



# Technobiophilia: Nature and human interactions in the digital age

Hiroko Oe, Yasuyuki Yamaoka & Max Weeks |

To cite this article: Hiroko Oe, Yasuyuki Yamaoka & Max Weeks | (2022) Technobiophilia: Nature and human interactions in the digital age, Cogent Arts & Humanities, 9:1, 2068823, DOI: [10.1080/23311983.2022.2068823](https://doi.org/10.1080/23311983.2022.2068823)

To link to this article: <https://doi.org/10.1080/23311983.2022.2068823>



© 2022 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.



Published online: 26 Apr 2022.



Submit your article to this journal [↗](#)



Article views: 37



View related articles [↗](#)



View Crossmark data [↗](#)



; Received: 16 November 2021  
Accepted: 14 April 2022;

\*Corresponding author:  
Hiroko Oe, The Business School,  
Bournemouth University Talbot  
Campus: Bournemouth University,  
United Kingdom  
E-mail: [hoe@bournemouth.ac.uk](mailto:hoe@bournemouth.ac.uk)

Reviewing editor:  
Jeroen van de Weijer, School  
of Foreign Languages, Shenzhen  
University, Shenzhen, Guangdong,  
China

Additional information is available at  
the end of the article

## DIGITAL HUMANITIES | RESEARCH ARTICLE

# Technobiophilia: Nature and human interactions in the digital age

Hiroko Oe<sup>1\*</sup>, Yasuyuki Yamaoka<sup>2</sup> and Max Weeks<sup>3</sup>

**Abstract:** Today, people around the world have greatly increased opportunities to interact with people and nature in virtual cyberspace. And because of the recent unprecedented disaster of covid, we are becoming more and more active in cyberspace day by day, flexibly moving between real and virtual space, and interacting with people in digital space to the extent that not a day goes by without contact with nature. And experience has shown that this has resulted in an increased attachment to nature and interest in environmental issues. The UK author, Dr Sue Thomas, presented the concept of “techno-biophilia” in 2013, which has the potential to become an important guiding principle in global environmental protection and urban development. In this perspective paper, the potential and prospects of the concept of techno-biophilia are discussed from the perspective of human interaction with nature. Rather than considering digital and real space as opposites, the paper considers the meaning of studying the effects of human-nature interaction in the 21st century space where the real and virtual merge, in a new anthropological frame of reference, and contributes to further stimulating debate.

**Subjects:** Environmental Studies & Management; Environmental Psychology; Information Technology

**Keywords:** Technobiophilia; Digital age; Environmental citizens

### ABOUT THE AUTHOR

Dr Hiroko Oe holds a PhD (Waseda University), MSc (LSE), UK, and BEcon (University of Tokyo). Her research interests include sustainable communications and citizens' well-being. She has extensive research experience in the fields of digital arts, digital archiving of local natural assets and learning materials. Dr Yasuyuki Yamaoka is the senior researcher at the Open University of Japan. His research interests cover ICT implementation to improve the effectiveness of learning. He holds a PhD in engineering from Nagoya Institute of Technology, Japan. Mr Max Weeks is a key member of the research group led by Dr Hiroko Oe. Currently he is working on the themes of digital tourism and digital archiving of historical assets in the communities. He also is interested in sub-culture in Japan and east Asia region, such as anime tourism and anime pilgrimage.

### PUBLIC INTEREST STATEMENT

The lockdown period during which people were restricted from going out by COVID-19 greatly increased the opportunities for people around the world to interact in virtual cyberspace. And we know empirically that digital contact with nature in cyberspace has the potential to increase our attachment and admiration for nature and, in turn, our interest in environmental issues.

Based on the concept of ‘technobiophilia’, this study discusses the possibilities and prospects for human-nature interaction in the digital age. Focusing on the interaction between humans and nature in the 21st century space where the real and virtual merge is expected to open up new horizons for a new humanities and digital cultural studies.

## 1. Introduction

### 1.1. Background of the study

The aim of this study is to discuss and propose avenues regarding the concept of “technobiophilia” and how it can be applied to solve environmental problems. The concept at the heart of this paper, technobiophilia, is a thought-provoking concept proposed, which has since attracted the attention of cyber analysts, experts in nature and human behaviour, neuroscientists. However, there is almost no research on this topic in the human sciences. (Thomas, 2013).

The catalytic function of this concept of technobiophilia has great potential and many possibilities. For example, interacting with nature in cyberspace could evoke a sense of awe towards nature in the real world and encourage environmentally friendly behavioural change. This argument may provide a useful perspective on the realisation of the SDGs, which are on the agenda around the world today.

The dynamism of the natural climate has a significant impact on our lives. In addition, actions for the protection and restoration of ecosystems and disaster prevention and mitigation are urgent issues. What can each of us do to help build resilient societies to cope with these situations? In order to raise awareness of these issues and change our behaviour, the benefits of technology may enable us to rethink the relationship between humans and the natural environment and promote ecological behaviour change.

Based on this awareness, this viewpoint paper discusses the function and potential of technobiophilia in addressing one of the major socio-economic issues that we, as global citizens, need to confront today: global environmental issues. We will suggest how technobiophilia can promote the “environmentally conscious behaviour” that each of us must to take responsibility for.

Technobiophilia is “the innate tendency to focus on life and vital processes as they appear in technology”, and the concept was an extrapolation of the biophilia hypothesis introduced (Thomas, 2013). Wilson (1984) defines biophilia as “an innate tendency to focus on life and vital processes.” Thomas (2013) discussed that technophilic practices and artefacts have one or more of the following characteristics:

- (a) A connection between life in nature and life in the digital world
- (b) Enhancing well-being through a balance between technology and nature
- (c) Support for future biodiversity through the proximity of technology and nature

### 1.2. Aim and rationale of this study

This study confirms that the theme of technobiophilia provides an effective basis for maintaining and developing a symbiotic and mutually sustainable relationship between nature and humans. This awareness of the issue is expected to contribute to the global citizens’ environmental agenda for the future, following the discussions at COP26 in Glasgow in November 2021. The study also proposes a further sub-theme. Namely, it discusses the contribution of techno-biophilia to sustainable community design as well, and presents a hypothetical grand design for eco-friendly strategic design with technobiophilia. This research therefore, contributes to the timely and interdisciplinary research theme of the connection between the physical and virtual worlds. Okubo et al. (2021) demonstrated the effect of technology on improving mindfulness and ecological awareness by enriching people’s imaginings of soundscapes in virtual space, touching especially on acoustic effects within virtual reality. Similarly, Strassmann et al. (2021) discussed the possibility of people empathising with ecological values in virtual seascapes as one of the major contributions of computer science. On the other hand, Rambach et al. (2021) argued in the context of computer-human interaction that the implementation of augmented, mixed and virtual reality technologies

could have a significant impact on the field of research on human interactions with nature and the environment.

Furthermore, Laukkanen et al. (2022) discussed the aid of virtual technologies in supporting sustainable consumption and the diversification and enhancement of consumer/citizen experiences brought about by multisensory experiences as one effective avenue for applying this argument to the social sciences in concrete terms.

## 2. Academic discussions

### 2.1. *Outline of discussions of technobiophilia*

Viveiros et al. (2021) proposed the genre of educational tourism in a context that parallels the above discussion, proposing to increase ecological awareness through the implementation of augmented and virtual reality technologies. Such discussions may be in line with the policy aim of awakening the consciousness of the next generation in line with the COP26 agenda. Similarly, Cooke et al. (2021) sensitively discuss the contribution of technology to teaching and learning in ecology, with real examples. Jaciow and Wolny (2021) also propose the significance and potential of new technology implementations in stimulating ecological behaviour in Generation Z, which is also the digital native generation.

Thomas (2012) was the first in the literature to propose and discuss the concept of Technobiophilia in the academic community. Following this, she has provided a perspective for examining the relationship between people and nature in the digital age through a series of works on nature and cyberspace (Thomas, 2013) and “nature by people” (Thomas, 2014). Furthermore, Davies (2016) suggested that technobiophilia research should be developed with the aid of philosophical and educational perspectives, and Smith (2016) argued that the fusion of the virtual and the real can be read as a religious knowledge reading. And Wolfs (2014) suggested that monitoring of urban ecosystem services with the help of technology is a useful guideline for development, with the concept of technobiophilia. Thus, in the context of increasing digitalisation, the need for symbiosis between nature and humans, and the demand for proactive intervention and action, the concept of technobiophilia is expected to be a useful guideline from the perspective of its applicability and scope of practical use.

### 2.2. *Technobiophilia in contemporary issues*

As discussed in the previous section, it may be possible to respond to the call of the times to awaken awareness of the symbiosis between nature and humans with a new concept of technobiophilia, which could offer a pathway to concrete solutions to specific problems. In the following, the potential contributions and implications of technobiophilia for contemporary issues are hypothesised.

#### 2.2.1. *Technobiophilia in urban development concept*

Beatley, (2016) used the concept of technobiophilia to suggest directions for urban development and community design with a focus on sustainability. He argues that technobiophilia is a valuable concept for urban and environmental planning because it provides a clear guide to action and suggests the possibilities and promise of technology. At the same time, he emphasises that the concept of technobiophilia enables us to recognise the reality of urban life, which has many interactions with nature, either in physical spaces or cyberspace. Urban dwellers tend to miss opportunities to physically interact with nature, forgetting the power it has over us and the fact that we are part of nature. Digital technologies have the potential to compensate for this situation and facilitate interaction with nature in virtual spaces, reminding us of our biophilic tendencies.

When considering the awareness and propagation of the symbiosis between nature and humans, it is an excellent approach to have an overview of how technobiophilia can contribute to the design of sustainable symbiotic communities. It has been running the Biophilic Cities

Initiative, also the first academic in that area to pick up on technobiophilia and write about it in many ways, discussing the importance of sustainable community design and environmentally friendly behaviour change. (Beatley, 2021).

Beatley (2020) suggests some useful key topics for us to consider.

- The need for urban design is to have strategic mechanisms in place that are flexible enough to respond to changes in the urban environment.
- We might need to expand our definition to include the city's moral obligations.
- Cities might have a duty to measure their impact beyond their local boundaries.
- City governments may need to consider the lives and well-being of future citizens.
- Cities may have specific ethical obligations towards local wildlife.
- Nature (and crucially, access to nature) may play a role in all of these critical topics.

The potential contribution that technobiophilia should make is not limited to the urban development, but encompasses great potential for solving problems in a wide range of fields. The power of the concept in the social sciences in general is worthy of attention. There are potentially immense implications for technobiophilia in dealing with environmental change, encouraging people to change their ecological behaviour, promoting ethical and eco-friendly purchasing practices, and ensuring environmentally friendly supply chains. There is another important argument that should not be forgotten in the context of contemporary increasingly urbanised environments. It is important to note that in the process of examining the meaning of techno-biophilia, we should bear in mind that inequalities also exist in urban areas, especially for disadvantaged urban areas, where the right of access to nature is excluded, and that the concept of techno-biophilia can compensatively ensure residents' access to the natural environment This can shine a spotlight on the possibility of doing so.

#### 2.2.2. *Technobiophilia and action for climate change*

COP26—the campaign on climate change reminded us that techno-biophilia is a theme that should be invoked COP26 took place in Glasgow, UK, in November 2021, but the work to protect our common planet continues: the IPCC Land Report (2022), arguing that land needs to be protected to address climate change and, in so doing, sounding the alarm that the window of opportunity is rapidly closing. In particular, a report by UN scientists concludes that the effects of the climate crisis are affecting the world's poorest communities the most, further underlining the urgent need for action on climate change.

Knowing that the dynamism of the climate is immense and that changes will continue to occur with catastrophic consequences even if emissions were reduced, we must do what we can to protect and restore ecosystems, ensure people's safety through disaster prevention and mitigation, and build resilient infrastructure and agriculture. It is important to experience nature and its ferocity in a fictional scenario setting in cyberspace, to understand the criticality of disaster preparedness and the magnitude of the impact of climate change. Stefanakis et al. (2021) proposed a new circular economy model for climate change adaptation and discussed nature-based solutions as tools for this. Their theme, circular economy and sustainability, in the light of the concept of techno-biophilia, may clearly suggest the importance of stakeholders promoting learning together in cyberspace and aiming at consensus building.

Similarly, Hurlimann et al. (2021) argued that environmentally friendly urban planning policies should integrate climate change adaptation and mitigation measures, and to this end, relevant stakeholders, including citizens, public authorities, policymakers, industry and advisors, should

work together to understand where the problems lie and to change behaviour in the report emphasises the argument that progress should be made. Again, the potential contribution of technology to resonate with nature and stimulate action, as presented by the concept of technobiophilia, is highlighted.

The Technobiophilia concept, through awareness-raising and behaviour change, will draw on the participation of financial institutions and public sector initiatives and contribute to the realisation of a financial framework for solving challenges at community, regional, national and global levels (Jacobs, 2021; Wynn & Beagley, 2021). We need to understand where the problems lie and are motivated to solve them (Arora & Mishra, 2021). In this way, the concept of technobiophilia can play a significant role in connecting the physical and virtual worlds and encouraging people to change their behaviour. The concept of technobiophilia also works well in accelerating people's awareness by enabling them to experience virtual scenarios in virtual space without leaving home. Experiencing the landscape of a natural environment in a virtual world, without being in the actual nature or physical landscape, awakens people's awareness of their symbiotic relationship with nature deep in their consciousness. When we were forced by COVID-19 to restrict our physical activities, we frequently appreciated nature on the internet, enjoyed digital forest bathing, and observed natural disasters caused by climate change and the reality of endangered species on the other side of the world. As this example illustrates, techno-biophilia can play an important role in awakening people's awareness of their symbiotic relationship with nature and encouraging behavioural change as they move back and forth between the physical and virtual worlds.

Technobiophilia, as already mentioned, has little support from academic arguments, so there is an undeniable limitation in the development of critical discussion based on past literature as a whole. Therefore, the new concept of technobiophilia was clearly positioned as a research theme and discussed again, and the discussion was enhanced to show that it is a valid research theme in these days of calls for the creation of a sustainable society and the symbiosis between nature and people.

### **3. Future research opportunities of technobiophilia**

#### ***3.1. Climate change, which is one of the focuses of the study***

Under the theme of connecting physical and virtual worlds, this section has explored new developments and the potential applications of ICTs, mainly how ICTs can play a role in supporting the sustainable development of a seamlessly interconnected world. This study offers a discussion of the relationship between humans and nature in cyberspace, mediated by the concept of technobiophilia, which promotes people's innate connection with nature and behavioural change. The technobiophilia proposed in this study is expected to be a catalyst for a more progressive and creative sustainable society. The relationship between humans and nature has been, and will continue to be, a topic of continuing interest to researchers.

Climate change, which is one of the focus of the study, is often misunderstood as the sole domain of the natural sciences. Still the social sciences, and human geography, in particular, have much to offer in identifying problems, proposing solutions, building partnerships between stakeholders, and integrating and bridging the latest interdisciplinary wisdom. This pilot discussion was a great success. The present discussion suggests that a concept of technobiophilia can be an effective guideline for responding to climate change and developing a sustainable symbiotic relationship between humans and the environment.

Modern human geography is a broad discipline that studies the spatial differentiation and organisation of human activity and human use of the natural environment. The studying population, ethnic groups, settlements, cities, agriculture, industry, commerce and transport, their geographical distribution, regional structure and their relationship with the environment has contributed to human life and economic and social well-being. The human being, whose address

is the earth, has an inextricable relationship with the natural and social environment. In particular, this relationship changes according to the development of culture and the needs of society. The relationship between man and his environment shows regional variations, and studying of these relationships is one of the main tasks of human geography.

In particular, since 1970, with the rise of environmental destruction, which was accelerated by the world's population growth, urban concentration and industrialization, human geography has contributed to many global and regional studies on human adaptation to the environment environmental assessment and adjustment, it will continue to play an essential role in the future.

### **3.2. The responsibility of academia in the humanities and digital relational debate**

The idea of technobiophilia being discussed is expected to take on increasing significance in the future. For example, when digitalisation will lead to increasingly seamless connectivity and the fusion of servers and real space, it will be possible to explore solutions to complex problems such as environmental issues while moving back and forth between real and virtual space at a moment's notice. As the boundary between the virtual and the real becomes lower, it will be important to understand the problems lie and propose solutions from a more interdisciplinary and complex perspective.

In bird's eye view research, the necessity of having a bird's eye view of the negative aspects that the application of science and technology creates in society at the start of research is pointed out. These proposals emphasise the importance of the relationship between science and society, which has been lacking in conventional scientific research, and further development is expected in the future. In particular, the "negative aspects" discussed in the overarching research are also related to human values and ethics.

Barreiros et al. (2018) proposed the implementation of technologies that contribute to the well-being and performance of users, aided by the concept of technobiophilia. Interestingly, they present the argument that if machines are perceived as more like living organisms, users will take better care of them, ideally leading to better maintenance of equipment. This idea encompasses values that are in tune with the spirit of technobiophilia. Williams et al. (2021) note that, given the compelling relationship between natural environmental experiences and positive health outcomes, proposals for immersive virtual nature experiences are discussed with promise for their potential beyond the fields of creativity and health. The potential of immersive virtual nature art as an intervention in creative well-being can be expected to further increase its impact and contribute to design strategies through the concept of techno-biophilia. And they proposed creative imagery for designing nature and social well-being through the use of advanced augmented reality (XR) technologies.

Menezes and Smaniotto Costa (2017) argued that ethnography is vital for providing sustainable and inclusive urban spaces, where they highlighted the significance of developing knowledge about the relationship between social practices and public green space. In the process of proposing a methodological approach to research in the field of urban ethnography, they assessed recent research findings on biophilic design, restorative environments, nature deficit syndrome and technobiophilia, verifying that green environments are essential for well-being in both analogue and digital environments. They also confirmed that the concept of technobiophilia is a key theory that supports today's urban development debate, which should contribute to sustainable healthy cityscape based on well-balanced human-nature relationships.

Thus, the debate in academia around technobiophilia is becoming increasingly diverse, and the relentless search for pathways to enable us to live in harmony with our digital lives and with nature in today's online world will continue and increase. Under the lofty banner of a digital detox, we are instructed to close our computers, shut off the internet and go outdoors to commune with "real nature" a few days a month. We are taught that an electronic Sabbath helps to improve

human wellbeing (Lomanowska & Guitton, 2016). But does it really? Is it appropriate to view the physical and virtual worlds as opposites and discuss them in a trade-off relationship (Hayes et al., 2016; Nurhas et al., 2021)?

More and more people are looking for ways to combine their love of technology with their love of nature. We will be connected to everything and everywhere, and the boundaries between real and virtual will become lower and lower. Under these circumstances, in order to raise public awareness and stimulate action to accelerate environmental conservation efforts that will increase in the future, we will mediate techno-biophilia, which is taught by the biophilia our DNA remembers, and through empirical research on behaviour change effects that are favourable to the environment, we will further explore the hidden facts to present robust suggestions.

#### Funding

The authors received no direct funding for this research.

#### Author details

Hiroko Oe<sup>1</sup>

E-mail: [hoe@bournemouth.ac.uk](mailto:hoe@bournemouth.ac.uk)

ORCID ID: <http://orcid.org/0000-0002-2841-7583>

Yasuyuki Yamaoka<sup>2</sup>

ORCID ID: <http://orcid.org/0000-0003-1082-9691>

Max Weeks<sup>3</sup>

ORCID ID: <http://orcid.org/0000-0003-3729-8659>

<sup>1</sup> The Faculty of Management, Bournemouth University, Bournemouth, UK.

<sup>2</sup> Department of Society and Industry, The Open University of Japan, Chiba, Japan.

<sup>3</sup> Department of Travel and Tourism, Brockenhurst College, Hampshire, UK.

#### Disclosure statement

No potential conflict of interest was reported by the author(s).

#### correction

This article has been republished with minor changes. These changes do not impact the academic content of the article.

#### Citation information

Cite this article as: Technobiophilia: Nature and human interactions in the digital age, Hiroko Oe, Yasuyuki Yamaoka & Max Weeks, *Cogent Arts & Humanities* (2022), 9: 2068823.

#### References

- Arora, N. K., & Mishra, I. (2021). COP26: More challenges than achievements. *Environmental Sustainability*, 4(1), 1–4. <https://doi.org/10.1007/s42398-021-00164-y>
- Barreiros, C., Veas, E., & Pammer, V. (2018, July). Bringing nature into our lives. In *International Conference on Human-Computer Interaction* (pp. 99–109). Springer, Cham.
- Beatley, T. (2016). Overcoming the obstacles and challenges that remain. In *Handbook of biophilic city planning and design* (pp. 245–253). Washington, DC: Island Press.
- Beatley, T. (2020). *The bird-friendly city: Creating safe urban habitats*. Island Press.
- Beatley, T. (2021). *Can nature make a city more ethical?*, Biophilic Solutions, [https://biophilicsolutions.buzzsprout.com/1628002/8408603-can-a-city-be-ethical?fbclid=IwAR0qMwVef4EM9x8x1-FNGwkDpuNV54JzvZC3-mznL2ZcR6IQ\\_oYZ2TjGRvM](https://biophilicsolutions.buzzsprout.com/1628002/8408603-can-a-city-be-ethical?fbclid=IwAR0qMwVef4EM9x8x1-FNGwkDpuNV54JzvZC3-mznL2ZcR6IQ_oYZ2TjGRvM) (accessed 15 November 2021)
- Cooke, J., Araya, Y., Bacon, K. L., Bagniewska, J. M., Batty, L. C., Bishop, T. R., Burns, M., Charalambous, M., Daversa, D. R., Dougherty, L. R., Dyson, M., Fisher, A. M., Forman, D., Garcia, C., Harney, E., Hesselberg, T., John, E. A., Knell, R. J., Maseyk, K., ... Lewis, Z. (2021). Teaching and learning in ecology: A horizon scan of emerging challenges and solutions. *Oikos*, 130(1), 15–28. <https://doi.org/10.1111/oik.07847>
- Davies, R. (2016). Ceaselessly exploring, arriving where we started and knowing it for the first time. *Studies in Philosophy and Education*, 35(3), 293–303. <https://doi.org/10.1007/s11217-016-9515-6>
- Hayes, J. F., Maughan, D. L., & Grant-Peterkin, H. (2016). Interconnected or disconnected? Promotion of mental health and prevention of mental disorder in the digital age. *The British Journal of Psychiatry*, 208(3), 205–207. <https://doi.org/10.1192/bjp.bp.114.161067>
- Hurlimann, A., Moosavi, S., & Browne, G. R. (2021). Urban planning policy must do more to integrate climate change adaptation and mitigation actions. *Land Use Policy*, 101, 105188. <https://doi.org/10.1016/j.landusepol.2020.105188>
- Jaciow, M., & Wolny, R. (2021). New technologies in the ecological behavior of generation Z. *Procedia Computer Science*, 192, 4780–4789. <https://doi.org/10.1016/j.procs.2021.09.256>
- Jacobs, M. (2021). Reflections on COP26: International diplomacy, global justice and the greening of capitalism. *The Political Quarterly*. <https://doi.org/10.1111/1467-923X.13083>
- Laukkanen, T., Xi, N., Hallikainen, H., Ruusunen, N., & Hamari, J. (2022). Virtual technologies in supporting sustainable consumption: From a single-sensory stimulus to a multi-sensory experience. *International Journal of Information Management*, 63, 102455. <https://doi.org/10.1016/j.ijinfomgt.2021.102455>
- Lomanowska, A. M., & Guitton, M. J. (2016). Online intimacy and well-being in the digital age. *Internet Interventions*, 4(2), 138–144. <https://doi.org/10.1016/j.invent.2016.06.005>
- Menezes, M., & Smariotto Costa, C. (2017). People, public space, digital technology and social practice: An ethnographic approach. In A. Zammit & T. Kenna (Eds.), *Enhancing Places Through Technology* (pp. 167–180). Edições Universitárias Lusófonas.
- Nagayama, M. 2005 October. *Organising and reconstructing theories on regional industrial revitalization: Mechanisms of new industry creation in regions*. Sinkin-Chukin Monthly Newsletter. Sinkin Central Bank.
- Nurhas, I., Geisler, S., Ojala, A., & Pawlowski, J. M. (2021). Barriers and wellbeing-oriented enablers of intergenerational innovation in the digital age. *Universal Access in the Information Society*, 1–17. <https://doi.org/10.1007/s10209-021-00844-w>
- Okubo, Y., Oishi, Y., & Kawai, Y. (2021, December). Preservation and reproduction of real soundscapes in virtual space for the “100 best soundscapes in Japan”. In *Proceedings of the 27th ACM Symposium on Virtual Reality Software and Technology Osaka*



- Japan December 8 - 10, 2021 (pp. 1-2). Association for Computing Machinery, New York, NY, United States. <https://dl.acm.org/doi/10.1145/3489849.3489902>
- Rambach, J., Lilligreen, G., Schäfer, A., Bankanal, R., Wiebel, A., & Stricker, D. (2021, July). A survey on applications of augmented, mixed and virtual reality for nature and environment. In *International Conference on Human-Computer Interaction* (pp. 653-675). Springer, Cham.
- Smith, P. (2016). *Meaningful communities, the growth of virtual churches. The Bible in Transmission*: [https://www.biblesociety.org.uk/uploads/content/bible\\_in\\_transmission/files/2016\\_spring/Bit\\_Spring\\_2016\\_Smith.pdf](https://www.biblesociety.org.uk/uploads/content/bible_in_transmission/files/2016_spring/Bit_Spring_2016_Smith.pdf) [Accessed 6 April 2022]
- Stefanakis, A. I., Calheiros, C. S., & Nikolaou, I. (2021). Nature-based solutions as a tool in the new circular economic model for climate change adaptation. *Circular Economy and Sustainability*, 1(1), 303-318. <https://doi.org/10.1007/s43615-021-00022-3>
- Strassmann, C., Arntz, A., & Eimler, S. C. (2021). Inspiring movement—physical activity in a virtual sea as a driver for ecological awareness. *International Journal of Semantic Computing*, 15(4), 539-559. <https://doi.org/10.1142/S1793351X21400158>
- Thomas, S. (2012). *Technobiophilia: Stories, memes and metaphors*. Bloomsbury Academic.
- Thomas, S. (2013). *Technobiophilia: Nature and Cyberspace*. Bloomsbury Academic.
- Thomas, S. (2014). Next nature: 'nature caused by people'. *Journal of Professional Communication*, 3(2). <https://doi.org/10.15173/jpc.v3i2.155>
- Viveiros, L. C., Pereira, A. I., Peroni, J. V., Fachada, I., & Gonçalves, E. (2021). Natureza virtual: Enhancing ecosystem awareness by using virtual reality in educational tourism. In: tom Dieck, M.C., Jung, T.H., Loureiro, S.M.C. (eds) *Augmented Reality and Virtual Reality* (pp. 291-302). Progress in IS. Springer, Cham. [https://doi.org/10.1007/978-3-030-68086-2\\_22](https://doi.org/10.1007/978-3-030-68086-2_22)
- Williams, J. L., Langley, S., & Borda, A. (2021). Virtual nature, inner forest: Prospects for immersive virtual nature art and well-being. *Virtual Creativity*, 11(1), 125-146. [https://doi.org/10.1386/vcr\\_00046\\_1](https://doi.org/10.1386/vcr_00046_1)
- Wilson, E. O. (1984). *Biophilia*. Harvard University Press.
- Wolfs, E. L. (2014). Techno-Biophilia: Monitoring, management, enhancement, and care of urban ecosystem services with the help of technology. *한국디자인학회 학술발표대회논문집*, 4-5. <https://www.dbpia.co.kr/Journal/articleDetail?nodeId=NODE02472802>
- Wyns, A., & Beagley, J. (2021). COP26 and beyond: Long-term climate strategies are key to safeguard health and equity. *The Lancet Planetary Health*, 5(11), e752-e754. [https://doi.org/10.1016/S2542-5196\(21\)00294-1](https://doi.org/10.1016/S2542-5196(21)00294-1)



© 2022 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

You are free to:

Share — copy and redistribute the material in any medium or format.

Adapt — remix, transform, and build upon the material for any purpose, even commercially.

The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made.

You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

No additional restrictions

You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.



**Cogent Arts & Humanities (ISSN: 2331-1983) is published by Cogent OA, part of Taylor & Francis Group.**

**Publishing with Cogent OA ensures:**

- Immediate, universal access to your article on publication
- High visibility and discoverability via the Cogent OA website as well as Taylor & Francis Online
- Download and citation statistics for your article
- Rapid online publication
- Input from, and dialog with, expert editors and editorial boards
- Retention of full copyright of your article
- Guaranteed legacy preservation of your article
- Discounts and waivers for authors in developing regions

**Submit your manuscript to a Cogent OA journal at [www.CogentOA.com](http://www.CogentOA.com)**

