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RESEARCH ARTICLE

Nature on screen: The implications of visual media for human–nature relationships

# Fostering ocean empathy through future scenarios

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## Abstract

1. Empathy for nature is considered a prerequisite for sustainable interactions with the biosphere. Yet to date, empirical research on how to stimulate empathy remains scarce.
2. Here, we investigate whether future scenarios can promote greater empathy for the oceans. Using a pre-post empathy questionnaire, participants ($N = 269$) were presented with an optimistic or a pessimistic future scenario for the high seas in a virtual reality (VR) or written format.
3. Results showed that post-test empathy levels were significantly higher than pre-test levels, indicating that future scenarios fostered ocean empathy. We also find that the pessimistic scenario resulted in greater empathy levels compared to the optimistic scenario. Finally, we found no significant difference between the VR and written conditions and found that empathy scores significantly decreased 3 months after the initial intervention.
4. As one of the first studies to empirically demonstrate the influence of a purposeful intervention to build ocean empathy, this article makes critical contributions to advancing research on future scenarios and offers a novel approach for supporting ocean sustainability.

KEYWORDS

empathy, oceans, scenarios, sustainability, transformations, virtual reality

## 1 | INTRODUCTION

> We live in a post-truth society … we don't care … we have lost empathy
>
> (Greta Thunberg, 2020).

The converging crises of climate change, biodiversity loss and social injustice have led scientists to argue that fostering empathy is required to repair the relationships between people and nature (Brown et al., 2019; Tschakert, 2020). As Greta Thunberg articulates in the comment above, our collective loss of empathy, for each other and for the planet, is one of our greatest contemporary challenges. Empathy is defined as a stimulated emotional state that relies on the ability to understand and care for the experiences of another person, animal or elements of the natural world (Tam, 2013; Young et al., 2018). Nurturing empathy is considered critical for garnering support for conservation efforts, reconnecting humans and nature, and shaping transformations towards more sustainable and equitable futures (Bennett et al., 2019; Brown et al., 2019; Ives et al., 2018).

The need to foster empathy is particularly acute for the world's oceans (Wharton et al., 2019). Marine ecosystems, which sustain life on Earth, are facing unprecedented challenges (Fleming et al., 2019; Lam et al., 2020; Nash et al., 2020). Yet, oceans are spatially distant from a large share of the world's population, which can render them 'out of sight and out of mind' (Dupont, 2017; Schuldt et al., 2016). For instance, a recent survey of 3,500 global leaders found that they consider SDG 14 (Life Below Water) to be the least important of the UN's Sustainable Development Goals (McDonnell, 2018). Reconnecting to oceans will depend, in part, on the ability of scientists to mobilize public concern, or empathy, for our oceans (Carley et al., 2013; Gelcich et al., 2014; Merrie et al., 2018). We define ocean empathy as taking the perspective of, and feeling an emotional bond with, ocean-dependent communities, marine organisms and marine ecosystems. Fostering ocean empathy presents an important opportunity to support the ambition of the UN's Decade of Ocean Science for Sustainable Development to create the 'ocean we want' (Claudet et al., 2020; Lubchenco & Gaines, 2019).

Despite growing literature on the importance of empathy for restoring human–nature relationships, there is little substantive empirical guidance on how empathy for nature can be effectively stimulated, particularly within the marine realm (Wharton et al., 2019). Some scholars claim that empathy is primarily a fixed outcome, while others argue that it can be learned and nurtured (Myers et al., 2009). For example, some research suggests that empathy for nature can be facilitated by simple interventions, such as prompting individuals to take the perspective of an animal harmed by pollution (Schultz, 2000). However, inducing ocean empathy may be challenging given our growing dissociation from oceans (Omstedt, 2020; Schuldt et al., 2016). In this context, innovative methods for stimulating ocean empathy are required (Brown et al., 2019; Claudet et al., 2020).

An emerging body of research recognizes the potential of future scenarios to 'create an opening for more empathetic responses' (Pereira et al., 2019, p. 1). Scenarios, which are explored in more detail in the following section, describe how the future may unfold, based on coherent and internally consistent assumptions about interacting drivers of change (Millennium Ecosystem Assessment, 2005). Within the growing body of sustainability literature, scenarios have mostly been used as an end in themselves (Bai et al., 2016). However, research increasingly suggests that information alone is not creating the transformative change required to meet the challenges of the Anthropocene (Bradshaw et al., 2021). Catalysing transformative change requires fostering emotional connections with each other and with the planet (Abson et al., 2017; Castree et al., 2014; Fazey et al., 2020). Therefore, understanding how scenarios shape affective, rather than simply cognitive, outcomes represents an important frontier in the field of scenarios and sustainability research (Brown et al., 2019; Pereira et al., 2019).

Here, we aim to advance this work by testing whether future scenarios stimulate ocean empathy in research participants. Specifically, we ask: (a) does engagement with future ocean scenarios increase empathy?; (b) do optimistic or pessimistic scenarios result in higher empathy?; (c) do virtual reality (VR) or written scenarios result in higher empathy?; and (d) do increases in empathy last? In the next section, we review the literature on visual scenarios as a tool for marine conservation and ocean science. In the methods, we outline the development of the two future ocean scenarios, data collection and analysis. Following the results, we discuss our four main findings, namely that future scenarios increased participants' ocean empathy, that empathy was higher following the pessimistic scenario, that there was no significant difference in empathy scores between the two methods of scenario presentations (VR vs. written) and that increases in empathy did not last over time.

## 2 | VISUAL SCENARIOS AS A TOOL FOR OCEAN SCIENCE

### 2.1 | Scenarios in conservation research and practice

Scenarios have a long history in conservation research and practice (Peterson et al., 2003). In conservation science, scenarios have been used to depict plausible futures and alternative policy approaches that may affect the achievement of conservation targets (Caves et al., 2013; Haward et al., 2013; Kok et al., 2017; Nicholson et al., 2019). Similarly, scenarios have been used to explore the possible consequences of human development on future biodiversity and associated ecosystem services (IPBES, 2019; Millennium Ecosystem Assessment, 2005). As a result, scenario analysis is a useful tool to inform policies and decision-making for conservation and ecosystem management in the context of uncertainty (IPBES, 2019).

Scenarios can be developed in a number of ways, from quantitative mathematical models to qualitative narrative futures. A key strength of narrative scenario development is the capacity to simplify immense quantities of information into a handful of potential

futures, thereby making complex systems and their processes more manageable for stakeholders and policymakers (Francis et al., 2011). The ability to deal with complexity and uncertainty is critical in the Anthropocene, an era characterized by rapidly changing, interconnected global systems, and social–ecological complexity that make it difficult to anticipate and respond to evolving and emerging issues (Steffen et al., 2018). Engagement with scenarios provides scientists and relevant stakeholders with an opportunity to understand and learn about the impacts of contrasting political, economic, social, institutional, technological, lifestyle and environmental choices, and how to adapt to them (Nash et al., 2021).

Scenarios research is characterized by a rich assortment of approaches, making agreement on typologies challenging (Börjeson et al., 2006). However, within the context of sustainability, scenarios approaches can be classified into three broad categories, namely predictive, exploratory and normative (Nash et al., 2021). Predictive scenarios describe future conditions based on existing evidence (Francis et al., 2011). They are often used to explore the impacts of a specific conservation intervention or management approach. For example, Travers et al. (2016) employ predictive scenarios to explore conservation outcomes under different policy interventions in the Keo Seima Wildlife Sanctuary, a protected area in Cambodia. Exploratory scenarios look at a range of plausible futures, both 'good' and 'bad' (Börjeson et al., 2006). The purpose of using exploratory scenarios is to investigate uncertainties, such as how the effects of climate change will play out (Francis et al., 2011). Österblom et al. (2013), for instance, use scenarios as a tool to explore possible futures and to inform marine stewardship in the Baltic Sea. Finally, normative scenarios describe preferable or desirable futures (Börjeson et al., 2006). For example, the UN's Sustainable Development Goals provide an internationally negotiated set of aspirational targets to guide action (UN General Assembly, 2015). Much of this work focuses on co-producing future visions and identifying the transformations required to realize normative goals (Blythe et al., 2018; Iwaniec et al., 2019, 2020; Pereira et al., 2018, 2019). By drawing on existing initiatives to articulate pathways towards more positive futures, the 'seeds of a good Anthropocene' program applies a normative scenario approach (Bennett et al., 2016; Raudsepp-Hearne et al., 2020). Likewise, the Nature Futures Framework describes preferred futures for nature as a method for realizing more sustainable futures (Pereira et al., 2020). Recently, scholars are engaging in participatory methods to co-design scenarios and are finding that participatory scenarios can broaden the participation of marginalized voices, identify a more diversity suite of possible futures and create transformative spaces for sustainability action (Aguiar et al., 2020; Pereira et al., 2018, 2020).

### 2.2 | The role of visual media in scenarios research

Research suggests that visual media and arts can make powerful contributions to how scenarios help people to overcome cognitive barriers, build emotional connections and, ultimately, catalyse transformative change (Bendor, 2018; Nash et al., 2021; Pereira et al., 2019; Westley et al., 2019; Wyborn et al., 2020). This field of research is based on the premise that art and visual content can be more persuasive than textual narratives in shifting social norms, values and worldviews (O'Brien et al., 2019; Westley et al., 2019). This may be, in part, because many people process visual information more effectively than in textual form, thus helping to simplify complex information (Tufte et al., 1990). Moreover, because humans are wired to respond to visual elements in their environment, visual content can elicit rapid emotional responses. Referring to the power of visual media to influence people, Yuval Harari recently quipped 'a good science-fiction movie is worth far more than an article in *Science* or *Nature*' (2019, p. 249). Visual media can communicate messages quickly, and more vividly, than written information and have the power to engage our emotions in support of environmental action (Galafassi et al., 2018).

Visual scenarios can help shape sustainable futures by changing how people understand the world, what they expect from it and what they deem possible (Wiek & Iwaniec, 2014). Bendor (2018, p. 158) argues '[s]ince we must be able to imagine change before we can pursue it, interactive media can support the transformational capacity of the imagination'. Art–science collaborations have also been shown to enable emotional connections, including empathy and perspective-taking (Brown et al., 2017). For example, a project called 'Radical Ocean Futures' employed digital art and science fiction narratives to inspire scientists to 'think differently' about social–ecological futures (Merrie et al., 2018, p. 23).

Virtual reality is a visual media experience that can simulate physical presence in real or imagined environments (McMillan et al., 2017). Within a VR environment, users have a 360-degree canvas to step into a narrative, making future scenarios truly immersive (Shin, 2018). Research is demonstrating the potential of VR to stimulate users' capacity to imagine and pursue alternative futures (Bendor, 2018; Portman et al., 2015) and to encourage pro-environmental behaviour (Ahn et al., 2015). For example, a recent study found that nature-based tourism experiences delivered via VR can be as effective as real-life experiences in influencing conservation behaviours (Hofman et al., 2021). Research has also shown that VR can stimulate empathy (Roswell et al., 2020; Schutte & Stilinović, 2017). For example, VR has been used to increase empathy for refugees and the homeless (Shin, 2018). The goal of this type of VR is to stimulate emotions that will influence action (Shin, 2018). Recently, researchers have begun to explore the VR as a tool for ocean education and its role in motivating empathy for marine conservation, yet this research remains relatively nascent (McMillan et al., 2017; Wharton et al., 2019; www.oceanempathy.org).

## 3 | METHODS

### 3.1 | Scenario development

The scenarios used in this study were adapted from scenarios developed during a workshop held in Vancouver, Canada, 19–20

November 2018 (Cheung et al., 2019). During the workshop, a transdisciplinary team of fisheries managers, marine ecologists, fisheries scientists, high-sea policy advisors and marine governance specialists applied the shared socio-economic pathways (SSPs) (O'Neill et al., 2014) to develop three distinct scenarios for the high seas (Cheung et al., 2019).

For this research, we adapted two of the three scenarios developed during the Vancouver workshop. To test the extent to which optimistic or pessimistic storylines influence empathy, we purposefully selected the two most contrasting scenarios. Based on these scenarios, we developed two condensed narratives that describe plausible social, economic, governance and ecological conditions on the high seas in the year 2050 (Box 1). The 'optimistic' scenario is based on SSP1 and depicts a world focused on environmental sustainability and social equality (O'Neill et al., 2017). The 'pessimistic' scenario is based on SSP3 and describes a world dominated by resurgent nationalism, regional conflicts and environmental degradation (O'Neill et al., 2017).

Once the narratives in Box 1 were established, we worked with a VR company, called XPertVR, to develop digital content to bring the two high-sea scenarios to life. The selection of content, including lighting conditions, weather settings, time of day, audio, fishing vessels and marine species were guided by prior research on VR and emotional responses (Baños et al., 2004; Bishop & Rohrmann, 2003; Riva et al., 2007; Toet et al., 2009), plus the expertise of the research team and the VR company. Both virtual scenarios begin with the participant standing on the deck of a fishing vessel and then transitioning to an underwater scene. After approximately 10 s, to allow the research participants to acclimatize to the VR environment, the narration begins. The scenarios are available, as 360 videos, on YouTube and can be watched on a smartphone, tablet or computer. They are best experienced through the YouTube app on a smart phone. The optimistic scenario can be viewed by searching for 'The high seas in 2050: imagining a better future' or at: https://www.youtube.com/watch?v=kQ7XZ0QCKpU%5C. The pessimistic scenario can be viewed by searching 'The high seas in 2050: a plausible dystopian future' or at: https://www.youtube.com/watch?v=-dYiaErO1aM.

**BOX 1 Optimistic and pessimistic scenarios for the high seas**

| Optimistic scenario | Pessimistic scenario |
|---|---|
| Sustainability has become a global priority. Actions at national and international levels have fostered more inclusive development and emphasized environmental stewardship | Global ocean governance efforts have broken down. Countries have become increasingly concerned with protecting their own economic interests at the expense of the marine environment |
| Members of the World Trade Organization have agreed to eliminate harmful fishing subsidies. This decision means that fishing on the high seas has become unprofitable and fishing effort has declined. To promote more equitable development, wealthy high-sea fishing nations have also donated their redundant fishing vessels to developing nations. These vessels boost coastal fishing capacity in developing nations, leading to more fishing income which is invested in education, infrastructure and healthcare | Wealthy fishing nations have increased their fishing subsidizes, which has driven overfishing. Increased consolidation in the fishing sector of rich nations has meant that high-income countries expand their control of high-sea resources. All nations have seen a rise in authoritarian forms of government, extremism and discriminatory political movements. Support for sustainable development, minority groups and human rights is low |
| The political climate in 2050 supports inclusive ocean governance. Indigenous groups, Small Island Developing States and small-scale fishers play a leading role in decision-making and management. Through the United Nations, the global community has signed a legally binding treaty for the high seas to protect biodiversity and share the wealth of the oceans. The treaty has led to the sustainable use of ocean resources, and a more equitable distribution of benefits to different nations and coastal populations. Technological developments allow for real-time tracking and effective monitoring of all fishing activities. The increased transparency supports sustainable and socially responsible fishing | Mistrust among governments has grown. Vulnerable groups and developing nations are further marginalized from decision-making and management processes. Opaque decision-making has led to reduced cooperation. Suspicion within and across organizations has undermined international efforts to develop a treaty for the high seas. No agreement has been reached, and the high-sea remain open access. The levels of illegal fishing have increased, particularly through encroachment by wealthy nations' high-seas fleets into the coastal waters of developing nations, leaving less fish for these nations. Inequality has risen as wealth is accumulated in the hands of a few wealthy nations and multinational corporations who prioritize income over environmental sustainability |
| Together, these efforts have led to the recovery of biodiversity. Healthy stocks of tuna, swordfish, sharks and turtles fill the high-sea once again. Increased fish stocks have led to improved catches for coastal populations in developing countries. The levels of food security, well-being and equity are high. Increased fishing income is invested in better education, healthcare and infrastructure across coastal communities | Biodiversity has plummeted. Deep-sea habitats have been damaged by bottom trawling and oil extraction. This decline has mainly affected developing nations, who depend on fish for food security. In coastal communities, food security concerns and poverty levels soar. Infrastructure is in decline in many coastal communities. Inequality among nations has risen exponentially |

On a desktop, you can explore the video with your arrow keys, mouse or trackpad. To optimize viewing on a computer, click and drag *slowly* anywhere in the video to change the viewing direction in 360-degrees and up or down.

## 3.2 | Participant recruitment and study design

A total of 269 people (183 females, 85 males and 1 undisclosed) participated in this study from 9–11 March 2020. Participants were recruited in person on Brock University campus and from sections of various psychology courses at Brock University. Participants ranged in age from 16 to 69, with a mean age of 21 years ($SD$ = 6.7). This study was approved by the Human Research Ethics Board at Brock University (REB 19-194 BLYTHE) and conducted in accordance with Tri-Council ethical guidelines.

A 2 × 2 survey was designed for this research. It consisted of two contrasting scenarios (optimistic and pessimistic) and two methods of scenario presentation (VR and written), which combined to produce four possible interventions. Participants were randomly assigned to one of the four interventions (Table 1).

Participants who were assigned the VR intervention watched either the optimistic or the pessimistic future scenario while wearing an HTC Vive Pro VR headset (Figure 1a). Within the scenarios, participant could turn around a full 360-degrees and look both up and down (Figure 1b). Participants who were assigned to the written groups read a hard copy of either the optimistic or the pessimistic future scenario for the high seas. The text that written participants read was identical to the narration that participants heard in the VR groups (Box 1).

Three months after completion of the study, all participants were invited to complete a follow-up questionnaire, and 69 participants did so ($N_{\text{optimistic VR}}$ = 15; $N_{\text{optimistic written}}$ = 19; $N_{\text{pessimistic VR}}$ = 17; $N_{\text{pessimistic written}}$ = 18). All participants provided written consent prior to participating. Participation in the study took approximately 30 min and was voluntary (unpaid).

## 3.3 | Empathy measurement scales and data analysis

Empathy was measured using the following three questions on a 5-point Likert scale, from 1 (not at all) to 5 (extremely): (a) how sympathetic do you feel about the current condition of the high seas?; (b) how compassionate do you feel for the animals of the high seas and developing countries that depend on high-sea fish stocks?; and (c) how concerned do you feel for the future of the high seas? These questions were adapted from the studies by Walker and Chapman (2003) and Baston et al. (1995), who use the terms sympathy and compassion to measure empathy. These questions have been statistically validated and used to measure empathy for ocean acidification (Kim & Cooke, 2020). The same three questions were asked of participants at each stage of the study: immediately pre-test, immediately post-test and at the 3-month follow-up. The complete survey is available in the Supplementary Information.

An empathy index was created by averaging the three items. Cronbach's alpha ($\alpha$ = 0.84, $m$ = 4, $SD$ = 0.81) was calculated to evaluate internal consistency among the three questions used to create this empathy index (Tavakol & Dennick, 2011). All data were analysed in IBM® SPSS Statistics.

**TABLE 1** Four intervention types employed in the study ($N$ = 269)

| | Virtual reality | Written |
|---|---|---|
| Optimistic | $N$ = 72<br>52 females, 20 males | $N$ = 62<br>43 females, 19 males |
| Pessimistic | $N$ = 76<br>49 females, 26 males, 1 undisclosed | $N$ = 62<br>39 females, 23 males |


**FIGURE 1** (a) Research participant viewing the optimistic future ocean scenario in virtual reality in March 2020 (photograph: J Blythe); (b) Scene from the pessimistic future ocean scenario depicting overfishing by subsidized commercial trawlers from wealthy nations on the high seas. The research participant in the figure has given consent for their photograph to be used in this publication

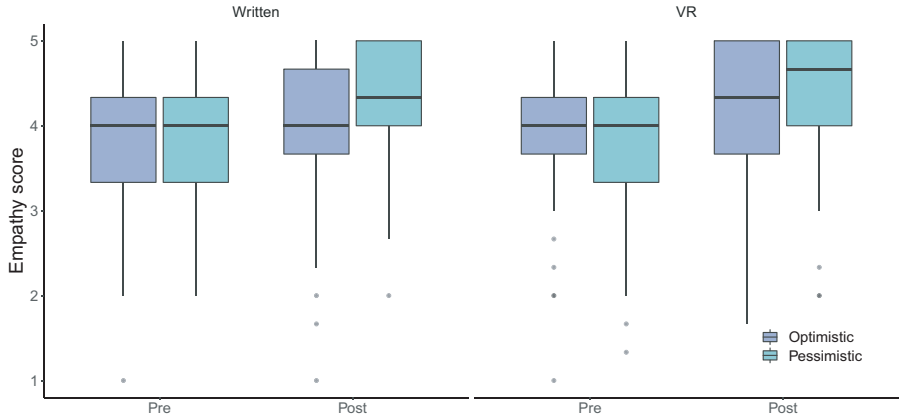


**FIGURE 2** Pre- and post-test empathy scores for the four interventions, which illustrate that empathy scores increased after the intervention. Box limits denote the 25th and 75th percentiles, with whiskers extending 1.5× the interquartile range from the box edges. Line inside the box indicates median value and circles represent outliers

## 4 | RESULTS

### 4.1 | Did empathy increase following the intervention?

A Wilcoxon signed-rank test showed that pre-test empathy scores ($M = 3.84$, $SD = 0.79$) differed significantly from immediately post-test empathy scores ($M = 4.19$, $SD = 0.78$), such that empathy significantly increased at post-test as compared to pre-test, $Z = 7.82$, $p < 0.001$, $r = -0.33$ (Figure 2).

### 4.2 | Did the optimistic or pessimistic scenario result in higher empathy?

To determine whether the type of scenario (optimistic vs. pessimistic) affected the increase in empathy scores, we created a normalized pre/post difference score [(post − pre)/pre] and conducted a series of Mann–Whitney *U* tests. There was a significant effect of type of scenario, such that the increase in empathy was significantly larger for the pessimistic scenario as compared to the optimistic scenario, $U(N_{optimistic} = 134, N_{pessimistic} = 131) = 11{,}295$, $z = 4.07$, $p < 0.001$, $\eta^2 = 0.06$ (Figure 3a).

### 4.3 | Did the method of scenario presentation (virtual reality vs. written) result in higher empathy scores?

To determine whether the way in which the scenario was presented (VR vs. written) influenced the increase in empathy scores, we created a normalized pre/post difference score [(post − pre)/pre] and conducted a series of Mann–Whitney *U* tests. The differences in empathy scores for participants who viewed the scenarios in VR and those who read the scenarios in written format were not statistically significant, $U(N_{VR} = 147, N_{written} = 118) = 8.033$, $z = -1.04$, $p = 0.298$, $\eta^2 = 0.004$ (Figure 3b).

### 4.4 | Did the increase in empathy last?

Finally, to examine whether the change in empathy following the intervention was sustained over time, we compared empathy scores at immediately post-test ($M = 4.19$, $SD = 0.78$) to empathy scores at a 3-month follow-up ($M = 3.87$, $SD = 0.89$) using a Wilcoxon signed-rank test. Overall, empathy scores significantly decreased at the 3-month follow-up as compared to post-test scores, $Z = -2.98$, $p = 0.003$, $r = 0.25$ (Figure 4).

Indeed, follow-up scores did not significantly differ from pre-test scores, $Z = 0.47$, $p = 0.64$, $r = 0.04$, indicating that empathy scores gradually returned to baseline levels. Interestingly, however, the decrease in empathy numerically (albeit not significantly) differed as a function of both scenario type and scenario method of presentation. Specifically, a Mann–Whitney *U* test using a normalized post/follow-up empathy difference score ([follow-up − post]/post) showed that the decrease in empathy was numerically larger for the pessimistic group ($\Delta_{post/follow\text{-}up} = -0.113$) as compared to the optimistic group ($\Delta_{post/follow\text{-}up} = -0.033$), $U(N_{optimistic} = 34, N_{pessimistic} = 35) = 479.50$, $z = -1.39$, $p = 0.164$, $\eta^2 = 0.03$. Additionally, the decrease in empathy was numerically larger for the VR group ($\Delta_{post/follow\text{-}up} = -0.148$) as compared to the written group ($\Delta_{post/follow\text{-}up} = -0.009$), $U(N_{virtual\ reality} = 32, N_{written} = 37) = 743.0$, $z = 1.82$, $p = 0.07$, $\eta^2 = 0.05$.

## 5 | DISCUSSION

Increasing empathy for nature has been identified as an important step in repairing our relationships with the biosphere (Brown et al., 2019; Tam, 2013). In this paper, we present an approach for fostering ocean empathy using future scenarios in VR and written formats. Our analysis revealed four key findings. First, we demonstrated that empathy increased significantly after engagement with future scenarios. Second, we showed that the pessimistic scenario resulted in significantly larger increases in empathy in comparison to the optimistic scenario. Third, we found no significant difference between

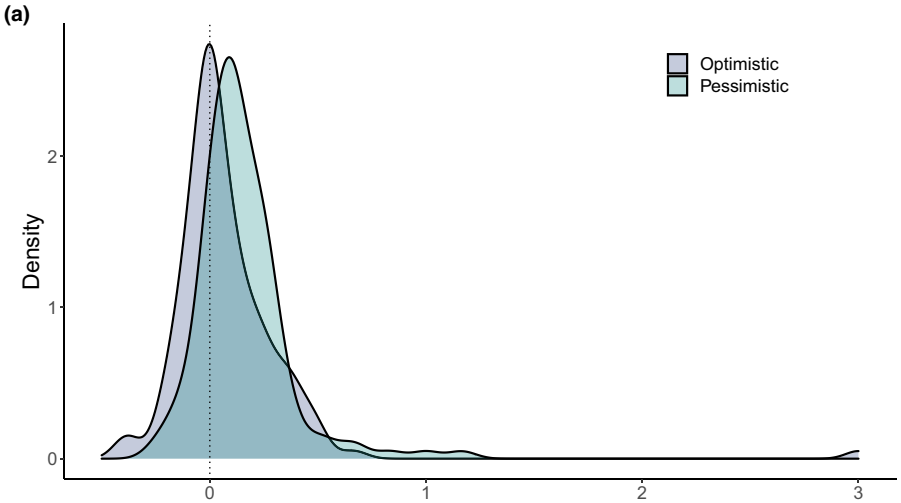



**FIGURE 3** (a) Kernel density plots comparing normalized pre- and post-test empathy scores for the optimistic and pessimistic scenarios. Normalized pre/post difference score was calculated as [(post − pre)/pre]. b) Kernel density plots comparing normalized pre- and post-test empathy scores for the two methods of scenario presentation (VR vs. written)

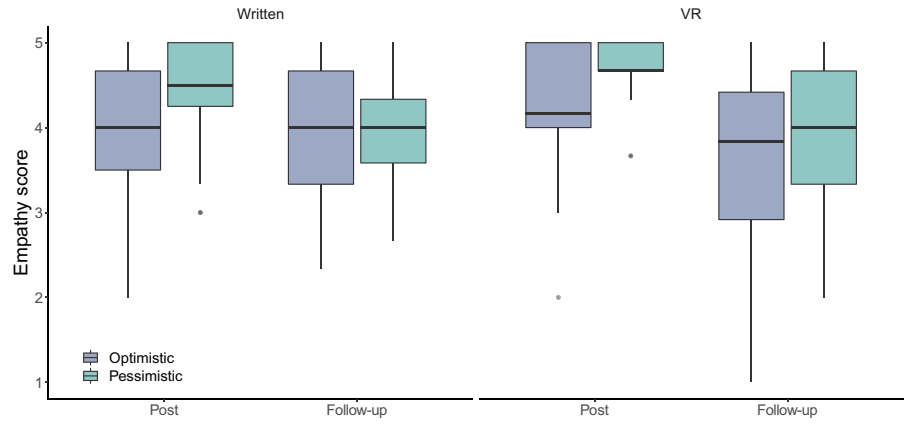


**FIGURE 4** Post-test and follow-up empathy scores for the four interventions, which illustrate that empathy scores decreased 3 months after the intervention

the two methods of scenario presentation (VR vs. written). Fourth, we found that changes in empathy did not persist 3 months after the intervention.

Our first finding, that future scenarios can increase empathy, extends the literature on empathy for nature in several ways. This result provides empirical evidence to support the assumption that engaging with scenarios can change how people feel about social–ecological systems (Elsawah et al., 2020; Pereira et al., 2019). We, therefore, build on scenarios research that often begins with the assumption that scenarios can change peoples' views, but rarely tests

it (Bai et al., 2016; Bennett et al., 2016; Pereira et al., 2020). This result also suggests that we can nurture empathy when we are spatially distant from the object of the intervention (e.g. the high seas) and do not need to interact with it directly (Gurney et al., 2017). In contrast, much of the existing work in this space finds that developing empathy towards marine ecosystems requires direct experience (Dupont, 2017; Maguire et al., 2020; Wharton et al., 2019). In the case of the high seas, research has shown that impacts may be too remote to register in the public's consciousness and garner policy support (Bellefontaine & Johansson, 2018; Game et al., 2009; Urbina, 2019). In seeking to understand why public opinion lags behind the urgency expressed by the scientific community on environmental issues, scholars point to the psychological distance at which environmental impacts are commonly construed as a barrier for public engagement (Schuldt et al., 2016). Our findings suggest that scenarios can build public empathy for remote natural places. It is important to acknowledge that there is not universal agreement on the value of empathy for environmental stewardship and sustainability. Some see conservation that is rooted in compassion as narrowly focused on charismatic species at the expense of, and risk to, other life-forms such as humans (Oommen et al., 2019). Büscher (2016) identifies negative consequences, which he calls the 'politics of hysteria', arising from emotive messaging on conservation issues. We recognize these critiques; however, we align with scholarship that identifies empathy as an important prerequisite for fostering sustainable relationships with the planet (Brown et al., 2019; Hendersson & Wamsler, 2020).

Our second key finding highlights that the pessimistic scenario was associated with larger increases in empathy as compared to the optimistic scenario. This result challenges the widely held view that good news stories inspire support for conservation and stewardship (Ahn et al., 2015; Bai et al., 2016; Bennett et al., 2016; Pereira et al., 2018; Wiek & Iwaniec, 2014). The notion that optimism can support conservation strategies is also prevalent in ocean literature. For example, Lubchenco and Gaines (2019) posit that negative messaging can invoke depression and lack of engagement and motivation. Similarly, Nancy Knowlton (2021, p. 479) recently argued that 'a greater focus on [ocean] solutions and successes will help them to become the norm rather than the exception'. A comparatively smaller body of literature argues that negative messaging is important for stimulating environmental concern (Bradshaw et al., 2021). For example, research has found that people who are shown images of environmental destruction or instructed to take the perspective of a distressed animal show increase levels of empathy for nature (Geiger et al., 2017; Schultz, 2000). It is important to point out that scenarios can be designed for different purposes. In this paper, we were trying to garner empathy through scenarios and found that the pessimistic scenarios elicited a stronger empathic response. In other applications, scenarios are designed to enable action by encouraging people to exercise their agency for transformation. In these cases, optimistic messaging may be more effective. For example, Raudsepp-Hearne et al. (2020, p. 606), who explore scenarios as a tool for enabling action, explain that '[o]ur scenario approach purposefully focuses on positive futures because inspirational visions can be key components of transformations to sustainability'. Our second finding adds to this growing body of literature. Importantly, we do not discount the important role of positive narratives in catalysing transformations towards sustainability and we recognize that pessimistic scenarios that invoke intensely negative emotions could prove counterproductive to efforts at environmental engagement or persuasion (Schneider-Mayerson, 2018). Yet, our findings indicate that there is value in communicating plausible pessimistic futures to decision-makers, governments and the public (Bradshaw et al., 2021).

Our third key finding highlights that the method of scenario delivery (VR or written) had no significant influence on changes in empathy. This result runs counter to the burgeoning body of work on the power of creative and visual scenarios to overcome cognitive barriers and enable emotional connections with nature (Kwan et al., 2019; Pereira et al., 2019; Thomsen, 2015; Westley et al., 2019) and encourage pro-social behaviour (Breves, 2020). Emerging work suggests that the ability of VR to stimulate empathy depends on whether the experience is truly immersive, meaning the line between reality and imagination is blurred (Chirico et al., 2020; Lee et al., 2020; Shin, 2018). Our null result may stem from the relatively simple quality of the VR content used in this research. As an exploratory study with a limited budget, the VR scenarios we tested may not be as realistic or immersive as top of the line VR content (e.g. video games, movies). Moreover, research has shown that interactive visual media, such as games and social media, can stimulate pro-environmental behaviour more effectively than non-interactive media (Hipólito, 2011). Our results are in line with previous research that has found that viewing nature videos through immersive technologies can have limited impacts on pro-environmental behaviours (Soliman et al., 2017). Future research could productively explore the influence of the quality of visual media in scenarios research (Dupont, 2017; Merrie et al., 2018; Schuldt et al., 2016). To date, conservation science has generally left these methods alone, or at least not studied them empirically or integrated them fully into research and practice (Bai et al., 2016).

Our fourth finding shows that changes in empathy did not persist over time. This finding speaks to a key challenge for fostering sustainable behaviours and transformations—how do we promote lasting changes in knowledge, attitudes, emotional states and behaviours (O'Brien, 2012)? Creating long-term impact is a concern for many environmental ocean literacy initiatives, education programs, conservation programs and behaviour change initiatives (Ashley et al., 2019; Borja et al., 2020; Ferraro & Pressey, 2015; Francesca et al., 2017; Kelly et al., 2021; McCauley et al., 2019). A single application of virtual scenarios may simply be insufficient to create lasting emotional changes, and a repetition of the scenarios over time might have been more effective. Previous research has shown that positively framed and interactive VR experiences can lead to longer lasting pro-environmental behaviours (Ahn et al., 2015). Moreover, research on participatory scenarios suggests that changes in environmental ethos and behaviours may be longer lasting when participants are engaged in the development of future scenarios (Pereira et al., 2018). In this context, more research is needed on the factors

that sustain empathy gains over time, such as the influence of framing and participation. Emerging work on behaviour change tools by community-based social marketing scholars could inform future research in this space (McKenzie-Mohr & Schultz, 2014).

This study offers practical guidance for conservation actors attempting to generate new knowledge to support change towards more sustainable futures (Pereira et al., 2020). The findings point towards the role of scenarios as a practical method for rebuilding the relationship between people and nature. For example, actors who are engaging in the UN's Decade of Ocean Science for Sustainable Development to generate the knowledge necessary to support healthy oceans and sustainable development might usefully incorporate future scenarios as a tool to support empathy for 'the ocean we want' (Claudet et al., 2020).

Fostering empathy through scenarios is not without challenges and this study has limitations we would like to acknowledge. First, our sample of participants from Brock University is not representative of the Canadian or global population. Samples from universities tend to be skewed towards those who are privileged, more highly educated and possess liberal ideology (Hanel & Vione, 2016). Going forward, exploring the role of scenarios and environmental empathy with more diverse research participants will be important. Second, in our study, empathy increased across all conditions. While it is possible that social desirability bias played a part in this (Kormos & Gifford, 2014), we were careful to implement practises, including our communications with participants, to reduce the likelihood of this. Nonetheless, future work investigating the use of scenarios in moving empathy should consider the use of a control group(s) to help account for social desirability and other unintended biases. Third, we recognize that VR is not a universally available technology. Virtual reality interventions intended to increase the public's empathy for nature may exclude marginalized communities, such as low-income families. In an attempt to broaden the accessibility of scenarios, we have made the scenarios produced for this research publicly available on YouTube. Future research might productively explore whether more scalable digital media, such as cell phones or YouTube, increase environmental empathy (Claudet et al., 2020). Finally, and arguably most importantly, empathy alone is insufficient for catalysing transformational change. Rather, increases in empathy need to be translated into action to drive change and realize more sustainable and equitable futures (Brown et al., 2019). To provide pathways to the imagined future, stakeholders and policymakers need to design and implement complementary and coordinated actions across all levels of society from local community groups to national governments and international organizations (Nash et al., 2021; Pereira et al., 2020).

## 6 | CONCLUSION

Though they are remote for many, oceans support all life on Earth. Healthy oceans are needed to sustain people and livelihoods, to realize the vision of the UN's Decade of Ocean Science for Sustainable Development and to achieve the Sustainable Development Goals (Lam et al., 2020; Nash et al., 2020; UN General Assembly, 2015). Yet, ocean health is declining globally at rates unprecedented in human history, making it clear that transformative changes are needed to repair our relationship with marine ecosystems (IPBES, 2019).

We argue that safeguarding the world's oceans, and the human well-being they support, requires nurturing ocean empathy since science, information and knowledge alone do not inherently lead to sustainable outcomes (Brown et al., 2019; Carley et al., 2013; Kelly et al., 2021). Here, we have demonstrated that engaging with future scenarios can boost ocean empathy, that pessimistic scenarios led to larger increases in empathy than optimistic scenarios, that there were no significant differences in empathy scores after VR or written scenarios and that the increases in empathy did not endure 3 months after experiencing the scenarios. Taken together, these findings offer insight on strengthening connections that humans feel to the natural world. As the UN's Decade of Ocean Science for Sustainable Development begins this year, we urge the international community to continue to explore the often-overlooked role of scenarios and empathy in shaping a future where people and nature can thrive.

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### CONFLICT OF INTEREST

On behalf of all authors, the corresponding author states that there is no conflict of interest.

### AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design; data collection was performed by J.B. and G.P.; data analysis and reporting was performed by G.D. and K.L.N.; the first draft of the manuscript was written by J.B. with contributions for all authors. All authors have read and approved the final manuscript.

### DATA AVAILABILITY STATEMENT

Data are publicly available through Brock University https://doi.org/10.5683/SP2/62ZWNF (Blythe et al., 2021).

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## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the Supporting Information section.

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