

Mountains and Slow Tech. Evolutionary Processes at the Interface with Natural and Virtual Ecosystems.

Luca Giunti¹, Elena Camino²

¹ Park Keeper, Protected Areas of the Cozie Alps, Italy.

² Interdisciplinary Research Institute on Sustainability, University of Turin, Italy

*There they are, you will have to go a long way round
if you want to avoid them.
It takes some getting used to. There are the Alps,
fools! Sit down and wait for them to crumble!⁴*

These lines by the poet Basil Bunting capture a sense of the human as an infinitesimally small biotic part of a web of abiotic and biotic immensity, relating the enormity of the spatial and temporal dimensions embodied by mountain ranges like those of the Alps to the multiplicity of human reactions to them: a sense of frenzy or of calm, acting to reduce or eliminate obstacles, ignoring or contemplating, denying or accepting. In the following personal reflections, Luca Giunti and Elena Camino explore many aspects of such dimensions and reactions as they consider ways in which natural and virtual worlds meet and interact, while the photos taken by Luca Giunti capture their essence.

ISSN 2384-8677

DOI: <http://dx.doi.org/10.13135/2384-8677/4043>

Article history: Submitted October 14, 2019. Accepted November 24, 2019. Published December 21, 2019

Citation: Giunti, L & Camino, E. (2019). Mountains and Slow tech. Evolutionary processes at the interface with natural and virtual ecosystems. *Visions for Sustainability*, 12: 62-70.

Copyright: ©2019 Giunti, L. & Camino, E. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Competing Interests: The authors have declared that no competing interests exist.

Corresponding Author: Luca Giunti Email: giunti@alpicozie.eu

⁴ Basil Bunting (2000), *Complete Poems*, New York: New Directions



The smaller we come to feel ourselves compared to the mountain, the nearer we come to participating in its greatness. I do not know why this is so. [...] Every living being is connected intimately, and from this intimacy follows the capacity of identification and as its natural consequences, practice of non-violence. Now is the time to share with all life on our maltreated earth through the deepening identification with life forms and the greater units, the ecosystems, and Gaia, the fabulous, old planet of ours (Arne Naess, Oslo, 1912-2009).⁵

⁵ Naess, A. (1989) *Ecology, Community and Lifestyle*. Cambridge: Cambridge University Press

Mountains and vital questions we cannot escape

Luca Giunti

All mountains are constantly subject to a process of crumbling and levelling out. Geologically, incessant erosion creates new rocks that fall due to the force of gravity. Climatically, rising temperatures cause glaciers to shrink, lowering mountain peaks and melting the permafrost that for thousands of years has held together layers of rocks, thereby permitting them to fall. The constant pressure exerted by the continental plates and the lifting of the continents that is ongoing since the end of the last glaciation are in themselves too slow to counter these phenomena and the speed of the decomposition they bring about.

Above all, a process of levelling out of our mountains has taken place in our minds and in our behaviours. Our contemporary world does everything possible to eliminate them, physically and culturally. Rail and road tunnels constantly penetrate them at the base in order to permit us to go straight ahead. Ski lifts and helicopters climb them using fossil fuel energy instead of that of humans and animals. Electricity and computer networks eliminate gradients and instantaneously connect places that up to twenty years ago were isolated.

Why has this happened? Because mountains present us with features that we do not want to see, or rather that we no longer want to see. In the first place, mountains, by definition, rise. Trivial as it may seem, it is essential to recognize this. Indeed, if we exclude all the various types of lifts or motor vehicles, mountains are places to go walking in. Something that today many young people and adults never do. Not strolling along a road but walking on tracks for hours and with a full rucksack. If, like me, you often accompany people along mountain pathways - even if they are easy, wide and well signposted - you find it worrying to see how many of them continuously stumble, are unable to maintain a rhythm and a quickly out of breath, after half an hour of walking declare themselves dead tired, and after two hours have huge blisters on their feet.

The reason is well-known. We are largely sedentary and lazy. While young people practise many kinds of sport, these are all highly structured and on surfaces that are absolutely perfect. They are used to having everything immediately and without effort and have no sense of appreciation of the healthy dimension of making an effort and feeling fatigue.

At the same time, at school they learn that the most important conquest by the human species

was an erect posture. They study the exploits of the great explorers and the campaigns of the ancient armies, all rigorously on foot. All the adventures of the Anabasis of Xenophon, Cyrus the Great, Hannibal of Carthage, Genghis Khan, Attila the Hun, the Crusaders, Marco Polo, Hernán Cortés, the pioneers of the Far West, may have involved some ships and horses, but primarily they were based on walking and the best-known event in the Olympic Games was based on running an immense distance to stretch the limits of physical endurance. And they may find out that their own grandparents covered distances now considered impossible on foot, perhaps even to attend their same school.

Little over half a century ago life in the mountains was very different. Many resident or seasonal communities lived there, growing crops and breeding cattle. There were fewer woods, more pastures and more irrigation channels. The paths used today by excursionists linked the villages, the fields, the grazing lands and the valleys. They were wide, open and well-tended because of their daily use, whereas today tourists complain that they are badly signposted and overrun by shrubbery. The dry-stone walls that still withstand gravity bear witness to the toil and fatigue of our ancestors. We can frequently come across the ruins of stone settlements covered by vegetation ("Stones once houses covered with wild roses"⁶). Stopping and trying to imagine the inhabitants' daily life without electricity and running water (still a reality in many parts of the world less fortunate than others) is a highly beneficial mental exercise.

Mountains also make us face something rare in cities - silence. Continuous noise is a cause of significant disorders and is something to which we become habituated. Often several hours of detoxification are necessary to be able to do without headphones or smartphones or to stop shouting continually, so as to appreciate once again a sense of quiet. Even though this is never absolute, since it is always full of rustling, whispering, popping, animal noises and voices, sound that are always different and never-ending, but all natural.

Then there is the question of space, another dimension that contemporary life has made us lose. Medical research shows a correlation between visual disturbances in young people and the lack of things to observe in the distance since we are hemmed in between walls and buildings.

⁶ Lyrics from a song by Lucio Battisti "Il mio canto libero" (1972)

Mountains make us look up as we climb, widening our gaze as we reach their peaks. In this way we realize how small we are and how little we know of our world. And this is disturbing, leading us to level them and level ourselves.

Mountains can also be places of darkness. Astronomers and stargazers increasingly decry how our artificial lighting is spreading and worsening. Many people can no longer see galaxies like the Milky Way. Pollution in the mountains is still at a relatively low level and the air is thinner, and this enables us to enjoy a starry sky with all its fascinating mixture of emotion, curiosity and mystery. And this is not just a question of ... scientific perspective or idle romantic imagination. From the origins of human conscious – perhaps some 100,000 years ago – we have always been able to simply look up and see the sky, the stars and the planets. This black dome has accompanied human evolution and been a source of inspiration for thinkers and artists alike. The great voyages of exploration, from the Phoenicians to Columbus, have used it as an instrument for spatial orientation, the Christian tradition has seen in it the sign of the birth of Christ, Galileo, Kepler and Copernicus used it to lay the bases of modern science, Kant found in it a principle of reason and universal judgement, poets and lovers have searched it for answers to the fundamental question of life. Its daily spectacle was free and brought together all humankind: kings and peasants, navigators and shepherds, monks and brigands, industrialists and office workers, drivers and labourers, miners and furnace workers. While returning home in the evening, everyone could freely cast a glance – and so formulate a thought – on the infinite. Only within the last fifty years – no more than the blink of an eyelid in terms of human history – have we almost entirely lost this ability. Mountains are still dark, but today this terrifies us. We rather light them up (skiing by night, beacons, lamps, cameras) or avoid them – and so inhibit our gaze and thought.

Being in the mountains means reflecting continuously, even if unconsciously, about what is necessary and what is essential. If initially we carry on our shoulders all that we consider indispensable, after two or three trips we drastically reduce the weight and the volume. We discover how much energy our electronic devices consume and how they cannot be plugged in to a fir tree to be recharged. And we might just be shocked to find out that we could perhaps learn to live without them.

The first basic lesson that every novice climber receives is that if you are in difficulty, if the weather changes or if your companion does not

feel well, then turn back! No matter if you are only a few metres from your goal, turn back! Even if you have spent months and money on organizing the climb, turn back! Wise and disinterested advice. Simple advice that can save lives, costs and hydrogeological instability. Advice that avoids television or newspaper headlines – which deal with wasted rescue expenses or landslides and never with money saved or floods avoided. The essence of this mountain warning is “be reversible”, because what is irreversible is never a good outcome. Today we tend to consider what is irrevocable as something positive and this is another reason why we do not like mountains and try to level them out. They put us face to face with our limits, while we would like to be omnipotent and unlimited.

Mountains teach us to face the unforeseeable and be adaptable. These are perhaps the most important specific characteristics that have favoured our evolution. Today we risk forgetting them. If I have planned a trip on a given day and with a given itinerary, nothing can make me change my mind. If I have planned it to last for two hours, no meeting or obstacle can slow down my progress. Better still if I arrive ten minutes early! A thunderstorm, a herd of cows, a group of trekkers, a park keeper, will never be seen as potentially enriching occasions to wait, look around me, discover new features, but rather only as impediments to my performance – naturally, to be shared as such on social media as soon as possible. We want safety at any cost and in any circumstance, but mountains remind us that this is an illusion. Lose our path, slip, fall, are all accidents we would like to avoid but which can happen. They will be less likely the more we are prepared inside ourselves (mental before physical training) rather than externally, because there will be times in which GPS and smartphone cannot help us. Every year alpine rescue units tell of highly equipped and costly expeditions to help someone wearing flip-flops in difficulty on snow slopes. Contemporary life tries to convince us that experience can be substituted by information. Mountains show us that this is not true and so we have to try to cancel them.

Finally, mountains offer refuge for those in need. It is no accident that for centuries it has been impossible for invaders to subjugate the afghan population because they always hide in the mountain peaks that they know better than their enemies, despite possessing inferior technology. For the same reason, in Italy the members of the resistance against the fascist regime took to the mountains. Likewise, mountain passes allow the movement of migrants, smugglers, victims of

persecution and clandestine travelers, all of whom need to escape the watchful eye of the established authorities in a given place and time. Fatigue, Silence, Vast Spaces, Darkness, Essentialness, Limits, Inborn Rebellion. Mountains

offer all these and many other dimensions. As with many other vital questions related to the development of human technology, we cannot escape asking ourselves for how much longer this will be so.



The dimension of time in the mountains. Catching the moment after waiting and watching for hours.

Mountains and evolutionary timescales.

Elena Camino

A rapid separation from nature

At first sight the relationship between mountains and ICT may not seem evident. Yet for Luca Giunti mountains clearly demonstrate how experience cannot be substituted by information. He speaks of mountains that with the passage of time are subject to a process of levelling out, both literally and metaphorically. Mountains that require effort, with few inhabitants, that are vast, silent and dark. At the same time, mountains teach us about what is essential (lightening the contents of our backpacks), about reversibility recognizing limits, turning back), about adaptability (in the face of the unforeseen, the new, the mysterious).

Working for many years as a Park Keeper he has built a deep knowledge both about mountains and about the numerous people (excursionists, children and adolescents) he has accompanied along their pathways. Over the years he has observed the increasing difficulty they have in walking, the rapid onset of fatigue in climbing, the perceptual dystonia that makes difficult the recognition of the relationship of proportion between animals, the difficulty in maintaining

concentration for even a short length of time, of listening or watching in silence to pick up the sounds or shapes of nature and take in the wide-reaching panorama.

He has learnt how to deal with the youngsters' dismay as they lose contact with their virtual reality in the absence of a wi-fi signal in valleys and on peaks and the lack (as yet?) of electric sockets in trees to recharge devices.

While the reflections from the Park Keeper's perspective are gentle and ironic, they also highlight a dramatic change that in less than a century for over half of humankind has led to the loss of direct experience of nature – what has both accompanied and forged our entire evolutionary history in terms of the development of our species and of our societies.

The common ancestor of humans, chimpanzees and bonobos that evolved into being 6 million to 8 million years ago gave rise to a succession of ancestors of hominids (and hence of modern humans, or *Homo sapiens*) known as hominins. Hominids first began forming their own tools about 2.6 million years ago, made purposeful use

of fire starting about 800,000 years ago and experienced an accelerated increase in brain size between roughly 800,000 and 200,000 years ago. Most modern human characteristics have evolved in the last 200,000 years, with a shift to farming and agricultural methods from hunting and gathering beginning about 12,000 years ago.⁷

In terms of evolutionary timescales, the sudden loss of full immersion in nature has been analyzed from various perspectives, in the attempt to understand its implications and act consciously and rationally in the light of this abrupt change. Each analysis inevitably starts from specific and often implicit views on human nature, on how individual human beings function, on the meanings and modes that characterize the relationships between humans and other living beings. Thus, the range of different interpretations of this rapid and radical separation lead to many diverse and often conflicting conclusions.

A dynamic interplay between body, mind, emotion and nature

Although viewed historically as separate functions, in recent years complex motricity and cognition are increasingly being considered as functionally connected. Along a timescale of millions of years, the human body and mind would have been gradually molded, in a slow evolutionary process at the interface with natural ecosystems. According to the view proposed of *embodied cognition*, “the nature of a living entity’s cognition is shaped by the form of its physical manifestation in the world ... [...] embodied cognition emphasizes how the particulars of human bodies acting in complex physical, social, and cultural environments determine perceptual and cognitive structures, processes, and operations. In contrast to traditional views of cognition, an embodied approach suggests that humans should be considered first and foremost as active agents rather than as disembodied symbol processors” (Antle, 2009, p. 27). More recently, Leisman et al. (2016, p.2) have pointed out that “all views of embodiment share the understanding that cognition is a complex set of internal activities, bound to each other and to the world through perception and action in real time with no static and isolated representation of anything, that is, that cognition is just a complex dynamic system”.

⁷ <https://sciencing.com/human-evolution-timeline-stages-theories-evidence-13719186.html>

According to Glenberg (2015), an embodied approach to cognition asserts that all cognitive processes are based on sensory, motor and emotional processes, which are themselves grounded in body morphology and physiology. Within this framework, the goal of cognition is effective action in the service of survival and reproduction.

The role of nature in personal self-realization in terms of evolutionary biology has given rise to the concept of *Biophilia*, a term which expresses the meaning of “love of life or living systems.” It was first used by Erich Fromm to describe a psychological orientation of being attracted to all that is alive and vital. E. O. Wilson used the term in the same sense when he suggested that biophilia describes “the connections that human beings subconsciously seek with the rest of life” thereby proposing the idea that “the deep affiliations humans have with other life forms and nature as a whole are rooted in our *biology*” (Kellert & Wilson, 1993, p.416).

Such a natural orientation towards other members of the web of life might be connected with a quality defined as a kind of *intelligence*. Over time, intelligence has been defined in many ways: the capacity for logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking, and problem solving. More generally, it can be described as the ability to perceive or infer information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context⁸. According to Gardner an intelligence is “a biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture” (1999, p. 33-34). To an original list of seven kinds of intelligence, he subsequently added naturalistic intelligence, defined as nurturing and relating information to one’s natural surroundings. As underlined by Morris (2004, p. 159) “this sort of ecological receptiveness is deeply rooted in a ‘sensitive, ethical, and holistic understanding’ of the world and its complexities – including the role of humanity within the greater ecosphere”.

Nature as educational subject: from biophilia to stewardship

Human bodies acting in complex physical, social, and cultural environments determine perceptual and cognitive structures, processes, and operations. Even processes that seem abstract, such as language comprehension and goal

⁸ <https://en.wikipedia.org/wiki/Intelligence>

understanding, are embodied. Growing evidence of the interdependence between mind, body and environment has led to many experiments within the field of education, even in terms of learning abstract notions in Mathematics or Physics and how motor activity is central to concept building (Yee et al., 2013; Weisberg et al., 2017). Moreover, as cognition is formatted in terms of sensorimotor experience, and sensorimotor systems make those thoughts dynamic, even language comprehension and goal understanding are embodied (Glenberg, 2015). An increasing collection of reports indicates shifts in perseverance, problem solving, critical thinking, leadership, teamwork, and resilience (Kuo et al., 2019). On the contrary, there is increasing evidence that “reduced postural activity in childhood harms natural exploration of the surrounding, thereby reducing the ability to learn from experiences, and leading to developmental delays” (Leisman et al., 2016, p. 2).

Since 1950, the world’s urban population has risen almost six-fold, from 751 million to 4.2 billion in 2018⁹. In 2009 the urban population surpassed the portion of people living in the rural areas. Over the next few decades, the rural population is expected to level out and eventually decline, while urban growth will continue to shoot up to six billion people and beyond. In this way, there is inevitably an increasing gap between the possession of abstract knowledge about the environment and real, concrete experience in nature. Meanwhile, hundreds of studies have recently been investigating the role that experience in nature – from wilderness backpacking to plants in a preschool to a wetland lesson on frogs— may have in promoting learning, and converging evidence strongly suggests that experience of nature boosts not only academic learning and personal development, but also environmental stewardship (Kuo et al., 2019).

Spending time in nature fosters an emotional connection to nature and, in turn, conservation attitudes and behavior. Awareness is increasing of how direct contact with nature may be the most effective way to nurture the growth of environmental stewards (Lekies et al., 2015). An emotional connection to nature, which may be more difficult to acquire in a classroom, is a

powerful predictor of children’s conservation behavior, so that a nature-based environmental education, which combines the acquisition of environmental knowledge with the promotion of an intrinsic driver, namely connectedness to nature, is proposed as a holistic approach to increase ecological behavior (Siegman & Pensini, 2017, abstract). In this respect, Gould affirms that “we cannot win this battle to save species and environments without forging an emotional bond between ourselves and Nature as well-for we will not fight to save what we do not love” (Gould, 1993, p.40). Biophilia is precisely that emotional bond with Nature and being innate in children it can be the most solid starting point to develop naturalist intelligence. At the same time, an extensive literature, together with much shared direct experience, demonstrates the efficacy of being exposed to natural environments in order to develop or regain a sense of wellbeing or serenity, or to improve or restore the capacity for attention or concentration. This is particularly significant as regards children, where research into their perception of restorativeness and the potential restorative effects of natural environments for this population suggests that children living in a place with more Nature are likely to benefit with respect to their cognitive functioning or attentional capacity (Berto et al, 2015).

According to Berto & Barbieri (2017, p.4), Biophilia, as the evolutionary legacy, and naturalist intelligence, as the potential goal of education, can be considered the two poles of an environmental education journey where perceived restorativeness and connection to Nature play a significant role”.

To summarize, we can say that various experimental approaches come together in indicating that direct, intense and prolonged experience in natural environments leads to advantages both in terms of cognitive development and wellbeing together with the promotion of attitudes and behaviors involving care and protection of nature.

9

<https://www.weforum.org/agenda/2019/09/mapping-the-dramatic-global-rise-of-urbanization-1950-2020/>



Natural environments promote wellbeing and serenity, care and protection

Virtual nature and elusive spaces

In recent years an increasing quantity of research and publications have been dedicated to “technological” solutions to the increasing deprivation of experience in nature, in order to re-establish a harmonious relationship between body, mind and nature. According to Truong et al. (2015), technology has today begun to change human's long-standing experiences with nature. Through videos and documentaries, we travel, discover magnificent windows opened onto wildernesses, landscapes, places and species we would not be able to reach and see otherwise. Virtual Reality (VR) aims to elicit sensory responses to simulated environments. Exponential increases in computing power, along with other innovations in display system hardware and software, have enabled dramatic improvements in the quality of simulation. Newer systems are capable of more modes of sensory stimulus (such as vision, hearing, and touch) with greater detail at higher frame rates. More physical phenomena can be computed in real time (rather than precomputed and “baked in”), allowing for higher fidelity interaction (Hall et al. 2012).

Embodied cognition literature has led some researchers – in particular those linked to commercial applications of VR for entertainment purposes – to explore ways in which virtual reality may be a surrogate for real-life natural environments. Truong et al. (2015) have focused on how players relate to Nature in the world's

number one online role-playing game, the World of Warcraft (WoW, millions of players throughout the world), and they suggest that gamers in these worlds actually prefer to gather and role-play in natural-looking areas with a predominance of greenery, even when not actively exploring. Indeed, in modern society, artificial constructs and electronic technology now dominate most peoples' interests (technophilia). Buettel & Brook (2016) argue that gaming technology can excite people about nature, unlock their inherent biophilia, and highlight the value of ecological restoration in their everyday lives. According to Shin (2018, p. 71) with the rise of VR technologies and services, “the user's role has changed from passive consumer of technologically provided immersion to active creator of immersion. The VR user creates, adapts, and modifies immersion, depending on his or her day-to-day activities and context”.

This computational approach to the relationship between people and nature is in rapid expansion, in a parallel fashion both to that of the exponential growth of calculation capacity and Big Data as well as market pressures that see in VR commerce vast developmental opportunities. Nevertheless, there are some areas of human experience that do not lend themselves to quantitative study, areas like childhood memories, insights, certain deep emotions, spiritual experiences, magical encounters, spaces which elude a computational and thingifying approach. In the words of Raimon Panikkar (2005) reality has a cosmic dimension of

matter and energy, of space-time, that cannot be ignored. Human beings are neither merely products nor masters of nature and the world is their extended bodies, with which they share life and destiny. The logos accompanies all our lives, but not everything can be related to or by the logos. The human, the infinite or divine and the material are not three separate realities but rather three aspects of one unique, same reality, the awareness of which reveals the ambiguities and limits of all strictly scientific or cultural discourse.

References

- Antle A. N. (2009) Embodied Child Computer Interaction: Why Embodiment Matters. *Lifelong interactions* doi: 10.1145/1487632.1487639
- Barbiero, G. & Berto R. (2018) From Biophilia to Naturalist Intelligence Passing Through Perceived Restorativeness and Connection to Nature *Annals of Reviews and Research*, 3(1): 555604.
- Berto R., Pasini M., & Barbiero G. (2015) How does Psychological Restoration Work in Children? An Exploratory Study. *J Child Adolesc Behav* 3: 200.
- Buettel J. & Brook, B. (2016). Egress! How technophilia can reinforce biophilia to improve ecological restoration: Coupling nature, restoration, and technology. *Restoration Ecology*. 24. 10.1111/rec.12387.
- Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. New York: Basic Books.
- Glenberg, A. M. (2015). Few believe the world is flat: How embodiment is changing the scientific understanding of cognition. *Canadian Journal of Experimental Psychology* 69(2), 165-171.
- Gould S.J. (1993) *Eight Little Piggies*. New York: Norton.
- Hall T.W., Navvab M., Maslowski E., Petty S. (2012) Virtual Reality as a Surrogate Sensory Environment. In: Gulrez T., Hassanien A.E. (eds.) *Advances in Robotics and Virtual Reality. Intelligent Systems Reference Library*, vol 26. Springer, Berlin, Heidelberg
- Kellert S.R., Wilson E.O. (1993). *The Biophilia Hypothesis* Washington DC: Island Press.
- Kuo M., Barnes M. & Jordan C. (2019) Do Experiences with Nature Promote Learning? Converging Evidence of a Cause-and-Effect Relationship. *Front. Psychol.* 10:305.
- Leisman G., Moustafa A.A. & Shafir T. (2016) Thinking, Walking, Talking: Integratory Motor and Cognitive Brain Function. *Front. Public Health* 4:94. doi: 10.3389/fpubh.2016.00094
- Lekies, K. S., Lost, G., and Rode, J. (2015). Urban youth's experiences of nature: implications for outdoor adventure education. *J. Outdoor Recreat. Tour.* 9, 1–10. doi: 10.1016/j.jort.2015.03.002
- Morris, M. (2004). "Ch. 8. The Eight One: Naturalistic Intelligence". In Kincheloe, Joe L. (ed.). *Multiple Intelligences Reconsidered*. Peter Lang. pp. 159–. ISBN 978-0-8204-7098-6.
- Panikkar R. (2005) *La porta stretta della conoscenza*, Milano: Rizzoli 2005
- Shin D. (2018) Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience? *Computers in Human Behaviour* 78, 64-73.
- Siegmar O. & Pensini P. (2017) Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behavior. *Global Environmental Change*. Volume 47, November, pp. 88-94.
- Truong, M-X., Prevot, A-C. & Clayton, S. (2015). Gamers like it green: Virtual Biophilia-like experience in Virtual Universes. Conference: ICCB ECCB 2015, Montpellier, France
- Weisberg, S.M., Newcombe, N.S. (2017) Embodied cognition and STEM learning: overview of a topical collection in *CR:Pl. Cogn. Research* 2, 38. doi:10.1186/s41235-017-0071-6
- Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.
- Yee, E., Chrysiou, E. G., Hoffman, E. & Thompson-Schill, S. L. (2013). Manual Experience Shapes Object Representations. *Psychological Science*, 24(6), 909–919.