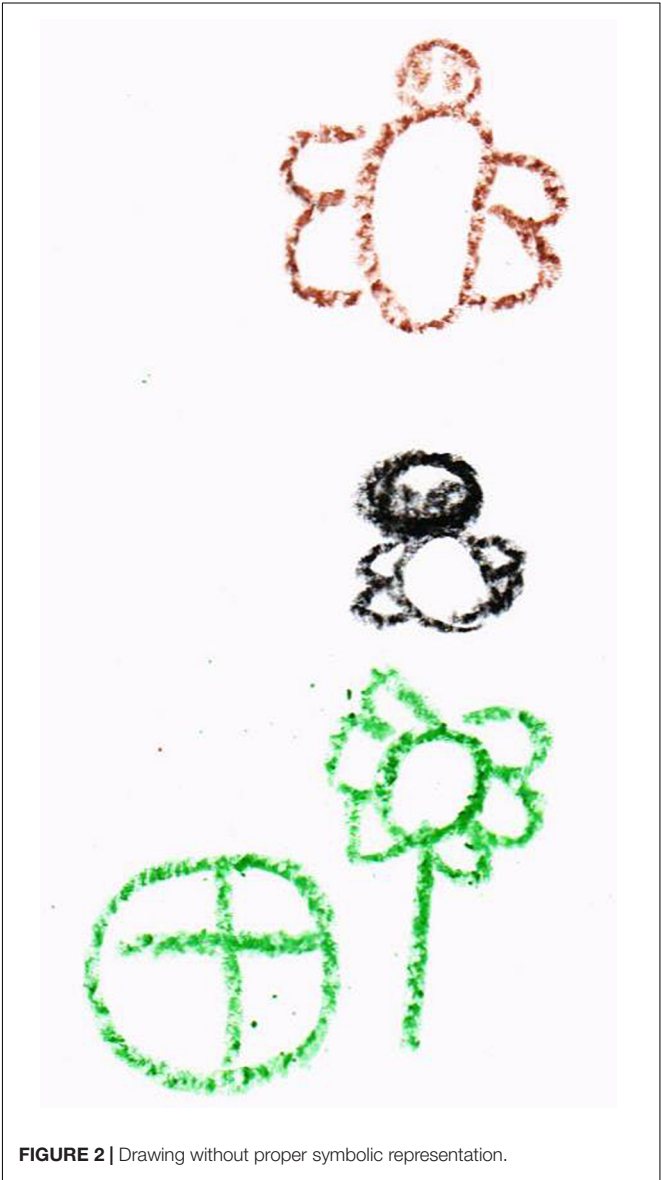
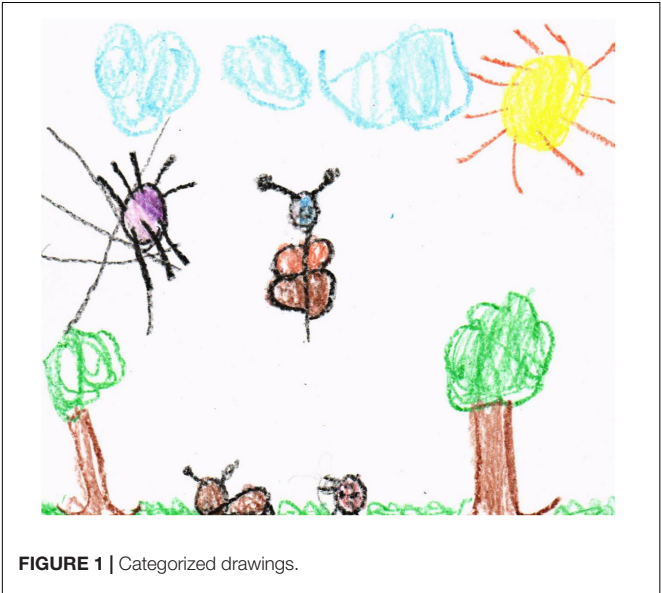




FIGURE 3 | Drawing with proper symbolic representation.



FIGURE 4 | Drawing with support system.

The use of art as tool of data collection proved to be an effective technique for the externalization of the participants' ideas regarding the studied phenomenon. This demonstrates children's deep understanding of the concept of nature.

For the analysis, the components of the productions were identified and granted keywords in order to determine the participant's perception of the subject. This way, ambiguities when interpreting the products were reduced, which is what Macdonald (2009) describes as a holistic approach of the representations that the participant has regarding the understanding of the phenomenon (Deguara and Nutbrown, 2018). The analysis was also based on the visual discourse analysis proposed by Albers (2007), which states that the support systems present in drawings help interpreters understand the meanings

the creator intended to depict by decoding the semantics of the symbols used through a cultural tenet.

The analysis showed that a general idea of what nature represents includes trees, birds, and food, which coincide with the areas where participants live; however, the number of endemic elements of the ecosystem in which they live was relatively low, omitting fauna and flora typical of their region such as snakes, iguanas, biznagas, or pitayas. This corresponds to the research of Bolzán et al. (2014), where it is established that the place of residence is not reflected in the way of drawing nature, but in learning from formal environmental education (2014: 38).

It was observed that productions contained elements of the environment that could be found in the nearby areas and were immediately recognizable by the participants, such as trees, flowers, birds, grass, butterflies, clouds, palm trees, mountains, fruits, snakes, or the sun. Additionally, there was a large number of symbols that represent elements not native of the environment where the participants live, including lions, giraffes, elephants, jungles, and forests, which can be attributed to the contact of the participant with material that contained this type of representations of nature (Bolzán et al., 2014). This supports the statement that knowledge of the phenomenon helps to create productions in greater detail and with a greater number of elements, as shown by the study by Barraza (1998), who affirmed that the perception of children is influenced by knowledge, age, and their ability to draw.

The visual representations themselves enclose properties that cannot be reduced to mere substitutions of objects in real life (Banks, 2007), and representations of nature by preschoolers show categories of natural elements such as animals, plants, food, abiotic factors, locations, and people (Alerby, 2000; Ulker, 2012; Özsoy, 2012).

According to the studies of Zabulis and Orphanoudakis (2001) and Kress and Van Leeuwen (2007), children's points of interest are indicated by the positioning of objects through the paper and attract the viewer's attention to these spaces. They explain that this selection of accommodation is itself qualitative information by the creator. This can be seen in the productions made by the participants that make spatial use according to the symbols they represent. This is how the sun and clouds were drawn in upper quadrants or "above," and trees or plants in the lower quadrants or "below." However, there were graphic texts that did not take into consideration the social conventions of "above" and "below" within the productions. This corresponds to the statements of Zabulis and Orphanoudakis (2001) who specify that the content of an image includes form, color, or intensity as well as spatial organization. However, some visual elements reside in the perceptual domain.

Additionally, it could be observed that there are, among the drawings, abstract and metaphorical creations about real-world referents, like what represents a tree, a dog, a person, and so on, with some participants. This also coincides with developmental theories that explain that, depending on the level of maturity of the child, these referents will get closer to more accurate representations or to the natural world. Bell's (2003) visual content analysis explains that objects are mutually exclusive

and should not be taken "literally," but as a manifestation of reality by the author.

None of the representations made reference to contaminated environments, and only a few showed human intervention that was different to the studies by Alerby (2000); Shepardson et al. (2007), Özsoy (2012); Ulker (2012), and Bolzán et al. (2014). The study carried out by Pasca et al. (2019) was also considered, where they sought to determine the way in which people categorized the environments according to the nature they saw in some pictures. One of the findings reported in this study was that people did not categorize as natural environments all photos where human presence or built places were depicted. This coincides with our study, where we found that children's representations of nature did not include any built environment in their drawings.

As mentioned before, the main objective of the study was to offer empirical evidence obtained through research methods different from the traditional ones in psychology and environmental education, i.e., qualitative approaches. This allowed us to construct knowledge from the child's perspective using their abilities. Further improvements to this approach are expected to enhance the understanding of children's representation of nature. One such improvement could be introduced by adding new questions to include in the proposed organization of perception of nature. These questions should consider family habits, outdoor and indoor activities, and time spent watching television or using the internet, if the children have traveled with their family, among other relevant lifestyle aspects. As mentioned by Carrus et al. (2015), the educational spaces and the experiences that children live in their school environments are qualitatively different from the experiences they live in their homes; therefore, environmental perception can be influenced by these other contexts. Regardless, the work presented here is also limited by classical considerations of qualitative studies, in which findings cannot be generalized or extended to wider populations even if they are similar. Thus, a high degree of certainty cannot be assured.

The dominant tradition in environmental psychology research is to use scales (self-reports) developed in studies with adults and "adapt" them to the study of children; thus, we sought to carry out an investigation adapted from the start to the study of the early stages in human development.

Our purpose was to research environmental perception and environmental identity in early childhood; in such manner, the results of this work will shed light on the understanding of an important methodological qualitative approach and contribution. Furthermore, results obtained here may have implications for understanding the concept of nature in early childhood, which may be useful in practical decision making for curricular design of environmental education programs and psychoeducational intervention in the future.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Comité de Ética en Investigación de la Universidad de Sonora. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception, design, and interpretation of the studies. BF was responsible for the planning and design of the study. NB was responsible for the collection and analysis of data. RV was responsible for the interpretation of data and writing. All authors contributed to revising it critically for important intellectual content and gave final approval of the final draft.

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REFERENCES

- Albers, P. (2007). "Visual discourse analysis: an introduction to the analysis of school-generated visual texts," in *Proceedings of the 56th Yearbook of the National Reading Conference*, Vol. 56 (Oak Creek, WI: National Reading Conference), 81–95.
- Alerby, E. (2000). A way of visualising children's and young people's thoughts about the environment: a study of drawings. *Environ. Educ. Res.* 6, 205–222. doi: 10.1080/13504620050076713
- Angell, C., Alexander, J., and Hunt, J. (2015). 'Draw, write and tell': a literature review and methodological development on the 'draw and write' research method. *J. Early Childh. Res.* 13, 17–28. doi: 10.1177/1476718x14538592
- Banks, M. (2007). *Using Visual Data in Qualitative Research*. London: Sage Publications.
- Banks, M., and Zeitlyn, D. (2015). *Visual Methods in Social Research*. London: Sage Publications.
- Baroutsis, A., Kervin, L., Woods, A., and Comber, B. (2019). Understanding children's perspectives of classroom writing practices through drawings. *Contemp. Issues Early Childh.* 20, 177–193. doi: 10.1177/1463949117741743
- Barraza, L. (1998). Conservación y medio ambiente para niños menores de 5 años. *Especies* 3:23.
- Bell, P. (2003). "Content analysis of visual images," in *Handbook of Visual Analysis*, eds T. Van Leeuwen, and C. Jewitt, (London: Sage Publications). doi: 10.4324/9780429426469-2
- Bland, D. (2015). Using drawing in research with children: lessons from practice. *Int. J. Res. Method Educ.* 41, 342–352. doi: 10.1080/1743727X.2017.1307957
- Bolzán, C., Sarriera, C., Costa-Dos, S., Áurea, Z., and Fedrizzi, B. (2014). Percepción de la naturaleza por niños de contextos urbano y costero: un análisis de dibujos y palabras clave. *Latin Am. J. Behav. Med.* 4, 31–40.
- Brandt, D. (2015). *The Rise of Writing: Redefining Mass Literacy*. Cambridge, MA: Cambridge University Press.

- Callaghan, T. C. (2013). "Symbols and symbolic thought," in *The Oxford Handbook of Developmental Psychology*, Vol. 1, ed. P. D. Zelazo, (Oxford: Oxford University Press), 974–1005.
- Carrus, G., Passiatore, Y., Pirchio, S., and Scopelliti, M. (2015). Contact with nature in educational settings might help cognitive functioning and promote positive social behaviour/El contacto con la naturaleza en los contextos educativos podría mejorar el funcionamiento cognitivo y fomentar el comportamiento social positivo. *Psychology* 6, 191–212. doi: 10.1080/21711976.2015.1026079
- Clayton, S. (2012). "Environment and Identity," in *The Oxford Handbook of Environmental and Conservation Psychology*, ed. S. Clayton, (New York, NY: Oxford University Press), 164–180.
- Clayton, S., and Myers, G. (2015). *Conservation Psychology: Understanding and Promoting Human Care for Nature*, 2nd Edn. Oxford: Wiley Blackwell.
- Coates, E., and Coates, A. (2011). "The subjects and meanings of young children's drawings," in *86 Exploring Children's Creative Narratives*, eds D. Faulkner, and E. Coates, (Abingdon: Routledge), 110.
- Corraliza, J. A. Y., and Berenguer, J. (2000). Environmental values, beliefs and actions: A situational approach. *Environ Behav.* 32, 832–848. doi: 10.1177/00139160021972829
- Deguar, J., and Nutbrown, C. (2018). Signs, symbols and schemas: understanding meaning in a child's drawings. *Int. J. Early Years Educ.* 26, 4–23. doi: 10.1080/0969760.2017.1369398
- Delval, J. (2004). *El Desarrollo Humano*, 6rd Edn. Madrid: Siglo XXI Editores.
- Fisher, T. R., Albers, P., and Frederick, T. G. (2014). When pictures aren't pretty: deconstructing punitive literacy practices. *J. Early Childh. Literacy* 14, 291–318. doi: 10.1177/1468798413485267
- Flores, R., García Ruiz, M., Rayas Prince, J. G. R., and del, S. (2018). La Educación ambiental en la formación docente inicial. *Pesquisa Educ. Ambiental* 12, 80–92. doi: 10.18675/2177-580X.vol12.n2.p80-92
- Fox, J., and Lee, J. (2013). When children draw vs when children don't: exploring the effects of observational drawing in science. *Creat. Educ.* 4, 11–14. doi: 10.4236/ce.2013.47A1002
- Günindi, Y. (2012). Environment in My point of view: analysis of the perceptions of environment of the children attending to kindergarten through the pictures they draw. *Proc. Soc. Behav. Sci.* 48, 594–603. doi: 10.1016/j.sbspro.2012.09.541
- Highet, M., Colquhoun, A., Munday, R., and Goodman, K. (2019). Engaging northern indigenous children through drawing for community health research: a picture of the social impact of h. pylori infection in fort McPherson in the Northwest Territories, Canada. *Vis. Anthropol.* 32, 174–192. doi: 10.1080/08949468.2019.1603036
- Kress, G., and Van Leeuwen, T. (2007). Reading images: the grammar of visual design. *J. Exp. Psychol.* 136, 23–42.
- Krippendorff, K. (2013). *Content Analysis: an Introduction to Its Methodology*, 4rd Edn. London: Sage publications.
- Linder, L. A., Bratton, H., Nguyen, A., Parker, K., and Phinney, S. (2017). Comparison of good days and sick days of school-age children with cancer reflected through their drawings. *Qual. Life Res.* 26, 2729–2738. doi: 10.1007/s11136-017-1621-6
- Macdonald, A. (2009). Drawing stories: the power of children's drawings to communicate the lived experience of starting school. *Aus. J. Early Childh.* 34, 40–49. doi: 10.1177/183693910903400306
- Maneja-Zaragoza, R., Varga, D., and Boada, M. (2013). "drawing analysis: tools for understanding children's perceptions of community conservation," in *Community Action for Conservation: Mexican Experiences*, eds L. Porter Bolland, et al. (New York, NY: Springer Science+Business Media), 159–170. doi: 10.1007/978-1-4614-7956-7_10
- Moragón, F., and Martínez, V. (2016). Juegos de niñas y juegos de niños: estudio sobre la representación del juego infantil a través del dibujo. *Rev. Educ.* 40:17439.
- Moser, G. (2014). *Psicología Ambiental. Aspectos de las Relaciones Individuo-Medioambiente*. Colombia: ECOE Ediciones.
- Myers, O. E. (2012). "Children and nature," in *The Oxford Handbook of Environmental and Conservation Psychology*, ed. S. Clayton, (Oxford: Oxford University Press).
- Nic Gabhainn, S., and Kelleher, C. (2002). The sensitivity of the draw and write technique. *Health Educ.* 102, 68–75. doi: 10.1108/09654280210418992
- Olivos, P., Talayero, F., Talayero, F., Aragonés, J. I., and Moyano-Díaz, E. (2014). Dimensiones del comportamiento proambiental y su Relación con la conectividad e identidad ambiental. *Comport. Pró Ambiental Sustentabil.* 45, 369–376.
- Özsoy, S. (2012). Investigating elementary school students perceptions about environment through their drawings. *Educ. Sci.* 12, 1132–1139.
- Özsoy, S., and Ahi, B. (2014). Elementary school students' perceptions of the future environment through artwork. *Educ. Sci.* 14, 1570–1582. doi: 10.12738/estp.2014.4.1706
- Pasca, L., Aragonés, J. I., and Frajio-Sing, B. (2019). Categorizing landscapes: approaching the concept of Nature/Categorizando paisajes: una aproximación al concepto de naturaleza. *Psychology* 11, 1–21. doi: 10.1080/21711976.2019.1659029
- Pellier, A. S., Wells, J. A., Abram, N. K., Gaveau, D., and Meijaard, E. (2014). Through the eyes of children: perceptions of environmental change in tropical forests. *PLoS One* 9:e103005. doi: 10.1371/journal.pone.0103005
- Piaget, J. (1964). *Seis Estudios de Psicología*, 9rd Edn. Barcelona: Seix Barral.
- Proshansky, H. M., Fabian, A. K., and Kaminoff, R. (1983). Place-identity: physical world socialization of the self. *J. Environ. Psychol.* 3, 57–83. doi: 10.1016/s0272-4944(83)80021-8
- Rojas, M. (2004). Identidad y cultura. *Educere* 8, 489–496.
- Sali, G., Akyol, A. K., and Baran, G. (2014). An analysis of pre-school children's perception of schoolyard through their drawings. *Proc. Soc. Behav. Sci.* 116, 2105–2114. doi: 10.1016/j.sbspro.2014.01.528
- Schultz, P. W. (2002). "Inclusion with nature: the psychology of human-nature relations," in *Psychology of Sustainable Development*, eds P. Schmuck, and W. P. Schultz (Boston, MA: Springer), 61–78. doi: 10.1007/978-1-4615-0995-0_4
- Selin, H. (ed.) (2013). *Nature Across Cultures: Views. (of) Nature and the Environment in Non-Western Cultures*, Vol. 4. Berlin: Springer Science & Business Media.
- Shepardson, D., Wee, B., Priddy, M., and Harbar, J. (2007). Students' mental models of the environment. *J. Res. Sci. Teach.* 44, 327–348. doi: 10.1002/tea.20161
- Sobko, T., Jia, Z., and Brown, G. (2018). Measuring connectedness to nature in preschool children in an urban setting and its relation to psychological functioning. *PLoS One* 13:e0207057. doi: 10.1371/journal.pone.0207057
- Ulker, R. (2012). Turkish children's drawing of nature in a certain way: range of mountains in the back, the sun, couple of clouds, a river rising from the mountains. *Kuram Uygulamada Egitim Bilimleri* 12(Suppl. 4), 3173–3180.
- Vivaldi, R. Y., and Salsa, A. (2017). Drawing for others: influence of referential intention in early production of drawings. *Infancia Aprendizaje* 40, 56–87. doi: 10.1080/02103702.2016.1263453
- Wright, S. (2010). *Understanding Creativity in Early Childhood: Meaning-Making and Children's Drawing*. London: Sage.
- Yilmaz, F., and Kahraman, A. D. (2015). Science and nature perception in the images and pictures of the children. *Proc. Soc. Behav. Sci.* 176, 650–658. doi: 10.1016/j.sbspro.2015.01.523
- Yilmaz, Z., Kubiak, M., and Topal, H. (2012). Czech children's drawing of nature. *Educ. Sci.* 12, 3111–3119.
- Zabulis, X., and Orphanoudakis, S. C. (2001). "Image content analysis and description," in *State-of-the Art in Content-Based Image and Video Retrieval*, eds R. C. Veltkamp, H. Burkhardt, H. P. Kriegel, (Dordrecht: Springer).
- Zelenski, J. M., Dopko, R. L., and Capaldi, C. A. (2015). Cooperation is in our nature: nature exposure may promote cooperative and environmentally sustainable behavior. *J. Environ. Psychol.* 42, 24–31. doi: 10.1016/j.jenvp.2015.01.005
- Zhang, J. W., Piff, P. K., Iyer, R., Koleva, S., and Keltner, D. (2014). An occasion for unselfing: Beautiful nature leads to prosociality. *J. Environ. Psychol.* 37, 61–72. doi: 10.1016/j.jenvp.2013.11.008
- Zimmermann, G. M. (2010). *Psicología Ambiental, Calidad de vida y Desarrollo Sostenible*, 3rd Edn. Bogota: Ecoe Ediciones.

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Beliefs About Parent Participation in School Activities in Rural and Urban Areas: Validation of a Scale in Mexico

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The objective of this study was to test a measurement and invariance model for a scale of beliefs about parent participation in school education for children residing in both rural and urban areas. The questionnaire was answered by 2,576 parents, 52% from urban areas and 48% from rural; also an exploratory confirmatory multigroup analysis was performed to identify invariance. The final version of the instrument consisted of two factors with three items each, showing a goodness of fit, in addition to adequate indices. The invariance analyses indicated that both samples were equivalent in structure and factorial weight. The comparative fit index was greater than 0.95 for each model, and when compared with the restrictive model, the differences were less than 0.01; therefore, the instrument is considered applicable.

Keywords: parental involvement, beliefs, parents, confirmatory factor analysis, invariance

INTRODUCTION

Parents play important roles in their children's learning process and in the regulation of their behavior at school; likewise, parents can also be support agents for the school and for educational outcomes (Valdés and Urias, 2010). Despite this, studies report a low involvement of parents in all school settings, from supporting children doing their homework to the school-parent relationship, including communication with teachers or principals (Valdés et al., 2009).

One of the main personal psychological motivators for parents to become involved and participate in the academic activities of their children consists of the beliefs they have about their roles as parents, getting involved in activities they consider as their responsibility and leaving the rest to the teachers or the school (Walker et al., 2011). Hoover-Dempsey and Sandler (2012) call this variable the construction of the parental role; these authors also consider it a basis for their model of the parental involvement process.

Hoover-Dempsey et al. (2005) propose a model by levels of influence. In the first level, parents are involved through: (a) beliefs about the parental role regarding what they consider their responsibility doing at their children's school; (b) self-efficacy to support their children doing their homework and respond to the invitations of their children and the teachers. In level two, contextual variables such as time and energy, knowledge and skills for involvement are added. The third level refers to the mechanisms of participation: behavior modeling, motivation, instruction, and reinforcement. The fourth level includes student perceptions of their parents' actions apropos of the previous level, their self-efficacy to learn and their relationship with teachers. Finally, in the fifth level, the student academic performance is explained.

The goal of this study is to test an instrument for measuring the beliefs of parents concerning what they should do to support their children at school environments as part of their parental role; such a tool is relevant because beliefs are the main motivators in the decision of parents to become involved in their children's school (Hoover-Dempsey et al., 2005). In general, parents who believe that they should have an active role in the education of their children are more likely to participate than are those who think that parent involvement is not necessary or that it is better not to intervene (Green et al., 2007). Deslandes and Bertrand (2005) explain that it is more frequent for parents to become involved in school activities at home when they believe it is their responsibility to do so, and especially when such belief is accompanied by invitations from their children to participate.

The beliefs parents have in relation to the roles they should assume in their children's education are developed through their own experience within the groups in which they have become socialized, such as family, school and community; this helps to establish their role beliefs, which affect their involvement behaviors in their children's school life and in their interactions at home as to school-related tasks, projects and other activities for which students ask for their parents participation. In general, these personal beliefs parents have about the goals of school education and their own role in it influence their involvement (Hoover-Dempsey et al., 2004).

There are diverse parents mindsets with respect to the objectives of education, their own involvement in educational centers, and their role in this process. Some parents believe that the school is responsible for ensuring the success of their children and that parent participation is not necessary, while others perceive a shared responsibility between the school and the family; the latter are the most willing to participate by supporting their children at home and at school (Reed et al., 2000).

Walker et al. (2005) present three types of role construction centered on parents: parent-focused, which reflects the beliefs and behaviors of parents, where the parent is ultimately responsible for the education of the child; school-centered roles, which reflects the beliefs and behaviors of parents where the school is ultimately responsible for the child education; and, finally, the partnership-focused role, which reflects beliefs and behaviors where parents and schools together are responsible for the education of the child.

Two qualitatively different aspects can be identified on the topic of parents participation in the education of their children: the first is related to parental engagement with the school, for example, communication with teachers and the principal, participation in events and activities organized by the school, and involvement in parents associations; the second refers to the learning support parents provide at home, for example, assist in doing homework; in doing so, they help their children to develop favorable attitudes toward school and they also create conditions for students to learn (Sánchez and Valdés, 2014).

Walker et al. (2005) developed an instrument for parental role beliefs, a nine-item scale with six response options that aims to measure two types of assistance: supporting the child and supporting the school. These are some examples of the items: "It is my responsibility to talk with my child about his or her

school day," "I believe that every parent is responsible for what is happening in school."

Urban and rural environments create different school contexts, therefore, parents have different experiences and perceptions about schools and the educational objectives aimed. Rural schools are often associated with indigenous and/or farming populations. Villarroel and Sánchez (2002), when comparing rural and urban areas, find that parent participation is similar, but there is a significant predominance of participating mothers in rural areas.

Azaola (2010) notes that in rural areas, mothers care for their children with regard to school affairs, and fathers do not consider it to be their job. Additionally, in rural environments, children get little support for solving complicated tasks or studying for exams, as parents do not feel capable of providing such help because of their own lack of education; besides, communication regarding what happens at school is scarce, since children talk little with parents about what happens at school and do not tell them when they have tests. In her study on rural communities of a central region in Mexico, Azaola (2010) notes that parents compensate the lack of intellectual and economic support for their children academic development by providing discipline and emotional support. In urban areas, this is a little different: there is a higher level of schooling among the population, and fathers do consider that academically supporting their children is their job, because more women financially contribute to the household, particularly in the early years of life and when boys and girls are at school age (Sandoval et al., 2017).

Durston (1995) highlights that cultural differences of rural areas with respect to language, thinking styles and expressions complicate learning, especially when teachers do not use what is already familiar to students; as the author states, a new school culture of communication and relationships should emerge from the interactions between the actors involved, mainly teachers and parents. Many teachers of rural schools are culturally deprived, and this creates a distance with parents instead of an assimilation process; in urban schools, at least in those attended by boys and girls with better living conditions and parents with higher education levels, teachers feel more comfortable and support parental beliefs about participating in the education of their children. This is in particular evident within areas where there are more conflicts at school environments. Of note are the fewer opportunities that children in rural areas have accessing goods, from the most basic needs to up-to-date technology, including computer equipment and internet; situations often resulting from the parents low education levels (Paes de Barro et al., 2009). Roemer and Ünveren (2017) remark that parental education levels, especially those of mothers, and occupations are indicators of inequity in the access to opportunities.

Given that beliefs are important for parental involvement in school activities, it is important to understand the existing differences and which ones of these can impact the measurement model posed in this document; as well as those differences affecting the results and interpretation. Because of the importance of beliefs in parental involvement, an instrument that allows an understanding of those beliefs, applicable to different schooling levels and parents cultural capital, suitable

for urban and rural areas, is necessary for decision-making that favors the family-school relationship in different contexts. It is also important to review the relevance of instruments and their psychometric properties in different contexts. Therefore, the objective of this study was to test a measurement and invariance model of a belief scale for parent participation in their children's school education, within both rural and urban areas.

MATERIALS AND METHODS

This is an instrumental study (Carretero-Dios and Pérez, 2005; Ato et al., 2013) in which the psychometric properties of a scale of beliefs about parent participation in their children's school education were obtained, as was the validity of the measurement model for parents residing in urban and rural areas.

Participants

The instrument was completed by 2,576 parents with children in basic education schools within either urban or rural areas. The sample was selected by convenience, taking into account the total population of elementary students in Sonora, a Mexican northwestern state that borders the United States of America. Rural populations are mainly located in the south of the state; the rural sample was taken from four towns located on this area. On the other hand, urban sample was taken from the four largest cities of the state.

For the analysis, random smaller samples (20%) were obtained from the general sample, in order to ensure suitable samples in line with both the model and the methods employed (Jackson, 2003). The subsample used to run the model consisted of 52% of parents residing in urban areas [95% CI 48–56 bootstrap%] and 48% of parents residing in rural areas [95% CI 46–49 bootstrap%]. For the urban areas, 40% were fathers and 60% were mothers; for the rural areas, 58% were mothers, and 42% were fathers. The four rural towns considered in this study fit in the rural population classification made by the National Institute of Statistics and Geography (INEGI, 2010): less than 2,500 inhabitants, limited urban services, no paved street (or just the main street), agriculture is the leading economic activity.

Parents' age information was removed because of a high percentage of missing values (up to 12%). No significant differences or correlations were observed between the presence of other children in elementary school or other educational levels and the participation of parents (supporting child and school) in urban and rural areas (see **Annex 1**). Mothers in rural areas had lower levels of education. In rural areas, a higher percentage of mothers reached only primary school education, and a lower

percentage got university education; for fathers, the results were similar, but the differences were slightly greater between those who resided in cities (urban) and those who resided in towns (rural) (see **Table 1**).

The referred existing learning opportunities differences between urban and rural families are: access to books, access to internet. A comparison of these scenarios within the urban and rural contexts of the region of interest is presented below (see **Table 2**). Access to a greater number of educational institutions near of their homes is most likely an important factor for students' educational progression; it is worth noticing that all the rural areas considered in the sample of this study were located at almost an hour from educational institutions, and had poor public transportation services.

On average, urban families had four members and rural families had five. The daily income per urban family was 20 United States, 5 dollars per member; in the rural family, it was 10 United States, 2 dollars per member. The most frequent occupations were similar for urban and rural fathers with unskilled jobs, especially in the rural area. In the case of mothers, predominated the unpaid work of housekeeping; a distinguishing fact is that women in the rural area had the highest percentage of skilled work, beyond that of fathers in rural or urban, and mothers in urban areas (see **Table 3**). This information reveals the two different realities experienced by the families that live in such areas.

Instrument

The instrument consisted of two parts, the first one with items aimed to obtain information of sex, age, number of child attending school, family's learning context aspects, and economic situation. Also, two general questions were added to ask: if parents believed that their participation influenced

TABLE 2 | Available sources of learning support for students in urban and rural areas (percentages).

	Urban (%)	Rural (%)
Computer access at home	65	30
Internet access at home	57	21
Books available at home (approximately 10 books)	20	13

TABLE 3 | Type of occupation parents in urban and rural areas have (percentages).

	Mothers		Fathers	
	Urban (%)	Rural (%)	Urban (%)	Rural (%)
Housewife (unpaid)	48	63	0	0
Not qualified job	3	7	59	73
Qualified job	38	18	17	10
Self-employed professional	9	9	12	8
Retired	0	0	1	1
Executive	0	0	2	0
Not present	2	3	9	8
Total	100	100	100	100

TABLE 1 | Education level of the parents in urban and rural areas (percentages).

	Mothers		Fathers	
	Urban (%)	Rural (%)	Urban (%)	Rural (%)
Elementary school	3	11	3	16
Middle school	30	40	28	38
High school	40	30	35	28
University	27	19	34	18

their children's school success; and about the time they spent supporting their children in educational matters.

The requested information on the learning contexts was on these subjects: (a) parents' educational levels, (b) computer at home, (c) internet at home, and (d) books at home. The economic situation indicators were: (a) average family income per day, (b) number of people who support themselves with said income, and (c) kind of occupation. The kind of occupation referred to labor activities for which an income was received; although it does not imply a payment, domestic labor (taking care of children) was also included. Unskilled jobs, meanwhile, were those occupations that only require brief training; the qualified were those requiring a degree of specialization and received higher remuneration than the non-qualified. Another category of professionals was included for self-employees, retirees and parents in executive jobs (these are responsible for decision-making and generally have higher salaries than people in the other categories). These job categories are simplifications of those included in the National Labor Classification System [Sistema Nacional de Clasificación del Trabajo] (INEGI, 2018).

The one-dimensional scale of beliefs about parent participation in school activities of their children developed by Walker et al. (2005) was applied in its original version with 10 items, in a continuum: from active (partnership oriented and with high score), to passive (with lower score). Two factors of the scale were tested in this study: (a) supporting children in their school activities, and (b) supporting the school. The instrument was answered using a scale with five values ranging from strongly disagree (1) to strongly agree (5). In its original version, the response scale had six response options, however, the options were reduced to five in order to facilitate understandability (a pilot test indicated confusion with the six-option version). For the original version, Cronbach's alpha was 0.816, but validation of the measurement model was not reported. For this instrument, Lavenda (2011) reported a measurement model with an adequate fit, reporting normed fit index (NFI) and comparative fit index (CFI) values higher than 0.90, a root mean square error of approximation (RMSEA) of 0.06 and invariance for samples of Jewish and Arab parents. As part of one study with Mexican population, an adequate model fit with a two-dimensional structure was reported (Sandoval et al., 2017).

Procedure

The instrument, originally written in English by Walker et al. (2005), was adapted to Spanish using a cross-translation. Then, was revised a version of the same scale in Spanish, presented by Hoover-Dempsey et al. (2005), which coincided with the Spanish version from the aforementioned instrument obtained by cross-translation. A panel of experts consisting of three specialists determined the content validity; two items were reworded due to redundancy. There was 100% agreement among the reviewers regarding editorial adjustments and the elimination of one item; but the full original scale was applied, that item was removed later during the different analyzes. The instrument was further adapted by adding two items to include aspects of school coexistence, which is a topic related to respect among classmates and required to be addressed by teachers and parents in Mexican schools

("Teaching my child to get along with children" and "Teaching my child how to coexist peacefully").

Once the instrument was finalized, it was applied. Before applying the questionnaire, authorizations from the different elementary education institutions principals were requested; from the beginning, it was made clear that parents had the option to reject participating in the study. Next, after explaining the objectives of the project to the teachers, their signatures indicating consensus support were requested. After gaining teacher support, each child was asked to deliver his or her parents an invitation to respond the instrument; prior informed consent from the parents was obligatory in order to complete the questionnaire. The instrument was sent to the parents through their children in an envelope; teachers supported this study by delivering the envelopes to the students. Finally, the parents answered the questionnaires at home and returned the sealed envelopes to the teachers.

Data Analysis

The SPSS statistical package was used to perform exploratory factor analysis (EFA) with maximum likelihood extraction (to reduce the effect of the normality requirement), and varimax rotation; AMOS was used to perform confirmatory factor analysis (CFA), and determine multigroup invariance. For the EFA, the general sample was used; followed by parents from urban areas and then by parents from rural areas. The distribution of the data for each of the variables had a guaranteed asymmetry between +1, -1, and a kurtosis of 0.6 or less (Lloret-Segura et al., 2014).

The same orthogonal rotation criteria were considered using varimax in agreement with those used for the original instrument (Hoover-Dempsey et al., 2005; Walker et al., 2005), noting that rotation was also performed obliquely using oblimin, and that the results were very similar, without differences that would reveal the necessity of a modification. In the case of extraction, maximum likelihood was used to decrease the parametric requirement, in addition to the use of a bootstrap technique to compensate for this requirement of normality. To verify the suitability of the sample for EFA, the Kaiser-Meyer-Olkin coefficient (KMO) and the Bartlett test of sphericity were used.

Returning to these considerations, once one of the items got eliminated because of its low factorial weight, CFA was performed using the variables that had previously met the requirements for this analysis from the Pearson correlation matrix with regressions to determine which items (variables) should be incorporated into the CFA. The use of structural and bootstrap equations in AMOS allowed the validation of model fit in other subsamples.

Reliability was determined using Cronbach's alpha and, although it was possible requirements of the first could not be met, coefficient omega was used to corroborate reliability (Dunn et al., 2014); this corroboration involved following the formula and procedure, using Excel and the data obtained from the EFA (Ventura-León and Caycho-Rodríguez, 2017). The composite reliability and average variance extracted (AVE) and the square root of the AVE showed that the correlation with other constructs were used to obtain evidences of convergent and discriminant validity (Fornell and Larcker, 1981).

Ethics Statement

Institutionally, an ethics committee approved the study protocol before research commenced. At all times, the participants were entitled to refuse to participate, including the principals, teachers and parents invited to complete the instrument. Feedback was provided through educational material designed for families, that is, a brochure with a magnet to place on the refrigerator (following the customs in this region of using the refrigerator to display children's documents); it was sent to the families through the principals of the participating schools.

RESULTS

It was observed that a similar percentage of parents responded that their participation in children's school affairs influences their learning; 51% indicated that it has no effect and 49% considered that it does contribute to the good academic performance of their children. When contrasting by area and gender of the parent, no significant differences were found.

Regarding time available to attend to their children's school affairs, as included as a variable in Hoover-Dempsey model, the parents in both regions dedicated similar amounts of time, and most believed that parent participation is appropriate (78% of parents residing in rural areas and 70% of parents residing in urban areas), with a significant difference between them ($X^2 = 14.93$, $gl = 2574$, $p = 0.01$); that is, a higher percentage of parents in rural areas feel comfortable with the time they invest on caring for their children apropos of education. The differences in access to opportunities lead to, in addition to CFA, the inclusion of a multigroup for the review of rural-urban invariance.

Convergent and Discriminant Validity

The composite reliability ranges were 0.83 (support child) and 0.78 (support school). The factor loads was up the 0.68–0.85 and AVE of the model was 0.63 and 0.54 (support child and school, respectively), which indicates the presence of convergent validity. The square root of the AVE of the construct was higher (up to 0.7) than the correlation with other constructs (lower than 0.60), thus verifying the discriminant validity (Fornell and Larcker, 1981).

Exploratory Factor Analysis

First, EFA was performed for the original scale with 10 items plus the two items added during the adaptation. The KMO value was 0.866, and the Bartlett test of sphericity result was 0.00 with a chi-square value of 7677. The factorial structure of the two factors was the same as the original. The first refers to the activities that parents believe they should support, and the second refers to the support they believe they should provide to the school. Two items were eliminated because they had factorial weights lower than 0.30 and were in two factors. The support at home factor had an internal consistency of 0.85, and the support at school factor had an internal consistency of 0.77; the alpha for the total scale was 0.83, and the model explained 53% of the variance. Subsequently, EFA was performed for each sample (rural and urban), and the structure of the two factors was verified.

EFA on Urban Area

A KMO value of 0.801 was obtained, the instrument had a total explained variance of 72.57%, and the items were grouped into two factors with four items each: (a) support for children at home, showing reactive factorial weights between 0.850 and 0.940, with a variance of 37.69%; and (b) support to school, with factor weights oscillating between 0.832 and 0.783, with a variance of 34.88%.

EFA on Rural Area

The KMO value of 0.789 was acceptable, with a total explained variance of 68.31%, and a two-factor structure with four items each. For the first factor, support for the child with his or her school-related tasks for home, the factorial weights were between 0.858 and 0.777, with an explained variance of 35%. For the school support factor, the factor weights ranged between 0.799 and 0.781, with an explained variance of 33.23%.

Confirmatory Factor Analysis -Multigroup- Invariance

In the CFA, six items were grouped into two factors, maintaining the two-factor structure and eliminating two items since they were substantially reducing the goodness of fit of the original model. The CFA of each sample indicated that the model measuring two factors with three items each was acceptable for both cases (parents in urban and rural areas). The comparative goodness of fit index (CFI), considered one of the main indices for these cases, had values above 0.90 (Cheung and Rensvold, 2002; Elosua, 2005), and RMSEA values were less than 0.05. According to the measures of incremental adjustment and parsimony, these values were significantly higher than those for the independent model and very similar to those for the saturated model (Ruiz et al., 2010; Table 4).

In the CFA, in both samples, the items saturated adequately, revealing moderate correlations between the factors (see Table 5), and an acceptable coefficient omega for each factor (Ventura-León and Caycho-Rodríguez, 2017; Table 6).

The indices obtained (Table 6) showed the equivalence of the basic measurement models between rural and urban areas; that is, there is invariance of the factorial structure between the two. Although the chi-squared value is high, the rest of the indices point to the similarity of both models, enough to accept the hypothesis of invariance (NFI greater than 0.9; CFI greater than 0.95; RMSEA lower than 0.05) (Elosua, 2005).

In the case of metric invariance by placing restrictions on the factorial loads on the base model, the general fit index (GFI) and the RMSEA indicated equivalence. Additionally, the CFI and Akaike results did not show relevant differences, although the values slightly increased with respect to the restricted model (see Table 6).

When assessing the strong factorial invariance (intercept) through the independent model and the model with nested metrics, the CFI of the models, other than the non-restrictive

TABLE 4 | Absolute, incremental and parsimony indices for the generated models, confirmatory factor analysis for urban and rural areas (* $p < 0.05$).

Model	Absolute indices			Incremental indices			Parsimony indices	
	χ^2	GFI	RMSEA	AGFI	TLI	CFI	CMIN/DF	AIC
Factor solution for the urban area								
Independent	3021.2	0.997	0.389	0.296	0.000	0.000	201.416	3033.24
Saturated	0.000	1.00						42.000
2 factors	10.406	0.497	0.015	0.993	0.999	0.999	1.300	36.401
Factor solution for the rural area								
Independent	2268.0	0.545	0.347	0.364	0.000	0.000	151.201	2280.01
Saturated	0.000	1.00						42.000
2 factors	19.016	0.995	0.033	0.987	0.991	0.995	2.377	45.016

GFI, (Adjusted) Goodness of Fit; RMSEA, Root Mean Square Error of Approximation; AGFI, Adjusted Goodness of Fit Index; TLI, Tucker Lewis index; CFI, Comparative Goodness of Fit Index; CMIN/D, Chi-Squared Ratio ff Degrees Of Freedom; AIC, Akaike Information Criterion.

TABLE 5 | Confirmatory factor analysis results for both samples.

Items	Support the child		Support the school	
	Urban	Rural	Urban	Rural
Support my child in understanding his/her homework.	0.850	0.839		
Help my child with his/her homework.	0.776	0.690		
Teach my child to live peacefully.	0.765	0.717		
Making the school better.			0.806	0.754
Speak with other parents about the school.			0.704	0.704
Ensure that the school has what it needs.			0.699	0.647
Correlations between factors				
Support the child	–	–		
Support the school	0.55	0.56	–	–

TABLE 6 | Goodness of fit indices for each of the models tested for factorial invariance (* $p < 0.05$).

Model	Fit indices						
	χ^2	g	CMIN/DF	NFI	CFI	RMSEA	AIC
Model without restrictions	29.420	16	1.839	0.994	0.997	0.018	105.420
Metric invariance	43.239	20	2.162	0.992	0.996	0.021	111.611
Strong factorial invariance	80.397	29	2.772	0.985	0.990	0.026	130.397

CMIN/D, Chi-Squared Ratio of Degrees of Freedom; NFI, Non-Normed-Fit Index; CFI, Comparative Goodness of Fit Index; RMSEA, Root Mean Square Error of Approximation; AIC, Akaike information criterion.

model, were less than 0.01; the difference in the CFI for metric invariance was 0.001, and that for strong factorial invariance was 0.007 (Cheung and Rensvold, 2002). The results of these estimations allow establishing that the two belief models for the parents who reside in rural and urban areas are equivalent with respect to the factor coefficients, as well as the strong or intercept coefficients (see **Table 7**).

According to the results obtained for each sample, the instrument had an acceptable coefficient of omega reliability in general, as well as for each one of the factors (see **Table 7**). The values of reliability (alpha) were also above 0.80; the omega coefficient verified the reliability (Revelle and Zinbarg,

2009; Peters, 2014). The scale in Spanish version is presented in **Annex 2**, with evidences of reliability, convergent and discriminant information.

TABLE 7 | Coefficient omega for the factors obtained.

Factor	Urban	Rural
	ω	ω
Support the child	0.939	0.886
Support the school	0.898	0.846
Total	0.915	0.874

DISCUSSION

The differences found when comparing rural to urban contexts, on the subject of opportunities to access information sources, revealed the relevance of identifying invariances in the instrument for measuring beliefs about the participation of parents in children's school education. In the multigroup CFA, the model fit adequately with two factors containing three items each, which is consistent with the bifactorial structure proposed by Hoover-Dempsey et al. (2005). The initial proposal consisted of 10 items, but this number was reduced to three per factor. This number of items is the minimum acceptable number; in the future, in other studies, items for these indicators should be written and tested to improve the instrument. Although the number of items is small, when this kind of brief instruments is answered, the acceptance rates are higher and are answered with greater caution, since the probability of fatigue is reduced, leaving fewer unanswered questions than when questionnaires are extensive.

The configurational invariance results indicate that the instrument is applicable for rural and urban samples, with consistency between the structure and factorial weights, with an instrument with two factors suitable for parents in both rural and urban areas. This instrument can be applied in schools in both areas; it is very short, making it easy for parents to respond, in contrast to low recovery rates characteristic of instruments that are extensive. The context of opportunities, while different in each area, maintains the variables for measuring invariance of the measurement model, with adequate fit with a two-factor structure for parents residing in both areas.

For reliability, the coefficient omega results were similar to those reported by Walker et al. (2005), who found an internal consistency of 0.81 (with Cronbach's alpha) for questionnaire that measures beliefs regarding parental roles in children's school activities.

The scale for beliefs regarding parent participation at school is appropriate for implementation in the northwestern area of Mexico, in addition to being brief and easily understood by parents in rural areas with an education level lower than those of parents in urban areas. Consistency with the model proposed by Hoover-Dempsey et al. (2005) was maintained. This brief scale provides the option of applying a short instrument for use in

the Mexican context, characterized by a diversity and breadth of schools in rural and urban areas.

It is necessary to mention several limitations of this study: first, since the participants lived in the northwestern region of the country, it is not possible to conclude that a representative sample of the Mexican population was used; furthermore, the present research did not consider the measure of other variables to test criterion validity. Despite these limitations, this questionnaire identifies role's beliefs about parental involvement in their children's school activities, which, in brief, is rewarding as it allows parents with different educational levels and reading habits to respond easily. The duration of about 5 min to answer makes parents more willing to respond. It makes it possible to teachers and principals to know the parents' beliefs about their responsibility regarding the children's academic succeed. Teachers can evaluate and discuss with parents the value of their involvement in both their child's and school's support. The matter is truly important because the data reveals that the actual behaviors of participation rates are reduced, especially in those related to the school attention around the country (Valdés and Urías, 2011).

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Instituto Tecnológico de Sonora. The patients or participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SE-C designed the project. RS-D and DR-E performed the data collection, SE-C and MS-C analyzed the data and supervised the findings of this study. SE-C and LB-H wrote the manuscript.

REFERENCES

- Ato, M., López, J., and Benavente, A. (2013). Un sistema de clasificación de los diseños de investigación en psicología [A classification system for research designs in psychology]. *Anal. Psicol.* 29, 1038–1059. doi: 10.6018/analesps.29.3.178511
- Azaola, M. C. (2010). Importancia, significado y participación en la escolarización en zonas rurales: un estudio etnográfico en Michoacán, México [Importance, meaning and participation in schooling in rural areas: an ethnographic study in Michoacán, México]. *Perf. Educ.* 32, 67–82.
- Carretero-Dios, H., and Pérez, C. (2005). Normas para el desarrollo y revisión de estudios instrumentales [Standards for the development and review of instrumental studies]. *Int. J. Clin. Health Psychol.* 5, 521–551.
- Cheung, G., and Rensvold, R. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Struct. Equ. Modeling* 9, 233–255. doi: 10.1207/S15328007SEM0902_5
- Deslandes, R., and Bertrand, R. (2005). Motivation of parent involvement in secondary-level schooling. *J. Educ. Res.* 98, 164–175. doi: 10.3200/JOER.98.3.164-175
- Dunn, T., Baguley, T., and Brunsden, V. (2014). From alpha to omega: a practical solution to the pervasive problem of internal consistency estimation. *Br. Psychol. Soc.* 5, 399–412. doi: 10.1111/bjop.12046
- Durston, J. (1995). "La participación comunitaria en la gestión de la escuela rural [The community participation in the management of rural schools]," in *Educación, Eficiencia y Equidad*, ed. E. Cohen (Chile: CEPAL/OEA/Ediciones SUR), 119–147.
- Elosua, P. (2005). Evaluación progresiva de la invarianza factorial entre las versiones original y adaptada de una escala de autoconcepto [Progressive

- evaluation of factor invariance between the original and adapted versions of a self-concept scale]. *Psicothema* 17, 356–362.
- Fornell, C., and Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: algebra and statistics. *J. Market. Res.* 18, 328–388.
- Green, C. L., Walker, J. M. T., Hoover-Dempsey, K. V., and Sandler, H. (2007). Parents' motivations for involvement in children's education: an empirical test of a theoretical model of parental involvement. *J. Educ. Psychol.* 99, 532–544. doi: 10.1037/0022-0663.99.3.532
- Hoover-Dempsey, K. V., Walker, J. M. T., Sandler, H. M., Whetsel, D., Green, C. L., Wilkinson, A. S., et al. (2005). Why do parents become involved? Research findings and implications. *Elem. Sch. J.* 106, 105–130. doi: 10.1086/499194
- Hoover-Dempsey, K., and Sandler, H. (2012). *Why is Parent Involvement Important? Hoover-Dempsey & Sandler Model of the Parental Involvement Process*. Fairfax Station, VA: The Parent Institute.
- Hoover-Dempsey, K., Walker, J., and Sandler, H. (2005). "Parents' motivations for involvement in their children's education," in *School Family Partnership for Children's Success*, eds E. Patrikakou, R. Weissberg, E. Redding, and H. Walberg (New York, NY: Teachers College Press), 40–57.
- Hoover-Dempsey, K., Wilkins, A., Sandler, H., and Jones, K. (2004). "Parental role construction for involvement: theoretical, measurement and pragmatic issues in instrument development," in *Paper Presented at the Annual Meeting of the American Educational Research Association*, San Diego, CA.
- INEGI (2010). *Población Rural y Urbana [Rural and Urban Population]*. Available online at: http://cuentame.inegi.org.mx/poblacion/rur_urb.aspx?tema=P
- INEGI (2018). *Sistema Nacional de Clasificación de Ocupaciones 2018 [National Occupational Classification System 2018]*. Available online at: https://www.inegi.org.mx/contenidos/app/consultapublica/doc/descarga/SINCO2018/proyecto/documento_sinco_2018.pdf
- Jackson, D. L. (2003). Revisiting simple size and number of parameter estimates: some support for the N:q hypothesis. *Struct. Equ. Modeling Multidiscip. J.* 10, 128–141. doi: 10.1207/s15328007sem1001_6
- Lavenda, O. (2011). Parental involvement in school: a test of Hoover-Dempsey and Sandler's model among Jewish and Arab parents in Israel. *Child. Youth Serv. Rev.* 33, 927–935. doi: 10.1016/j.childyouth.2010.12.016
- Lloret-Segura, S., Ferreres-Traver, A., Hernández-Baeza, A., and Tomás-Marco, I. (2014). El análisis factorial exploratorio de los ítems: una guía práctica, revisada y actualizada [Exploratory factor analysis of items: a practical guide, revised and updated]. *Anal. Psicol.* 3, 1151–1169. doi: 10.6018/analesps.30.3.199361
- Paes de Barro, R., Ferreira, F. H. G., Molinas, J. R., and Saavedra, J. S. (2009). *Measuring Inequality of Opportunities in Latin America and the Caribbean*. Washington, DC: The World Bank
- Peters, G. (2014). The alpha and the omega of scale reliability and validity. Why and how to abandon Cronbach's alpha and the route towards more comprehensive assessment of scale quality. *Health Eur. Psychol.* 16, 56–69.
- Reed, R., Jones, K., Walker, J., and Hoover-Dempsey, K. (2000). "Parent's motivations for involvement in children's education: testing the theoretical model," in *Paper presented at the Annual Conference of the American Educational Research Association*, New Orleans, LA.
- Revelle, W., and Zinbarg, R. (2009). Coefficients alpha, beta, omega and the GLB: comments on Sijsma. *Psychometrika* 74, 145–154. doi: 10.1007/s11336-008-9102-z
- Roemer, J. E., and Ünveren, B. (2017). Dynamic equality of opportunity. *Economica* 84, 322–343. doi: 10.1111/ecca.12197
- Ruiz, M., Pardo, A., and San Martín, R. (2010). Modelo de ecuaciones estructurales [Structural equation model]. *Papeles Psicol.* 31, 34–45. doi: 10.1111/famp.12392
- Sánchez, P., and Valdés, Á (2014). "Análisis de la participación de las familias en la educación en México. Una guía para la intervención y la investigación [Analysis of the participation of families in education in Mexico. A guide to intervention and research]," in *Familia-Escuela-Comunidad: Teorías en la Práctica*, eds A. Bazán and N. Vega (México: Universidad Autónoma del Estado de Morelos. Ediciones mínimas), 51–66.
- Sandoval, R., Echeverría, S., and Valdés, Á (2017). Participación de los padres en la educación: una prueba del modelo de Hoover-Dempsey y Sandler [Parental involvement in education: a test of the Hoover-Dempsey and Sandler model]. *Perspect. Educ.* 56, 139–153. doi: 10.4151/07189729
- Valdés, A., and Urías, M. (2010). "Familia y logro escolar [Family and school achievement]," in *Familia y crisis: Estrategias de Afrontamiento*, eds A. Valdés and J. Alcántar (México: Pearson), 39–67.
- Valdés, A., and Urías, M. (2011). Creencias de padres y madres acerca de la participación en la educación de sus hijos [Parents' beliefs about participation in their children's education]. *Perf. Educ.* 134, 99–114.
- Valdés, Á, Martín, M., and Sánchez, P. (2009). Participación de los padres de alumnos de educación primaria en las actividades académicas de sus hijos [Participation of parents of primary school students in their children's academic activities]. *Rev. Electrón. Invest. Educ.* 11, 1–17.
- Ventura-León, J., and Caycho-Rodríguez, T. (2017). El coeficiente Omega: un método alternativo para la estimación de la confiabilidad [The Omega coefficient: an alternative method for estimating reliability]. *Rev. Latinoam. Ciencias Soc. Niñez Juventud* 15, 625–627.
- Villarreal, R. G., and Sánchez, S. X. (2002). Relación familia y escuela: un estudio comparativo en la ruralidad [Family and school relationship: a comparative study in rural areas]. *Estud. Pedagógicos* 28, 123–141.
- Walker, J., Ice, C., Hoover-Dempsey, K., and Sandler, H. (2011). Latino parents' motivations for involvement in their children's schooling. *Chic. J.* 111, 409–429. doi: 10.1086/657653
- Walker, J. M. T., Wilkins, A. S., Dallaire, J. R., Sandler, H. M., and Hoover-Dempsey, K. V. (2005). Parental involvement: model revision through scale development. *Elem. Sch. J.* 106, 85–105.

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ANNEXES

ANNEX 1 | Number of children in family.

Have children in primary or other educational levels	Type of area	
	Urban %	Rural %
Other child in kindergarten	18	38
Other child in middle school	40	23
Only one child in elementary school	2	0
Have two children in elementary school	26	23
Have three children in elementary school	3	5
Have four or more children in elementary school	1	1
Total	100	100

ANNEX 2 | Parental Role Construction for Involvement in the Child's Education Scale - Spanish version.

Factor	Items	λ	CR*	AVE
Apoyo al niño/ Support for the child	Apoyar a mi hijo a que entienda sus tareas.	0.85	0.84	0.631
	Ayudar a mi hijo con la tarea.	0.77		
	Enseñar a mi hijo a convivir pacíficamente.	0.76		
Apoyo a la escuela/ Support for the school	Hacer que la escuela mejore.	0.80	0.77	0.54
	Hablar con otros padres de familia de la escuela.	0.70		
	Asegurarme de que la escuela tenga lo que necesita.	0.69		

CR*, Composite reliability; AVE, Average Variance Extracted.



Socialization of Gender Stereotypes Related to Attributes and Professions Among Young Spanish School-Aged Children

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Modern societies increasingly show more egalitarian attitudes related to sexism and gender equality. However, there is still an important gender gap in wages and professions as well as in expectations surrounding male and female characteristics. Developmental studies carried out from an ecological perspective confirm that these influences come from the closest environments (mainly family and school) but also from more distant systems such as media or cultural values. As children are socialized in these norms and values, they increasingly internalize those schemes and use them to judge others, to choose friends and playmates, and to construct expectations of them. On this basis, the aim of this study was to examine the degree of gender bias internalization in a group of Spanish children. Two tasks were applied to a group of 149 public school boys and girls (aged 4–9 years). Results showed that, already from an early age, the participants had internalized traditional gender roles, especially when asked to assign masculine attributes. Moreover, group differences were found given that boys seemed to be more aware of expectations surrounding masculinity and girls assigned the attributes associated with femininity to women more often than boys. Furthermore, a developmental pattern similar to one obtained in previous studies was observed. Younger children already apply gender roles as part of their increasing acquisition of knowledge in the social field, but there is a big increase in the strength of this bias as they grow older. Psychological and educational implications of these findings are discussed, especially considering that the male gender role seems to be more rigid and less malleable. In this regard, developmental and environmental studies should be considered when designing early intervention programs to reduce sexism and to promote equity in schools and families. As research has already shown what type of environments affect children's acquisition of traditional gender roles, society must make an effort to promote more egalitarian environments that will serve as protective factors in their future psychological, social and professional development.

Keywords: gender schema, professional roles, personal attributes, childhood development, environment, gender flexibility

INTRODUCTION

In recent decades there have been significant advances in terms of gender equality in the economic, education, and employment fields. These advances have resulted in numerous laws and regulations that seek to promote equal opportunities for men and women throughout their life and to reduce sexism in all its aspects. However, significant gender inequality in adulthood still exists in crucial areas such as wages and positions of power (vertical segregation) (Cohen and Hilgeman, 2006), as well as large differences in numerous areas of life: to give some examples, girls tend to perceive themselves as less competent in science-related fields (OECD, 2020), and women tend to be underrepresented in traditionally male professions, which are usually the ones with greater social prestige (horizontal segregation) (Cohen and Hilgeman, 2006). On a personal level, gender roles affect the physical and mental health of men and women (World Health Organization [WHO], 2002; Mayor, 2015), with gender inequality being at the base of gender violence (McCarthy et al., 2018). Moreover, although life expectancy is greater for women, they have a worse quality of life (Rollero et al., 2014).

Regarding childhood, there are multiple studies that show how boys and girls internalize the traditional gender roles that prevail in society from an early age (Jackson, 2007). This internalization has a decisive effect on their academic development, their perception of their own abilities (regardless of their real abilities), and their personal, vocational and job aspirations (Kollmayer et al., 2018).

Under these differences a persistence of traditional gender stereotypes exists, among other social factors, according to which certain attributes, behaviors and expectations are associated with men and women in a biased manner. Research in the area of developmental and social psychology has been asking for decades about the development and acquisition of gender roles in childhood, and what factors affect these ongoing events. Sex typing or the process of acquiring gender roles is a global phenomenon that children from all cultures go through, considering this as a part of regular development and a consequence of differentiated socialization processes in the first years of life. This phenomenon continues to evolve throughout life with messages that come from the contexts with which children interact (Bem, 1983; Liben and Bigler, 2002c).

Understanding how gender roles arise and are constructed has obvious practical implications. It can be useful for researchers working in the field of psychology and education or in the design of public policies when implementing real measures that promote authentic social changes in this regard (Liben and Bigler, 2002a). In addition, as these authors suggest, the study of the acquisition and development of these roles would allow us to deepen the classic nature versus nurture debate. Even when there may be small basic biological differences between men and women, the different environmental experiences we receive from the moment of birth on, as well as the interaction between both factors, determine separate paths for both.

Research in this area has proposed three major types of theories to explain gender differentiation (Liben and Bigler,

2002b). First, there are investigations that consider gender stereotypes to develop because they reflect real biological differences inherent in the two sexes (related to sex-linked genes, hormones or brain differences). Developmental psychology is framed within this approach, which states that men and women are different because human evolution has caused us to face different adaptive problems, which causes natural selection to prioritize characteristics in men and others in women (Buss, 1995). Recent studies also indicate that certain cultural values, universally associated with femininity and masculinity, could have a certain genetic origin, especially for cases where the person shows counter stereotypic values (Knafo and Spinath, 2011). Other works carried out with large samples of sibling pairs indicate that genes seem to have some weight in the development of sex-typed behavior, although the influence of the environment is very relevant (Iervolino et al., 2005).

Beyond biological theories, multiple investigations highlight precisely the role of the environment in the construction of gender roles (Carli and Bukatko, 2000). According to these approaches, men and women behave differently because of the existence of socialization practices and learning mechanisms that generate and maintain gender differentiation (Liben and Bigler, 2002b).

Here we can find the traditional learning theories, which indicate that the different environments in which children grow up reinforce and punish behaviors associated with sex, especially by significant adults (family and teachers) (Eccles et al., 2000; Beaman et al., 2006) but also by peers and equals (Witt, 2000). Social learning theories further indicate that children learn what is appropriate for their sex by observation and by imitating the behaviors of the people they identify with, who are more often of the same sex, and by observing the reactions of the environment to the models' behaviors through a process of vicarious learning (Endendijk et al., 2018).

There is a third group of cognitive theories, which have been described as "gender constructivism." The authors highlight the processes of individual development in the construction of gender identity and sexual roles (Bem, 1981). As a child starts to perceive that there are two types of people in social life (men and women), he/she develops a gender scheme that will guide the future processing of information from this categorization (Bem, 1981). When children understand which group they belong to and assume the stability of this situation, they begin to associate behaviors and expectations with one or the other according to their experiences, given that this scheme becomes a highly available category in social life (Bem, 1983). From this moment on, they apply gender schemes to the development of their own identity (Ruble et al., 2007), as well as to the expectations they develop regarding people with whom they interact in the attitudinal, personality or occupational spheres (Levy and Sadovsky, 2000; Halim et al., 2013). However, children are not limited to assuming and copying the gender roles that the environment provides or that biology imposes, instead they are active agents that modify the schemes as they interact with different contexts. Certain environmental experiences stimulate the restructuring of these schemes (for example, showing counter-stereotypical models) (Olsson and Martiny, 2018), which

promote an accommodation of new information which results in the roles gaining a more personal content. In this line, the contributions of poststructural feminism could be framed (Renold, 2004): if gender identity were something immutable, we would limit ourselves to copying and reproducing roles as fixed schemes, which would have prevented great social advances regarding the place that men and women occupy in society.

The theories that emphasize the role of the environment in the construction of gender roles can be framed in the ecological model of Bronfenbrenner (1994), who highlights the role of the contexts with which we interact in human development and learning. Applying this model to the acquisition of gender roles, it is currently known that the socialization of gender identities and stereotypes is built upon the basis of multiple messages. These messages are often explicit (for example, a father saying to his son “boys don’t cry”), but they are also often implicit or subtle (such as underrepresentation of women in textbooks associated with science, or the low participation of men in housework). In addition, these influences come from all socialization agents (family, teachers, school, media, laws, etc.) (Shen-Miller et al., 2011; Baker et al., 2016; Paul Halpern and Perry-Jenkins, 2016).

Among the studies that analyze purely environmental variables and their effect on gender socialization processes, the negative influence of the contexts in which institutional sexual segregation is applied (Wong et al., 2018) could be highlighted. This would include, for example, the existence of educational centers segregated by sex, but also other aspects in the educational context such as the use of gender labels to form lines or the organization of classroom structures or school activities (Bigler, 1995) or basically any type of context in which the saliency of a social categorization variable (such as sex) increases the development of more rigid stereotypes (Bigler and Liben, 2007).

Considering the environmental variables that affect the development of gender roles, purely physical aspects of the environment have been studied, but also symbolic and discursive. Within the school, the use of spaces has been analyzed profusely, highlighting how in general boys tend to make greater use of public spaces (playgrounds or even hallways) with games that displace other activities (Clark and Paechter, 2007), compared with girls, who tend to make smaller groups and relegate to private spaces (Børve and Børve, 2017). Along these lines, some reviews highlight how the classroom is not only a context in which interactions occur, but rather that it reproduces and is in turn produced by the inequalities of power that exist in society (Shilling, 1991). The distribution of the classroom, objects and spaces within a school seem to reproduce gender differences, although they sometimes leave room for more flexible non-normative discourses (Lyttleton-Smith, 2019). On a more symbolic level, the school context also transmits gender stereotypes through the so-called hidden curriculum, which would include subtle and implicit messages, in some unconscious cases, about situations of power and subordination, what is expected of each child in function of their social origin, or ethnicity, as well as whether they are a boy or a girl (Basow, 2004).

Differentiated environments for children are also observed in the family, even before birth. Different studies show how different colors are used in children’s rooms, including different

types of objects, decorations and toys which highlight the performative nature of the use of the space (Pomerleau et al., 1990). Furthermore, family contexts where sexual differentiation of tasks is more traditional influence the child’s acquisition of gender stereotypes (Paul Halpern and Perry-Jenkins, 2016).

The power of the messages included in children’s popular culture, including television, series or internet, which children and adolescents seem to consume increasingly despite reproducing evident forms of sexist messages and gender stereotypes, should also be considered when talking about environmental influences (Aubrey and Harrison, 2004; Döring and Mohseni, 2019).

From all these environmental influences, during their first years of life, children construct the gender schemes that will guide the elaboration of expectations about what society expects of men and women. In developmental psychology, the process of acquiring these schemes is called sex typing (Bem, 1981), and implies the application of gender stereotypes to multiple areas that range from material aspects that are differentially associated with one group or another (colors, toys, or objects), to complex social constructions such as expectations in regard to personality, skills, or professions that men and women carry out (Jackson, 2007; Wilbourn and Kee, 2010; Patterson, 2012). These stereotypes involve the development of differentiated schemes associated with masculinity and femininity (Liben and Bigler, 2002c), which interact with the child’s own sex as he/she is building them. This causes an earlier acquisition of stereotypes associated with men by boys, and with women by girls, giving priority to those that are most useful for building their own identity (Bem, 1981; Liben and Bigler, 2002c).

Developmental studies that have been carried out on this subject therefore seem to indicate that we are faced with a multidimensional construct that is acquired gradually (Liben and Bigler, 2002c; Halim et al., 2017), in interaction with the physical and symbolic environments that surround us, whose acquisition also influences cognitive (mainly flexibility and multiple categorization abilities) and motivational aspects of children (Bem, 1981; Bigler, 1995; Weisgram, 2016; Halim et al., 2017). Around the age of 3, children seem to clearly understand that the world is divided between men and women, and that they belong to one of those categories. From the moment in which they acquire the notion of gender constancy (Ruble et al., 2007), they identify with one of the groups and begin to fill these categories with information, tending to prefer one’s own group over the foreign group, attributing positive aspects to the in-group over the out-group and preferring peers over those who belong to the other category (Halim et al., 2017). Thus, what some authors call gender rigidity appears (Halim, 2016), which leads to gender differentiation to become especially strict during these years. Children begin to progressively associate professions, skills and objects in a biased way in line with the cultural knowledge they have absorbed (Jackson, 2007; Bian et al., 2017). The phenomenon of gender typing usually progresses throughout the primary school stage (6–11 years), when the stiffness of the traditional roles that apply to themselves and the rest begins to decrease (Trautner et al., 2005; Ruble et al., 2007; Siyanova-Chanturia

et al., 2015), due to an increase in cognitive flexibility, among others (Bigler, 1995; Banse et al., 2010). From this moment on, if cognitive progress continues and learning environments are sufficiently egalitarian, stereotypes tend to become more flexible and roles blur (Bennett and Sani, 2006; Halim, 2016). However, as is obvious, in many cases stereotypes also persist throughout life and continue to influence the behavior of adolescents and adults.

The developmental pattern described has been confirmed in multiple investigations that have been carried out in recent decades with children from different cultures, although as mentioned before there are differences in the developmental course of the different components associated with gender schemes, as this is a multifaceted construct (personal attributes, professions, skills, objects, etc.). It seems that gender biases tend to be more congruent in their multiple facets as the child's age progresses (Liben and Bigler, 2002c). In addition, the developmental course varies significantly when we talk about aspects associated with masculinity, compared to the characteristics that are usually associated with femininity. The data seem to indicate that, in a general way, the professions, objects or attributes associated with men tend to be more rigid, punishing more radically the behaviors that transgress gender mandates for men in some way (Wilbourn and Kee, 2010).

In this sense, an asymmetry of gender stereotypes exists: gender stereotyping is less restrictive for female stereotypes than for male stereotypes (Wilbourn and Kee, 2010; Siyanova-Chanturia et al., 2015). In addition, several studies indicate that girls generally show more flexible gender stereotypes than boys (Shen-Miller et al., 2011; Siyanova-Chanturia et al., 2012), especially in the area of domestic activities (Poulin-Dubois et al., 2002).

Furthermore, there are important differences in the development of gender differentiation between boys and girls, undoubtedly related to the social position they occupy. For example, both groups tend to associate positive characteristics preferentially with their own group, but after the age of 6 girls stop showing this pattern and mostly consider that something that requires a lot of intelligence should preferably be done by a man (Bian et al., 2017).

Based on these previous findings, the objective of this study is to analyze the presence of gender schemes in a group of Spanish children between 4 and 9 years of age, being as far as we know, the first study conducted on this topic with a children's sample in our country, a country which has historically been dominated by a macho culture that has evolved in recent years toward more egalitarian attitudes (López-Sáez et al., 2008). Although some researches have been done on the topic with Spanish adolescents and young adults (Colás Bravo and Villaciervos Moreno, 2007; Ferrer-Pérez and Bosch-Fiol, 2014), none of them have focused on early ages, where the origin of the problem is located, using a developmental approach. The results of the study might be helpful when designing educational and policy interventions in order to eliminate gender stereotyping as soon as possible, before those social shared schemes have been irrevocably internalized by the children.

MATERIALS AND METHODS

Participants

The participants were school children from a public primary school in the Community of Madrid in an area of medium socioeconomic status. After the acceptance of the school's management team regarding participation in the study, an informative document with an authorization was sent to the families of students between the ages of 4 and 9. Ultimately, 149 children participated in the study and their ages ranged from 4 to 9 years ($M = 6.25$; $SD = 1.38$), distributed in three age ranges. A first interval included 4- and 5-year-old participants and consisted of 22 boys and 27 girls. The next interval covered the range of 6- and 7-year-olds and consisted of 40 boys and 27 girls. The third interval, the 8- and 9-year-olds, included 16 boys and 17 girls.

Materials

Two types of tasks were developed specifically for this study: Task 1, aimed at assessing stereotypes related to typically female or male personal attributes, and Task 2, designed to identify stereotypes related to professional roles. **Supplementary Material** includes the instructions used to apply both tasks.

Task 1: Personal Attributes

The personal attributes selected for this study were: smart, kind, aggressive, vain, happy and grumpy. These attributes were chosen from the Bem Sex Role Inventory (BSRI) (Bem, 1974), including a positive and a negative attribute for each category, as well as characteristics that could be understood by the children of these ages. According to this instrument, the smart and aggressive attributes are stereotypically masculine adjectives, while the kind and vain attributes are typically feminine. The happy and grumpy attributes would be considered neutral (they are not culturally associated with either the male or the female gender).

The procedure for applying the task was based on the one used in a recent study that had similar objectives (2). Each participant was told six stories in which the protagonist was a very smart, kind, aggressive, vain, happy or grumpy person. This task had two versions: one in which the protagonist was an adult (man or woman) and another in which the protagonist was a child (boy or girl). The participants had to choose, in different tests, between four images of adults (two women and two men) and four images of children (two boys and two girls), who they considered the protagonist of the different stories was. The stories are described in more detail in the next section.

The photographs of men, women, boys, and girls used for the smart and kind attributes were taken, with prior consent of the authors, from the study carried out by Bian et al. (2017). To select the photographs corresponding to the rest of the personal attributes, a previous study was carried out, in order to homogenize the level of physical attractiveness of the men and women that appeared in the photographs, so that this characteristic did not bias the participants' responses. To do this, 16 photos of men, 16 of women, 16 of boys and 16 of girls were located in a databases of free-use photographs. All subjects were approximately the same age, appeared in the photograph only in

portrait format (mainly the face and some of the upper body) and were smiling. The photos were included in a questionnaire applied through the Google Form tool to 55 adults, who were asked to rate the level of physical attractiveness of each person from 1 to 4. Of the 64 photographs included in the previous study, 32 were selected for this study: 8 photographs of men, 8 of women, 8 of boys and 8 of girls. The selected photographs were matched (men with women on the one hand, and boys with girls on the other) considering the means of each person's level of attractiveness. These photographs were added to the previous 16, so a total of 48 photographs distributed in 12 tests were finally used (6 with adult photos and 6 with children photos). The 48 cards with photographs had dimensions of 9×6 cm. For each attribute, 4 cards were presented (for the adult attributes version, 2 photographs of men and 2 photographs of women; for the children attributes version, 2 photographs of boys and 2 of girls). With this task, three different scores were calculated:

Male roles attributed to men measured the degree of stereotyping of male attributes. To calculate the corresponding score, each time a participant chose the photograph that corresponded to the stereotype, it was scored with a 1. For example, if a characteristic stereotypically attributed to men, such as aggressive, was being assessed, and the participant attributed that feature to the photo of a man or a boy, it was assigned a score of 1 in that test. Subsequently, a proportion of the biased responses on the total male attributes, which ranged from 0 to 1, was calculated in order to compare the scores obtained in all tasks on the same scale.

Female roles attributed to women measured the degree of stereotyping of female attributes. For its calculation, a criterion similar to that previously mentioned was followed, but in this case in relation to female attributes.

Stereotyped roles attributed to men and women measured the degree of global stereotyping with respect to gender, applied to men and women as a whole. In this case, the score was also calculated proportionally at a value of 0 to 1, which summarizes the degree to which the participants apply the gender scheme when assigning attributes associated with masculinity and femininity.

Task 2: Professional Roles

Task 2 is adapted from the professional role attribution instrument included in the work of Liben and Bigler (2002f). The task was to show an image related to a profession and ask who should carry out that profession, giving the option of answering "only women," "only men," or "both." The selected professions considered in this study represented four typically masculine jobs (police, ship captain, scientist, and computer specialist), four typically feminine (nurse, cashier, florist, and hairdresser) and two neutral (artist and baker). To support the application of this task, 10 rectangular cards were used, measuring 10×11 cm. Each card contained a representative drawing of the professions with objects associated with them (for example, a bouquet of flowers for the florist profession). Three rectangular cards, 18×14.5 cm, were also used which served as visual support for the three response options. For each profession, the participants were asked who they thought should do each job, giving them the option to answer "only women" (card with a woman's silhouette),

"only men" (card with a man's silhouette), or "both" (card with the silhouette of a man and a woman together). Information on the following variables was obtained with the administration of this task.

Male professions attributed to men measured the degree of stereotyping of masculinized professions (police, ship captain, scientist and computer specialist).

Female professions attributed to women measured the degree of stereotyping of feminized professions (nurse, cashier, florist and hairdresser).

Stereotyped professions attributed to men and women measured the degree of global stereotyping regarding gender in the professional domain, applied to men and women as a whole. In this case, the score was also calculated proportionally at a value of 0 to 1, which summarizes the degree to which the participants apply gender schemes when giving their opinion about who should perform different types of strongly stereotyped professions.

To codify these variables, the criteria proposed by the creators of the measure (4) were followed. The scores were obtained by calculating the proportion of stereotyped responses in each case. That is, the proportional number of responses in which the items of male professions were assigned to the category "men only" was considered, as well as the proportion of items of female professions assigned to "women only," obtaining final scores of 0 to 1. Higher values in these variables indicate greater gender stereotyping.

To complement the results of the stereotyped responses observed in this task, several measures that represent the degree of flexibility when applying gender schemes to professions were also calculated following Liben and Bigler (2002f). Higher values indicate greater flexibility in the profession's field regarding gender roles. Thus, proportional scores (with values from 0 to 1) were recalculated for three specific areas:

Flexibility male professions measured the degree of flexibility of typically male professions. For the response to be considered flexible, the subject had to choose the option "both men and women" in the specific items.

Flexibility female professions measured the degree of flexibility with respect to professions considered "feminine." As in the previous variable, in order for the response to be considered an indicator of flexibility, the subject had to choose the option of "both men and women" with respect to professions considered typically feminine.

Global flexibility measured the combined degree of flexibility, both for typically male and typically female professions.

Procedure

The participants performed the tasks in classrooms of their school that met the necessary conditions of space, silence, and luminosity to conduct the interviews and outside of their usual school hours. In the task related to personal attributes, the application procedure was similar to the one applied in the original study by Bian et al. (2017).

For each attribute, a story was told in which the protagonist stood out because of this specific attribute. Subsequently, the subject was asked to select, from four options, the photograph of

the person who he/she considered that could be the protagonist of that situation. When the tests were conducted in Spanish, gender neutral terms were used, such as: “a person,” or “someone” avoiding biasing the answers with the questions asked. For example, one of the stories explains: “*In the place where I work there are many people. But there is one particular person who is different. That person is very, very vain. This person looks constantly in the mirror and worries about whether their hair and clothes look good. This person is quite vain. Who do you think, out of these 4 people, is the vain person from the story?*”. Four different photos were then placed on the table for each attribute (2 men and 2 women in the adult version/2 boys and 2 girls in the children’s version). When the participants pointed to one of the photos, the response was recorded, and the next story began. This continued in the same way until all the attributes of the adult version were completed, and then all those corresponding to the children’s version. In both versions, the traits evaluated were the same, using stories adapted for adulthood and childhood, in the same order of presentation. In each test the four photographs were presented randomly for each participant and for each attribute. The possibility of selecting the “don’t know” option was offered when the participant could not decide between the different people, although this response was only sporadically used by 5 of the participants in regard to some specific attribute. These cases have been coded as “lost cases” for those specific attributes.

Regarding the procedure for applying task 2, the same procedure proposed by Liben and Bigler (2002f) was applied, accompanied by the visual support cards. Before presenting the professions, the three cards with the silhouettes of men and women were placed on the table, placing the card that indicated that “both” could carry out each of the professions in the center, and the other two randomly to the right and to the left of the participants. In this case, participants were explained that they would be presented with different cards with drawings related to different professions. The task was to decide if they considered that this profession should be carried out only by men, only by women, or by both, by placing the card of each profession on the table space occupied by the silhouettes already described. The order of appearance of the cards was as follows: nurse, police, cashier, artist, ship captain, florist, scientist, baker, hairdresser, computer specialist, interspersing typically male, female and neutral professions randomly. For example, for the hairdressing profession, a card with an image of a comb and scissors was shown and the following was said: “*Who do you think should be the person who cuts your hair when you go to the hairdresser? Is it a profession that only men should do, only women, or that both should?*” In each test, the order of presentation of “men only” and “women only” in the instructions was varied, so that the order of presentation of the response options did not bias the results.

RESULTS

Descriptive Statistics of Measures

Table 1 presents the proportion of tests in which the participants assigned both male and female attributes to the two types of

targets, including in all cases the photos of adults and those of children as a whole. As can be seen, the attributes considered as masculine were associated more frequently with men than with women, this difference being significant [$t(145) = 7.07, p = 0.00$]. On the other hand, the attributes considered feminine were attributed more to women than to men [$t(144) = 4.51, p = 0.00$]. Considering the attribution of stereotyped responses globally in this task (Stereotyped attributes – total score), the value obtained in this variable indicates that biased attributes were assigned to the target gender in more than 60% of the tests.

To test whether there was a greater stereotyping of male or female roles, the t -test was applied for related samples, confirming that there were no significant differences in both types of stereotyping ($p = 0.16$), although the mean was slightly higher for the stereotyping of masculine attributes.

The data therefore confirmed the biased assignment of personal attributes to unknown people, both adults and children. In terms of the specific individual attributes, the smart attribute was the most skewed attribute in its assignment, being mostly associated with men ($M = 0.70$) versus women ($M = 0.30$) [$t(146) = 6.88, p = 0.00$]. Aggression was also preferentially assigned to male targets ($M = 0.62$) versus female targets ($M = 0.38$) [$t(146) = 3.75, p = 0.00$]. Regarding the attributes considered feminine, being vain was the attribute most frequently associated with women ($M = 0.73$) versus men ($M = 0.27$) [$t(146) = -7.95, p = 0.00$]. However, being kind was assigned to men and women to the same extent ($M = 0.51$ and 0.49 , respectively).

Table 2 summarizes the scores regarding the assignment of professions to men, women, or both. As can be seen, the average

TABLE 1 | Proportion of masculine/feminine attributes assigned to male/female targets in Task 1.

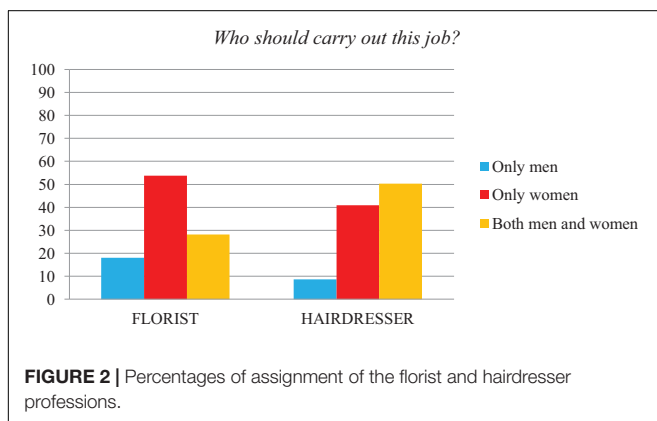
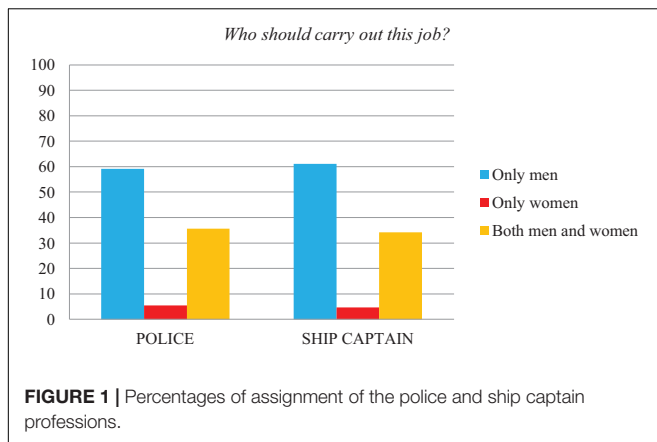
		<i>M (SD)</i>
Masculine attributes	<i>Male targets</i>	0.66 (0.28)
	<i>Female targets</i>	0.34 (0.28)
Feminine attributes	<i>Male targets</i>	0.39 (0.29)
	<i>Female targets</i>	0.61 (0.29)
Stereotyped attributes (total score)		0.63 (0.19)

Minimum score = 0; maximum score = 1.

TABLE 2 | Proportion of masculine/feminine professions assigned to male/female targets and flexibility scores in Task 2.

		<i>M (SD)</i>
Masculine professions	<i>Only men</i>	0.51 (0.30)
	<i>Only women</i>	0.09 (0.16)
Feminine professions	<i>Only men</i>	0.12 (0.18)
	<i>Only women</i>	0.38 (0.27)
Stereotyped professions (total score)		0.45 (0.25)
Flexibility for masculine professions		0.40 (0.30)
Flexibility for feminine professions		0.50 (0.29)
Flexibility (total score)		0.45 (0.25)

Minimum score = 0; maximum = 1.



of the responses that indicated that stereotyped jobs should be carried out by both sexes reached a high value ($M = 0.45$), with it being the most frequent type of response. This score indicates a remarkable flexibility in the professional area.

Analyzing only the responses regarding male professions, these were assigned to a much greater extent only to men than to women [$t(148) = 14.21, p = 0.00$]. For their part, professions considered feminine tended to be considered as something that only women should do in many more cases than something that only men should do [$t(148) = -8.53, p = 0.00$]. In order to verify if there was a greater application of gender schemes in the domain of male or female professions, the t -test was applied for related samples, observing significant differences between the average for male professions assigned to men and the average for female professions assigned to women [$t(148) = 5.42, p = 0.00$]. This result is confirmed by comparing flexibility measures for male and female professions, with less flexible responses for male professions than for female professions [$t(148) = -4.12, p = 0.00$].

Diving in to a more precise analysis of the specific professions included in this study, the most biased professions that can be observed in the case of the male gender (see **Figure 1**) were those of police (59.1% of the participants thought that “only men” should exercise this profession) and ship captain (61.1% of restrictive responses for men). On the other hand, the professions most linked to women (see **Figure 2**) were those of florist (53.7% of stereotyped responses) and hairdresser (40.9%).

Gender Differences

Table 3 shows the information related to gender differences in all the variables of interest. To simplify the analysis of the results and given that the attribute scores assigned to masculine targets and feminine targets in each case are complementary, only the stereotyped attributes of each personal attribute are presented. The results indicate that boys stereotype more male attributes by assigning them more to boys than girls [$t(129.07) = 3.63, p = 0.00$]. On the other hand, girls seem to internalize the attributes associated with femininity more intensely than boys [$t(143) = -3.77, p = 0.00$]. Furthermore, the total score regarding stereotyped attributes (which includes male and female attributes assigned in a manner consistent with gender schemes) does not show differences in either group ($p = 0.68$).

Regarding professions, boys and girls stereotype traditionally masculine professions to the same extent ($p = 0.65$). In the case of the attribution of female professions assigned only to women, this is a more common response among girls than among boys, although the differences only reached a level close to statistical significance ($p = 0.09$). Flexibility when assigning stereotyped professions, does not differ between boys and girls when analyzed together ($p = 0.78$), nor when masculine or feminine professions are analyzed separately ($p = 0.93$ and $p = 0.57$, respectively).

Age Group Differences

Table 4 shows the results for the three age groups. The results of the ANOVA, applied to compare the statistics of the three groups, are also included in the table, in addition to the corresponding *post hoc* test when significant age differences were found. As can be seen in the table, significant differences appear in the stereotyped assignment of male attributes to men. Specifically, the internalization of these schemes seems to increase with age, being only the differences between the youngest and oldest group significant. Regarding the other two scores related to personal attributes, there are no significant differences between the three age groups, the attribution of female roles to women and the total stereotyping score of personality attributes being stable. The univariate analysis does not yield significant interactions between gender and age group for any of the variables related to Task 1.

Regarding the assignment of male professions to men, there are no significant differences between the different age groups.

TABLE 3 | Descriptive statistics for boys and girls.

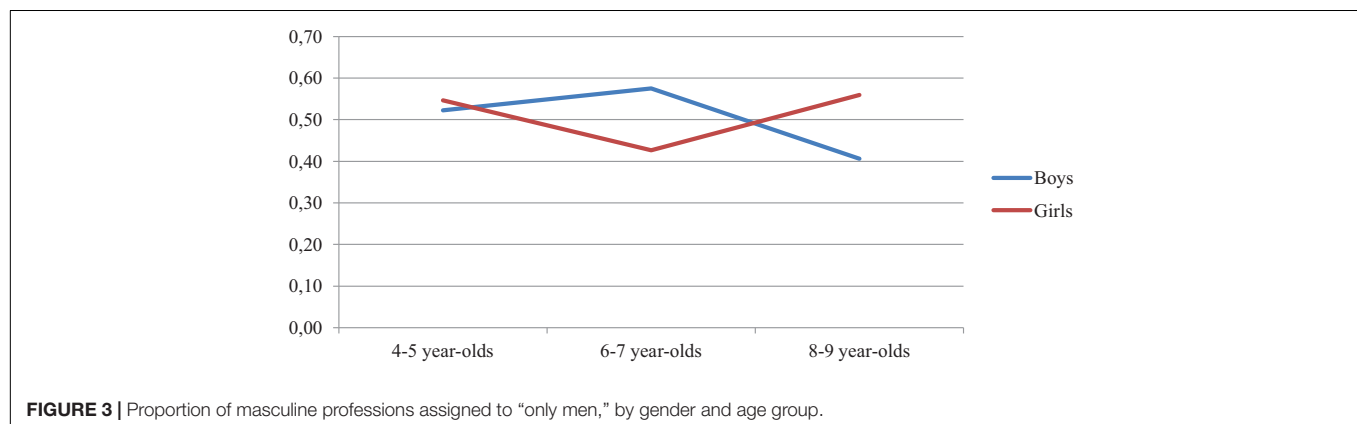
	<i>M (SD)</i>	
	Boys (<i>n</i> = 78)	Girls (<i>n</i> = 71)
Masculine attributes assigned to male targets	0.74 (0.24)	0.58 (0.30)
Feminine attributes assigned to female targets	0.53 (0.29)	0.70 (0.28)
Stereotyped attributes (total score)	0.63 (0.17)	0.64 (0.20)
Masculine professions assigned to “only men”	0.53 (0.32)	0.50 (0.27)
Feminine professions assigned to “only women”	0.34 (0.29)	0.42 (0.25)
Flexibility for masculine professions	0.40 (0.32)	0.40 (0.27)
Flexibility for feminine professions	0.51 (0.30)	0.49 (0.26)
Flexibility (total score)	0.45 (0.27)	0.44 (0.22)

Minimum score = 0, maximum = 1.

TABLE 4 | Descriptive statistics for the three age-groups.

	ANOVA						
	<i>M (SD)</i>			<i>F</i>	<i>DF</i>	<i>p-Value</i>	<i>Games-Howell</i>
	Group A 4- and 5-year-olds (<i>n</i> = 49)	Group B 6- and 7-year-olds (<i>n</i> = 67)	Group C 8- and 9-year-olds (<i>n</i> = 33)				
Masculine attributes assigned to male targets	0.59 (0.32)	0.65 (0.26)	0.78 (0.18)	5.07	2,143	0.007	C > A** C > B**
Feminine attributes assigned to female targets	0.61 (0.32)	0.61 (0.30)	0.60 (0.25)	0.007	2,142	0.993	–
Stereotyped attributes (total score)	0.60 (0.19)	0.63 (0.19)	0.69 (0.16)	2.41	2,141	0.093	–
Masculine professions assigned to “only men”	0.54 (0.29)	0.51 (0.31)	0.48 (0.29)	0.287		0.287	–
Feminine professions assigned to “only women”	0.46 (0.25)	0.37 (0.27)	0.26 (0.25)	6.20	2,146	0.003	C < A**
Flexibility for masculine professions	0.31 (0.26)	0.42 (0.31)	0.49 (0.29)	4.39	2,146	0.014	C > A*
Flexibility for feminine professions	0.37 (0.24)	0.54 (0.29)	0.62 (0.28)	9.84	2,146	0.000	C > A*** B > A**
Flexibility (total score)	0.34 (0.19)	0.48 (0.25)	0.56 (0.26)	9.37	2,146	0.000	C > A*** B > A**

Minimum score = 0, maximum = 1; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

**FIGURE 3 |** Proportion of masculine professions assigned to “only men,” by gender and age group.

A univariate analysis of variance, including age and gender subgroups, was performed to analyze the possible interaction between these two variables. The results of this test show significant differences in this variable for the interaction between gender and age group [$F(2,148) = 3.089$, $p < 0.05$], observing that stereotypes regarding male professions increase with age in girls, but decreases among boys (see **Figure 3**).

Regarding the allocation of female professions only to women, there is a gradual reduction in this type of response as the participants' age progresses. However, the corresponding *post hoc* test indicates that the differences between groups turn out to be significant only between the youngest and the in-between children, on the one hand, compared to the oldest. The univariate analysis again indicates that there is a significant interaction between the gender and the course of the participants age in relation to this score [$F(2,148) = 3.069$, $p = 0.05$]. As can be seen in **Figure 4**, the girls' scores hardly vary with age, while the boys' scores fall drastically in the group of the oldest children, with the percentage of boys of these ages who consider that these professions should be carried out only by women being very small.

Regarding the scores related to the flexibility in the professions task, the results of the ANOVA showed significant differences between the age groups in the global flexibility score, in line with the other variables obtained from this task [$F(2,148) = 9.377$, $p = 0.00$]. An increase in flexibility is observed as the age of the participants increases (especially among boys). The differences are significant both for the scores regarding the flexibility of typically male professions [$F(2,148) = 4.397$, $p < 0.05$], and for typically female professions [$F(2,148) = 9.841$, $p = 0.00$]. *Post hoc* tests indicate, as can be seen in the table, that the differences between the age groups were significant between the youngest and the oldest (flexibility for male professions) and between the youngest and the other two groups (flexibility for female professions).

Correlational Results

A correlational analysis of all the scores calculated in Tasks 1 and 2 was performed. The results indicate that, in general, there is only a significant correlation between the measures: positive relationship between the variables Masculine professions assigned to “only men” and Feminine professions assigned to “only women” ($r = 0.39$, $p = 0.00$). This result shows that

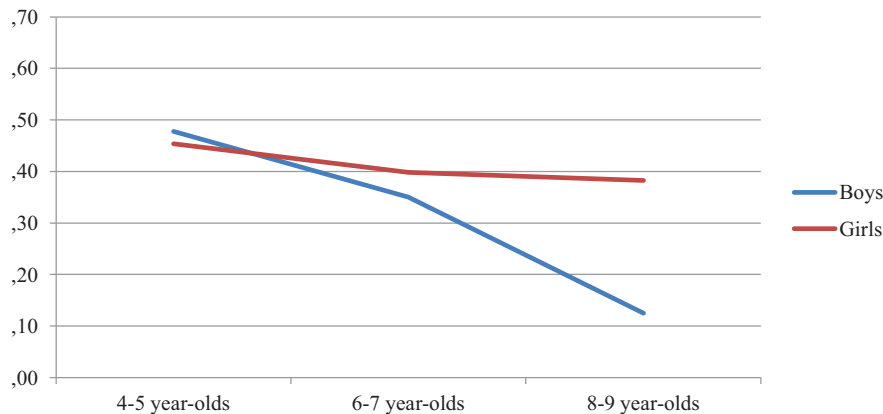


FIGURE 4 | Proportion of feminine professions assigned to “only women,” by gender and age group.

participants who stereotype the professions considered more typically male tend to do the same for professions usually considered female. For the rest of the scores, there is no significant relationship between the variables, which reveals that these are independent variables when all participants are considered as a group.

When the sample is divided into different groups and the sociodemographic variables (gender and age group) considered in this study are included in the analysis, interesting results appear in the specific correlations of the different subgroups. Thus, the correlation between the stereotyping of male and female professions turns out to be significant again in the boys' and girls' groups, considering them separately, but more intense among boys ($r = 0.461$, $p = 0.00$) than among girls ($r = 0.311$, $p = 0.008$).

On the other hand, dividing the sample into the three age groups that have participated in the study, no significant correlations are found between any of the measures included in the study for the youngest group. For the in-between group, the relationship between the variable Masculine professions assigned to “only men” and Feminine professions assigned to “only women” once again reaches an important value ($r = 0.430$, $p = 0.00$), with correlation values increasing between the oldest group ($r = 0.501$, $p = 0.003$).

Moreover, in the group of older participants, significant relationships are observed among other variables. Thus, the participants who stereotype the supposedly masculine personal attributes are also the ones that stereotype the male professions most rigidly ($r = 0.378$, $p < 0.05$) and therefore show lower levels of flexibility in this type of tasks ($r = -0.360$, $p < 0.05$). This relationship is not observed for the relationship between personal attributes associated with femininity and the responses of participants in the field of feminized professions.

DISCUSSION

The results confirmed that the children between 4 and 9 years of age who took part in our study have generally internalized gender

schemes, which they clearly make use of when assigning personal attributes or professional roles. However, these general results have slight variations and different developmental trajectories between the boy and girl groups, as well as in the relationship to masculinity and femininity, following the line of multiple previous studies carried out in this area (Levy and Sadovsky, 2000; Liben and Bigler, 2002b; Jackson, 2007; Miller et al., 2009; Wilbourn and Kee, 2010; Halim et al., 2017). As it will be thoroughly described above, most of the findings of the present study are similar to the ones obtained in previous researches with children in another countries, although the heterogeneity of measures makes difficult in some cases to obtain clear conclusions about the generalization of them.

Stereotyping of Personal Attributes

As recent previous studies have shown (Liben and Bigler, 2002b; Siyanova-Chanturia et al., 2012, 2015), boys tend to produce biased responses more frequently when assigning male traits, while girls tend to issue stereotyped responses more frequently for female traits. This indicates that boys and girls pay more attention to the traits associated with their own group. They internalize them earlier and incorporate them as more rigid schemes when it comes to creating expectations regarding unknown people. Given that the construction of this scheme occurs in parallel to gender identity development, it is more efficient for girls, from an adaptive point of view, to pay attention to what society expects of them because they are women. This acquisition allows them to incorporate these expectations into their own identity, in the same way that happens to boys. Incorporating specific gender roles at such early ages (for example, associating aggressiveness with masculinity and lower intelligence to women), in parallel to the development of gender identity, is something that can have obvious implications for children as it adds constraints to their development at such an early stage (Bem, 1981; Brinkman et al., 2014; Kurtz-Costes et al., 2014).

Moreover, the biased responses in the assignment of personal attributes were more frequent for male attributes, although the difference does not have a sufficient level of significance.

However, previous research done in this area confirms that gender roles are generally more rigid for men than for women, so we can confirm that this greater lack of flexibility associated with masculinity is already perceived and internalized by our participants in the first years of life (Wilbourn and Kee, 2010; Siyanova-Chanturia et al., 2012). Nevertheless, it must be noted that other studies have found the opposite result (Halim et al., 2014; Baker et al., 2016).

The fact that in a very high proportion of the tests (almost three quarters of them) intelligence was assigned to boys has undeniable consequences for the development of girls, as described in other previous studies with similar results (Bian et al., 2017). If girls perceive that very intelligent people are usually men, they will tend to apply that association to their own self-concept and will project expectations aligned with this association which reinforces their low presence in STEM careers, as well as a worse self-perception of personal skills to face general problems, because intelligence is a necessary attribute for all areas of life. Data obtained in multiple studies indicate that these types of expectations often function as a self-fulfilling prophecy, especially in situations in which girls feel that they are being evaluated, which reduces their performance in objective evaluation tests (Jussim et al., 1996; Neuburger et al., 2012; Plante et al., 2013). The educational and environmental interventions that are carried out to reduce the gender gap in the vocational and professional aspirations of children and young people should undoubtedly use this information to design effective strategies from an early age which draw on a thorough analysis of their expectations and dismantle this type of bias that is so limiting for women's aspirations.

It should also be noted that an important part of the responses indicate that aggressiveness is also a trait strongly associated with masculinity, as found in previous studies (Baker et al., 2016). This seems to confirm that children perceive, from a very young age, that men tend to be more aggressive than women, a characteristic that can undoubtedly be found at the root of phenomena such as gender violence. Although in this study the participants have been asked to generate expectations about the presented targets (appropriation of culturally shared roles) and have not explicitly been asked whether these types of behaviors are adequate, the data show that from an early age children perceive this behavior as an attribute more associated with normative masculinity, with the implications that this has for the socio-emotional development of both groups. Boys seem to assume early on that aggressiveness is more frequent among their peers and male adults, while girls also perceive that difference, which they may find inevitable. It is convenient to consider this perception when designing strategies to prevent gender violence and any form of sexual abuse, taking away the normality surrounding this issue and teaching children that it is a cultural aspect that can be avoided. The educational objective in these cases will be to provide boys with alternative strategies to manage conflicts and to promote in all children a critical analysis of media messages that often idealize violence associated with masculinity compared to other forms of solving non-violent problems, such as negotiation or cooperation.

Regarding women, they seem to be perceived by the participants as much more concerned about their physical appearance than men. If girls internalize early on that women naturally care a lot about their image, they are more likely to feel insecure with their physical appearance and develop a more negative body image by comparing how they look with prevailing beauty canons. This aspect is at the base of various mental health problems such as eating disorders, much more frequent among women than among men (Baker et al., 2016). In this regard, learning environments should foster a more polyhedral image of women, cultivating the development of skills that are not focused on physical appearance and taking importance away from their looks. Contexts that stimulate the development of skills and competencies in all areas and foster a body experience based on enjoyment and personal acceptance (for example, through participation in sports or physical activities) will foster a positive experience and care of the body that goes beyond the socially established beauty canon.

Stereotyping of Professional Roles

Regarding the application of gender schemes to the analyzed professions, it should be noted that an important part of the participants considered that the professions presented should be carried out interchangeably by men and women (Liben and Bigler, 2002d). This result seems to be related to the multidimensionality of the development of gender schemes (Liben and Bigler, 2002b,e), noting that the application of these schemes may vary depending on the domain in which they are applied, and the type of response options presented.

However, the data show the application of a non-negligible amount of traditional gender stereotypes when assigning professions. As in the task of personal attributes, there is a greater stereotyping of the male professions than of the female professions, again confirming the appearance of a gender asymmetry (Wilbourn and Kee, 2010; Siyanova-Chanturia et al., 2015). Consistently, the responses that indicated greater flexibility ("both men and women can carry out this profession") were more frequent for professions associated with women than for those associated with men. The professional field seems to be, as the personal one, more rigid with respect to masculine-related schemes than with those associated with traditional feminine schemes. Thus, the more traditionally masculinized professions were more frequently "banned" for women than womanized professions were for men (for example, almost 60% of the participants considered that the police profession should be carried out only by men).

On the other hand, although the participants also applied gender biases when analyzing female professions (for example, more than half of the responses reported that the florist profession should be carried out only by women), the girls were slightly more rigid than boys when considering such professions. The tendency to perceive and internalize to a greater extent the roles attributed to one's own group seems to be confirmed in the professional sphere only for girls, but not for boys. In short, all (boys and girls) know and moderately internalize gender schemes for male professions. However, girls seem to acquire the

professional biases associated with their own sex more strongly (Baker et al., 2016).

It is interesting to note that a very important part of the participants considered that the profession of police or ship captain should only be carried out by men. This shows that although there are currently frequent contra-stereotypical examples in the workplace, there are still professional areas that are generally associated with men (Cohen and Hilgeman, 2006), in which, for children in this age range, women do not seem to have a place. The exposure of more contra-stereotypical models seems necessary when presenting examples that destroy these rigid schemes (Olsson and Martiny, 2018), since in these two professions it is certainly less frequent to find women. If early on children look at different examples of people who carry out a number of different jobs in society, regardless of their sex, they will internalize a greater flexibility as something natural that gradually destroys the horizontal gap that persists in the workplace.

It should be considered here that, as found in previous studies (Vervecken and Hannover, 2015), the professions with greater social prestige are those that are most associated with men, compared to those who receive less salary and have less status, in which case the answers are frequently more flexible. In this sense, the contexts surrounding the child (whether immediate, such as school or family, or virtual ones such as television or internet) must make an effort to destroy this rigid stereotyping of schemes when considering a specific profession such as typical of men or women. The choice of a job must be associated with the personal interests and real abilities of each person, without limiting the professional expectations of children and affecting their vocational choices on the basis of sex.

Gender Schemes Development

Regarding the pattern observed in the development of gender schemes, the results show relevant developmental differences in some of the measures analyzed, but not all, following the results of previous studies (Liben and Bigler, 2002b; Martin and Ruble, 2004; Trautner et al., 2005; Bennett and Sani, 2006; Halim, 2016; Halim et al., 2017). Although traditional gender schemes appear to be incorporated in the youngest group (both for male and female attributes), their application of expectations regarding unknown people increases significantly with age for male roles, while in the case of women it remains stable. This indicates that the asymmetry observed with respect to male and female schemes would not yet be present at 4 and 5 years of age. However, already at 8 and 9 years of age the masculine scheme (associated with intelligence and aggressiveness) seems to be more incorporated than the feminine scheme.

The data indicate that, as of the age of 8, children have already perceived the asymmetry regarding the gender mandates previously mentioned (greater social pressure regarding the characteristics associated with masculinity), internalizing and making their own stricter schemes for the masculine attributes than those associated with women. This greater appropriation of male roles is undoubtedly related to greater exposure and salience of more strongly stereotyped male models, present in multiple learning environments. Currently, very different models

of women are shown in the media and in general in public life in a normalized manner, with women presenting traditionally more masculine characteristics such as assertiveness or leadership. However, male models remain very stereotyped and their roles have not become more flexible as has been the case with women. In this line, it seems important to work at the school and family level on an educational approach that promotes alternative masculine schemes that break the constrictions of traditional masculinity (Renold, 2004), and allow boys to identify from the first years of life with men who care for others, are affective or are dedicated to feminized professions (Swain, 2005).

With respect to professional roles, general developmental differences tend to increase the flexibility of responses (greater proportion of choices in the response “both can carry out that profession”), in line with previous research (Bigler, 1995; Banse et al., 2010) that associates the decrease in biases to the increase of cognitive abilities. However, certain differences appear in developmental trajectories when considering boys and girls separately. Thus, it is observed that stereotypes regarding male professions remain stable among girls, while they decrease slightly among boys. In the case of the assignment of female professions to women, there is also a decrease in gender stereotypes as the child’s development progresses, becoming in general the most flexible participants in this type of study. However, the developmental differences are observed to be manifested mostly among boys, stereotyping these professions with less intensity as their age increases, without observing this decrease among girls.

This would imply that, in general, older boys are more flexible in the understanding of typically male or female professions than girls, which will undoubtedly have a negative impact on girls in their future vocational and professional choices. As they get older, children seem to broaden their perceptions of their possible professional expectations. However, this greater flexibility in the workplace does not seem to have been incorporated to the same extent by girls aged 8–9, especially with regard to professions traditionally considered “male.” Assuming that cognitive development is at the base of the flexibility of gender roles in general, it is worth asking why, if this development is present in equal measure in both sexes, girls have more difficulty than their male counterpart to make gender schemes more flexible in terms of the professional world. This greater constriction of the professional area among the older female participants (associating to a greater extent certain jobs with men and women), compared to their male classmates, can be found at the base of the gender gap observed in the workplace, along with other social factors that seem to limit women’s career opportunities.

As stated in previous studies (Vervecken and Hannover, 2015), the development of vocational interests is forged in the primary education stage, so we must pay special attention to the messages that are sent from all learning environments in this regard. Furthermore, as previously mentioned, counter-stereotypical models must be offered (Olsson and Martiny, 2018) to teach children from an early age that what one dedicates their life to must be related to what one likes to do and what one does well. In this regard, it should not be forgotten that what

children project as a possible profession is also influenced by the perceptions of accessibility to these jobs (status and difficulty), as well as by their own beliefs of self-efficacy (Vervecken and Hannover, 2015). In the case of the participants in this study, this perception of self-efficacy is undoubtedly diminished because, as we have seen, intelligence is associated with men in a very biased way.

Relationship Between Variables

Regarding the relationships observed between the variables in this study, the complexity and multidimensionality of gender schemes are determined, as well as their differential application to different areas of life (Liben and Bigler, 2002d; Banse et al., 2010) and the existence of differences regarding the masculine and feminine schemes, in line with previous studies (Wilbourn and Kee, 2010; Siyanova-Chanturia et al., 2015). The correlational analysis shows a near absence of significant correlations between the measures included in the study, although the stereotyping processes analyzed are supposedly based on the common application of an underlying gender scheme (Bem, 1981, 1983; Weisgram, 2016). The only two measures that seem to correlate in a positive but moderate way when considering all the participants at a general scale are the assignment of male professions to men and female professions to women. This indicates that the participants (especially the boys) who most believe that police officers or captains should only be men, also tend to think that florists and hairdressers should always be women. However, a similar relationship is not observed in the field of personal characteristics, as one would expect if we were faced with a monolithic scheme that is applied with the same intensity to different areas. In short, gender schemes seem to be gradually incorporated into children's development and with different intensity depending on the specific scheme that is activated (male or female), as well as their area of application, as indicated by other studies in this area (Liben and Bigler, 2002e).

Furthermore, when the relationships between variables in the different age groups were analyzed, none of the variables considered were found to be significantly related among the children. This data indicates that in these ages the gender scheme is still forming and turns out to be quite inconsistent. From this moment on, the data indicate a greater coherence between the responses, probably caused by a gradual incorporation of environmental knowledge and experiences that feed the information that is socially associated with the labels of men and women. In the group of the 6- and 7-year-old participants there is already a greater consistency among gender schemes in the professional field, which continues to increase in the group of the older participants. At 8 and 9 years of age it seems that there is already a greater consistency in the gender scheme when applied to the two areas analyzed (personal attributes and professions), but only with respect to male attributes and professions, not with respect to women.

Ultimately, these data indicate that although gender schemes are already present at the age of 4, as children grow up, they seem to be enriching these gender schemes more consistently and coherently for different domains and with regard to the man/woman dichotomy. The masculine scheme (and all that

it implies regarding personal attributes and professions) seems to be more compact in these ages than the feminine scheme which seems to be more flexible and diverse. As previously mentioned (Bigler, 1995; Halim, 2016), the more advanced cognitive development that characterizes the older ages seems to promote less rigid gender schemes for femininity in all areas, but not for masculinity. In addition, the beneficial effect of cognitive development in making these schemes more flexible seems to be more efficient among boys than among girls. At this point it is important to remember that more flexible gender schemes will promote a development that is more free in terms of how to be and what professions to carry out (Trautner et al., 2005; Banse et al., 2010), promoting a better quality of life and a more adequate future physical and mental health.

Environmental Influences in the Construction of Gender Schemes

Based on all these findings, a series of measures can be implemented in learning contexts to promote a freer and more flexible society with respect to the identity categories of men and women are proposed below. As Bem states with his theory (Bem, 1981, 1983), the fact that a social category becomes the core of a cognitive scheme is not inevitable but rather depends on the nature of the social contexts in which this category is immersed. Social categories tend to become relevant schemes if society constantly associates a specific label with different attributes, behaviors, professions, etc. In addition, the gender category becomes a relevant variable for children when different social institutions, norms and taboos are built upon it.

Learning environments that separate boys from girls (for example, segregated schools) or, on a broader level, societies that are not equal, will promote more gender schematic children than those in which being a man or woman is merely another personal characteristic, among many others. As Bem (1983) states, when a culture insists (with explicit and implicit messages) that a social category is very important at a functional level, the passive associations that children have been able to build between that category and certain human traits becomes an active scheme that is available when interpreting the reality that surrounds them. Children will apply this scheme as far as they find it helpful to predict the world around them. This author states that children will show less sex typed behaviors if, from all educational contexts, an effort is made to avoid associations that reinforce the prevailing gender scheme. For example, distributing tasks traditionally associated with one or the other should be avoided, or presenting models of biased occupations, as is often the case in textbooks. Learning environments should also promote alternative categorization schemes, in which individual differences between people stand out above intergroup differences (emphasizing variability within a group and things that are shared between people from different groups).

Furthermore, Bem (1983) argues that it does not seem enough to ignore the prevailing sexist messages in part of society, but that the school and the family should promote a critical analysis of them. This analysis should help children understand that gender roles depend on socialization and culture and have little

to do with the biological differences of men and women. With this in mind, it seems necessary to discuss the origin of gender inequalities with children, reflecting on their social and historical roots and the reasons why they still endure even though societies seem more egalitarian at the formal level.

In a similar vein, the Developmental Intergroup Theory (Bigler and Liben, 2007) states that certain environmental characteristics can promote the development of more rigid stereotypes associated with a category. This occurs, for example, when perceptual discrimination between groups is exaggerated in certain environments. In this line, educational contexts where boys and girls dress differently (for example with different school uniforms), or perceptual cues, such as earrings, used to distinguish boys from girls at birth, should be avoided.

According to these authors, contexts in which attention is drawn to creating groups, labeling them or using routines in which group membership is explicitly used as the basis for school activities also produce more rigid biases. Along these lines, schools should avoid championships in which the gender category is applied to divide the groups or using children's sex to organize the activities they practice, the classroom or the educational center. School segregation also increases the salience of this category, so it would be detrimental when promoting more egalitarian attitudes because it fosters a more dichotomous and prescriptive worldview. In addition, according to Allport's contact theory (Allport, 1954), prejudices are reduced when people belonging to different groups meet and interact to achieve common goals. In this sense, segregated schools would be inhibiting children from establishing contacts with people "from the other group," thus preventing the discovery of the large number of things that they probably have in common and the benefits of dealing with human diversity.

All these precautions should be especially considered when children's cognitive abilities are still very limited (mainly in regard to classification skills) (Bigler, 1995). In this sense, the interaction of the cognitive limitations of the first years of life with very segregated contexts (in which the salience of the gender variable is very important) can lead to the development of rigid and very limiting stereotypes that already begin to determine the choices of children, their preferences or their expectations about themselves and others in these early ages. Although in later stages cognitive skills increase, the early construction of rigid schemes in the first years of life can determine different paths that involve, for example, the choice of different types of toys, the personal attributes that they will develop to adapt to social expectations, or even the type of activities they will practice and in which they will acquire higher levels of competence. Although, throughout childhood, growing cognitive skills allow children to build less rigid schemes, early environmental experiences and the limited cognitive abilities of these ages can cause very divergent initial developments that can later be difficult to reverse.

Regarding schools, although formal educational systems are trying to be more equal every day at a theoretical or legislative level, data shows that even today the leisure environments are still very differentiated for boys and girls, both in terms of the use of space and the type of objects and activities offered (Pomerleau et al., 1990). In this regard, it is appropriate to pay attention to this

aspect and ensure that school environments respect an equitable and cooperative use of space, promoting activities that are not gender biased and providing toys and materials that promote active play and children's sense of agency for both boys and girls, while also working on activities related to mutual care and cooperation between both groups.

In addition, within learning environments, there are also a number of important influences that are not so direct which have to do with the presentation of gender roles and sexist stereotypes in the media, children's literature or toys (Wille et al., 2018). In recent years, we have also found a powerful environmental influence regarding the information that children and young people absorb from an early age through social networks and the Internet (Murnen et al., 2016). This environmental influence includes for example, the role of youtubers, or social networks such as Instagram or Facebook, that configure different worlds for the boys and girls who approach them, both with respect to the models they transmit and with respect to the information they include (advertising, topics covered, models of masculinity and femininity, etc.) (Plakoyiannaki et al., 2008).

In short, if we want to educate today's children to be more equal and have more freedom to choose how they want to be, without the constraints associated with traditional gender roles, we must apply a comprehensive perspective that promotes the application of the gender mainstreaming approach to all institutions that educate in today's society (Hussain et al., 2015), beyond schools. Society educates children and laws should promote family, social, educational and media-oriented policies from this cross-cutting approach that promote the reduction of sexist attitudes and individual freedom to each develop as a person, regardless of sex or identity. In this sense, all learning environments should work together to promote more egalitarian messages that do not perpetuate traditional schemes, which can be so harmful and limiting.

Limitations and Future Works

Regarding the limitations of this study, reference should be made to the fact that different measures have been used for the two types of domains that were analyzed (personal and professional), an aspect that may have influenced the low observed relationship between the different variables. In the first task regarding personal attributes, participants were asked to choose a man or a woman as the protagonist of the story, without giving the option to answer that both could be intelligent or kind. However, in the task of assigning professions the option of responding that "both should carry out that profession" was offered. It should be explained here that the very nature of the tasks required a different response format. Thus, the first task required "forcing" the assignment of the attribute to one of the two types of targets, since the formulation of the questions forces the child to opt for a person in question. If the option "can be anyone" were given, the task would lose its meaning. In any case, in general, the participants did not have problems to assign the attributes quickly when they were told the stories, and only 5 participants sporadically responded with "do not know - do not answer." In addition, in the task of assigning professions it made more sense to provide a third intermediate option, since a work expectation

is not being applied (who do you think is the police or the hairdresser, in which case it would be more logical to apply a dichotomous response scheme like in the previous task), but a more attitudinal response (who do you think should do that job). In any case, the flexibility that the task of professions brings could also be indirectly reflected in the subjects' responses to the different attributes that are presented in the task, although it is not a proper response option in each test.

Furthermore, we cannot ignore that the task regarding professional stereotypes is more explicit and probably because of this it is easier for the answers to be more biased by social desirability, which can promote flexible responses. The characteristics of the task of assigning personal characteristics (forcing an answer and presenting the question implicitly) give rise to a greater projection of the schemes present in the cognitive system of children, without being aware that they are being explicitly asked about this topic.

In the face of future studies, designing measures that are more comparable to each other should be explored, allowing the collection of similar data on the different domains to which gender schemes apply, as previous studies suggest (Liben and Bigler, 2002b). In addition, it would be interesting to include measures related to the development of gender identity in these studies, as numerous studies indicate that the acquisition of these schemes is carried out in parallel and the development of the self-concept seems to play a fundamental role in this process (Martin and Ruble, 2004; Tobin et al., 2010). Ideally, replication studies should be conducted in the future with bigger samples, including higher and more balanced number of participants in each age group in order to safeguard the confidence in the developmental findings and the generalization of the results. In future research it would also be interesting to include a greater variety in regard to the type of participants, including people with diverse backgrounds and environments (for example, children of families with different socioeconomic backgrounds or parents with different type of professions, as well as students from mixed schools versus segregated schools). Those correlational studies might be helpful to improve our knowledge on the influence of environmental variables on acquisition and development of gender schemes. In this line, from an experimental approach, it would be interesting to apply intervention models that modify some of the aspects

of the environment previously mentioned (for example, the presence of women in textbooks, or the development of more inclusive schoolyards) to be able to observe the effect of these environmental modifications on the formation of gender stereotypes.

Finally, it seems necessary to cover a broader range of children's ages in this type of study, given that the results observed in the group of the oldest children continue to show a wide presence of gender biases in the two analyzed areas (especially in terms of personal attributes and in the case of the masculine scheme), although the cognitive abilities of children in these ages already allow them to move toward more flexible schemes.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

IS-C, SV-M, and PH-H have equally participated in all the tasks carried out to conclude this research and the paper itself: search of references, design of the material, data collection, data analysis, and writing of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00609/full#supplementary-material>

REFERENCES

- Allport, G. V. (1954). *The Nature of Prejudice*. Cambridge, MA: Addison-Wesley.
- Aubrey, J. S., and Harrison, K. (2004). The gender-role content of children's favorite television programs and its links to their gender-related perceptions. *Media Psychol.* 6, 111–146. doi: 10.1207/s1532785xmep0602_1
- Baker, E. R., Tisak, M. S., and Tisak, J. (2016). What can boys and girls do? Preschoolers' perspectives regarding gender roles across domains of behavior. *Soc. Psychol. Educ.* 19, 23–39. doi: 10.1007/s11218-015-9320-z
- Banise, R., Gawronski, B., Rebetez, C., Gutt, H., and Bruce Morton, J. (2010). The development of spontaneous gender stereotyping in childhood: relations to stereotype knowledge and stereotype flexibility. *Dev. Sci.* 13, 298–306. doi: 10.1111/j.1467-7687.2009.00880.x
- Basow, S. (2004). "The hidden curriculum: gender in the classroom," in *Praeger Guide to the Psychology of Gender*, ed. M. A. Paludi (Westport, CT: Praeger Publishers/Greenwood Publishing Group), 117–131.
- Beaman, R., Wheldall, K., and Kemp, C. (2006). Differential teacher attention to boys and girls in the classroom. *Educ. Rev.* 58, 339–366. doi: 10.1080/00131910600748406
- Bem, S. L. (1974). The measurement of psychological androgyny. *J. Consult. Clin. Psychol.* 42, 155–162. doi: 10.1037/h0036215
- Bem, S. L. (1981). Gender schema theory: a cognitive account of sex typing. *Psychol. Rev.* 88, 354–364. doi: 10.1037/0033-295X.88.4.354
- Bem, S. L. (1983). Gender schema theory and its implications for child development: Raising gender-aschematic children in a gender-schematic society. *Signs: J. Women Cult. Soc.* 8, 598–616. doi: 10.1086/493998

- Bennett, M., and Sani, F. (2006). Contextual variation in stereotype content: an investigation of children's central tendency and group variability judgements. *Soc. Dev.* 15, 692–708. doi: 10.1111/j.1467-9507.2006.00365.x
- Bian, L., Leslie, S. J., and Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science (New York, N.Y.)* 355, 389–391. doi: 10.1126/science.aah6524
- Bigler, R. S. (1995). The role of classification skill in moderating environmental influences on Children's gender stereotyping: a study of the functional use of gender in the classroom. *Child Dev.* 66, 1072–1087. doi: 10.1111/j.1467-8624.1995.tb00923.x
- Bigler, R. S., and Liben, L. S. (2007). Developmental intergroup theory. *Curr. Direct. Psychol. Sci.* 16, 162–166. doi: 10.1111/j.1467-8721.2007.00496.x
- Børve, H. E., and Børve, E. (2017). Rooms with gender: physical environment and play culture in kindergarten. *Early Child Dev. Care* 187, 1069–1081. doi: 10.1080/03004430.2016.1223072
- Brinkman, B. G., Rabenstein, K. L., Rosén, L. A., and Zimmerman, T. S. (2014). Children's gender identity development: the dynamic negotiation process between conformity and authenticity. *Youth Soc.* 46, 835–852. doi: 10.1177/0044118X12455025
- Bronfenbrenner, U. (1994). "Ecological models of human development," in *International Encyclopedia of Education*, eds I. T. Husen and T. N. Postlethwaite (Oxford: Pergamon Press/Elsevier Science), 1643–1647.
- Buss, D. M. (1995). Psychological sex differences: origins through sexual selection. *Am. Psychol.* 50, 164–168. doi: 10.1037/0003-066X.50.3.164
- Carli, L. L., and Bukatko, D. (2000). "Gender, communication, and social influence: a developmental perspective," in *The Developmental Social Psychology of Gender*, eds T. Eckes and H. M. Trautner (Mahwah, NJ: Lawrence Erlbaum Associates Publishers), 295–331.
- Clark, S., and Paechter, C. (2007). 'Why can't girls play football?' Gender dynamics and the playground. *Sport Educ. Soc.* 12, 261–276. doi: 10.1080/13573320701464085
- Cohen, P. N., and Hilgeman, C. (2006). Occupational ghettos: the worldwide segregation of women and men. *Contem. Sociol.* 35, 247–249. doi: 10.1177/009430610603500313
- Colás Bravo, P., and Villaciervos Moreno, P. (2007). La interiorización de los estereotipos de género en jóvenes y adolescentes. *Rev. Investig. Edu.* 25, 35–38.
- Döring, N., and Mohseni, M. R. (2019). Male dominance and sexism on YouTube: results of three content analyses. *Femin. Media Stud.* 19, 512–524. doi: 10.1080/14680777.2018.1467945
- Eccles, J. S., Freedman-Doan, C., Frome, P., Jacobs, J., and Yoon, K. S. (2000). "Gender-role socialization in the family: a longitudinal approach," in *The Developmental Social Psychology of Gender*, eds T. Eckes and H. M. Trautner (Mahwah, NJ: Lawrence Erlbaum Associates Publishers), 333–360.
- Endendijk, J. J., Groeneveld, M. G., and Mesman, J. (2018). The gendered family process model: an integrative framework of gender in the family. *Arch. Sex. Behav.* 47, 877–904. doi: 10.1007/s10508-018-1185-8
- Ferrer-Pérez, V. A., and Bosch-Fiol, E. (2014). The measure of the masculinity-femininity construct today: some reflections on the case of the bem sex role inventory. *Int. J. Psychol.* 29, 180–207. doi: 10.1080/02134748.2013.878569
- Halim, M. L., Ruble, D. N., and Tamis-LeMonda, C. S. (2013). Four-year-olds' beliefs about how others regard males and females. *Br. J. Dev. Psychol.* 31, 128–135. doi: 10.1111/j.2044-835X.2012.02084.x
- Halim, M. L., Ruble, D. N., Tamis-LeMonda, C. S., Zosuls, K. M., Lurye, L. E., and Greulich, F. K. (2014). Pink frilly dresses and the avoidance of all things "girly": children's appearance rigidity and cognitive theories of gender development. *Dev. Psychol.* 50, 1091–1101. doi: 10.1037/a0034906
- Halim, M. L. D. (2016). Princesses and superheroes: social-cognitive influences on early gender rigidity. *Child Dev. Perspect.* 10, 155–160. doi: 10.1111/cdep.12176
- Halim, M. L. D., Ruble, D. N., Tamis-LeMonda, C. S., Shrout, P. E., and Amodio, D. M. (2017). Gender attitudes in early childhood: behavioral consequences and cognitive antecedents. *Child Dev.* 88, 882–899. doi: 10.1111/cdev.12642
- Hussain, M., Naz, A., Khan, W., Daraz, U., and Khan, Q. (2015). Gender stereotyping in family: an institutionalized and normative mechanism in pakhtun society of Pakistan. *SAGE Open* 5, 1–11. doi: 10.1177/2158244015595258
- Iervolino, A. C., Hines, M., Golombok, S. E., Rust, J., and Plomin, R. (2005). Genetic and environmental influences on sex-typed behavior during the preschool years. *Child Dev.* 76, 826–840. doi: 10.1111/j.1467-8624.2005.00880.x
- Jackson, S. (2007). "She might not have the right tools and he does": children's sense-making of gender, work and abilities in early school readers. *Gender Educ.* 19, 61–77. doi: 10.1080/09540250601087769
- Jussim, L., Eccles, J., and Madon, S. (1996). Social perception, social stereotypes, and teacher expectations: accuracy and the quest for the powerful self-fulfilling prophecy. *Adv. Exp. Soc. Psychol.* 28, 281–388. doi: 10.1016/s0065-2601(08)60240-3
- Knafo, A., and Spinath, F. M. (2011). Genetic and environmental influences on girls' and boys' gender-typed and gender-neutral values. *Dev. Psychol.* 47, 726–731. doi: 10.1037/a0021910
- Kollmayer, M., Schober, B., and Spiel, C. (2018). Gender stereotypes in education: development, consequences, and interventions. *Eur. J. Dev. Psychol.* 15, 361–377. doi: 10.1080/17405629.2016.1193483
- Kurtz-Costes, B., Copping, K. E., Rowley, S. J., and Kinlaw, C. R. (2014). Gender and age differences in awareness and endorsement of gender stereotypes about academic abilities. *Eur. J. Dev. Psychol.* 29, 603–618. doi: 10.1007/s10212-014-0216-7
- Levy, G. D., and Sadovsky, A. L. (2000). Aspects of YOUNG Children's perceptions of gender-typed occupations. *Sex Roles* 42, 993–994.
- Liben, L. S., and Bigler, R. S. (2002a). I. Introduction. *Monogr. Soc. Res. Child Dev.* 67, 1–6.
- Liben, L. S., and Bigler, R. S. (2002b). II. Review of past work. *Monogr. Soc. Res. Child Dev.* 67, 7–21. doi: 10.1111/1540-5834.00189
- Liben, L. S., and Bigler, R. S. (2002c). III. Gender constructivism reconsidered. *Monogr. Soc. Res. Child Dev.* 67, 22–39. doi: 10.1111/1540-5834.t01-1-00190
- Liben, L. S., and Bigler, R. S. (2002d). IV. Empirical data related to scale development. *Monogr. Soc. Res. Child Dev.* 67, 40–75. doi: 10.1111/1540-5834.t01-1-00191
- Liben, L. S., and Bigler, R. S. (2002e). VI. General discussion. *Monogr. Soc. Res. Child Dev.* 6, 96–104. doi: 10.1111/j.1744-7348.1920.tb06482.x
- Liben, L. S., and Bigler, R. S. (2002f). Appendix C: test administration versions of short coat and oat scales. *Monogr. Soc. Res. Child Dev.* 67, 122–133. doi: 10.1111/1540-5834.t01-1-00197
- López-Sáez, M., Morales, J. F., and Lisbona, A. (2008). Evolution of gender stereotypes in Spain: traits and roles. *Span. J. Psychol.* 11, 609–617. doi: 10.1017/S1138741600004613
- Lyttleton-Smith, J. (2019). Objects of conflict: (re) configuring early childhood experiences of gender in the preschool classroom. *Gender Educ.* 31, 655–672. doi: 10.1080/09540253.2017.1332343
- Martin, C. L., and Ruble, D. (2004). Children's search for gender cues: cognitive perspectives on gender development. *Curr. Direct. Psychol. Sci.* 13, 67–70. doi: 10.1111/j.0963-7214.2004.00276.x
- Mayor, E. (2015). Gender roles and traits in stress and health. *Front. Psychol.* 6:779. doi: 10.3389/fpsyg.2015.00779
- McCarthy, K. J., Mehta, R., and Haberland, N. A. (2018). Gender, power, and violence: a systematic review of measures and their association with male perpetration of IPV. *PLoS ONE* 13:e0207091. doi: 10.1371/journal.pone.0207091
- Miller, C. F., Lurye, L. E., Zosuls, K. M., and Ruble, D. N. (2009). Accessibility of gender stereotype domains: developmental and gender differences in children. *Sex Roles* 60, 870–881. doi: 10.1007/s11199-009-9584-x
- Murnen, S. K., Greenfield, C., Younger, A., and Boyd, H. (2016). Boys act and girls appear: a content analysis of gender stereotypes associated with characters in children's popular culture. *Sex Roles* 74, 78–91. doi: 10.1007/s11199-015-0558-x
- Neuburger, S., Jansen, P., Heil, M., and Quaiser-Pohl, C. (2012). A threat in the classroom: Gender stereotype activation and mental-rotation performance in elementary-school children. *Z. Psychol.* 220, 61–69. doi: 10.1027/2151-2604/a000097
- OECD (2020). "Do boys and girls have similar attitudes towards competition and failure?," *PISA in Focus*, No. 105. Paris: OECD Publishing. doi: 10.1787/a8898906-en
- Olsson, M., and Martiny, S. E. (2018). Does exposure to counterstereotypical role models influence girls' and women's gender stereotypes and career choices? A review of social psychological research. *Front. Psychol.* 9:2264. doi: 10.3389/fpsyg.2018.02264
- Patterson, M. M. (2012). Self-perceived gender typicality, gender-typed attributes, and gender stereotype endorsement in elementary-school-aged

- children. *Sex Roles* 67, 422–434. doi: 10.1007/s11199-012-0184-9
- Paul Halpern, H., and Perry-Jenkins, M. (2016). Parents' gender ideology and gendered behavior as predictors of children's gender-role attitudes: a longitudinal exploration. *Sex Roles* 74, 527–542. doi: 10.1007/s11199-015-0539-0
- Plakoyiannaki, E., Mathioudaki, K., Dimitratos, P., and Zotos, Y. (2008). Images of women in online advertisements of global products: does sexism exist? *J. Bus. Ethics* 83, 101–112. doi: 10.1007/s10551-007-9651-6
- Plante, I., De la Sablonnière, R., Aronson, J. M., and Théorêt, M. (2013). Gender stereotype endorsement and achievement-related outcomes: the role of competence beliefs and task values. *Contem. Educ. Psychol.* 38, 225–235. doi: 10.1016/j.cedpsych.2013.03.004
- Pomerleau, A., Bolduc, D., Malcuit, G., and Cossette, L. (1990). Pink or blue: environmental gender stereotypes in the first two years of life. *Sex Roles* 22, 359–367. doi: 10.1007/BF00288339
- Poulin-Dubois, D., Serbin, L. A., Eichstedt, J. A., Sen, M. G., and Beissel, C. F. (2002). Men don't put on make-up: toddlers' knowledge of the gender stereotyping of household activities. *Soc. Dev.* 11, 166–181. doi: 10.1111/1467-9507.00193
- Renold, E. (2004). "Other" boys: negotiating non-hegemonic masculinities in the primary school. *Gender Educ.* 16, 247–266. doi: 10.1080/09540250310001690609
- Rollero, C., Gattino, S., and De Piccoli, N. (2014). A gender lens on quality of life: the role of sense of community, perceived social support, self-reported health and income. *Soc. Indic. Res.* 116, 887–898. doi: 10.1007/s11205-013-0316-9
- Ruble, D. N., Taylor, L. J., Cyphers, L., Greulich, F. K., Lurye, L. E., and Shrout, P. E. (2007). The role of gender constancy in early gender development. *Child Dev.* 78, 1121–1136. doi: 10.1111/j.1467-8624.2007.01056.x
- Shen-Miller, D. S., Olson, D., and Boling, T. (2011). Masculinity in nontraditional occupations: ecological constructions. *Am. J. Men's Health* 5, 18–29. doi: 10.1177/1557988309358443
- Shilling, C. (1991). Social space, gender inequalities and educational differentiation. *Br. J. Sociol. Educ.* 12, 23–44. doi: 10.1080/0142569910120102
- Siyanova-Chanturia, A., Pesciarelli, F., and Cacciari, C. (2012). The electrophysiological underpinnings of processing gender stereotypes in language. *PLoS ONE* 7:e48712. doi: 10.1371/journal.pone.0048712
- Siyanova-Chanturia, A., Warren, P., Pesciarelli, F., and Cacciari, C. (2015). Gender stereotypes across the ages: on-line processing in school-age children, young and older adults. *Front. Psychol.* 6:1388. doi: 10.3389/fpsyg.2015.01388
- Swain, J. (2005). *Handbook of Studies on Men and Masculinities*. Thousand Oaks: SAGE Publications, Inc. doi: 10.4135/9781452233833
- Tobin, D. D., Menon, M., Menon, M., Spatta, B. C., Hodges, E. V. E., and Perry, D. G. (2010). The intrapsychics of gender: a model of self-socialization. *Psychol. Rev.* 117, 601–622. doi: 10.1037/a0018936
- Trautner, H. M., Ruble, D. N., Cyphers, L., Kirsten, B., Behrendt, R., and Hartmann, P. (2005). Rigidity and flexibility of gender stereotypes in childhood: developmental or differential? *Infant Child Dev.* 14, 365–381. doi: 10.1002/icd.399
- Vervecken, D., and Hannover, B. (2015). Yes I can! Effects of gender fair job descriptions on children's perceptions of job status, job difficulty, and vocational self-efficacy. *Soc. Psychol.* 46, 76–92. doi: 10.1027/1864-9335/a000229
- Weisgram, E. S. (2016). The cognitive construction of gender stereotypes: evidence for the dual pathways model of gender differentiation. *Sex Roles* 75, 301–313. doi: 10.1007/s11199-016-0624-z
- Wilbourn, M. P., and Kee, D. W. (2010). Henry the nurse is a doctor too: implicitly examining children's gender stereotypes for male and female occupational roles. *Sex Roles* 62, 670–683. doi: 10.1007/s11199-010-9773-7
- Wille, E., Gaspard, H., Trautwein, U., Oschatz, K., Scheiter, K., and Nagengast, B. (2018). Gender stereotypes in a children's television program: effects on girls' and boys' stereotype endorsement, math performance, motivational dispositions, and attitudes. *Front. Psychol.* 9:2435. doi: 10.3389/fpsyg.2018.02435
- Witt, S. D. (2000). The influence of peers on Children's socialization to gender roles. *Early Child Dev. Care* 162, 1–7. doi: 10.1080/0300443001620101
- Wong, W. I., Shi, S. Y., and Chen, Z. (2018). Students from single-sex schools are more gender-salient and more anxious in mixed-gender situations: results from high school and college samples. *PLoS ONE* 13:e0208707. doi: 10.1371/journal.pone.0208707
- World Health Organization [WHO] (2002). *Gender and Mental Health: What do We Know?* Available online at: <http://apps.who.int/iris/bitstream/10665/68884/1/a85573.pdf>.

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Natural Environment and Social Relationship in the Development of Attentional Network

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The attention mechanism is related to both voluntary and automatic processes, that may be summarized in three distinct networks: alert, orientation, and inhibitory control. These networks can be modulated by different contextual and relational situations. Aim of this review is to explain how a combination of natural and social stimuli can positively affect the attentional processes. It has been proposed that the exposition to natural environment can positively affect direct attention, a common resource supporting both executive functioning and self-regulation processes in cognition. It has been suggested that the decrease of the effort required to voluntary control attention from the bottom upwards could determine some internal reflection that may support creative thinking secondarily to a simultaneous reduction in the effort required to orient attention between thoughts and impressions. In my view, not only exposition to natural and green environment improves attentional processes but also the involvement in social relationship. The development of the orientation and inhibitory control networks is sensitive to the social nature of the stimuli, for instance, in a task, including socially relevant stimuli the efficiency of these two attentional networks increases in children, in adults and in elderly subjects. Social attention, starting very early in the life (joint attention) is a very important mechanism for the regulation of social relationships. A key for a better development of cognitive functions such as attentional processes is the promotion of the immersion in the natural environment and the involvement in social relationship.

Keywords: natural environment, attentional network development, social attention, stress, social relationships

DEVELOPMENT AND MODULATION OF ATTENTIONAL PROCESSES

One of the most qualified theories on attention with solid experimental support (e.g., Posner and Rothbart, 2007) is the Attention Network Theory (Posner and Petersen, 1990) that considers the attention processes divided into three anatomically and functionally different networks: alert, orientation, and executive conflict. The alert system is an automatic process responsible for maintaining the activation state allowing the rapid identification of environmental unexpected stimuli; the orientation system is responsible of the voluntary direction of attention toward a stimulus of interest; finally, the executive conflict is involved in solving challenging actions in tasks where conflicts are presents. The alerting system has a high performance in the requiring attention tasks, it seems to be developed at an premature age since infants show an improved capability to

preserve the alert state during the first year of life (Rueda et al., 2005). The orienting response seems to be related to a diffuse neural network, involving the frontal eye fields (Wardak et al., 2006), the superior parietal lobe and temporal-parietal junction (Fuentes and Campoy, 2008), the superior colliculus, and the pulvinar nucleus of the thalamus (Shipp, 2004).

These three distinct networks have a different development *t* and also their interaction changes from childhood to adulthood (Mullane et al., 2016).

For example, when the alerting system is assessed by matching reaction times to targets with and without visual warning cues, 5-year-old subjects exhibited a more evident reduced alerting effects than 7-year-old children (Mezzacappa, 2004); 10-year-old children showed better alerting effects than adults (Rueda et al., 2004a), suggesting that children have higher difficulties than adults in preserving an alert state over time (Curtindale et al., 2007) without any exogenous cues.

The improvement of the orienting network has been very much investigated by cognitive (e.g., Akhtar and Enns, 1989; Enns and Brodeur, 1989; Schul et al., 2003; Leclercq and Sieroff, 2013) and clinical researches (e.g., Huang-Pollock and Nigg, 2003; Alvarez and Freides, 2004). Orienting oneself toward the source of information is the first operation to be done and it is necessary before moving on to other cognitively more complex operations (Wainwright and Bryson, 2002).

In consequence, this ability should be earlier developed and it is present in a more simplified form since the age of 4–6 months (Colombo, 2001). Exogenous orienting, that is stable across all the lifespan, is well developed by the age of 6 years (Plude et al., 1994).

Executive attention, that seems to be present in a very simple way in 6–7 months old infants, (Berger et al., 2006; Sheese et al., 2008) is further developed during middle and late childhood (e.g., Band et al., 2000). Rueda et al. (2004a,b) found an evident improvement of executive attention between 3 and 7 years of age. Although much of this development is under genetic control, it is also likely that the home and school environment and some specific training can influence it, as reported for other cognitive networks (Shafritz et al., 2004; Rueda et al., 2005).

THE DIFFERENT CONTEXTUAL ENVIRONMENT CAN DIFFERENTIALLY AFFECT ATTENTIONAL PROCESSES: THE URBAN ENVIRONMENT VERSUS THE NATURAL ENVIRONMENT

Attentional processes are on the basis of extraction from the environment several characteristics useful to target activities. Different contexts may elicit crucial different patterns of attention selection. Since this is an active cognitive process, the attentional process, and in particular voluntary attention, has a very high individual costs. The attention restoration theory (ART), proposed by Kaplan in 1989 and more recently receiving attention in many articles, hypothesized that natural contexts are able to renew attention after exerting mental energy. ART

suggests that the natural context provides the opportunity to avoid everyday stresses, experiences distensible spaces and contexts (“extent”), take part in activities that are “compatible” with our intrinsic motivations, and seriously faces stimuli that are “softly fascinating” (Kaplan, 1995; Ohly et al., 2016). This arrangement of elements stimulate “involuntary” or “indirect attention” and allows our “voluntary” or “directed” attention space to repair and renew (Kaplan, 1995). A recent review by Stenfors et al. (2019), conducted on different samples of students, showed that the natural environment provided several cognitive benefits on executive cognitive tasks with high implication on directed attention processes. Cognitive performance significantly improves after to be immersed in a green country environment. Studies with typically developed adults (Lee, 2015; Veit et al., 2018), and children (Wells, 2000; Davdand et al., 2015; Schutte et al., 2017) or atypical developed subjects (Kuo and Taylor, 2004) showed a positive role of natural environments on cognition and a stress reduction after the immersion in a natural environment.

Assignment and circumstances demanding that subjects deliberately direct attention or inhibit unwanted stimuli, thoughts, or impulses utilize a shared mechanism leading to fatigue (Kaplan, 1995). After prolonged or intense use of this mechanism, fatigue is established, and an amplified difficulty to pay attention and to inhibit impulses are revealed. These findings also explain the behavior and performance of individuals without ADHD who temporarily show many of the ADHD patterns.

The ADHD symptoms and “attention fatigue” are so similar that the Attention Deficit Disorders Evaluation Scale has been used also to evaluate attention fatigue (Wells, 2000). However, differently from ADHD, attention fatigue has been measured as a transitory situation; when the deliberate attention mechanism has the occasion to rest, fatigue vanishes and behavior and performance improve (Kuo and Taylor, 2004). According to Kaplan, natural environments help in the rehabilitation from attention fatigue, partially because they effortlessly enroll the mind, (Ulrich, 1981) giving a breathing space from having to voluntarily direct attention. Thus, the sense of wellness commonly experienced after spending time in a natural settings may in part reflect a systematic restorative effect on directed attention. Even a short visits in a green environment shows a positive effect on perceived stress release compared to built-up environment (Tyrvaäinen et al., 2014). Previous studies have reported the associations between the presence of a green space near home and significant lower stress levels (Gidlof-Gunnarsson and Ohrstrom, 2007). Even if the exact mechanism explaining how the natural environment can reduce the stress level is still unclear, it has been documented that the natural environment safeguards the negative impact of stressors (e.g., Brown et al., 2013) and decreases recovery time following exposure to a stressor (van den Berg et al., 2014).

In addition, an increase of gray matter volume in the left and right prefrontal cortex and in the left premotor cortex and an increase of white matter volume in the right prefrontal region, in the left premotor region, and in both cerebellar hemispheres has been reported in subjects exposed to a natural environment (Davdand et al., 2015). Some of these regions partly overlapped with regions related to cognitive test scores (prefrontal cortex

and cerebellar and premotor white matter) and peak volumes in these regions predict higher working memory performance and decreased inattentiveness. Schutte et al. (2017) reported a positive effect of walking in natural versus walking on urban environments on attentional performance only in school-aged children but not in kindergarten-aged children. These results probably were linked to the important changes occurred in higher cognitive functions that in part reflect changes in brain structure after the age of 5 (Dennis and Thompson, 2013).

Following the numerous and now proven brain changes occurring during childhood and adolescence, with an increase in brain plasticity and therefore in the brain system's vulnerability, the environment may play an important role in the social and cognitive development.

The effect of environment on brain activity and associated moods has been described by Ulrich (1981), who found increased alpha waves and less subjective emotional stress among participant exposed to the vision of slides of nature.

The Urban fragmentation and the reduction of urban green spaces are one of the cause of the decrease of wellness in the present time since green spaces have been reported to reduce stress and increase well-being (Tzoulas et al., 2007; Berto, 2014; Hartig et al., 2014).

Hedblom et al. (2019) describe that habitat incorporating multisensory stimuli of green areas (forest and park), are able to mitigate physiological stress induction and promote a more ready stress decrease in comparison to an habitat without green areas (i.e., urban areas).

THE IMPORTANCE OF SOCIAL STIMULI IN ATTENTIONAL FUNCTIONS DURING DEVELOPMENT

The ability to control social information influencing attention is important for the child's adaptive development. Among the social signals, the faces are the most important source of social

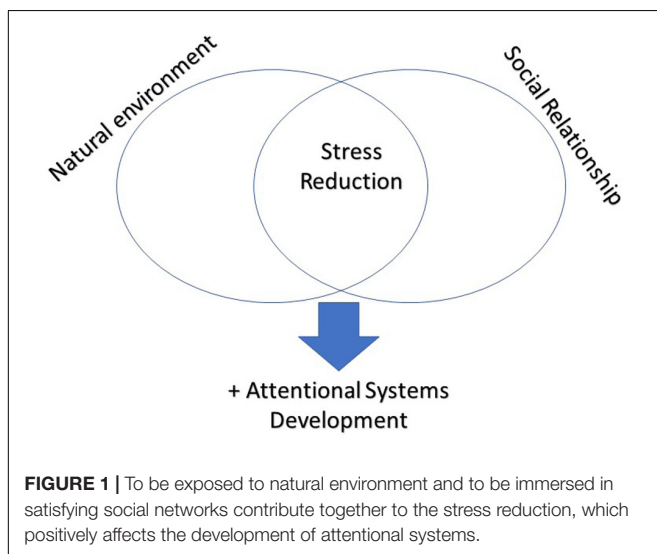
information and the control of the gaze could have a fundamental role in the development of socialization. The direction of the gaze provides a very strong signal that could be used to learn information about the internal states of other people. The peculiarity of the faces used as stimuli for the development of attention systems has been demonstrated in many studies using different methods. Frischen et al. (2007) investigated the meaning of perception of the gaze and its impact on other people, also investigating the shifting behavior of gaze direction and its influence on other persons and on joint attention in children, adults and in the clinical population. The authors focused on the paradigm of signaling the gaze direction, used to investigate the mechanism of joint attention. The contribution of this paradigm is significant and can bring advances in knowledge in different fields of psychology and neuroscience. The eyes and the surrounding region are highly expressive and can communicate complex mental states such as emotions, beliefs, and desires.

The authors focused on the aspect of gaze perception, the use of gaze direction to shift visual attention, the automatic propensity to direct attention to an object that other people are also observing.

Shared attention has been investigated in children for decades. Cognitive control is mediated by the suppression of interferences between different competing responses and is evaluated through experimental paradigms using attentional tasks such as the flanker task (Eriksen and Eriksen, 1974).

In a study of our group (Federico et al., 2013) comparing a social variant of the Attention Network Test (ANT) with schematic and real faces, with an ANT with fish-shaped stimuli in a sample of adults, we shown that the photographs of the faces positively influenced executive control in a significant way with respect to the performance of ANT participants with targets in the shape of fish or schematic faces. This evidence suggests that the participants engaged in a more effective cognitive control process during exposure to relevant social stimuli, demonstrating that people automatically focus more attention on real central faces, excluding the faces flanking the target, and achieving speed response time. This advantage was not observed for non-socially relevant stimuli. An advantage in the orienting system using social stimuli was observed also in children. We also (Federico et al., 2017) tested 5–10 years-olds children from 5 to 10 in the same three versions of the task demonstrating a larger cognitive interference (i.e., slower RTs and a higher percentage of errors to incongruent relative to congruent conditions) when fish and schematic faces were presented, compared to photographs of real faces stimuli. These issues advice that, similarly to adults, children have a higher control of social information as compared to non-social information. This is in line with several recent studies using different methods describing a higher interference effects from non-social than from eye-gaze stimuli (Barnes et al., 2007; Dichter and Belger, 2007; Kuhn and Tatler, 2011).

Many data suggested that social features are preferred over competing for physically salient objects when viewing complex naturalistic scenes (Birmingham et al., 2009; End and Gamer, 2017; Flechsenhar and Gamer, 2017; Rosier et al., 2017). In particular, End and Gamer (2017) assumed that social features in complex naturalistic scenes would be primary processed,



regardless of their physical saliency. They shown that social attention and physical saliency collaborate in predicting the very first fixations during scene processing. More specifically, they reported that the preferred processing of social features in complex naturalistic scenes does not only depend on a voluntary controlled mechanism but reflects the influence of a reflexive and automatic process trading off physical saliency by the presence of social features on very early fixations. Another important aspect is the finding that social relationships may be a stress reduction facilitator factor. Social support has been widely studied as a factor that minimizes the effects on stress, and the results are somewhat striking. Sherman and colleagues demonstrated that social support is protective against depressive symptoms. In the aging brain social support was positively associated with right medial prefrontal cortical thickness whereas amygdala volume was negatively correlated with social support and positively linked to stress (Sherman et al., 2016): the authors suggested that social support was straightly related with brain circuitry that has been involved in psychological well-being. These results move ahead the understanding of how supportive relationships are significantly linked to brain circuitry implicated in emotional and social processing. During childhood, early stressful events affects people's capacity to control, or regulate their emotions and the brain regions supporting these skills. For example, children with high stress appear to have more difficulties in containing negative emotions like anger or anxiety (Burkholder et al., 2016).

REFERENCES

- Akhtar, N., and Enns, J. T. (1989). Relations between covert orienting and filtering in the development of visual attention. *J. Exp. Child Psychol.* 48, 315–334. doi: 10.1016/0022-0965(89)90008-8
- Alvarez, J. A., and Freides, D. (2004). Research on attention deficit hyperactivity disorder using the covert orienting paradigm. *Dev. Neuropsychol.* 26, 627–645. doi: 10.1207/s15326942dn2602_6
- Band, G. P. H., Van Der Molen, M. W., Overtom, C. C. E., and Verbaten, M. N. (2000). The ability to activate and inhibit speeded responses: Separate developmental trends. *J. Exp. Child Psychol.* 75, 263–290. doi: 10.1006/jecp.1999.2538
- Barnes, K. A., Kaplan, L. A., and Vaidya, C. J. (2007). Developmental differences in cognitive control of socio-affective processing. *Dev. Neuropsychol.* 32, 787–807. doi: 10.1080/87565640701539576
- Berger, A., Tzur, G., and Posner, M. I. (2006). Infant brains detect arithmetic errors. *Proc. Natl. Acad. Sci. U.S.A.* 103, 12649–12653. doi: 10.1073/pnas.0605350103
- Berto, R. (2014). The role of nature in coping with psycho-physiological stress: a literature review on restorativeness. *Behav. Sci. (Basel)* 4, 394–409. doi: 10.3390/bs4040394
- Birmingham, E., Bischof, W. F., and Kingstone, A. (2009). Get real ! Resolving the debate about equivalent social stimuli. *Vis. Cogn.* 17, 904–924. doi: 10.1080/13506280902758044
- Brown, D. K., Barton, J. L., and Gladwell, V. F. (2013). Viewing nature scenes positively affects recovery of autonomic function following acute-mental stress. *Environ. Sci. Technol.* 47, 5562–5569. doi: 10.1021/es305019p
- Burkholder, A. R., Koss, K. J., Hostinar, C. E., Johnson, A. E., and Gunnar, M. R. (2016). Early life stress: effects on the regulation of anxiety expression in children and adolescent. *Soc. Dev. (Oxf. Engl.)* 25, 777–793. doi: 10.1111/sode.12170
- Colombo, J. (2001). The development of visual attention in infancy. *Ann. Rev. Psychol.* 52, 337–367. doi: 10.1146/annurev.psych.52.1.337
- Curtindale, L., Laurie-Rose, C., Bennett-Murphy, L., and Hull, S. (2007). Sensory modality, temperament and the development of sustained attention: a vigilance

CONCLUSION

Attentional control processes are multimodal and include the capacity to achieve and maintain a vigilance state (alerting system), the capacity to focus attention for a protracted period to specific, mainly, visuospatial stimuli (orienting system) as well as the capacity to inhibit challenging responses and regulate/monitor actions (executive component or conflict resolution system; Sperduti et al., 2016). Attentional processes dynamically interact with higher-order cognitive processes; therefore, the proper functioning of attention circuits is the basis of good general cognitive functioning. In particular, stress reduction is a determining factor for the optimal works of attention circuits.

In conclusion, as you can see in **Figure 1**, given the importance of stress reduction for the correct development of cognitive processes and in particular of attentional processes, promoting the immersion in a natural environment and the involvement on many social relationships could be the key to optimizing cognitive and attentional processes.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

- study in children and adults. *Dev. Psychol.* 43, 576–589. doi: 10.1037/0012-1649.43.3.576
- Dadvand, P., Nieuwenhuisen, M. J., Esnaola, M., Fornis, J., Basagana, X., Alvarez-Pedrerol, M., et al. (2015). Green spaces and cognitive development in primary schoolchildren. *Proc. Natl. Acad. Sci. U.S.A.* 112, 7937–7942. doi: 10.1073/pnas.1503402112
- Dennis, E. L., and Thompson, P. M. (2013). Typical and atypical brain development: a review of neuroimaging studies. *Dial. Clin. Neurosci.* 15, 359–384.
- Dichter, G. S., and Belger, A. (2007). Social stimuli interfere with cognitive control in autism. *Neuroimage* 35, 1219–1230. doi: 10.1016/j.neuroimage.2006.12.038
- End, A., and Gamer, M. (2017). Preferential processing of social features and their interplay with physical saliency in complex naturalistic scenes. *Front. Psychol.* 8:418.
- Enns, J. T., and Brodeur, D. A. (1989). A developmental study of covert orienting to peripheral visual cues. *J. Exp. Child Psychol.* 48, 171–189. doi: 10.1016/0022-0965(89)90001-5
- Eriksen, B. A., and Eriksen, C. W. (1974). Effects of noise letters on the identification of a target letter in a nonsearch task. *Percept. Psychophys.* 16, 143–149. doi: 10.3758/BF03203267
- Federico, F., Marotta, A., Adriani, T., Maccari, L., and Casagrande, M. (2013). Attention network test-The impact of social information on executive control, alerting and orienting. *Acta Psychol.* 143, 65–70. doi: 10.1016/j.actpsy.2013.02.006
- Federico, F., Marotta, A. M., Art Ell, A. D., and Casagrande, M. (2017). Development in attention functions and social processing: evidence from the attention network test. *Br. J. Dev. Psycho.* 35, 169–185. doi: 10.1111/bjdp.12154
- Flechsengar, A. F., and Gamer, M. (2017). Top-down influence on gaze patterns in the presence of social features. *PLoS One* 12:e0183799. doi: 10.1371/journal.pone.0183799
- Frischen, A., Bayliss, A., and Tipper, S. (2007). Gaze cueing of attention: visual attention, social cognition, and individual differences. *Psychol. Bull.* 133, 694–724. doi: 10.1037/0033-2909133.4.694

- Fuentes, L. J., and Campoy, G. (2008). The time course of alerting effect over orienting in the attention network test. *Exp. Brain Res. Mar.* 185, 667–672. doi: 10.1007/s00221-007-1193-8
- Gidlof-Gunnarsson, A., and Ohrstrom, E. (2007). Noise and well-being in urban residential environments: the potential role of perceived availability to nearby green areas. *Lands. Urban Plann.* 83, 115–126. doi: 10.1016/j.landurbplan.2007.03.003
- Hartig, T., Mitch, J. R., De Vries, S., and Frumkin, H. (2014). Nature and Health. *Annu. Rev. Pub. Health* 35, 207–228. doi: 10.1146/annurev-publhealth-032013-182443
- Hedblom, M., Gunnarsson, B., Lravani, B., Knez, I., Schaefer, M., Thorsson, P., et al. (2019). Reduction of physiological stress by urban green space in a multisensory virtual experiment. *Sci. Rep.* 9:10113. doi: 10.1038/s41598-019-46099-7
- Huang-Pollock, C. L., and Nigg, J. T. (2003). Searching for the attention deficit in attention deficit hyperactivity disorder: The case of visuospatial orienting. *Clin. Psychol. Rev.* 23, 801–830. doi: 10.1016/S0272-7358(03)00073-4
- Kaplan, S. (1995). The restorative benefits of nature: toward an integrative framework. *J. Environ. Psychol.* 15, 169–182. doi: 10.1016/0272-4944(95)90001-2
- Kuhn, G., and Tatler, B. W. (2011). Misdirected by the gap: the relationship between inattention blindness and attentional misdirection. *Conscious. Cogn.* 20, 432–436. doi: 10.1016/j.concog.2010.09.013
- Kuo, F. E., and Taylor, A. F. (2004). A potential natural treatment for attention-deficit/ hyperactivity disorder: evidence from a national study. *Am. J. Pub. Health* 94, 1580–1586. doi: 10.2105/ajph.94.9.1580
- Leclercq, V., and Sieroff, E. (2013). Development of endogenous orienting of attention in school-age children. *Child Neuropsychol.* 19, 400–419. doi: 10.1080/09297049.2012.682568
- Lee, Y. K. (2015). Restorative effect of natural landscape on university student stress reduction and cognitive enhancement. *J. Korea Inst. Lands. Architect.* 43, 127–137. doi: 10.9715/KILA.2015.43.6.127
- Mezzacappa, E. (2004). Alerting, orienting, and executive attention: Developmental properties and socio-demographic correlates in an epidemiological sample of young urban children. *Child Dev.* 75, 1373–1386. doi: 10.1111/j.1467-8624.2004.00746.x
- Mullane, J. C., Lawrence, M. A., Corkum, P. V., Klein, R. M., and McLaughlin, E. N. (2016). The development of and interaction among alerting, orienting, and executive attention in children. *Child Neuropsychol.* 2, 155–176. doi: 10.1080/09297049.2014.981252
- Ohly, H., White, M. P., Wheeler, B. W., Bethel, A., Ukoumunne, O. C., Nikolaou, V., et al. (2016). Attention restoration theory: a systematic review of the attention restoration potential of exposure to natural environments. *J. Toxicol. Environ. Health B* 19, 305–343. doi: 10.1080/10937404.2016.1196155
- Plude, D. J., Enns, J. T., and Brodeur, D. M. (1994). The development of selective attention: a lifespan overview. *Acta Psychol.* 86, 227–272. doi: 10.1016/0001-6918(94)90004-3
- Posner, M. I., and Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annu. Rev. Psychol.* 58, 1–23. doi: 10.1146/annurev.psych.58.110405.085516
- Posner, M. I., and Petersen, S. E. (1990). The attention system of the human brain. *Annu. Rev. Neurosci.* 13, 25–42.
- Rosier, L., End, A., and Gamer, M. (2017). Orienting towards social features in naturalistic scenes is reflexive. *PLoS One* 12:e0182037. doi: 10.1371/journal.pone.0182037
- Rueda, M. R., Fan, J., Halparin, J., Grub, D., Lercari, L. P., McCandliss, B. D., et al. (2004a). Development of attentional networks in childhood. *Neuropsychologia* 42, 1029–1040. doi: 10.1016/j.neuropsychologia.2003.12.012
- Rueda, M. R., Posner, M. I., and Rothbart, M. K. (2004b). *Handbook of Self-Regulation: Research, Theory, and Applications*, eds R. F. Baumeister and K. D. Vohs (New York, NY: Guilford Press), 283–300.
- Rueda, M. R., Rothbart, M. K., McCandliss, B. D., Saccomanno, L., and Posner, M. I. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proc. Natl. Acad. Sci. U.S.A.* 102, 14931–14936. doi: 10.1073/pnas.0506897102
- Schul, R., Townsend, J., and Stiles, J. (2003). The development of attentional orienting during the school age-years. *Dev. Sci.* 6, 262–272. doi: 10.1111/1467-7687.00282
- Schutte, A. R., Torquati, J. C., and Beattie, H. L. (2017). Impact of urban nature on executive functioning in early and middle childhood. *Environ. Behav.* 49, 3–30. doi: 10.1177/0013916515603095
- Shafritz, K. M., Marchione, K. E., Gore, J. C., Shaywitz, S. E., and Shaywitz, B. A. (2004). The effects of methylphenidate on neural systems of attention in attention deficit hyperactivity disorder. *Am. J. Psychiatry* 161, 1990–1997. doi: 10.1176/appi.ajp.161.11.1990
- Sheese, B. E., Rothbart, M. K., Posner, M. I., White, L. K., and Fraundorf, S. H. (2008). Executive attention and self-regulation in infancy. *Infant Behav. Dev.* 31, 501–510. doi: 10.1016/j.infbeh.2008.02.001
- Sherman, M., Cheng, Y. P., Fingerman, K. L., and Schnyer, D. M. (2016). Social support, stress and th aging brain. *Soc. Cogn. Affect. Neurosci.* 11, 1050–1058. doi: 10.1093/scan/nsv071
- Shipp, S. (2004). The brain circuitry of attention. *Trends Cogn. Sci.* 8, 223–230. doi: 10.1016/j.tics.2004.03.004
- Sperduti, M., Makowski, D., and Piolino, P. (2016). The protective role of long-term meditation on the decline of the executive component of attention in aging: a preliminary cross-sectional study. *Aging Neuropsychol. Cogn.* 23, 691–702. doi: 10.1080/13825585.2016.1159652
- Stenfor, C., Van Hedger, S. C., Schertz, K. E., Meyer, F., Smith, K., Norman, G. J., et al. (2019). Positive effects of nature on cognitive performance across multiple experiments: test order but not affect modulates the cognitive effects. *Front. Psychol.* 10:1413. doi: 10.3389/fpsyg.2019.01413
- Tyrvainen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., and Kagawa, T. (2014). The influence of urban green environments on stress relief measures: a field experiment. *J. Environ. Psychol.* 38, 1–9. doi: 10.1016/j.jenvp.2013.12.005
- Tzoulas, K., Korpela, K., Venn, S., Yli Pelkonen, V., Kazmierczak, A., Niemela, J., et al. (2007). Promoting ecosystem and human health in urban areas using green infrastructure: a literature review. *Lands. Urban Plann.* 81, 167–161.
- Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. *Environ. Behav.* 13, 523–556. doi: 10.1177/0013916581135001
- van den Berg, A. E., Jorgensen, A., and Wilson, E. R. (2014). Evaluating restoration in urban green spaces: does setting type make a difference? *Lands. Urban Plann.* 127, 173–181. doi: 10.1016/j.landurbplan.2014.04.012
- Veit, C., Lambrechts, W., Quintens, L., and Semeijn, J. (2018). The impact of sustainable sourcing on customer perceptions: association by guilt from scandals in local vs. offshore sourcing countries. *Sustainability* 10:2519. doi: 10.3390/su10072519
- Wainwright, A., and Bryson, S. E. (2002). The development of exogenous orienting: mechanisms of control. *J. Exp. Child Psychol.* 82, 141–155. doi: 10.1016/S0022-0965(02)00002-4
- Wardak, C., Lbos, G., Duhamel, J. R., and Olivier, E. (2006). Contribution of the monkey frontal eye field to covert visual attention. *J. Neurosci.* 26, 4228–4235. doi: 10.1523/jneurosci.3336-05.2006
- Wells, N. M. (2000). At home with nature: effects of “greenness” on children’s cognitive functioning. *Environ. Behav.* 32, 775–795. doi: 10.1177/00139160021972793

Conflict of Interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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