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Pathways to nature connection? A photo-elicitation exploration on how children engage with a nature connection programme

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ABSTRACT

While environmental education programmes have been shown to be effective in increasing knowledge and pro-environmental behaviour, it is not clear what characteristics of the intervention contribute to these outcomes. Detailed evaluations are needed to assess intermediary outcomes of such programmes to clarify the pathways to change. In this study, primary school children were asked to take photos while participating in a nature connection programme and later interviewed about those photos ($N = 14$). This photo-elicitation method explored which parts of the programme drew their situational interest, how they connected to nature, and how they felt while participating. Results indicated that the participating children were most interested in animals and connected to nature in a variety of ways, with emotional and sensory experiences being most important. Children mostly experienced positive emotions during programme participation. These results can inform the design of environmental education programmes to more effectively foster children's interest and nature connection.

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School intervention; intermediary outcomes; nature connectedness; situational interest; affect

1. Introduction

1.1. General introduction

The triple crisis of climate change, pollution, and biodiversity loss are major planetary challenges. These crises are anthropogenic (Allen et al. 2018; Ceballos et al. 2015; Vitousek et al. 1997) and therefore, profound behaviour change is required to address them (Evans 2019). One means of potentially addressing such crises is through environmental education programmes for adults and children. The latter are vital, as children are physically and mentally more vulnerable to negative effects caused by

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environmental problems than adults (Sanson, Van Hoorn, and Burke 2019). In addition, the roots of pro-environmental behaviour often originate in childhood (e.g. Evans, Otto, and Kaiser 2018; Hahn 2021).

While researchers often agree that changing behaviour is the ultimate goal of environmental education (e.g. Carmi, Arnon, and Orion 2015; Farmer, Knapp, and Benton 2007; Stern, Powell, and Hill 2014), other desired outcomes include increasing knowledge, awareness and attitudes towards the environment, as well as increasing participants' enjoyment, skills, and psychological well-being (Ardoin, Biedenweg, and O'Connor 2015; Ardoin et al. 2018; Stern, Powell, and Hill 2014). Reviews and meta-analyses suggest that environmental education programmes are largely successful in achieving these outcomes (Ardoin, Bowers, and Gaillard 2020; Ardoin et al. 2018; Stern, Powell, and Hill 2014; van de Wetering et al. 2022). However, such research has been unable to attribute the effects of environmental education to specific programme characteristics and approaches (Stern, Powell, and Hill 2014; van de Wetering et al. 2022).

Ewert (1983) referred to this as the 'black box' in environmental education design and evaluation. This suggests that, while there is a general sense that environmental education programmes are effective in delivering desired outcomes, little is known about the specific mechanisms that lead to these positive impacts. This is because, for one, environmental education programmes are often evaluated by quantitative surveys administered before and after the delivery of the programme to assess the short-term effects on a small number of outcome variables (Carleton-Hug and Hug 2010). Few evaluations take place during the delivery of programmes to assess participants' experiences and the context in which the programme takes place. Researchers have called for more formative evaluations and the evaluation of intermediary outcomes to address this issue, as such evaluations can identify specific components of the programme that have affected people (Ardoin, Biedenweg, and O'Connor 2015; Carleton-Hug and Hug 2010).

Intermediary outcomes are defined as outcomes that are not the main desired outcome of an intervention but the stages in the process to achieve the main outcome (Ardoin, Biedenweg, and O'Connor 2015). For example, one possible pathway to behaviour change is how feeling connected to nature leads to the development and/or growth of personal biospheric values, which in turn provide the motivation to act in an environmentally friendly way (Martin and Czellar 2017). Both stages of achieving higher nature connection and changing biospheric values in this example, can be seen as intermediary outcomes to achieve the ultimate goal of behaviour change. By assessing if and how intermediary outcomes are reached, it becomes possible to identify the mediators and mechanisms that contribute to a programme's effectiveness.

The aim of the current study is to address this gap in programme evaluation research by investigating three early-stage intermediary outcomes of (1) situational interest, (2) pathways to nature connection, and (3) affect, during the delivery of a nature connection programme called Generation Wild (GW). The Generation Wild programme and its intended outcomes, as well as the relationship between the selected intermediary outcomes and the main outcomes, are described in the next section (see also Figure 1).

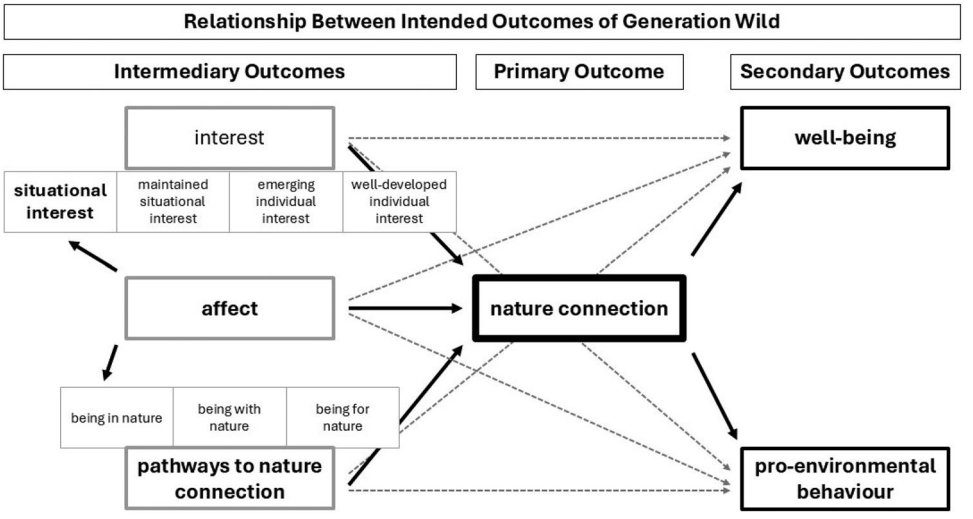


Figure 1. Schematic presentation of process model on how investigated intermediary, primary and secondary outcomes (presented in bold) relate to each other. The stages of interest development (four-phase model of interest development, Hidi & Renniger, 2006) and development of nature connection (ACHUNAS framework, Giusti et al. 2017) are also presented.

1.2. Programme outcomes

1.2.1. Main outcomes

Generation Wild (GW) is a nature connection programme aimed at primary school children from disadvantaged communities, designed and administered by WWT, the charity for wildlife and wetlands. GW is a school-based programme that includes a class visit to one of seven WWT wetland centres across the United Kingdom, as well as follow-up nature engagement activities at home and school, outlined and recorded through a dedicated programme website (Stead 2022, 2023). The primary goal of GW is to increase children's feeling of connection to nature. It differs from knowledge-based environmental education programmes as it aims to instil a deep love for nature and the feeling that nature is for everyone, which is especially important for children from disadvantaged communities who often feel disconnected from nature (Barrable and Booth 2022) or unwelcome in natural environments (Waite et al. 2023). Building an emotional relationship with nature is seen as an important first step to awaken the desire to gain more knowledge about nature (Carson 1998). Furthermore, developing a relationship with nature during childhood through active nature engagement, such as developing a sense of nature connection, provides the foundation for healthy child development, care for nature and an opportunity to directly learn and practice environmentally relevant behaviours (Chawla 2021). Nature connection explains substantial variance in pro-environmental and conservation behaviour (Otto and Pensini 2017; Richardson et al. 2020) and increases in nature connection can lead to more pro-environmental behaviour (Mackay and Schmitt 2019). As such nature connection can also be seen as an intermediary outcome to achieve the ultimate goal of behaviour change. Consequently, secondary outcomes of GW are increasing children's

pro-environmental behaviour and well-being, which is also connected to higher nature connection (e.g. Arola et al. 2023; Pritchard et al. 2020).

While a summative evaluation of the programme has shown that GW achieves these outcomes in the short-term (Junker et al. 2024), it is unclear which programmatic elements contribute to this. Therefore, this study investigates three intermediary outcomes of the programme.

1.2.2. Situational interest

The first intermediary outcome is situational interest. Situational interest can be defined as focused attention and affective reaction triggered by environmental stimuli at the time of the programme and typically does not persist over time (Hidi and Renninger 2006).

Assessing situational interest in relation to environmental education programmes is useful for two reasons. First, investigating which aspects of the programme elicit participants' interest, provides information on children's engagement with different elements of the programme. This can show which aspects of the programme elicit most interest, and whether key elements of the programme need to be changed to increase participants' interest in and further engagement with these elements.

Second, interest in nature is a desirable goal of nature connection programmes as it promotes a deeper engagement with, and enjoyment of, nature (Hecht, Knutson, and Crowley 2019; Talebpour et al. 2020). According to the four-phase model of interest development (Hidi and Renninger 2006), situational interest is the necessary first stage in interest development. If situational interest is maintained (phase 2), it can emerge into individual interest (phase 3). With repeated engagement a well-developed individual interest will manifest (phase 4). Within this process interest evolves from momentary bottom-up engagement driven by situation and environment to prolonged top-down engagement driven by the individual (Hidi and Renninger 2006). A well-developed individual interest provides motivation to engage with and learn about the topic of interest further with a variety of different methods and over varying situations. Crucially, it provides a motivation strong enough to overcome barriers that might prevent one from engaging with the topic (Barron 2006; Hidi and Renninger 2006). Furthermore, interest is also linked to the secondary outcomes of the programme, as it mediates the relationship between nature connection and pro-environmental behaviours (Kals, Schumacher, and Montada 1999), and interest enhancing strategies lead to more cognitive engagement with nature which increases psychological well-being (Duvall 2011).

It is important to assess whether the GW programme elicits situational interest in nature in the participants as a necessary first step in interest development. Within environmental education settings, it has previously been shown that factors such as pre-existing individual interest, ease, meaningfulness and autonomy can promote situational interest (Aivelo and Huovelin 2020; Kirchhoff et al. 2025). While studies such as these can provide insight into design characteristics that promote interest, they often neglect the influence of the specific environmental setting. As situational interest is highly specific to individual environmental stimuli, it is important to investigate which parts of the environment trigger situational interest more readily and how. For example, a study with adolescents showed that while novelty consistently

triggered situational interest, emotions primarily elicited interest in animals, whereas beauty triggered interest in plants and landscapes (Applasawmy 2021). Whether similar patterns can be observed in younger children remains to be investigated. Accordingly, this study examines whether GW triggers situational interest not only in programme activities but also in different aspects of the natural environment in young children.

1.2.3. Pathways to nature connection

This study investigates how children connected to nature during the programme as the second intermediary outcome. Multiple environmental education programmes have been shown to successfully increase nature connection, but it is unclear which factors contributes to these results (see Barrable and Booth 2020, for a meta-analysis). Literature reviews suggest that childhood nature contact is the best way to increase nature connection in children (Mockovcáková and Barrable 2024) and later in life (Chawla 2020). However, meta-analyses have shown that environmental education programmes involving direct nature contact do not generally outperform programmes without nature contact (Stern, Powell, and Hill 2014; van de Wetering et al. 2022; Świątkowski et al. 2024; but see Dale et al. 2020). The outcome of nature connection studies have yielded mixed results (Ernst and Theimer 2011), but there is some evidence that wilder environments as well as longer programme duration and younger participants lead to larger increases in nature connection (Barrable and Booth 2020; Braun and Dierkes 2017; Bruni et al. 2017; Ernst and Theimer 2011; Liefländer et al. 2013). But it is important to note that nature contact alone is not sufficient to increase nature connection. Some programmes that include nature contact have failed to increase nature connection (e.g. Hignett et al. 2018), while others increased nature connection without direct nature contact (e.g. Bruni et al. 2018). Thus, it remains unclear as to which programme characteristics increase nature connection.

Based on responses from environmental educators, the Assessment framework for Children's Human Nature Situations (ACHUNAS) framework (Giusti et al. 2017) was developed as a guide to connecting children to nature. It proposes that there are three stages in the development of nature connection and that different activities are necessary for each stage. In the first stage, children learn to be *in nature* and feel comfortable while being there. In the second stage, children are *with nature*, which includes doing activities in nature and learning about nature. The third and final stage leads children to be *for nature* by taking care of nature and feeling a sense of oneness with nature (Giusti et al. 2017).

As GW works with a population that is more likely to feel disconnected from nature, its main focus is on the earlier stages of ACHUNAS and on activities that lead children to feel comfortable in nature. These GW activities are based on the five pathways to nature connection framework (Lumber, Richardson, and Sheffield 2017), which proposes that people connect to nature through five pathways: contact, emotion, compassion, meaning, and beauty. Within GW, children are asked to complete different nature activities that encompass one or more of these nature connection pathways. For example, children are asked to identify smells they like and dislike (contact), lead their friend to a nice view (beauty), or take the perspective of an animal (compassion). The nature engagement focused approach of the programme and framework provides ample opportunity for contact with nature, which is important for the earlier stages

in the developmental process towards nature connection. Individual pathways in the framework are also relevant for the secondary outcomes as compassion is also relevant for the development of pro-environmental behaviours (Pfattheicher, Sassenrath, and Schindler 2016; Prokop, Belzárová, and Tomanová Čergeťová 2025) and sensory contact with nature leads to more positive emotions through nature connection (Chen and Yang 2025).

While the five pathways are commonly used in environmental education, particularly in the UK, the framework was developed based on adults and has not been fully validated for children. A recent study with under 19-year-olds suggests that the pathways of emotion and beauty were more accessible to a younger audience compared to other pathways within an intervention (Holland et al. 2025). Furthermore, nature consists of many different entities, and just as different entities might elicit situational interest in different ways (Applasawmy 2021), children might use different pathways to connect to different natural entities. Therefore, this research investigates whether children within GW use all of Lumber, Richardson, and Sheffield (2017) five pathways, or whether they express other pathways to connect to natural elements.

1.2.4. Affect

The final intermediary outcome is the emotions that children experience during programme participation. Affect is important to investigate as emotions are linked to several intended outcomes. First, participants' enjoyment is usually at least an implicit goal of environmental education programmes. Furthermore, children's mood during the programme affects their willingness to engage with the programme and therefore its effectiveness (Friedman et al. 2024). Second, short-term enjoyment of nature and the expression of positive emotions towards nature could be an indication of an overall positive relationship with nature. If children experience too many negative emotions during a programme, such as fear of a novel environment, it might prevent them from engaging with the programme effectively and inhibit their future engagement with nature (Bixler et al. 1994; Bixler and Floyd 1997; Chalmeau and Julien 2023). Third, positive emotions that children feel at the wetland centres, being in direct contact with nature, might indicate long-term well-being they gain through nature connection. Fourth, emotions, such as awe, compassion and fear have all been linked to pro-environmental behaviour (Ibanez, Moureau, and Roussel 2017; Johansson et al. 2012; Prokop, Belzárová, and Tomanová Čergeťová 2025; Weinstein et al. 2015). This is especially true for children, as their feelings can outweigh the effects of information in predicting their pro-environmental behaviours (Kelemen, Brown, and Pizza 2023). Finally, affective factors are particularly relevant in the earlier stages of interest development (Renninger and Hidi 2011) and nature connection (Giusti et al. 2017), as positive emotions provide motivation to approach the natural environment, which furthers situational interest and comfort in nature. Cognitive factors, such as knowledge, gain more relevance in later stages of the developmental processes (Giusti et al. 2017; Renninger and Hidi 2011).

In sum, the emotions children experience during the programme influence whether they approach and engage with the programme and the environment which affects a multitude of outcomes (see Figure 1). Consequently, this research investigates

whether children experience more approaching or avoiding emotions towards GW programme activities and elements of the natural environment.

2. Methodology

This study employed a photo-elicitation methodology. Photo-elicitation describes the process of incorporating photos into a research interview (Shaw 2021), where the photos serve as stimuli to generate high-quality verbal qualitative data (Barley and Russell 2019). Having photos as an anchor to interview responses is especially useful for children, who often struggle to form clear narratives of abstract processes and circumstances in traditional interviews (Shaw 2021). The photos can be either provided by the researcher or by the participants themselves (Smith, Gidlow, and Steel 2012). In this study, the latter approach was taken. By using children's own photographs, the intention was to give them agency to capture their experiences during the programme from their own perspective, in a way that is accessible and natural to them (Smith, Gidlow, and Steel 2012): one of the main reasons this method is recommended for investigations into intermediary outcomes within environmental education (Ardoin, Biedenweg, and O'Connor 2015). Because photos can capture fleeting moments, photo-elicitation and other visual methods have been proven particularly effective to investigate situational interest within environmental education settings (Applasawmy 2021; Ardoin et al. 2014). The photos also aide participants to remember other factors that occurred in the situation the photos were taken, such as their feelings. For these reasons, the photo-elicitation methodology was selected to investigate children's experiences during GW.

2.1. Procedure

In this study, photo-elicitation methodology was used to assess children's engagement with the GW programme during their visit to Llanelli (South Wales, UK) WWT wetland centre. The children were asked to take photos during their visit to the centre in June and July 2023. After a short introduction to the day programme by a WWT staff member, they were given a child-friendly digital camera ('myFirst' camera). The cameras were matched with a bracelet, with the camera number and a numerical participant ID linking the children anonymously to their photos. This approach kept participation in the photo part of the study open to all children, regardless of whether they had written parental consent to participate. The children were instructed that they could take pictures of everything they wanted, except people's faces. Children were asked to take photos in a way that, if they were showing the photos to their families, they would know what it was like to be at the wetland centre that day. The researchers accompanied the children throughout the day. The cameras were collected from the children at the end of the GW activity, after which they were free to explore the wetland centre with their teachers.

For one class, the semi-structured interviews took place at the end of the GW activity, during the free, unstructured part of the Llanelli visit, and involved only children with written parental consent to be interviewed. Children from another class

were interviewed at a later date, as there was not enough time on the wetland visit day to complete all the interviews. Three questions were asked about each photo:

1. What is in this photo?
2. Why did you choose to photograph this?
3. How did you feel while doing/seeing this?

Questions 1 and 2 were asked to investigate children's situational interest, as well as to prompt them to keep talking about their experiences, to analyse how they related to nature (pathways to nature connection). Question 3 was included to investigate the intermediary outcome of affect. If a child took more than 20 photos and there was not enough time to talk about all of them, the researcher and the child went through the photos together and the child was asked to say stop when they saw a photo they would like to talk about. The interviews were audio-recorded and subsequently transcribed using otter.ai. Each transcript was double-checked and edited for legibility by both the primary author and a research assistant. Interview transcripts were coded using MAXQDA 2020 (VERBI Software 2020). Data visualisation plots were designed using the ggplot2 package (Wickham 2016) in R (v4.4.0; R Core Team 2024).

2.2. Sample

Children from two GW-participating classes obtained written parental consent to be interviewed. Both classes were from schools in South Wales: one a Welsh-medium school and the other an English-medium school. In total, 14 children (8 girls, 6 boys; 7 children in year 4, 4 children in year 5, 3 children in year 6; 8–11 years) were interviewed. Nine of these children were from a mixed class with children from years 4 to 6, who were interviewed on site. Five children from a year 4 class were interviewed in their school 3 days after the visit because of limited time on site. All interviews were conducted in English, the first language of all the children. This research was approved by the Psychology Ethics Committee of Cardiff University (EC.21.06.15.6360R3A4).

2.3. Analysis

2.3.1. Situational interest

Children's responses to the question 'What is in this photo?' were coded into categories, such as plants, animals, and GW activity. The number of times a photo from each category was taken was then calculated to assess which element of the visit interested the children most. The length of time each child talked about each picture was also recorded, as people engage longer with visual stimuli that they find more interesting (Russell 1975).

2.3.2. Pathways to nature connection

Two analyses were conducted to explore the pathways to nature connection, that is, (a) an exploratory *thematic content analysis*, and (b) a *confirmatory analysis* based on the five pathways to nature connection framework (Lumber, Richardson, and Sheffield 2017). To further analyse pathways to nature connection identified by the two analyses, separate *codes-relations analyses* were conducted to examine whether the

pathways children used to connect to nature differed across the types of natural elements they photographed.

2.3.2.1. Thematic content analysis. This was a bottom-up exploratory analysis to assess how children talked about their trip and the nature around them. Themes in the children's narrations were identified using thematic content analysis (based on Braun and Clarke 2006). In this analysis, each passage in the children's narration that provided information about the research question was coded. Coded passages with similar content were then grouped into themes. The aim of this data-driven approach was to identify ways in which children connect to nature during GW and to potentially identify new pathways to nature connection in children's narrations that had not been considered in previous research.

2.3.2.2. Codes-Relations analyses. Afterwards, a codes-relations analysis (analytic tool embedded in MAXQDA) between photo content and themes was conducted to assess if pathways of connection identified in the thematic content analysis differed between different elements, that is, if pathways of connection differed between, for example, animals and plants. In a codes-relations analysis the number of co-occurrences between two codes are counted to examine how strongly codes are associated with each other. Codes-relations analyses were also employed to further investigate findings in the confirmatory analysis (see next paragraph) and for the intermediary outcome of affect (see section 2.3.3.)

2.3.2.3. Confirmatory analysis. This was a top-down confirmatory analysis to investigate if children connected to nature during GW *via* the five pathways to nature connection suggested by the framework of Lumber, Richardson, and Sheffield (2017) described above. In this analysis, passages that fit one of the five pathways to nature connection – contact, emotion, compassion, meaning, and beauty – were coded. Lumber, Richardson, and Sheffield's (2017) descriptions of the five pathways of nature connection, as well as items in their questionnaire, were used to inform the inclusion criteria for each category. Each passage was coded with one pathway, but sentences could be split into multiple passages. The most specific code was chosen for each passage. For example, expressions of caring for something or saying something was beautiful were coded as compassion and beauty, respectively, even though these might also be expressions of emotions. Additionally, a codes-relations analysis was conducted to investigate if children employed different pathways of the five pathways to connect to various natural elements.

The results from both analyses were then compared to assess whether children participating in GW connected to nature within the proposed framework, or if additional pathways to nature connection could be identified.

2.3.3. Affect

A sentiment analysis was conducted to investigate the intermediary outcome of affect, following MAXQDA's guidelines for manual sentiment analysis (VERBI Software 2025). In this analysis, all instances of emotion expressions by the children were coded. The emotions were then grouped into positive/approaching, for example, admiration or happiness, and negative/avoiding emotions, for example, disgust or fear. Additionally,

a codes-relations analysis between expressed emotions and the object of these emotions was conducted to examine whether different elements of the programme elicited different types of emotions.

3. Results

3.1. Situational interest

During the interviews, the children chose to talk about 181 photos in total (mean of 12.9 photos per child). The photos were grouped into categories based on the content as described by the children themselves. For example, if a photo only contained plants but the child said it was supposed to be a photo of a dragonfly, but the dragonfly flew away, the photo was still classified as a photo of an animal.

The content of the photos encompassed the following seven categories:

- Artefact (when the focus of the photo was on a non-living manufactured object)
- Generation Wild activity (when the photo was anything related to the GW programme, e.g. photos of puppet performance or nature activities)
- Non-living natural kind (when the focus of the photo was on a natural non-living entity)
- Landscape (when the focus of the photo was not on a specific entity, but on a wider natural scene)
- Animal (when focus of photo was on an animal)
- Plant (when focus of photo was on a plant)
- Other (when a focus did not fit any of the categories)
- Blurry (when it was not possible to recognise the content or focus of the photo)

Most photos were of animals (63), followed by photos of landscapes (23), GW activities (22), and plants (21) (see Table 1).

The children spent different amounts of time talking about photos from different categories. The total amount of time roughly follows the same distribution as the number of photos in each of these categories. However, in terms of the average time children talked about each photo in the different categories, they talked the longest about photos of GW activities and artefacts (about 44 s per photo). On average, children spent roughly equal amounts of time talking about photos containing different kinds of natural entities (about 35 s per photo). By far the least amount of time was spent talking about photos from the 'other' and 'blurry' categories (about 15 s per photo) (see Table 1).

When the children were asked why they had chosen to photograph something, they provided a variety of reasons. Most of them were based on the characteristics of what was photographed, such as the saliency of the objects because of their colour or size, e.g. *'They [the animals] stuck out of it […] because they were white and everything else was green.'* (child 1), *'It's a really unique way of building a building.'* (child 2). This indicates the formation of situational interest, which is typically driven by the

Table 1. Amount of time spent on talking about photos in each of the categories in minutes (minutes:seconds.milliseconds).

Content	Number	Percentage	Total time	Average time per photo
Artefact	15	8.3%	11:08	00:44.5
GW activity	22	12.2%	15:53	00:43.3
Non-living natural kind	10	5.5%	06:07	00:36.7
Landscape	23	12.7%	13:46	00:35.9
Animal	63	34.8%	36:54	00:35.2
Plant	21	11.6%	11:00	00:31.5
Other	12	6.6%	03:21	00:16.8
Blurry	15	8.3%	03:38	00:14.5

environment through a bottom-up process (Hidi and Renninger 2006). In contrast, some children indicated that they had photographed something because they were already interested in it, for example because they owned this kind of animal (e.g. ducks) or because family members had elicited their interest in it. This top-down engagement is indicative of the later stages of interest development (Hidi and Renninger 2006), illustrating the effect of children's previous experiences on their engagement with aspects of the programme (see Table 2).

3.2. Pathways to nature connection

3.2.1. Thematic content analysis

3.2.1.1. Themes. Overall, eight themes were identified in the children's narrations of the photos (see Table 3). These are described here from the most to the least common. The most common theme was 'affect' (211 instances, 26.7% of all coded instances), which encompassed every time a child expressed how they felt when talking about the photos, e.g. '*And then I felt really really happy when I saw it*' (child 11), *'And I like him. And he's my favourite*' (child 12). The theme was further subdivided into emotion categories, such as enjoyment, fear or happiness (see also section 3.3. for a more detailed discussion on affect). The second theme was 'content characteristics' of whatever was photographed in the photo, such as saliency, perceived character traits, size, colour or material (167 instances, 21.1%), e.g. *'It was bigger than my fingers. It was huge, it was.*' (child 2), *'Because it was vibrant colours'* (child 7). The next theme were narrations related to 'experiences' (111 instances, 14.0%), such as *'I felt the rocks.*' (child 11), *'Because it smells nice*' (child 9). Apart from sensory experiences, such as listening, watching or proximity to entities, this theme also encompassed the experience of gaining knowledge, doing physical activities, or experiencing something new or very rare.

The next themes occurred less often. 'Aesthetics' was mentioned 65 times (8.2%), e.g. '*Ava was really, really pretty*' (child 11), followed by children's relationships to 'other people' (53 instances, 6.7%). This theme included family and peer relationships, such as wanting to be different from others, e.g. '*[I hid my rock there] because everyone else was hiding theirs in bush*' (child 4). The next theme was 'memories', which included how the things the children photographed elicited memories in them or reminded them of something else, such as stories, animals or objects (44 instances, 5.6%), e.g. *'And it made me feel happy because it made me think of my two horses. And it made it*

Table 2. Examples of reasons children gave for photographing something. Example of bottom-up interest (left) and top-down interest (right).

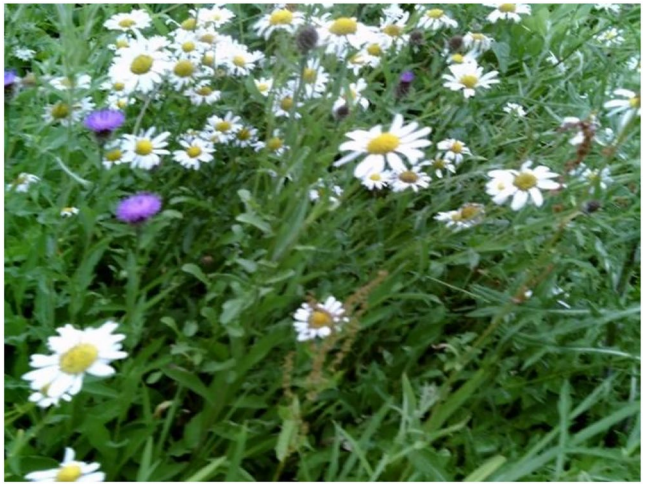
Researcher: Why did you choose to photograph this?	
	
Child: I took the picture of the dandelion […] and the purple flowers because I love the colour purple and I love the colour yellow and white (child 11)	**Child:** Right! So I was really amazed like how how it was built in like the map like the way all the wood was built and stuff like that and, um, and my dad as well he's really interested in like, stuff like that like how wooden things have been builded and really made but I have never see anything like this before that's made that way my dad he always says it's made of, like them big wooden buildings, like [inaudible] he's made the big shed so that's why I took a photo of that (child 2)

Table 3. Themes in photo narrations identified by the thematic content analysis.

Theme	N	%	Explanation	Example quotes
Affect	211	26.7	Expressed feelings/ emotions, e.g. happiness, liking	I love the duck so much. So I got embarrassed.
Content characteristics	167	21.1	Descriptions of properties, e.g. size, colour, character traits	The blue beak The grass was very long. When they bite you or poison you.
Experience	111	14.0	Sensations and activity descriptions, e.g. smelling, watching	Because I've never seen a white flower. Yeah, we couldn't find much rocks.
Aesthetics	65	8.2	Descriptions of aesthetic properties, e.g. beauty	I found it so pretty. The view was very nice.
Other people	53	6.7	Narrations relating to other people, e.g. peer relationships	And I took a picture of it because I wanted to show everyone. Because it, you would have to work as teamwork.
Memories	44	5.6	Things that evoke memories or remind children of different things	It looks like the Jurassic Park one. It also reminds me of when I was little and I wore like a frozen dress to the school dance.
Relationships	25	3.2	Descriptions of how children related to what they photographed	We're friends. If I was like that duck [… I could go to places …] with nature stuff.
Circumstances	17	2.2	Influence of external circumstances, e.g. time constraints, weather	You got to take advantage of like, this lighting. Yeah, it was windy that day.
Other	16	12.4	Miscellaneous narrations that did not fit with other themes	Yes, I forgot. I'm gonna try and draw it. And I was trying to capture the sky, but it's gone grey. That was a rubbish photo.

made reminded me of how when they're on their field. They never, they never stopped sticking together.' (child 3).

The last two themes were rarely mentioned. One of these themes was 'relationships' (25 instances, 3.2%), when children described how they related to the entity they photographed (mostly animals), e.g. *'She looked hungry and I was also hungry, so we were twinning'* (child 12). This included being their friend, ownership, wanting to be that animal, or doing something because they thought it might be good for the animal. The last theme, 'circumstances', was mentioned 17 times (2.2%) and related to children doing things because of external factors, such as the weather, e.g. *'The sun. […] And no clouds'* (child 6).

The category 'other' (12.4%) encompassed passages that did not fit with any of the other themes and were mentioned less than 10 times, so no new theme was added, such as freedom/openness or being motivated by the content to pursue further activity, e.g. drawing the entity in the photo. It also encompassed narrations that describe the photo-taking process, such as not being able to control animals to stay in the photo, taking photos by accident or comments on how they thought the photo turned out.

3.2.1.1. Codes-relations analyses. Next, a codes-relations analysis between the themes and the content of the photos was conducted to investigate whether the different photo categories elicited different themes (see Figure 2). When the focus of the photo

was an animal, the theme that occurred most often was 'content characteristics.' When this category was mentioned for entities other than animals, it almost exclusively referred to physical characteristics of the entity, such as size or colour, e.g. *'There is a pink rock […] and I also like the other colours of it'* (child 11), *'Because [the grass] was a bit long'* (child 6). For animals, additional characteristics were mentioned, such as habitat, perceived character traits, specific behaviours, social relationships to conspecifics and the experience of emotions, e.g. *'I thought they are like a big family'* (child 3), *'Because Fred looks like a fun otter'* (child 12). 'Affect' was also mentioned often, especially 'liking' the animal and finding the animal 'cute.' However, a wide variety of emotions were mentioned. Over half of the mentions of the theme 'relationships' were in relation to animals. In contrast, the theme of 'experience' was mentioned less often in relation to animals compared to other content categories.

Artefacts were most strongly associated with the themes of 'affect', in particular admiration, physical 'characteristics' (i.e. materials), and 'aesthetics.' For the theme 'memories', artefacts were mentioned to a higher proportion as in the overall mentions of artefacts, whereas the themes of 'relationships' and 'circumstances' were not mentioned when talking about artefacts at all.

GW activities brought up many different themes, but the most common one was 'affect', in particular admiration and experiences such as exploration, e.g. *'I thought it was really cool, how we could talk to the animals'* (child 14), *'And then I found something where there's like a little view-gap there where you can have a look […] there's a huge view!'* (child 10). Within the themes of 'other people' and 'relationships' GW activities elicited 45% and 32% of narrations respectively, e.g. *'So my family can learn about grass snakes'* (child 8).

Landscape photos were most strongly associated with 'aesthetics' as well as 'experience', particularly watching. Compared to other content categories, non-living natural kinds were more strongly linked to the theme of 'memories', indicating that non-living natural kinds evoked memories of other things in the participants.

Plants were most strongly associated with 'affect', most importantly liking and only positive emotions were mentioned when talking about plant photos, e.g. *'I love those flowers I can see up close'* (child 14). Physical 'characteristics' (primarily colour), 'experiences' (primarily novel experiences) and 'aesthetics' were also commonly mentioned themes when children talked about plants, also to justify their liking of plants, e.g. *'Because it [the flower] smells nice and it is one of my favourites because it is beautiful'* (child 9). In contrast, the theme of 'other people' was only mentioned once regarding

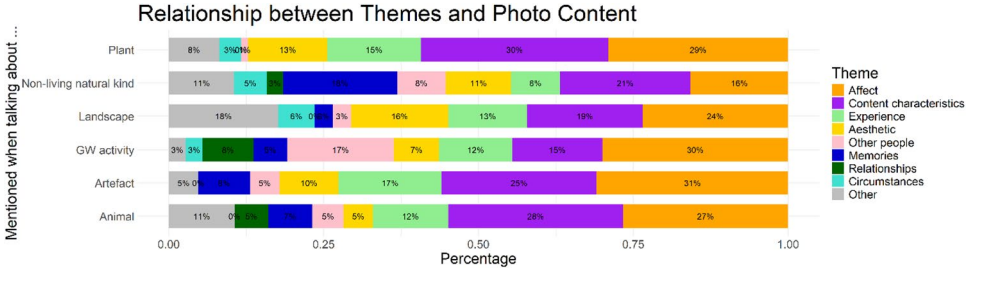


Figure 2. Proportion of number of mentions of each theme within photo content categories.

photos of plants and the themes of 'relationships' and 'memories' were not mentioned at all (see all models in Supplementary Material).

3.2.2. Confirmatory analysis

For this analysis, every instance that fit with one of the five pathways to nature connection as defined by Lumber, Richardson, and Sheffield (2017) was coded. The pathways of contact, emotion and beauty can be considered to reflect the themes of 'affect', 'experience' and 'aesthetics' from the thematic content analysis. Therefore, the inclusion criteria were similar to the examples described above. In contrast, the pathways of meaning and compassion did not have a direct equivalent to the themes identified in the thematic content analysis. Meaning was described in the article by Lumber, Richardson, and Sheffield (2017) as, for example, using nature metaphors to describe one's experience, so elicitations of memories were also included in this category. Compassion for nature was not explicitly mentioned in any interview. However, instances that implied compassion, such as building a nest away from predators or touching an animal carefully to avoid hurting the animal, were also included in this category.

All five pathways to nature connection were identified in the interviews, although with varying degrees of frequency. Emotion was the most common (141 instances), followed by beauty (114 instances) and contact (67 instances). Meaning (24 instances) and compassion (3 instances) were rarer, indicating that these pathways are not common for children when talking about participating in GW.

3.2.2.1. Codes-relations analyses. As above, a codes-relations analysis was conducted to investigate whether certain pathways to nature connection were more present for some elements of the trip to the wetlands centre. Only in relation to animals were all five pathways mentioned. All the other photo contents were missing one of the pathways with plants, artefacts, landscapes, and non-living natural kinds missing the pathway of compassion, and GW activities missing the pathway of meaning (see the Supplementary Material for all models). The pattern of prevalence of each pathway also differed between the different entities (see Figure 3). The pathway of beauty was more present when talking about plants, landscapes, and human-made and natural objects compared to the overall percentage. Similarly, emotions made up a larger percentage when children talked about GW activities and animals (see Figure 3).

3.3. Affect

For the sentiment analysis, all emotions or affective expressions were coded and then related to what elicited this emotion (see Supplementary Material for models). Here, a more fine-grained approach was used to identify the specific element of the photo the emotions related to and to also include elements in children's narrations that were not explicitly represented in the photos. Therefore, there were more categories than in the previous analyses. Apart from the six categories that were also present as photo content – plant, non-living natural kind, GW activity, landscape, artefact, and animal – there were four additional categories (see Figure 4). 'Research' included

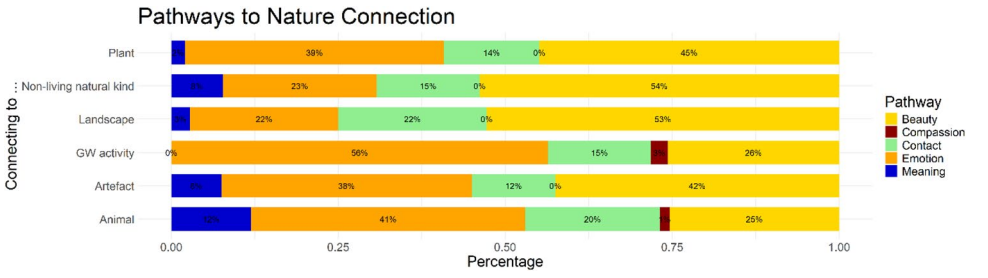


Figure 3. Pathways to nature connection as a percentage of the pathways to nature connection mentioned for each area.

everything the children said about participating in the research project or about taking photos. 'Trip' described the experience of going on a school trip in general, without further mention of any of the other categories. 'Wetland centre' included emotions the children expressed about the environment of the wetland centres outside the other categories. Finally, 'other' included emotions expressed in contexts unrelated to the GW programme, such as children's school or homelife.

The emotions were then categorised in positive/approaching and negative/avoiding emotions. Generally, most of the emotions children expressed were positive, e.g. *'I really enjoyed my day here and I'm excited to come here again.'* (child 5). The most common positive emotions were expressions of liking or love towards something (74 mentions, 30.5% of all emotion expressions), e.g. *'One of my favourite animals is a snake'* (child 7), or expressions of admiration (45 mentions, 18.5%), e.g. *'[the house] looks really cool'* (child 13). Other positive emotions included, for example, awe, joy, amazement, fun, and inspiration. There were only few expressions of negative emotions (16 mentions, 6.6% of all emotion expressions), e.g. *'I spotted this snake made out of sticks, I think? […] And I just thought that I'm kind of scared of snakes, see?'* (child 6), *'I was embarrassed that I didn't take pictures of the flamingos'* (child 12).

3.3.1. Codes-relations analyses

Only some categories were associated with negative emotions, such as other, research and animals, but for categories related to the GW programme, negative emotions were never more than 10%. The wetland centre, the trip in general, non-living natural kinds and landscapes were not associated with negative emotions at all (see Figure 4). Different emotions were expressed towards different natural elements. Children expressed more emotions and more varied emotions towards animals (see Supplementary Material). For natural entities other than animals, emotions were mostly limited to expressions of admiration, interest and general liking with a few mentions of awe or happiness, e.g. *'The rocks look cool.'* (child 10); *'I like these leaves'* (child 6), *'They [flowers] made me feel like happy.'* (child 5). For animals, other emotions were also important, in particular expressions of adoration, e.g. *'It's the cutest snake that I've ever seen'* (child 11), but also more negative emotions like annoyance, e.g. *'It [butterfly] zipped up right above me, it was so annoying'* (child 2). The intensity of expressed emotions also varied, with emotional expression towards animals, e.g. *'Ew, you held a snake? Ew!'* (child 11), *'I just love Fred [name child gave to otter]'* (child 12),

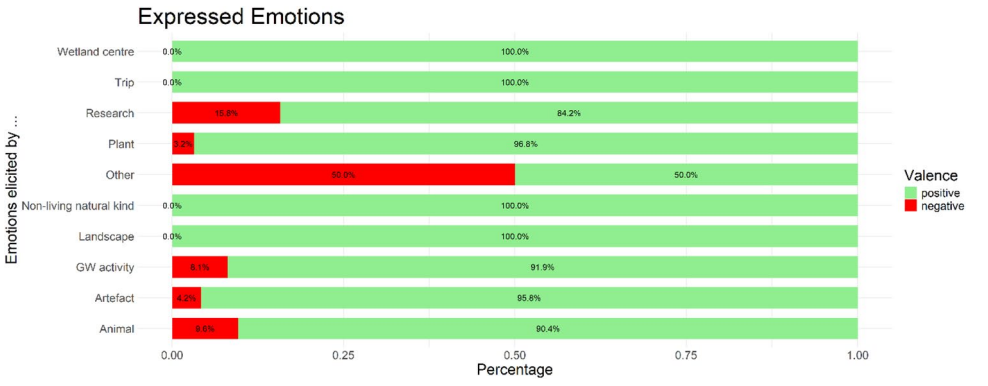


Figure 4. Percentage of positive and negative emotions elicited by content category.

usually being more intense than towards other kinds, e.g. *'I didn't like, like the lemon one'* (child 8), *'It [landscape] looked cool.'* (child 7).

4. Discussion

4.1. Situational interest

Overall, the children participating in GW were interested in a variety of natural and anthropogenic elements of the programme and the environment. There was no substantial part of the GW programme or the environment in the wetland centre that was overlooked in children's photos and their narrations about the day. This demonstrates that the programme was successful in eliciting situational interest in the children for both the programme activities and the wider natural environment in which the activities took place. However, it should be noted that situational interest is only the first step in interest development and there is no guarantee that situational interest will lead to a well-developed individual interest. Further engagement with the topic, as well as structural support to maintain interest, are needed to achieve this goal (Hecht, Knutson, and Crowley 2019; Hidi and Renninger 2006). Without those, most children might lose their awakened interest when the intervention programme ends (Kong and Chen 2024).

In addition, the quantity of interest and engagement differed among the different entities. Children chose to photograph animals the most, and non-living and unmoving things (non-living natural kinds and artefacts) the least. These results fit well with previous research that demonstrates how from a young age children are more interested in interacting with animals than objects (LoBue et al. 2013) and plants (Barrutia et al. 2022). On the one hand, animals might have been more salient to the children because animals move (Guerra et al. 2024): plus, there were fewer animals than plants at the wetlands centre. On the other hand, this could be an indication of 'plant blindness' (Wandersee and Schussler 1999), that is, people generally do not pay attention to plants. The finding that children spent the least amount of time talking about pictures of plants, apart from photos from the blurry or other categories, also supports this argument.

Together, these results and similar findings from previous studies on situational interest within environmental education settings (Applasawmy 2021; Ardoin et al. 2014), indicate that animals might be effective at capturing children's attention and getting them to engage in a programme, but other parts of the environment, such as plants and non-living natural entities, do not elicit situational interest to the same extent. If a programme wants children to engage with these parts as well, specific strategies must be developed. Based on these data, instructors expressing an interest in plants and focusing children's attention on them could be a promising strategy. Engaging with other people has been shown to aid in interest development (Ardoin et al. 2014; Barron 2006; Hecht, Knutson, and Crowley 2019) and this strategy seems currently to be underutilised in this programme as the theme of 'other people' mostly came up when talking about GW activities and animals. For example, during GW visits, rare animals were often pointed out, and children observed them for some time while instructors or teachers provided information. Potentially, the same could be done with plants to provide longer periods of focused attention on them. An intervention including prolonged observation and identification of individual species has been shown to enhance attitudes towards trees (Wyner and Doherty 2022). Other strategies, such as drama interventions or play, have also been shown to be useful to get children to engage with plants (e.g. Stagg 2020).

4.2. Pathways to nature connection

When comparing the results of the two analyses conducted to investigate how children connect with nature, there was an overlap for three of the pathways in both analyses. From the five pathways to nature connection, the pathways of emotion, contact, and beauty (Lumber, Richardson, and Sheffield 2017) were also prominent themes in the exploratory thematic content analysis. This strongly indicates that children connect to the natural world through these three pathways. Additionally, the exploratory analysis identified two more prominent themes in how children connected to nature that are not present in the five pathways framework, that is, other people and content characteristics. This suggests that other people and characteristics of specific natural elements and entities influence how children connect to nature and this influence should be accounted for better within interventions.

In contrast, the pathways of meaning and compassion in the five pathways framework could not be confirmed, as there were limited mentions in children's narrations. There are several possible explanations for this observation. First, these pathways might have been implemented in the programme to a lesser extent than other pathways. There were many more nature activities that focused on direct contact with nature, and aspects meant to elicit compassion and meaning were therefore overlooked. Second, the original research on the five pathways to nature connection was conducted with adults (Lumber, Richardson, and Sheffield 2017). The pathways of meaning and compassion might not be as accessible to children as they are to adults, as these are more abstract concepts. Third, compassion and meaning might only be relevant for later stages in the development of nature connection, such as the being

for nature stage (Giusti et al. 2017). Reviews of the nature connection literature have shown that there are different types of nature connection, such as experiential or philosophical (Ives et al. 2017). Ives et al. (2018) argue that certain forms of nature connection are based on an individual's internal experience, rather than others that form as a result of external stimuli. As with interest development, external environment-driven nature connection, such as experiential nature connection (contact), might be the first step in the development of a nature connection that has a more stable, internal philosophical basis (meaning). Therefore, as with situational interest only the earlier stages of nature connection might have been present during this intermediary outcome analysis.

Additionally, there were two prominent themes in the exploratory analysis that were not present in the five pathways to nature connection – content characteristics and other people. The importance of content characteristics demonstrates that nature consists of many different elements and entities that elicit different responses from children. This is not a new finding, as a wealth of previous research has shown that characteristics such as size, aesthetics, and similarity to humans influence people's attitudes and behaviours (e.g. Borgi and Cirulli 2015; Gunnthorsdottir 2001; Westbury and Neumann 2008; Wyner and Doherty 2022). As a connection is an interaction with something outside oneself, it is important to know how the characteristics of different entities influence the relationship. Accounting for different relationships with various natural elements is vital to develop effective connection strategies in intervention programmes. For example, if species are perceived as dangerous or creepy because of small size or many legs, this might lead to a negative relationship towards the species that leads to avoidance or threatening behaviour towards it due to fear or disgust. Interventions focused on increasing knowledge, contact and exposure have been shown to enhance affect and attitudes towards unpopular species (see, e.g. Ballouard et al. 2012; Collado, Rodríguez-Rey, and Sorrel 2022; Randler, Hummel, and Prokop 2012).

Furthermore, the influence of other people should be considered, especially within a school intervention programme. As demonstrated by the data, peer relationships influence if and how children engage with the programme, e.g. *'It was really fun. […] cause you could just ask like anyone to do it with you'* (child 1). During a programme children do not only build a relationship with nature but also with other people participating in the programme, such as peers or educators (McCree, Cutting, and Sherwin 2018). Prior research has also shown that other people can promote or hinder the success of an environmental education programme. If the general attitude towards the programme is positive and peers, parents, schools and teachers support the programme and appreciate the learning within the programme, it promotes enthusiasm for the programme within the children as their newfound skills are appreciated (McCree, Cutting, and Sherwin 2018). However, the presence of other people can also distract children from interacting with nature as solitary activities in nature have been found to be more influential in promoting nature connection (Kals, Schumacher, and Montada 1999; Szczytko et al. 2020). Within a programme, instructors can guide pupils' attention (Ardoin et al. 2014) and teachers determine whether their class participates in environmental education programmes.

4.3. Affect

Children overwhelmingly reported positive emotions regarding GW participation, indicating that they enjoyed the trip and experienced emotions that allowed them to approach and engage with the programme and the environment. The natural elements of the trip, apart from animals, were almost exclusively associated with positive emotions, which is a strong indication that children have a positive relationship to nature and experience positive feelings while in nature. The children expressed a wider array of emotions towards animals, including negative emotions, which is consistent with previous findings (Olivos-Jara et al. 2020). For animals, negative emotions can inhibit engagement and pro-social behaviour (Kelemen, Brown, and Pizza 2023). Within this programme, many of the expressed negative emotions towards animals were pre-established, such as fear or disgust towards snakes, while only few were elicited momentarily, such as annoyance or shock due to sudden movement. Therefore, interventions including some of the more unpopular species, such as snakes, might need to focus on reducing these negative emotions to promote engagement (see e.g. Ballouard et al. 2012, for an intervention including scary and Randler, Hummel, and Prokop 2012, for an intervention including disgusting animals).

Only one negative emotion was expressed towards a natural element that was not an animal, the dislike of the smell of a flower. Therefore, the expressed emotions towards other natural entities point towards different challenges to address within interventions. At first glance, the almost complete absence of negative emotions about natural elements, apart from animals, may seem positive. However, this can also be taken as a further indication that, apart from positive feelings about the nice aesthetics of nature, no strong emotional connections are formed, which fits with children also using emotion expressions with less intensity when talking about plants and other natural kinds, e.g. 'like' instead of 'love', which was used for animals. While aesthetics are an important factor for expressing concern and pro-social behaviour towards something (Collado, Rodríguez-Rey, and Sorrel 2022; Gunnthorsdottir 2001; Henseler Kozachenko and Piazza 2021; Klebl, Luo, and Bastian 2022), emotions have been found to be the best predictor of pro-social behaviour in children (Junker, Neldner, and Liebal 2023; Kelemen, Brown, and Pizza 2023). The stronger emotional connection towards animals compared to plants might explain why children show more concern for animals compared to plants (Collado and Sorrel 2019). Therefore, strategies to build a more emotional connection between children and plants should be developed. For example, presenting plants as living organisms that have (emotional) reactions towards their environment, such as suffering, can increase empathy, compassion and pro-social behaviour towards them (Hall 2022; Prokop, Belzárová, and Tomanová Čergeťová 2025; Verdijk et al. 2015).

It is also important to note that emotions children expressed towards elements outside of the intervention programme, such as their school or homelife were more varied, for example, one child expressed sadness at having to leave primary school soon, whereas another was reminded of many happy family moments during the programme. While children's general emotions towards their life are hard to influence during an environmental education programme, there is some evidence that children's general mood during programme participating impacts their engagement (Friedman

et al. 2024). Therefore, educators should be mindful of that and try to create a positive experience of the programme for the children regardless of their mood, something that seems to have been achieved within the Generation Wild programme demonstrated by the overwhelmingly positive emotional response towards the programme by the children.

4.4. Limitations and further research

A limitation of this research is that the interviewed children might not have been representative of all the children participating in GW, as written parental consent for interviews could only be obtained for less than 5% of GW participants. Apart from selection bias for individual parents and children, the sample also included no children from years 1 to 3 (5–7 years) and only children who visited in one of the seven WWT wetland centres. There is also evidence that the children in the sample behaved differently from other children participating in GW. Children who were interviewed about their photos took less than half the number of photos than the other children, which might indicate that they were more intentional in their photo-taking, as they knew that they would be asked about them afterwards. Further research with a more diverse set of children would be valuable in determining whether results can be generalised to other children. Given that studies involving digital photography have high ethical requirements (Kleine, Pearson, and Poveda 2016), this sampling bias is difficult to avoid.

This research only focused on one part of the GW programme: the school trip to the wetland centre. Therefore, only initial intermediary outcomes could be assessed. As these are the first steps in longer processes, longitudinal research is required to assess the long-term effects of these outcomes. Follow-up activities at home or at school are built into the programme design. However, completion is up to the children, their families, and their teachers. From the data WWT collected during their internal evaluation of GW, it is known that while follow-up numbers are steadily increasing, there is still a substantial number of children whose teachers have never set them up on the GW website. This means that they cannot do follow-up activities even if they want to. Research investigating differences between children in outcome measurements—whether primary, intermediary, or secondary outcomes—based on their follow-up behaviour would be valuable to evaluate the effectiveness of the follow-up and the programme overall. Furthermore, in this study only intermediary outcomes that were deemed especially relevant for the GW programme were investigated, but these are not the only intermediary outcomes that present stages on the way to achieve nature connection or behavioural change more broadly. Other intermediaries relevant for later stages, such as knowledge acquisition, need to be explored in future research.

As a next step, an experimental or quantitative approach could be employed to assess whether differences in intermediary outcomes affect the primary and secondary outcomes. For example, it could be investigated whether children who expressed more positive emotions during the trip also performed higher on well-being or nature connection measurements after the trip.

Furthermore, the five pathways to nature connection framework (Lumber, Richardson, and Sheffield 2017) could not be fully confirmed within this research with children. Some pathways within the framework, meaning and compassion, could not be confirmed and additional pathways, other people and characteristics of natural elements, could be identified. Future research should investigate different pathways to nature connection further to develop a pathways to nature connection framework more suitable for children.

5. Conclusion

This study provided new insights into intermediary outcomes of environmental education. The evaluation showed that the GW programme was effective at reaching the intermediary outcomes of situational interest, engagement with nature through different pathways, and positive affect. Children expressed an interest in a variety of different elements of the programme, connecting to nature mainly through contact, emotions, and beauty, and experiencing mostly positive emotions during their participation.

A finding for all three intermediary outcomes was that children showed different patterns of engagement with a variety of natural entities. This indicates that nature is not one thing, but rather a union of many different individual entities and species that all have individual properties that lead to different interactions between them and children. To successfully design intervention programmes to alter children's relationship with nature, different strategies must be employed, depending on the focus of the programme. For example, to successfully connect children to plants the challenge is to awaken interest in plants and form an emotional connection with them that leads to further engagement (see e.g. Wyner and Doherty 2022 for an EE programme regarding trees). By contrast, when the focus is on animals, there is less need to awaken interest but negative emotions towards them need to be overcome (see e.g. Randler, Hummel, and Prokop 2012 for an EE programme regarding unpopular animals). If the focus is on nature in general, an environmental education programme needs to include a variety of different strategies to accommodate different pre-existing relationships with various natural entities and species. Only then can the ultimate goal of environmental education, promoting sustainable behaviour towards all aspects of the natural environment, be reached.

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CRediT: **Magie Junker**: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft; **Kersty Hobson**: Supervision, Writing – review & editing; **Wouter Poortinga**: Supervision, Writing – review & editing; **Jonathan P.**

Reeves: Supervision, Writing – review & editing; **Julia Newth**: Supervision, Writing – review & editing; **Mark Stead**: Resources, Writing – original draft; **Morgan Marshall**: Resources, Writing – review & editing; **Merideth Gattis**: Supervision, Writing – review & editing.

Disclosure statement

MM, JN, JR, and MS are employed by WWT. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

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Data availability statement

At the end of the project, data will be deposited in ReShare, an online data repository of the UK Data Service.

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