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ABSTRACT

As tourism research has paid limited attention to children, this study investigates children's reactions to tourism development, focusing on their unique viewpoints on the World Heritage Site of Dubrovnik, Croatia. It employed cognitive neuroscience methods with 397 participants, revealing that, despite their preference for sustainable tourism scenarios, children exhibit a notable fixation on images emblematic of overtourism and associated challenges, particularly overcrowding. When exposed to sustainable tourism photographs, there was an observable increase in physiological arousal, albeit not as pronounced as when confronted with an overtourism scenario. Intriguingly, regardless of the scenario, children predominantly expressed neutral emotions. Within the sustainable tourism context, gender differences manifest as girls exhibiting lower levels of place attachment. Furthermore, inner-city residents exhibit diminished levels of nature connectedness, and emotions are indirectly linked to nature connectedness, place attachment, or pro-environmental behaviour. Conversely, in the unsustainable scenario, older children and inner-city residents exhibited a heightened sense of neutrality towards overtourism-related concerns, whereas those outside the inner city displayed a stronger affinity for nature connectedness. Positive emotions were negatively associated with nature connectedness and pro-environmental behaviour but positively associated with place attachment. Accordingly, this study advocates a more inclusive and sustainable future through children's empowerment in tourism development.

Introduction

The global tourism industry has been at a crossroads in recent years. Given increasing overtourism, it faces multifaced challenges that demand immediate attention (Hall, 2019; Higgins-Desbiolles, 2018, 2020a; Rutty et al., 2015). These challenges encompass the intertwined goals of social

justice, environmental sustainability, and economic prosperity, navigating which has become increasingly urgent (Higgins-Desbiolles, 2020a). The tourism sector's (lack of) sustainability has drawn heightened scrutiny, sparking a surge in research (Font et al., 2023) to inform policy decisions and address climate change concerns (Loehr & Becken, 2021; D. Scott, Hall, et al., 2019), fortify socio-ecological systems (Cheer & Lew, 2017), and advocate for responsible and transformative travel (Mihalic, 2016). Many of these critical contemporary challenges are anthropogenic (Sharpley, 2020), largely reflecting a failure to adapt human behaviour towards greater environmental consciousness (N. Nguyen & Johnson, 2020) for a more sustainable future, hence the "code red" to address the issue of sustainability in tourism and cognate industries (Higham et al., 2022).

Studies on human behaviour show how environmentally sustainable behaviour has different drivers, many in the environmental psychology and sustainable tourism stream (see Bilynets & Knežević Cvelbar, 2020; Collado & Evans, 2019; Filimonau et al., 2018; Gosling & Williams, 2010; Juvan & Dolnicar, 2014, 2016, 2017; Kormos & Gifford, 2014; Mandić & Vuković, 2022; Miller et al., 2015; Steg & Vlek, 2009). Despite progress in understanding human (tourist) behaviour (Bilynets & Knežević Cvelbar, 2020), the tourism industry's movement towards enhanced sustainability over the past three decades has remained largely incremental (Sharpley, 2020). This inertia primarily stems from the prevalence of incremental strategies that perpetuate the *status quo* rather than radical innovations that seek to disrupt existing practices (Brooker & Joppe, 2014). Consequently, the adverse impacts associated with excessive tourism development continue to escalate (Higgins-Desbiolles, 2020b; Higgins-Desbiolles et al., 2019). Considering these challenges, innovative and radical approaches are imperative to catalyse the transformation of tourism and society towards greater responsibility, environmental stewardship, and social justice (Higgins-Desbiolles, 2020a).

Children have emerged at the forefront of the global call for sustainability as potential agents of change, taking on activist roles dedicated to addressing critical sustainability issues, such as *Friday for Future* or *Extinction Rebellion* (Moor et al., 2021). Aligned with the recent UNICEF (2019) report, this study recognises children as dynamic "agents of change" who possess the capacity to drive a paradigm shift in the current economic development model (Séraphin et al., 2022). Within the framework of a burgeoning childism research stream, which views children as socially constructed agents (Wall, 2019), this study advocates a heightened focus on the development of environmental norms (De Groot & Steg, 2009; Steg & de Groot, 2010) in children's education across all aspects of their lives (Schill et al., 2020). This emphasis on inculcating environmental norms serves as a crucial cornerstone for fostering a better future (Costa et al., 2019; McCrae et al., 2021; Villarreal & Heckhausen, 2015).

However, a pivotal milestone involves understanding how children react to excessive tourism development, as knowledge and awareness of issues are fundamental to developing such norms (Costa et al., 2019; McCrae et al., 2021; Villarreal & Heckhausen, 2015). While children are, indeed, the tourists of tomorrow, their perceptions often differ significantly from those of adults (Canosa et al., 2018, 2019; Canosa and Graham, 2016; Poria and Timothy, 2014). Unfortunately, tourism research has, until recently, paid limited attention to children (Josefsson & Wall, 2020). The importance of involving children in sustainability issues cannot be overstated, as they are future tourists and policymakers. Their engagement in sustainability concerns is key to shaping a more sustainable future (Séraphin et al., 2020; Unterhalter, 2019).

One critical facet supporting this perspective is the understanding that what children learn and embrace as sustainable practices during their formative years profoundly shapes their adult behaviour. As illustrated by Schill et al. (2020), personal, environmental, and behavioural determinants significantly mould environmentally responsible behaviour among children. Exposing children to sustainable practices at a young age can foster environmental sensitivity and awareness. Moreover, Mandić and Vuković (2022) highlight a noteworthy trend of growing ecocentrism among youths, particularly concerning the negative impacts of overtourism. This heightened

awareness suggests a potential shift in attitudes towards more sustainable and responsible tourism practices as they mature and take on decision-making roles.

Indeed, investing in children's education and exposing them to sustainable practices during their formative years are vital. Empowering children as sustainability advocates can nurture the generation of policymakers who prioritise environmental and social well-being in decision-making processes. Thus, policymakers, educators, and society today must ensure that children are equipped with the knowledge and values necessary to drive positive change and build a sustainable future.

This study addresses crucial gaps in our understanding of children's reactions to tourism development by building on the relevant literature. It delves into their unique perspectives as host community members by examining their attitudes, values, and emotional responses for comprehensive insights into the interactions between tourists and children. Further, it investigates how the reactions shape children's affection towards nature, the city, and their future behaviour, providing valuable insights to promote sustainable tourism practices. By actively involving children in decision-making processes and considering their reactions, this study fosters transformative advocacy for sustainability within families, schools, and communities, thereby contributing to the development of more inclusive and responsible tourism strategies. Accordingly, the study addresses the following research questions:

How do children react to contrasting scenarios of tourism development, differentiating between positive-sustainable and negative-unsustainable contexts, and are there variations in their reactions based on gender, age, and area of residence? How does long-term exposure to overtourism influence children's nature connectedness, pro-environmental behaviour, place attachment, and tolerance of the negative consequences of tourism development?

Literature review

Lifespan theories—social cognitive theory

Lifespan development theories focus on individual development, recognising that each period of life has unique challenges and accomplishments (Chibucos et al., 2004). The two central tenets of these theories are the influence of biological and cultural factors on individual development and the acquisition of culturally transmitted knowledge (Baltes et al., 1998). Lifespan development exhibits characteristics such as "*plasticity*", allowing individuals to adapt their behaviour across their lifespan based on contextual factors (see Baltes et al., 1977; Burton et al., 2022; Villarreal & Heckhausen, 2015; West-Eberhard, 2008). Further, along with plasticity, "*contextual factors*" within families, schools, cities, and countries influence personal development *via* historical, economic, societal, and cultural aspects (Baltes et al., 1977; Villarreal & Heckhausen, 2015).

The domain of personality has garnered significant attention within lifespan theory studies exploring the association of the big five personality traits—*neuroticism, openness to experience, agreeableness, conscientiousness,* and *extraversion* (see Milfont & Sibley, 2012)—with environmental engagement. Notably, *agreeableness* and *conscientiousness* positively influence environmentally conscious behaviour (Milfont & Sibley, 2012). Personality traits interact with external environments, shaping beliefs, values, emotional reactions, and behaviours (McCrae et al., 2021). Early personality development is crucial for predicting future outcomes, including behavioural and emotional reactions (Costa et al., 2019; Herzhoff et al., 2017). Recent attempts to change personality traits have yielded promising empirical evidence; however, the nature of intervention-driven personality change and the factors promoting successful interventions remain ambiguous (Hudson, 2021). Therefore, creating a supporting contextual environment for the development of sustainable thinkers and responsible children in the future is a desirable and feasible alternative.

Among human development theories, Bandura's (1986) social cognitive (social learning) theory offers insights into how individuals learn and translate information into knowledge and behaviour

across their lifespan. In the pro-environmental behaviour domain, this theory is an alternative to widely used theories, such as the planned behaviour and norm activation theories (see Sawitri et al., 2015). Social cognitive theory emphasises self-efficacy, where people's actions are influenced by their self-assessment of their capabilities and the expected outcomes of their actions, considering external influences (Bandura, 1986). By understanding these cognitive processes and the interplay between internal and external influences, this study seeks to uncover the critical factors that promote environmentally conscious actions among children, contributing to developing effective strategies for raising future sustainability thinkers.

Understanding children's perception of tourism development

Research on children's perceptions of tourism development remains underexplored, as they traditionally focus on adult members of host communities (Almeida García et al., 2015). However, the transformational nature of tourism affects the entire community, including children, making more in-depth insight into their perspectives essential (Koščak et al., 2023; Yang et al., 2020). Children's perceptions of tourism can differ from those of adults because of various factors, including cognitive development, limited experience, and different travel priorities (Bleidorn et al., 2021; Canosa et al., 2019; Otto et al., 2019). Their cognitive abilities are evolving, inducing a more immediate and emotionally driven understanding of tourism focused on their direct experiences rather than broader implications. Moreover, children may have limited exposure to diverse travel destinations and varying tourism practices, resulting in narrower perspectives on the overall impact of tourism. While some children may exhibit strong environmental awareness, others may not fully grasp tourism's ecological consequences (Collado et al., 2015; Collado & Evans, 2019). Similarly, their understanding of the social and cultural complexities of tourism may be limited. Trusted adults can also influence children's perceptions, shaping their views on tourism's impacts (Costa et al., 2019; McCrae et al., 2021). Recognising these differences, it is essential to provide children with age-appropriate educational materials and engage them in activities that cater to their unique perspectives.

A recent study involving children aged 11–16 years revealed their negative attitudes toward tourism development, primarily regarding perceptions of power relations between tourists and locals (Koščak et al., 2023). Additionally, attempts to evaluate children's perception of tourism impacts *via* illustrations and interviews have yielded inconsistent results (Ertaş et al., 2021; Yang et al., 2023), warranting further research, particularly regarding future behaviours. Understanding the linkages between children's attitudes toward tourism development and their subsequent behaviour is crucial for designing an appropriate contextual environment that fosters future sustainability thinkers and developing interventions to influence desired changes in personality traits during early childhood when they are being shaped (McCrae et al., 2021). Thus, the social cognitive perspective underpins this study's exploration of the concepts and informs the approach to address sustainability challenges among children. Therefore, the study proposes the first hypothesis:

> H1—Children's reactions to photographs differ per age, gender, and area of residence. *H1a (H1b) regards a positive (negative) scenario.*

H1 examines children's responses to two distinct scenarios: a positive scenario with sustainable tourism development, reflecting responsible tourism with minimal harm to the destination, and a negative scenario characterised by overtourism issues, depicting the adverse effects of overtourism, including overcrowding and littering (see Subsection "Evaluation of the children's reaction to photographs"). The study investigated how children's age, gender, and location influenced their reactions and emotions when exposed to these scenarios. This investigation furnishes insight into whether demographic factors shape

responses and attitudes, revealing potential effects on future behaviour and environmental consciousness.

Pro-environmental behaviour: shaping sustainable choices

With escalating environmental concerns, the study of pro-environmental behaviour has gained significant momentum. Social science researchers recognise the importance of understanding which behaviours should be changed, the contextual factors influencing them, the feasible policies and interventions driving positive change, and the expected outcomes of such initiatives (Steg & Vlek, 2009).

Over the past decade, considerable attention has been directed toward understanding and influencing consumer behaviour in various contexts (Asadi et al., 2021; Filimonau et al., 2018; Kos et al., 2016; T. N. Nguyen et al., 2016; N. Nguyen & Johnson, 2020; Qu et al., 2019). Scholars have drawn on various theories, such as planned behaviour and goal-framing theories and the norm activation model (Meng & Choi, 2016). Environmental psychology has been crucial to identifying drivers of environmentally conscious consumption, including values; norms; identity; moral obligations; and environmental, normative and social concerns (Abrahamse, 2019; Balundė et al., 2019; De Groot & Steg, 2009; Lindenberg & Steg, 2007; N. Nguyen & Johnson, 2020; Steg & Vlek, 2009). Strategies to drive positive change have been explored, ranging from education to penalties, interventions targeting perception and knowledge transformation, and contextual redesigns to promote environment-friendly choices (Abrahamse 2019; Ertz et al. 2016; Kos et al. 2016; Messick et al. 1983).

In the context of sustainable tourism, studies have largely focused on environmentally conscious behaviour (Han, 2021; Loureiro et al., 2022). Scholars have investigated the factors influencing such behaviour (Gupta & Sharma, 2019; He & Filimonau, 2020; Huang et al., 2019; Mandić, Walia, & Kautish, 2023; Mandić & Vuković, 2022; Meng & Choi, 2016; Poudel & Nyaupane, 2017; Saleem et al., 2021; Tkaczynski et al., 2020; Wu & Geng, 2020), strategies for inspiring sustainable consumption (Cheng & Wu, 2015; Errmann et al., 2021; Esfandiar et al., 2019; Kim, 2012; Lin & Lee, 2020; Oliver et al., 2019; Warren & Coghlan, 2016), and predictive models for pro-environmental behaviour (Choi & Kim, 2021; Rezapouraghdam et al., 2021). A recent meta-analysis (Bilynets & Knežević Cvelbar, 2020) highlights the transition from contextual and sociodemographic to psychological determinants (e.g. norms, goals and emotions) in understanding pro-environmental behaviour (Juvan & Dolnicar, 2016, 2017; Mandić & Vuković, 2022; Miller et al., 2015).

Childhood experiences with nature are key to fostering environmental concerns (Palmer & Suggate, 1996). However, knowledge of the development of environmental attitudes and behaviours during childhood and the influence of unique contexts is scanty (Bleidorn et al., 2021; Otto et al., 2019). Some longitudinal studies indicate that environmental attitudes and behaviours in children increase around the age of seven and remain stable until approximately 10 years, declining afterwards (Collado et al., 2015; Collado & Sorrel, 2019). The scarcity of empirical studies on children's pro-environmental behaviours has yielded inconsistent results in explaining such behavioural patterns, primarily drawing on determinants established in environmental psychology, such as affinity toward nature (Collado et al., 2015), expected outcomes of such behaviours (Collado & Evans, 2019), connectedness to nature (Otto & Pensini, 2017), place attachment (Hartig et al., 2001), and learning opportunities (Chawla & Derr, 2012).

Contextual factors regarding cultural and socioeconomic development play a crucial role in shaping early personality, providing a foundation for pro-environmental behaviour (Costa et al., 2019; McCrae et al., 2021; Villarreal & Heckhausen, 2015). However, few studies address these factors. This study bridges the gap by exploring children's reactions and attitudes in a unique socioeconomic development context to understand how these factors influence their affinity for cities, nature, and pro-environmental behaviour. Drawing on lifespan and social cognitive

theories, this research sheds light on the dynamic interplay between children, their environmental and pro-environmental attitudes, and their behaviours. The next hypotheses, thus, follows:

H2—Children's attitudes towards pro-environmental behaviour differ per their sociodemographics. *H2a (H2b) regards a positive (negative) scenario.*

H6—Children with different reactions to viewed photos (visual attention, arousal, and emotions) exhibit diverse attitudes towards pro-environmental behaviour.

H6a: Children with positive reactions to photographs (visual attention, arousal, and positive emotions) in a sustainable scenario exhibit positive attitudes towards pro-environmental behaviour.

H6b—Children with negative reactions to photographs (visual attention, arousal, and negative emotions) in an unsustainable scenario exhibit positive attitudes towards pro-environmental behaviour.

Accordingly, this study sheds light on the complex interplay between children, their environmental attitudes, and pro-environmental behaviour for a better understanding of how variations in children's attitudes towards pro-environmental behaviour in different scenarios (including their diverse attitudes towards pro-environmental behaviour per their reactions to photographs, as in H6) are influenced by sociodemographic factors and emotional responses. It elucidates the role of affection toward nature and place attachment in shaping sustainable choices among children.

Affections toward nature: environmental connectedness and place attachment

The profound connection between nature and humans (often referred to as environmental connectedness and place attachment) has been recognised for its transformative potential, potentially influencing behavioural patterns (Deville et al., 2021; Gkargkavouzi et al., 2019; Krettenauer et al., 2020; Martin & Czellar, 2017). However, it remains unclear whether such connectedness drives or mediates pro-environmental behaviour (Mayer & Frantz, 2004; Nisbet et al., 2009). While studies on connectedness have focused on Western societies (Krettenauer et al., 2020), cross-cultural community-level research can furnish fresh insights and inform strategies for positive change (Ives et al., 2017; Mandić, Walia, & Rasoolimanesh, 2023; Zylstra et al., 2019).

Research exploring this connection with nature suggests that this association is age-dependent and typically low during childhood (Krettenauer et al., 2020), with no significant gender-based variation (Di Fabio & Rosen, 2019). As research has shifted from the cognitive to the emotional dimension of connectedness with nature (Zylstra et al., 2019), affective strategies have been suggested to inspire environmentally conscious consumption (Restall & Conrad, 2015). However, empirical evidence on the causal connection between environmental awareness, emotional affinity toward the environment, and children's behaviour remains limited. Thus, the efficacy of affective factors as drivers of desired personality development and behaviours in this age group requires further investigation. Within the sustainable tourism domain, environmental connectedness and place attachment have also received considerable attention (Bilynets & Knežević Cvelbar, 2020). However, most studies treat them as predictors of pro-environmental behaviour rather than exploring them as a standalone concept (Basu et al., 2020). Hence, the study proposes the following hypotheses:

H3—Children's attitudes towards nature connectedness vary per their sociodemographics. *H3a (H3b) regards a positive (negative) scenario.*

H4—Children's attitudes toward place attachment vary per their sociodemographics. *H4a (H4b) corresponds to a positive (negative) scenario.*

H5—Children with different reactions to photographs (visual attention, arousal, and emotions) demonstrate diverse attitudes towards nature.

H5a—Children with positive reactions to photographs (visual attention, arousal, and positive emotions) in a sustainable scenario exhibit positive attitudes towards natural connectedness.

H5b—Children with negative reactions to photographs (visual attention, arousal, and negative emotions) in an unsustainable scenario exhibit positive attitudes towards nature connectedness.

H7—Children with different reactions to viewed photographs (visual attention, arousal, and emotions) exhibit diverse attitudes towards place attachment.

H7a—Children with positive reactions to photographs (visual attention, arousal, and positive emotions) in a sustainable scenario exhibit positive attitudes towards place attachment.

H7b—Children with negative reactions to photographs (visual attention, arousal, and negative emotions) in an unsustainable scenario exhibit positive attitudes towards physical activity.

By examining these hypotheses, this study contributes to a better understanding of how children's emotional reactions to photographs affect their attitudes toward nature and place attachment. Figure 1 illustrates the study model, summarising the hypotheses.

Methods

This study adhered to the rigorous guidelines for laboratory experiments proposed by Viglia and Dolnicar (2020). The following sections provide a comprehensive breakdown of each pivotal step of the research methodology.

Neuroscience techniques in tourism research

The application of neuroscience research methods to tourism began in 2014 (Kim et al., 2014). Since then, 52 studies based on this approach have been published in 32 scientific journals (Al-Nafjan et al., 2023). These studies explore various aspects of tourism, such as destination advertisements, accommodation, experiences, and pricing, using techniques such as electrodermal activity (EDA), electroencephalogram, eye tracking (ET), and facial electromyography (fEMG), which, in many cases, demonstrate better performances than traditional self-report measures (Bastiaansen et al., 2018, 2022; González-Rodríguez et al., 2020; S. Li et al., 2018a; Michael et al., 2019; Zoëga Ramsøy et al., 2019). The combination of neuro-techniques and traditional surveys
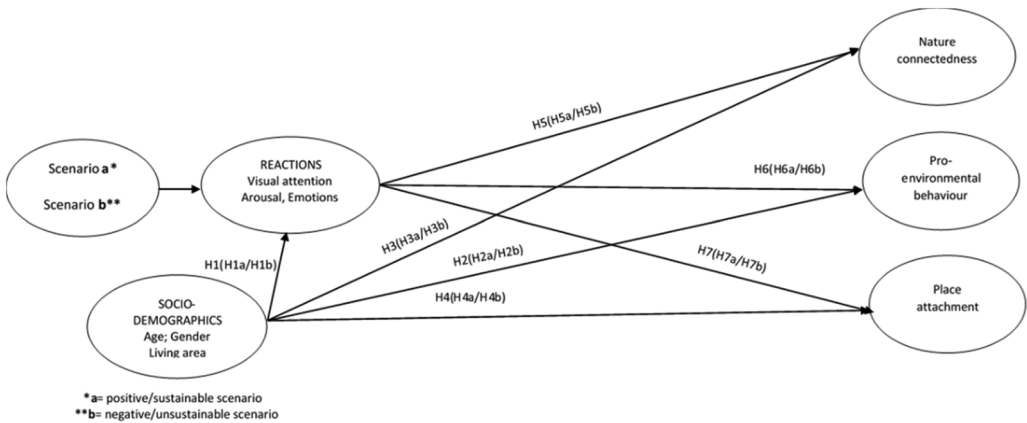

Figure 1. Conceptual model.

has been highlighted as beneficial for understanding emotional experiences in tourism (Hadinejad et al., 2019). Further, these methods have been employed to analyse tourist behaviour, perceptions, and preferences for destinations (Hong et al., 2022; Lever et al., 2019; Pike et al., 2022). Recent research has also explored the impact of specific stimuli such as cartoons on children's attention towards tourism photographs (M. Li et al., 2020). Overall, neuroscience techniques have proven valuable for gaining insights into tourist responses and preferences (N. Scott et al., 2020; Zhao et al., 2022). While some apply neuroscience techniques to children (e.g. M. Li et al., 2020), the novelty of this study lies in its perspective of the host community, where tourism is essential to economic development. This unique approach contributes to a better understanding of emotional experiences from the local community's viewpoint, creating a foundation for building a more sustainable tourism industry and resilient communities in popular destinations.

Research design

This study employed a group of 10 child psychologists working in schools in Dubrovnik in the research design process. The research comprised two stages: (1) analysis of children's reactions towards photographs showcasing sustainable and unsustainable tourism development in Dubrovnik, and (2) a self-administered questionnaire to explore how children's reactions to tourism development affect their inclinations toward pro-environmental behaviour, nature connectedness, and place attachment.

The child psychologists helped in the selection of photographs (out of 65, 42 were retained) and the adjustment of scale items to facilitate evaluation and comprehension. Before conducting the main research, a pre-testing phase helped validate the photographs and questionnaires. Fifteen children from various age groups participated in this pre-test, and various research methods were applied to gauge their appropriateness and effectiveness.

Two experimental scenarios were developed. *Group 1* included 21 photographs showcasing sustainable tourism (e.g. photographs showcasing conservation efforts, responsible activities, eco-friendly accommodations, and the empowerment of local people), and *Group 2* included 21 photographs displaying the consequences of overtourism in Dubrovnik (e.g. overcrowding, traffic congestion, littering, and disrespectful visitor behaviour) (Peeters et al., 2018; Sharpley, 2020). Experienced researchers who had lived in the city for over four decades and witnessed a tourism-induced transformation selected context-specific photographs, providing an authentic and insightful portrayal of the impact of tourism. Their in-depth understanding of the area enabled them to capture meaningful images that showcase the positive and adverse changes induced by tourism practices. Both scenarios had photographs of the same size and quality, with permission from the Dubrovnik Tourist Board. The study employed a between-subjects design, where each child was exposed to only one scenario.

As the two groups were randomly organised, the study obtained causal estimates by comparing the reactions of children in Group 1 (sustainable experimental scenario) with those of children in Group 2 (unsustainable) (Charness et al., 2012). After being exposed to photographs, both groups completed the same questionnaire to determine whether there were any differences in their attitudes towards pro-environmental behaviour, nature connectedness, or place attachment between these two groups.

Evaluation of the children's reaction to photographs

Few studies examine tourism utilising a combination of different behavioural neuroscience techniques (Al-Nafjan et al., 2023; Boz et al., 2017; Hadinejad et al., 2019). This study adopted a combined approach to address the advantages and disadvantages of each technique and comprehensively analyse children's reactions to photographs. It employed ET to analyse visual

attention, EDA/galvanic skin response (EDA/GSR) to detect arousal, and facial expression analysis (FEA) to determine the valence (+/−) and type of emotions evoked by different scenarios. Moreover, it collected self-reported data to further enhance the analysis.

The study collected data on children's visual attention using the ET technique *via* a Smart Eye AI-X tracker at a sampling rate of 60 Hz, attached to a monitor (27 inches) with a 1920×1080 resolution. This technique monitors eye movements on a screen using an ET camera to understand their visual processing behaviours. This study used an optical device to detect eye movements recorded automatically using the *iMotions 9.3* software. It used heatmaps to reflect the children's visual attention to the displayed photographs. The variables included fixation count, time to first fixation (TTFF), dwell time, average fixation duration, saccade count, and average saccade duration. The study employed these variables following previous tourism research (Barcelos et al., 2019; Hong et al., 2022; Kong et al., 2019; Lever et al., 2019; S. Li et al., 2018a; M. Li et al., 2020; Lourenção et al., 2020; Pike et al., 2022; N. Scott et al., 2020; Shi et al., 2021; Zhao et al., 2022). The fixation count is the number of fixations recorded inside an area of interest (AOI) and shows how often children's eyes stop at one or more parts of a photo. This tool defines the areas of a presented stimulus and selects specific metrics for the specific part of the stimulus. TTFF is the timestamp of the first fixation inside the AOI. The study measured the average duration of fixation inside the AOI to present the children's time on one fixation or gaze. Only respondents who watched the AOI contributed to this metric. Saccades were eye movements between fixations. They showed a path until fixation. A longer duration and a higher number of saccades indicated a shorter fixation duration. The dwell time is the total time participants spent looking at an AOI (Casado-Aranda et al., 2023; M. Li et al., 2020; N. Scott, Zhang, et al., 2019).

The study employed the EDA/GSR technique to track children's emotional arousal towards sustainable and unsustainable stimuli. A Shimmer 3 EDA/GSR device was used to collect the data. The galvanic skin response is a function of the sympathetic nervous system that is triggered automatically and cannot be controlled by will or cognition (Sun et al., 2012). The two main components of EDA/GSR analysis are the skin conductance level (SCL) and skin conductance response (SCR). The first slowly changes part of the EDA/GSR signal and is computed as the mean value of the skin conductance. The second fast-changing part of the EDA/GSR signal occurs relative to a single stimulus. The data underwent several filtering steps to ensure measurement accuracy and avoid the underestimation of the SCR amplitude. First, the study extracted the average to normalise the data and provide a clearer view of the process. It then removed background noise using a low-pass filter to eliminate lower-range signal values. Additionally, it set specific thresholds for the onset, offset, peek amplification, and signal jump to refine the data. The study set the onset at >0.1 μS to filter the signal direction; it set the offset at <0.0 μS. It then set the peek amplification threshold to 0.05 μS, and the signal jump threshold limited peek amplification amounts that passed 0.1 μS. Widely used parameters for the EDA/GSR include the SCR amplitude and latency and the average SCL value (Sun et al., 2012). The EDA/GSR metrics applied were the number of peeks, peeks per minute, and average peek amplitude (Bastiaansen et al., 2022; Di-Clemente et al., 2022; Hadinejad et al., 2019; Kim et al., 2014; S. Li et al., 2018a).

The study employed FEA using the *iMotions* AFFDEX software based on a frame-to-frame analysis of static photographs or videos (at 30 fps). First, the study detected the position of the child's face in a photograph. Second, it identified the facial landmarks. Third, an internal facial model emerges. This model is a basic version of the actual face, encompassing the facial features required for the technique to be completed (Franĕk et al., 2022). The study then translated the position and orientation information of all the essential features into specific action units built on Ekman's emotional facial action coding system to detect facial expressions (*anger*, *disgust*, *fear*, *joy*, *sadness*, *surprise*, and *contempt*) (Ekman & Friesen, 2007). The iMotions software algorithm transformed the detected values of the raw indicators into Ekman's seven basic

emotions, each represented on a scale of 0–100 based on the probability of appearance, with a value of 50 as the initial threshold. Respondents' attention and engagement ranged from 0 to 100. Valence, indicating positive, neutral, or negative emotions ranged from −100 to 100, with thresholds set at ±50 (Franěk et al., 2022; González-Rodríguez et al., 2020; Hadinejad et al., 2019; Otamendi & Sutil Martín, 2020).

Self-administrated questionnaire

After exposing the children to photographs showcasing sustainable tourism and overtourism in Dubrovnik, the study employed identical self-administered questionnaires for both groups to measure their level of nature connectedness, place attachment, and inclination toward pro-environmental behaviour. The analysis considered children's age (10–14 years and 15–18 years), gender (male, female, and other), and living location (inner city or city surroundings). The study adopted the following scale items from previous research: nature connectedness, tourism pro-environmental behaviour (Basu et al., 2020; Xu et al., 2020), and place attachment (Basu et al., 2020). It required the children to evaluate the items on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Considering the suggestions of child psychologists, the numbers on the scale were substituted with emojis (Figure 2).

Sampling and data collection

This research was conducted from April to June 2022 in Dubrovnik, Croatia, a UNESCO World Heritage Site (since 1979) experiencing irreversible changes associated with overtourism. A sample of 397 children from 15 schools (eight primary and seven secondary schools) was sufficient to achieve acceptable levels of statistical power (80%) in the experimental between-subject research design (Bellemare et al., 2014), as the required sample sizes ranged from 232 to 1054 respondents (Bellemare et al., 2014). For a t-test (difference between two independent groups) with a statistical power of at least 95% and an alpha of 0.05, a minimum sample size of 356 (178 per group) was required for a medium effect size ($d = 0.35$). As the respondents were children, the study increased the sample size by 10%, resulting in 397 participants. Age had two subsamples: 10–14 (primary school) and 15–18 (secondary school) year-olds. The study chose these age ranges because the formal operational phase begins at 11–12 years and lasts into adulthood, during which abstract thinking emerges; thus, they can contribute to logically testing the hypotheses (Piaget, 1964). Additionally, children aged between 12 and 18 years seek a sense of self and identity and explore their values, beliefs, and goals (Erikson, 1950; Tisza & Markopoulos, 2023). This developmental stage also relates to increasing awareness of significant social issues, declining social responsibility, and prosocial action (Eisenberg et al., 2002; Wray-Lake et al., 2016). As per the neuroscience approach in prior studies (M. Li et al., 2020; Moore & Lutz, 2000), the sample did not include children below 10 years.

The study used a stratified random sampling technique regarding age to obtain the representative samples. It grouped children by the class or school they attended. From each group, it randomly selected participants based on age (10 from every age range) for both scenarios.
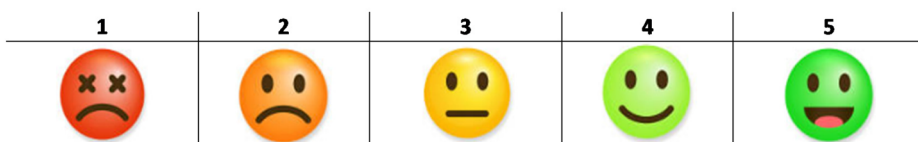
1	2	3	4	5

Figure 2. Emojis used to substitute the five-point Likert scale numbers.

Parents signed consent forms: their children's participation was voluntary, and the researchers ensured the confidentiality of all collected information. Ethical considerations are paramount when involving children in research; indeed, the study integrates the Ethical Research Involving Children approach, emphasising children's rights, respect, and researchers' reflexivity (Powell et al., 2016).

The study obtained equipment from each of the 15 schools. It arranged the controlled conditions of the research location (room) to ensure that a noisy environment did not disrupt the experiment with different distractions. The study employed the following procedures to collect data. First, the researchers explained the research procedure to each child to ensure a better outcome on viewing patterns (Müller et al., 2012). It employed a calibration test on each child before the experiment began to confirm that the average deviations in the two directions were less than 1°. Children with satisfactory calibration (excellent and good) proceeded with the experiment. It then required participants to view every photograph and answer the questionnaire. Further, to ensure the reliability of the survey, it is essential to adjust the length of the tasks to the child's attention span (Goss Lucas & Bernstein, 2005).

A survey is not an engaging task for children and should not require sustained attention for more than 10–15 min (Tisza & Markopoulos, 2023). Considering the number of photographs and the questionnaire length, we allocated eight seconds to watch each photo. We pseudo-randomised the presentation order of the photographs to validate the results and prevent children from identifying the patterns therein. After the experiment with the photographs, the children completed the questionnaire. We processed photographs showing the most reactions for further analysis.

Results

Of the 397 children, 196 were in Group 1 (positive-sustainable scenario) and 201, Group 2 (negative-unsustainable scenario). All age groups (Supplementary Appendix A) were almost equally represented (10.1%–12.6%), except for the youngest respondents (6%). Moreover, 46.6% (53.4%) were males (females). Respondents exposed to photographs displaying sustainable tourism (49.4%) and unsustainable scenarios (50.6%) were almost equal. Further, 54.9% (45.1%) lived in the inner (surrounding) city (cities).

Evaluation of the children's reaction to photographs

Heatmaps
Heatmaps reflected the respondents' visual attention to the displayed photographs. Notably, the analysis involved 42 photographs, displaying sustainable and unsustainable tourism in Dubrovnik. However, the preliminary results demonstrated that the respondents reacted substantially to *heritage photographs associated with overcrowding*, an acute symptom of overtourism. Consequently, further photographs were retained. We coded heatmaps with a red-green spectrum to present the respondents' visual attention and patterns while watching different scenarios. We created final heat maps by merging individual maps for each respondent. The red and green areas represent the longest and shortest fixation times, respectively. Hence, *respondents paid more attention to people in the photographs than other elements, such as cultural heritage* sites (city walls, bridges, towers, and trees). The heat maps of the sustainable and negative-unsustainable scenarios exhibited differences. There were more fixations (red areas) on photographs in the negative-unsustainable scenario than on photographs in the sustainable scenario. Further heat maps were analysed using AOI metrics for in-depth differences between the two scenarios (see Figures 3–7).

Figure 3. Photographs a1/aa. *Source*: Authors' research

Figure 4. Photographs d1/dd. *Source*: Authors' research.

Figure 5. Photographs e1/ee. *Source*: Authors' research.

Area of interest metrics, arousal, and emotions

Supplementary Appendix B lists the AOI metrics of the viewed photographs. The fixation count was higher for the unsustainable photographs (although this difference was not notable), except for photographs e1/ee. The TTFF time was also higher for negative photographs, indicating that participants needed more time until the first fixation. Although the number of fixations was higher for negative photographs, respondents spent more time on positive photographs because the dwell time (in ms and %) was higher for positive photographs. Moreover, the average

Figure 6. Photographs f1/ff. *Source*: Authors' research.

Figure 7. Photographs n1/nn. *Source*: Authors' research.

fixation duration was higher for positive photographs, particularly photographs e1 and n1. The number of saccades and their durations were higher for negative photographs, which aligned with previous results: a higher number of fixations implies a higher (lower) number (duration) of saccades (fixations). Therefore, photographs displaying overtourism attracted children's attention more than positive photographs.

As the positive and negative photographs attracted children's attention, the study analysed whether such stimuli resulted in arousal. It measured the arousal of positive and negative photographs using GSR metrics (Supplementary Appendix C) as follows: *peeks*, whether there are peeks on the photo; *peek count*, number of peeks on the photo; *peek per minute*, number of peeks in a minute; and *average peek amplitude*.

The positive photographs induced a higher number of peeks, though their amplitudes were slightly lower than those regarding the negative photographs. Thus, in Dubrovnik, children exposed to positive photographs showed more arousal, but the intensity was lower than children exposed to photographs displaying overtourism. The study employed Affectiva's metrics (Supplementary Appendix D) to detect the emotion beneath the arousal.

From Supplementary Appendix D, regardless of the photograph displayed (sustainable-unsustainable), the respondents mainly expressed neutral emotions. Surprisingly, children exposed to photographs showcasing overtourism were slightly more "neutral". Positive emotions (joy) were expressed more frequently among children exposed to positive photographs. Negative emotions (*anger, sadness, disgust, fear, and contempt*) were predominantly

expressed by children watching more positive photographs than by those exposed to negative ones. The predominant negative emotions related to the positive photographs were fear and sadness.

Testing the differences between samples (Group 1—Group 2)

The Mann-Whitney U test (Supplementary Appendix E) analysed the differences between children exposed to sustainable and unsustainable scenarios.

Sustainable tourism scenario. Supplementary Appendix E suggests a statistically significant difference in time until the first fixation regarding age, as younger respondents aged 10–14 years required more time until the first fixation on positive photographs. Moreover, younger respondents' dwell times were longer than those of older respondents (aged 15–18 years). Regarding living location, respondents from city surroundings had a longer average fixation duration on positive photographs.

Negative-unsustainable scenario. The number of fixations, average fixation duration, number of saccades, and average saccade duration by gender exhibit statistically significant differences. Females had more fixations, but the average duration was higher in males, followed by a higher number of saccades and their duration in females. *Therefore, there was a higher focus on negative photographs among boys, while girls were fixated on all the photographs*. Regarding age, younger respondents aged 10–14 years needed more time until the first fixation, but their dwell time and fixation duration were longer than those of older respondents. There were no statistically significant differences in the ET metrics for negative photographs regarding location. See Supplementary Appendix F for the GSR results.

Sustainable tourism scenario. The GSR metrics indicate differences in arousal per age, as younger respondents have more peeks per minute than older respondents.

Negative-unsustainable scenario. The GSR metrics show statistical differences regarding age. Younger respondents showed a higher number of peeks, peeks per minute, and average peek amplitudes than older respondents, suggesting that they experienced more substantial arousal. See Supplementary Appendix G for the Affectiva metrics results.

The Affectiva metrics results indicate statistically significant differences in negative emotions about photographs showcasing sustainable tourism, considering gender and age. Males and older respondents tend to express more negative feelings about positive photographs. Considering photographs displaying overtourism, the results indicate statistically significant differences in neutral and negative emotions regarding age and positive emotions regarding the location of residence. Younger respondents tend to have more negative emotions about negative photographs, while older ones have more neutral emotions. Respondents living in the inner city express more positive emotions about negative photographs. These results confirm H1a and H1b.

Self-administrated questionnaire

Below is the connection between sociodemographic characteristics of children (age, gender, and location of living), neuroscience metrics (emotions–AFFDEX, visual attention–ET, and

arousal–GSR), and children's self-assessment regarding nature connectedness, place attachment, and inclinations toward pro-environmental behaviour.

Methodology

We assessed the reliability of the applied measurement scales (nature connectedness, pro-environmental behaviour, and place attachment) using Cronbach's alpha and analysed the impact of certain statements on the Cronbach's alpha coefficient of the corresponding measurement scale. Accordingly, we identified and excluded statements that reduced the reliability of the corresponding measurement scales from further analysis (Kline, 1998). Supplementary Appendix H shows the Cronbach's alpha coefficients for the three measured scales.

The resulting Cronbach's alpha coefficients suggested that the reliability of the applied measurement scales for both scenarios ranged from acceptable to very good and excellent. We then assessed the convergent and discriminant validity of the applied measurement scales using exploratory factor analysis (EFA) (Kline, 1998). Three factors emerged from the EFA using the principal component analysis. Following the Kaiser-Guttman rule for selecting the number of factors in both cases, the study further analysed all factors with an eigenvalue greater than 1. Supplementary Appendix I shows the resulting factor structure with a Promax rotation of the factors.

The three factors selected (retained) in the sustainable (unsustainable) tourism scenario explain 60.7% (58.8%) of the total variance. We excluded statements with factor loadings less than 0.5 in both scenarios from further analysis, three (four) in the (un)sustainable tourism scenarios. The factor structures for both scenarios show that the measurement scales have convergent and discriminant validities, which were tested using confirmatory factor analysis (CFA). CFA also examined the dimensionality of the analysed measurement scales, as it is considered a more rigorous discriminant and convergent validity test (Gerbing & Anderson, 1988). The applied measurement model assumed that every manifest variable loads on one construct (latent variable/impact) and that factors are correlated. Therefore, to test the unidimensionality of the measurement scales, we presumed the independence of measurement errors, along with the manifest variable loading on one factor. Considering the cutoff points for fit values, the proposed models fulfilled these criteria (Kline, 1998). For the *sustainable* ($p = 0.058$; RMSEA = 0.044; GFI = 0.875; AGFI = 0.869; NFI = 0.913; CFI = 0.948) and *unsustainable* ($p = 0.064$; RMSEA = 0.066; GFI = 0.901; AGFI = 0.896; NFI = 0.895; CFI = 0.923) scenarios, the CFA showed that the measurement model fit the data well. As most of the indicators were satisfactory, the CFA confirmed that the measurement scales showed convergent and discriminant validity and the unidimensionality of the applied model.

We applied structural equation modelling (SEM) to test the connections between the aforementioned concepts. The proposed model was tested separately for sustainable and unsustainable tourism scenarios. In both cases, the overall model fit statistics showed that SEM adequately fit the datasets (sustainable tourism: GFI = 0.957, NNFI = 0.878, CFI = 0.926, RMSEA = 0.044; negative-unsustainable tourism: GFI = 0.881, NNFI = 0.820, CFI = 0.908, RMSEA = 0.049).

Results of the analysis: positive-sustainable scenario (a)

Table 1 presents the regression weight estimates for the path model, where *younger respondents experienced a higher arousal* level and enjoyed sustainable tourism more than older respondents. Respondents *living outside the city centre* expressed more positive emotions than those living inside the city centre. Furthermore, *boys showed more negative emotions* about sustainable tourism, particularly those aged 15–18 years with more negative emotions about the sustainable tourism scenario. The results indicated no significant relationship between sociodemographics and pro-environmental behaviour in this scenario, thus rejecting H2a. The relationship between

Table 1. Results of regression weight estimates of the path model: positive-sustainable scenario (a).

			Estimate	SE.	CR.	p
PEEKS_AMP_POZ	<---	Age_gr	−0.020	0.006	−3.120	0.002
PEEKS_AMP_POZ	<---	Gender	−0.007	0.006	−1.095	0.273
PEEKS_AMP_POZ	<---	LOC_GR	0.007	0.006	1.145	0.252
AVR_DWELL_MS_POS	<---	Age_gr	91.071	83.477	1.091	0.275
AVR_DWELL_MS_POS	<---	Gender	3.233	81.724	.040	0.968
AVR_DWELL_MS_POS	<---	LOC_GR	29.835	81.598	.366	0.715
POS_TIME_pos	<---	Age_gr	−3.097	2.319	−1.336	0.182
POS_TIME_pos	<---	Gender	2.860	2.270	1.260	0.208
POS_TIME_pos	<---	LOC_GR	5.542	2.267	2.445	0.014
NEG_TIME_pos	<---	Age_gr	1.301	0.708	1.837	0.066
NEG_TIME_pos	<---	Gender	−2.442	0.693	−3.521	***
NEG_TIME_pos	<---	LOC_GR	−0.196	0.692	−0.284	0.777
NEUT_TIME_pos	<---	Age_gr	1.796	2.545	.706	0.480
NEUT_TIME_pos	<---	Gender	−0.419	2.491	−0.168	0.867
NEUT_TIME_pos	<---	LOC_GR	−5.346	2.488	−2.149	0.032
NAT_CON	<---	PEEKS_AMP_POZ	−1.268	.966	−1.313	0.189
PL_ATT	<---	PEEKS_AMP_POZ	−2.154	1.987	−1.084	0.278
PROEN	<---	PEEKS_AMP_POZ	1.897	1.576	1.204	0.229
NAT_CON	<---	AVR_DWELL_MS_POS	0.856	0.000	1.840	0.066
PL_ATT	<---	AVR_DWELL_MS_POS	0.718	0.000	−1.394	0.163
PROEN	<---	AVR_DWELL_MS_POS	0.922	0.000	1.930	0.054
PROEN	<---	POS_TIME_pos	0.005	0.004	1.045	0.296
NAT_CON	<---	Age_gr	−0.050	0.080	−0.621	0.535
PROEN	<---	LOC_GR	−0.050	0.131	−0.386	0.699
PL_ATT	<---	Age_gr	−0.097	0.165	−0.587	0.557
PL_ATT	<---	Gender	−0.314	0.161	−1.949	0.051
NAT_CON	<---	Gender	0.034	0.078	.437	0.662
PROEN	<---	Gender	0.015	0.132	.111	0.911
PL_ATT	<---	LOC_GR	0.039	0.157	.246	0.806
NAT_CON	<---	LOC_GR	0.130	0.076	1.709	0.087
NAT_CON	<---	NEG_TIME_pos	−0.007	0.009	−0.838	0.402
PL_ATT	<---	NEG_TIME_pos	−0.011	0.018	−0.633	0.527
PROEN	<---	NEG_TIME_pos	0.006	0.015	0.412	0.680
NAT_CON	<---	NEUT_TIME_pos	−0.003	0.002	−1.063	0.288
PL_ATT	<---	NEUT_TIME_pos	0.005	0.005	1.056	0.291
PROEN	<---	NEUT_TIME_pos	0.000	0.004	0.028	0.977

Note: SE: Standard errors; CR: Critical ratios; *p*: *p*-value; ***p-values equal 0.000. *Source*: Authors' research.

nature connectedness, pro-environmental behaviour, and average dwell time was significant and positive ($p < 0.1$): more visual attention to photographs displaying sustainable tourism measured by average dwell time was related to a higher level of nature connectedness and pro-environmental behaviour ($p = 0.05$). Thus, H5a and H6a were partially confirmed, though H7a was rejected, given no statistically significant connections between children's reactions and place attachment. Gender exhibits a significant negative relationship ($p < 0.1$); thus, boys are more place-attached than girls, partially confirming H4a. Additionally, a positive relationship exists between living location and nature connectedness, showing that residents in the inner city display less nature connectedness than those living in city surroundings. Thus, H3a is partially confirmed. *Emotions regarding positive photographs were not directly related to nature connectedness, place attachment, and pro-environmental behaviour.*

Results of the analysis: negative-unsustainable scenario (b)

Table 2 presents the regression weight estimates for the path model, where *younger children experience higher arousal regarding the negative-unsustainable scenario*. Children aged 10–14 years show a higher level of visual attention to photographs showcasing overtourism. Age and neutral emotions toward overtourism showed a statistically significant and positive relationship, showing that *older children have more neutral emotions toward overtourism. Age groups were significantly*

Table 2. Results of regression weight estimates of the path model: negative-unsustainable scenario (b).

			Estimate	SE.	CR.	p
peeks_amp_neg	<---	age_gr1	−0.146	0.033	−2.408	0.015
AVE_DW_MS_neg	<---	age_gr1	−85.833	0.241	−1.627	0.010
POS_TIME_neg	<---	age_gr1	−0.863	1.670	−0.517	0.605
NEG_TIME_neg	<---	age_gr1	0.830	0.619	1.340	0.180
NEUT_TIME_neg	<---	age_gr1	0.030	1.871	1.016	0.098
peeks_amp_neg	<---	gender1	0.011	0.033	0.346	0.730
AVE_DW_MS_neg	<---	gender1	−139.637	114.138	−1.223	0.221
POS_TIME_neg	<---	gender1	1.162	1.669	0.696	0.486
NEG_TIME_neg	<---	gender1	−0.587	0.619	−0.949	0.343
NEUT_TIME_neg	<---	gender1	−0.572	1.869	−0.306	0.760
peeks_amp_neg	<---	loc_gr_1	0.004	0.033	0.113	0.910
AVE_DW_MS_neg	<---	loc_gr_1	−158.397	115.473	−1.372	0.170
POS_TIME_neg	<---	loc_gr_1	4.508	1.688	2.670	0.008
NEG_TIME_neg	<---	loc_gr_1	−0.100	0.626	−0.160	0.873
NEUT_TIME_neg	<---	loc_gr_1	−4.411	1.891	−2.333	0.020
NAT_CON_neg	<---	age_gr1	0.033	0.081	0.410	0.682
PL_ATT_neg	<---	age_gr1	0.094	0.159	0.589	0.556
PROEN_neg	<---	age_gr1	−1.024	0.126	−0.186	0.085
NAT_CON_neg	<---	gender1	0.099	0.080	1.235	0.217
PL_ATT_neg	<---	gender1	0.078	0.157	0.497	0.619
PROEN_neg	<---	gender1	0.099	0.125	0.793	0.428
NAT_CON_neg	<---	loc_gr_1	0.144	0.084	1.712	0.087
PL_ATT_neg	<---	loc_gr_1	−0.114	0.164	−0.691	0.490
PROEN_neg	<---	loc_gr_1	−0.090	0.131	−0.687	0.492
NAT_CON_neg	<---	peeks_amp_neg	0.175	0.192	0.912	0.362
PL_ATT_neg	<---	peeks_amp_neg	0.105	0.376	0.280	0.780
PROEN_neg	<---	peeks_amp_neg	0.022	0.298	0.074	0.941
NAT_CON_neg	<---	AVE_DW_MS_neg	0.000	0.000	1.001	0.317
PL_ATT_neg	<---	AVE_DW_MS_neg	0.000	0.000	1.628	0.104
PROEN_neg	<---	AVE_DW_MS_neg	0.000	0.000	−0.197	0.844
NAT_CON_neg	<---	POS_TIME_neg	−0.270	0.004	−72.066	***
PL_ATT_neg	<---	POS_TIME_neg	3.437	0.007	468.790	***
PROEN_neg	<---	POS_TIME_neg	−3.164	0.006	−543.600	***
NAT_CON_neg	<---	NEG_TIME_neg	0.283	0.010	27.967	***
PL_ATT_neg	<---	NEG_TIME_neg	−3.433	0.020	−173.611	***
PROEN_neg	<---	NEG_TIME_neg	3.177	0.016	202.401	***
NAT_CON_neg	<---	NEUT_TIME_neg	−0.267	0.003	−79.785	***
PL_ATT_neg	<---	NEUT_TIME_neg	−3.442	0.007	−525.938	***
PROEN_neg	<---	NEUT_TIME_neg	−3.162	0.005	−608.537	***

Note: SE: Standard errors; CR: Critical ratios; *p*: *p*-value; ***p-value equal 0.000. *Source*: Authors' research.

($p < 0.1$) *related to pro-environmental behaviour*, partially confirming H2b. *After exposure to the negative-unsustainable scenario, children aged 10–14 show a higher level of pro-environmental behaviour than those aged 15–18.*

Respondents *living in the inner city show more neutral emotions about the negative-unsustainable scenario.* Respondents living outside the inner city experienced higher nature connectedness than those living in the inner city ($p < 0.1$), partially confirming H3b. However, H4b was rejected, as there was no statistically significant relationship between place attachment and sociode-mographics. Other results, statistically significant at the level of $p = 0.000$, show that *positive emotions regarding photographs showcasing overtourism are negatively related to nature connectedness and pro-environmental behaviour and positively related to place attachment*. Thus, children with higher levels of positive emotions have higher levels of place attachment but lower levels of nature connectedness and pro-environmental behaviour in the negative-unsustainable scenario.

Finally, children who expressed more negative emotions in this scenario showed a lower level of place attachment, rejecting H7b. However, children with more negative emotions, higher levels of nature connectedness, and pro-environmental behaviour exhibited a positive correlation,

partially confirming H5b and H6b. Less neutral time and emotions regarding photographs showcasing overtourism suggest a higher level of nature connectedness, pro-environmental behaviour, and place attachment.

Discussion and conclusion

Theoretical contributions

Exposure and reactions to (over)tourism in Dubrovnik

Understanding children's reactions to the impact of tourism development is a critical yet neglected area of research (Canosa et al., 2018, 2019; Yang et al., 2020). Recent studies employing self-reported questionnaires and children's drawings yield conflicting results, with children perceiving tourism as both a "disruptive power for family life and the community" (Koščak et al., 2023; Yang et al., 2023); and a positive force affecting local community development (Ertaş et al., 2021), and life quality (Yang et al., 2023). However, traditional research methods are sensitive to bias, prompting the use of neuroscience and psychophysiological tools to overcome the limitations and explore the affective dimension of children's behaviour with greater precision (Falk et al., 2012).

Relatedly, Kim et al. (2014) highlight the significance of attention and arousal in understanding the emotional responses to tourism. S. Li et al. (2018a, 2018b) show the importance of exploring emotional dimensions in children's reactions to tourism scenarios using skin conductance and fEMG to emotional responses to tourism advertising. Additionally, Muñoz-Leiva et al. (2012) highlight the value of understanding user behaviour in online travel sites. Building on such findings, this study expands the knowledge base by employing neuroscientific and psychophysiological tools for deeper insights into children's emotional connections with tourism scenarios, particularly in the unique context of overtourism.

The results demonstrated how children were more attracted to photographs displaying overtourism and primarily focused on people (crowding) rather than cultural and natural heritage sites. Furthermore, children's reactions given contextual changes were inconsistent. For example, in the sustainable (negative-unsustainable) tourism scenario, the critical contextual factors were age and location (gender). Indeed, the level of pro-environmental interest depends on many factors (Séraphin, 2022). Furthermore, children exposed to photographs displaying sustainable tourism showed more arousal, but the intensity was lower than those exposed to photographs displaying overtourism. Although they mainly expressed neutral emotions regardless of the photograph displayed, negative emotions were predominantly expressed by the children who observed positive photographs. As the challenges associated with overtourism, particularly crowding, have a long history in Dubrovnik, perhaps children associate tourism development with crowding. This attitude can be assimilated into the protective self-representation of a phenomenon to conform to norms (Rui & Stefanone, 2013). Consequently, their attitude matches their expectations given the material (financial) and sociocultural (learning, pride, cultural exchange) benefits of tourism development (Yang et al., 2023; Ertaş et al., 2021).

Factors impacting children's reactions and behaviour

Studies highlight how an individual's behaviour is influenced by some factors, including environment-context, personality, level of education, values, norms, identity, emotions, connectedness with nature, and place attachment (Abrahamse, 2019; Balundė et al., 2019; Burton et al., 2022; De Groot & Steg, 2009; Juvan & Dolnicar, 2017; Lindenberg & Steg, 2007; Mandić, Walia, & Rasoolimanesh, 2023; N. Nguyen & Johnson, 2020; Séraphin, 2022; Steg & Vlek, 2009; Villarreal & Heckhausen, 2015). However, little is known about how environmental attitudes

and behaviours develop in childhood, how unique contexts such as overtourism affect the development (Bleidorn et al., 2021; Otto et al., 2019), or how contextual factors regarding cultural and socioeconomic development affect the development of early personality, which furnishes the foundation for pro-environmental behaviour (Costa et al., 2019; McCrae et al., 2021; Villarreal & Heckhausen, 2015).

The results demonstrate that children who spent more time observing specific AOIs showed a higher level of nature connectedness and inclination toward pro-environmental behaviour. In the sustainable tourism scenario, girls were less attached than boys, whereas older children had more neutral emotions toward overtourism. In the scenario displaying overtourism, children aged 10–14 years showed a higher level of pro-environmental behaviour than those aged 15–18 years. Those living in the inner city showed more neutral emotions about the negative-unsustainable scenario, while children living outside the inner city experienced higher nature connectedness than those living outside the inner city. Furthermore, positive emotions regarding what seems to be overtourism were negatively related to nature connectedness and inclination toward pro-environmental behaviour. These results confirm how (over)tourism development as a unique context, along with gender, age, and distance from the destination (location of living), affects children's sense of connectedness with nature, place attachment, and, ultimately, inclinations toward pro-environmental behaviour. Notably, the COVID-19 outbreak played a significant role in how essential nature became for individuals (Guzman et al., 2021) and how important it was for local authorities to reconnect children with their environment (Séraphin, 2021).

Regarding Dubrovnik, children's exposure to overtourism shapes their behaviour (McCrae et al., 2021; Herzhoff et al., 2017), whereas expectations regarding material and sociocultural benefits affect their conscientiousness (McCrae et al., 2021). Thus, children in Dubrovnik have developed an affection or tolerance for overcrowding and, consequently, overtourism, which negatively influences their relationship with nature, bonds with the city, and, ultimately, pro-environmental behaviour intentions.

Methodology

This study offers a novel methodology, unlike the mostly conceptual methods in prior studies (Bleidorn et al., 2021; Otto et al., 2019). It can help overcome the main limitations of research involving children; that is, their metaphorical and objective visions of the world (Séraphin & Green, 2019) and the provision of an answer to please the investigator. The results suggest that children's reactions, such as visual attention, arousal, and emotions, vary when exposed to different scenarios. Additionally, significant differences regarding sociodemographic factors, such as age, gender, and area of residence, were observed in their reactions to the scenarios. Children living in areas with higher exposure to overtourism (e.g. the inner city) exhibited more positive and neutral emotions when presented with negative-unsustainable scenarios. However, they exhibited lower levels of natural connectedness. Thus, children residing in heavy tourist areas may develop a sense of tolerance and ignorance towards the negative consequences of tourism. The findings shed light on the potential impact of overtourism on children's psychological and emotional connections with their environments.

Childism

Childism is a perspective that challenges the notion that children are passive and powerless individuals controlled by parents or caregivers (Tisdall & Punch, 2012). It views children as active agents socially constructed in their own right (Wall, 2019). This study employs the childism principles by recognising children as insightful informants. Unfortunately, many empirical studies on children often rely on parental surveys rather than directly involving children (Poria & Timothy,

2014). Children's responses are sometimes checked or validated through parental surveys (Lugosi et al., 2016). However, this study takes a progressive approach by directly engaging with children, making them active participants in the research process. This process empowers children and complies with their right to be involved in matters that concern them, such as research on their own lives (Canosa & Graham, 2016).

This study contributes to the emerging field of childism by treating children as socially constructed agents with unique perspectives. Understanding and studying children on their terms furnishes valuable insights into their reactions, emotions, and connections with the environment. This approach enriches our understanding of children's experiences and reinforces the importance of considering their voices and agency in various research domains, including the investigation into the impact of overtourism on children's emotional connections to nature and place attachment.

The implications of this research in the context of childism extend beyond the findings of this study. They advocate for a fundamental shift in how society perceives, engages, and supports children. By valuing children's agency and perspectives, this study opens the door to a more inclusive, empathetic, and sustainable future that prioritises the well-being of current and future generations.

Practical contributions

Amidst the mosaic of children's reactions to diverse tourism scenarios in Dubrovnik, it becomes palpable that their perspectives, imbued with fresh, unconstrained insights, could mould the trajectory of sustainable tourism within the local context and, importantly, offer a scaffold for global applications. The pivotal role of parents, educators, and the tourism industry in nurturing sustainable thinkers goes beyond geographical or cultural confines. Indeed, structuring and interweaving sustainability education into the societal fabric, as exemplified in this study, can cascade into a myriad of settings, transcending the particularities of Dubrovnik's context and folding into the broader tableau of global sustainable tourism initiatives.

Embedding sustainability in curricula involves introducing pertinent modules and engaging in partnerships with local businesses to bridge the gap between theoretical knowledge and practical applications. Children, when exposed to real-world sustainable practices through hands-on experiences, begin to internalise these values, which, as Schill et al. (2020) affirm, can significantly impact their perspectives towards sustainable tourism. This framework can be scaled and adapted in varied educational settings, aligning with regional specifics while maintaining the core of experiential and continuous sustainability learning.

Facilitating parental engagement through organised eco-tours and strategic involvement in trip planning induces family-centric sustainable practices to become normative. The model, where parents communicate the importance of sustainability and actively involve children in it, can unfold across diverse cultural and socioeconomic contexts, offering a universal approach to inculcating sustainability from a tender age.

The tourism industry's role in catalysing child-centric sustainability programmes elucidates a model where learning becomes synonymous with enjoyment and active participation. The orchestration of ongoing sustainability programmes, such as eco-themed scavenger hunts or recycling workshops, fosters a continual engagement that extends beyond episodic events and becomes an integral part of children's recreational activities. The scalable nature of these initiatives is shown by their potential application in varied tourism contexts, each moulded by its unique offerings yet tethered by the underlying principle of consistent child engagement in sustainable activities.

Community projects and regular child involvement shed light on a viable pathway towards entrenching sustainability within community practices, ensuring that children are not mere

spectators but active contributors to the local sustainable initiatives. Whether tree-planting initiatives or cultural festivals, providing structured platforms where children observe but engage and contribute ensures that sustainability values are preached and actively practised and lived.

Empowering children in policy formulation is not an exclusive domain of the Dubrovnik context but echoes a universal sentiment. The incorporation of children's perspectives into policies fosters an environment where they are perceived and respected as stakeholders, thereby nurturing an informed generation that feels a sense of ownership towards sustainable practices, potentially amplifying their role as change agents across varied regional contexts (Yang et al., 2020; Séraphin & Thanh, 2020).

Limitations and future research

Despite the valuable insights into children's reactions to overtourism in Dubrovnik, this study has certain limitations that should be considered when interpreting the results. First, the sample size and focus on Dubrovnik's context may limit the generalisability of the findings to other regions and populations. Second, the study focused on children aged 10–18 years, potentially overlooking crucial developmental stages in younger children's environmental attitudes. Another limitation is the predominantly quantitative approach used to measure emotional responses, which potentially limits the level of depth of understanding of the underlying reasons for children's reactions.

Additionally, the study's cross-sectional design captured the children's reactions at specific time points. Longitudinal studies can offer valuable insights into the dynamics of children's environmental attitudes, allowing researchers to track temporal changes and the development of these attitudes over an extended period. Despite these limitations, the findings contribute significantly to our understanding of children's reactions to overtourism and their emotional connections to the environment. By addressing these limitations and pursuing the proposed avenues for future research, the field can further advance our understanding of how to empower children as advocates for positive change in the tourism industry through sustainability education and fostering pro-environmental behaviour.

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Disclosure statement

The authors report there are no competing interests to declare.

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