Visualizing Worldviews:
Shifting Perspectives on Global Change

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Abstract

This essay encourages a reflective approach to communicating the urgency of global change issues. Recognizing that multiple factors shape personal intuitions and interpretations of the world, it seeks to highlight some of the entrenched paradigmatic assumptions that continue to reinforce misperceptions about humanity's relationships to the natural world. Multiple critiques of how these misperceptions arise are summarized, and alternate proposals that encourage expanded comprehension of the integral role played by humans within nested ecosystems are considered. It concludes with a description of a communication strategy based on literal and metaphorical interpretations of the term "worldview," employing immersive scientific visualizations to experientially expand perspectives on these critical issues.

Introduction

As recognition of the complexities of accelerating global changes has increased, so too has the acute relevance of questions concerning interconnections between individual actions, socioeconomic structures, and processes of the natural world. Though scientific understanding regarding the dynamics of these relationships on a global scale has progressed, effective means of communicating them to the public and decision makers to affect behavior changes remain elusive. But even if successful approaches to enhancing scientific literacy are identified, one recent study suggests that they can sometimes induce the opposite of the desired effect, leading to a diminished sense of personal responsibility while increasing faith in an eventual technological panacea (Kellstedt et al, 2008).

This essay encourages a more reflective approach to communicating the urgency of global change issues. Recognizing that multiple factors shape personal intuitions and interpretations of the world, it seeks to highlight some of the entrenched paradigmatic assumptions that continue to reinforce misperceptions about humanity's relationships to the natural world. Multiple critiques of how these misperceptions arise are summarized, and alternate proposals that encourage expanded comprehension of the integral role played by humans within nested ecosystems are considered. It concludes with a description of a communication strategy based on

literal and metaphorical interpretations of the term "worldview," employing immersive scientific visualizations to experientially expand perspectives on these critical issues.

Illuminating Worldviews

The term *worldview* is calqued from *Weltanschauung*, coined by Immanuel Kant (1987) in the late 18th century. His single use of the term described the literal "view" or "intuition" of the world that is provided by human sensory perceptions, particularly the sense of vision. Kant asserted that the "mere appearance" of things provides a limited impression of the nature of reality. To account for the capacity of humans to conceive of the infinite, he contended that the mind "must have within itself a power that is supersensible." By dividing the human experience into perceptual and conceptual domains, he was attempting to rectify what he viewed as a contradiction between the world-intuition informed by finite sensual experiences and the seemingly limitless capacity of the imagination.

The degree to which embodied senses influence perspectives on the world is widely recognized as they are inextricably linked to perception. As Kant suggested, the physiological construction of the senses necessarily limits the range of perceived phenomena, shaping experiences through finite spatial, temporal, and spectral impressions of the world. In the case of vision, the eyes serve as biological transducers that detect and respond to electromagnetic radiation in the wavelengths of the visible spectrum. These stimuli are then converted into chemically mediated signals that the nervous system can perceive and transmit, which are interpreted as "external" visual-spatial events. These sensory experiences undoubtedly provide the strongest intuitions on the nature of reality, as is evidenced by the close connection between scientific advancements and the development of devices that enable empirical observation of phenomena at scales beyond unaided perception.

Since its original use, the concept of *worldview* has largely lost its original association with sensory perception. It is commonly used as a metaphor to describe the conceptual lens or "mental map" of an individual or group, comprised of the cognitive, practical, and emotional frames of reference through which experiences are interpreted. This map is said to enable us to "integrate everything we know about the world and ourselves into a global picture, one that illuminates reality as it is presented to us within a certain culture" (Aerts, et al., 1994). It is frequently used interchangeably with terms such as *perspective* (Esbjörn-Hargens & Zimmerman, 2009), *cosmology*, *outlook*, *world picture*, *knowledge space* (Turnbull, 2000), and *paradigm* (Kuhn, 1962) to outline qualitative and cultural developmental models that emerge from specific assumptions, beliefs, and customs.

In addition to perceptual and conceptual influences, there is expanding recognition within contemporary cognitive sciences that *enaction* plays a significant role in the shaping of experience (Varela et al, 1992). In contrast to the objectivist view that perception is the result of purely passive reception of sensory information, enactive theory holds that perception is inexorably tied to reflexive and iterative processes. This constitutive position asserts that, consciously or not, reciprocation, iteration, and participation are integral to perceptual experience, shaped by the agency of the percipient as well as the biological and sociocultural systems within which they occur.

Constructing Perception

Questions regarding the exact relationship between observers and the world have been central to the development of Western science and philosophy. The notion of the "objective observer," in which a percipient is assumed to passively witness an external reality that is ontologically independent, is deeply ingrained within Western thought and discourse. Critics

have attributed this dualistic separation to a number of historical influences, frequently asserting that the polarization it reinforces leads to an array of misperceptions. David Abrams (1996) contends that the widespread adoption of the phonetic alphabet in ancient Greece led to a domination of abstract referents that severed the intimate connection between the human and non-human natural realms. He argues that this separation weakened the sensitivity of oral cultures to the rhythms and inflections of local environments, diminishing the perceived importance of participation within sensuous experience. In contrast, Alfred Korzybski (1933) maintains that *all* experiences are constructed of different orders of abstraction, whether communicated through sensory perceptions or the structures of language. However, he asserts that false dichotomies have been imposed on perceptions of the world by the continued application of Aristotle's mutually exclusive "either/or" logic that is deeply imbedded within Western thought. Francisco Varela et al. (1992) further connect the binary compulsion to the emergence of what they call "Cartesian anxiety," suggesting that failed attempts to identify the "ultimate ground" of reality – the driving quest behind reductionist science – inevitably leads to nihilism.

While these linguistic and conceptual factors undoubtedly encourage abstract, binary tendencies, the most intrinsic influences on the formulation of the idealized "objective observer" may well have been the optical instruments that imposed specific technical configurations on acts of observation. For instance, the developments of the telescope and microscope in the 17th century gave rise to new visions and conceptions of a natural world, expanding capabilities to visually scrutinize phenomena at macro and micro scales. But while these enabled a series of revolutionary revelations, including Galileo Galilei's empirical confirmation of the de-centering Copernican cosmology and Antony van Leeuwenhoek's discovery of microorganisms, they bolstered the impression that nature exists independent of human experience.

The perception of an inexorable separation between subject and object was further strengthened by the widespread adoption of what Johannes Kepler termed the *camera obscura*. Latin for "dark room," this device displayed reflections of outdoor images onto indoor surfaces via a tiny aperture in a separating wall (Figure 1). Though its discovery predated the scientific revolution by several centuries (the underlying phenomena had first been described in ancient Greece and later within Alhazen's 11th century *Book of Optics*), it was widely employed from the late 17th century on as a tool for assisting with the study and re-presentation of the "exterior" world. Furthermore, variations on the camera obscura utilizing optics are believed to have been critical in the establishment of single-point linear perspective. This enabled artists to trace a scene projected onto a flat canvas to create the illusion of three-dimensionality on a two-dimensional surface, effectively freezing a fixed view of a seemingly objective world within a representational window.

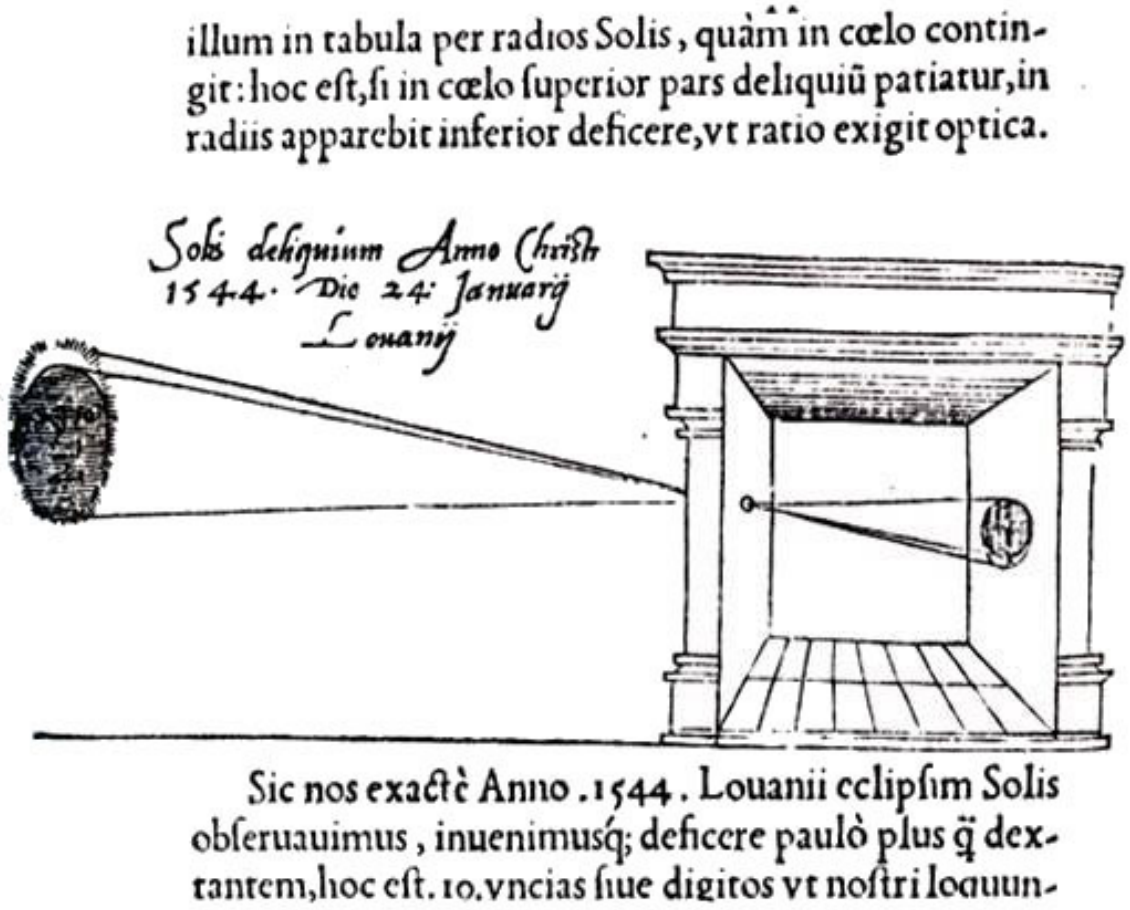

Figure 1. Earliest published illustration of a camera obscura depicting the solar eclipse he observed in Louvain on January 24, 1544 through a camera obscura. By Reinerus Gemma-Frisius.

The confluence of these observational and representational mediation devices and techniques had a profound impact on the construction of the epistemological assumptions embedded within Enlightenment-era scientific and artistic thought. The principles demonstrated by the telescope, microscope, and camera obscura reinforced a dominant dualistic paradigm in natural philosophy in which the perceiving subject was conceived as being independent of the external world (Crary, 1990, p. 30). This is reflected in the diagrammatic interpretations of Rene Descartes, who asserted that the accuracy of his retinal schematics (Figure 2), illustrating the physiological processes of vision, were confirmed by what he called the "natural perspective" of the camera obscura (Wees, 1992, p. 32). Like linear perspective, this provided the illusion of framed scenes unconnected to the observer. Combined with new mathematical formulations and philosophical theories (most notably Kant's *transcendental idealism*), this rationalization of sight was essential to the establishment of perspectives on the "interiority" of subjective human experience and the "exteriority" of the natural phenomena. As a result, these approaches paradoxically expanded insights into natural processes while fragmenting relationships to them. They reinforced the impression of a critical distance between the human subjects and the observed world (Latour, 1990), fortifying the mechanistic perspective that all natural phenomena are subject to observation, quantification, reduction, and representation.

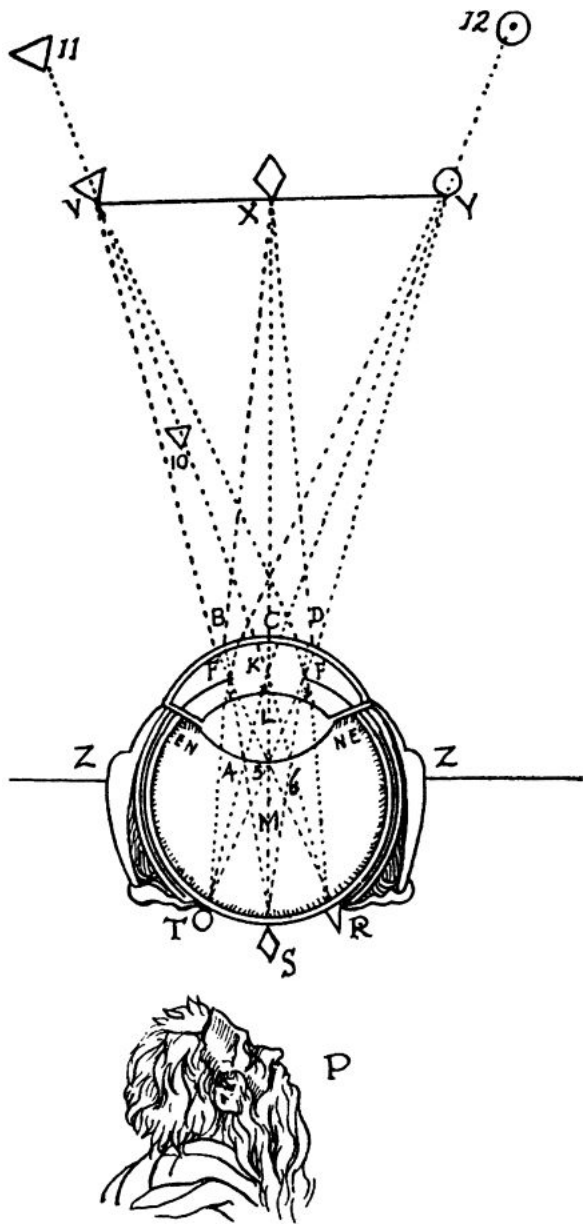

Figure 2. Illustration from René Descartes' La Dioptrique (1637).

Shifting Perspectives

In the 20th century, advanced methods of observation and modeling revealed that the relationships between perceiver and perceived are considerably more complex and interdependent than previously believed. Quantum discoveries and relativistic theories forced scientists to reconsider many assumptions and develop new models to account for the complexity of systems – including the active, participatory role played by observers within them. As awareness of these findings spread across the arts, sciences, and humanities, it contributed to ongoing reflections on the uncertainty and perspectivalism inherent within all interactions and perceptual acts. The resultant array of "postmodern" discourses, problematizing the dichotomous abstractions of subject/object, self/other, mind/body, and human/nature, initiated substantial intellectual and emotional disruptions within many fields that continue to the present day.

Regardless, the profound implications of these discoveries for the veracity of dualistic logic and assumptions have yet to be meaningfully absorbed within many areas of popular understanding. The lingering linguistic and cognitive impacts of centuries-old polarizing beliefs continue to assert far-reaching influences on contemporary thought. This disconnect has led Fritjof Capra (1996) to argue that the many converging global crises should be considered facets of a single "crisis of perception," precipitated by "the fact that most of us, and especially our large social institutions, subscribe to an outdated worldview." He contends that though some paradigmatic explanations undoubtedly provided an essential framework for the scientific revolution, today they promote "a perception of reality inadequate for dealing with our overpopulated, globally interconnected world." Capra proposes that "radical shifts in perceptions, thinking, and values" are necessary, in which new perspectives are informed by ecological principles derived from the study of the interrelated, dynamically balanced processes and patterns of living systems.[2]

A similar emphasis on the necessity of achieving a non-dualistic, dynamic equilibrium with living systems can also be found within many indigenous knowledge systems. Nancy Maryboy et al. (2006) cite the central importance of what they call "paradox thinking" within the Navajo worldview, in which recognition of the importance of complementarity, continuity, non-linearity, and interconnectedness is derived from close observation of the natural order.

Instead of employing specialization, abstraction, and fragmentation as essential ingredients of empirical thinking, they describe the Navajo view of the world as a nested series of related phenomena that are unified within regenerative and cyclic processes. They assert that this worldview provides fluid movement between practical and expansive perspectives (as opposed to pretending that "whatever exists outside its field of vision is either non-existent or irrelevant") so that problem-solving skills can be informed by and exercised within an holistic "wisdom matrix." Echoing Capra's call for radical perceptual shifts based on ecological principles, Maryboy and her coauthors argue that a revitalization of the cultural wisdom, values, and principles associated with indigenous knowledge systems could transform the "tacit infrastructure of polarity thinking" that "artificially freezes and divides the forms of the living world."[3]

Practitioners in the nascent field of integral ecology (Esbjörn-Hargens & Zimmerman, 2009) have further emphasized the critical importance of recognizing the processes of worldview creation, claiming, "consciousness is embodied in flesh, embedded in culture, and enmeshed in eco-social systems." They contend that cultivating self-reflection is an essential step towards appreciating the unique perspectives of others, identifying with global societies and ecosystems, and appreciating the unbroken whole of existence. They propose that enhancing reflective processes can assist individuals and societies with overcoming seemingly irreconcilable positions, recognizing common values, and facilitating collaboration on necessary courses of action.[4]

Visualizing the Big Picture

Informed by both modern scientific understanding and indigenous knowledge systems, the *World View* project is currently developing a strategy to provide new perspectives on global changes by focusing attention on the myriad ways in which worldviews are constructed. The heart of this approach involves the combination of mediated communication techniques designed to conceptually and perceptually appeal to a diverse range of modern audiences. It integrates interactive narratives, scientific data, and immersive displays within a social computing environment, seeking to leverage the potential of virtual worlds to stimulate linguistic, emotional, and visual-spatial intelligence (Gardner, 2006; West, 2004). Employing the *Uniview* software platform (SCISS, 2009) and a portable *GeoDome* display system (Elumenati, 2009), participants are immersed within interactively guided journeys of elegantly visualized scientific datasets. These visual simulations and their accompanying narratives are contextualized within a continuous, dynamic virtual space that models vast scales of spacetime across many orders of magnitude derived from observational measurements.

Instead of encouraging participants to "suspend disbelief" and accept the visualizations as representations of objective phenomena, this strategy seeks to facilitate reflection on the nature of subjective perception by enhancing awareness of the multiple factors that influence data collection, evaluation, and visualization. Playing on multiple interpretations of the *worldview* concept, these presentations explore a) the temporal, spatial, and spectral limits of human vision, b) multiple representations of Earth systems presented within a cosmic context, and c) the unique perspectives provided by contemporary mappings of the observable universe. Satellite maps of the non-visible range of the electromagnetic spectrum, as well as spatiotemporal simulations of movement, are used to rhetorically demonstrate the limits of human perception. Global datasets, such as human population, biodiversity distribution, atmospheric carbon accumulation, and polar ice cap retreat, are mapped onto a photorealistic virtual globe, enabling multiple data layers to be interactively examined and correlated (Figure 3). For additional affect, these views are situated within NASA's Digital Universe

Figure 3. Inside the GeoDome Theater displaying Earth visualizations within Uniview's Geoscope. Image credit: Jennifer Saylor.

Atlas (American Museum of Natural History, 2008) to simulate the cosmic context that gave rise to the "overview effect" reported by some astronauts (White, 1987). Furthermore, this Atlas provides the ability to navigate through a three-dimensional model representing observations of 14 billion years of cosmic evolution, the outer boundary of which represents the edge of the observable universe. This affords a novel way to shift epistemic frames of reference while rhetorically illustrating humanity's relative perspective that stems from perceptual paradoxes related to the speed of light (Figure 4).

In addition to seeking instinctive ways of communicating scientific data, this experiential technique is being developed as a means to induce reflexive insights into the nature of perception as well a deeper sense of the profound ecological relationships between humanity, the Earth, and the cosmos. While it is impossible to represent the full complexity of these cognitive, terrestrial, and celestial interactions, the use of contemporary mappings of Earth and space within a sensuous immersive environment is intended to intellectually and affectively convey the extraordinary network of processes and systems necessary to support life. By accentuating the interconnected patterns, flows, and cycles of nature within and beyond the range of human sense perceptions, this approach seeks to highlight the principles underlying the relationships between phenomena. Ultimately, it is hoped that these experiences might provoke a renewed intuition of the world, informed by an enhanced apprehension and appreciation of the nested, holarchical ecosystems within which we are all active participants.

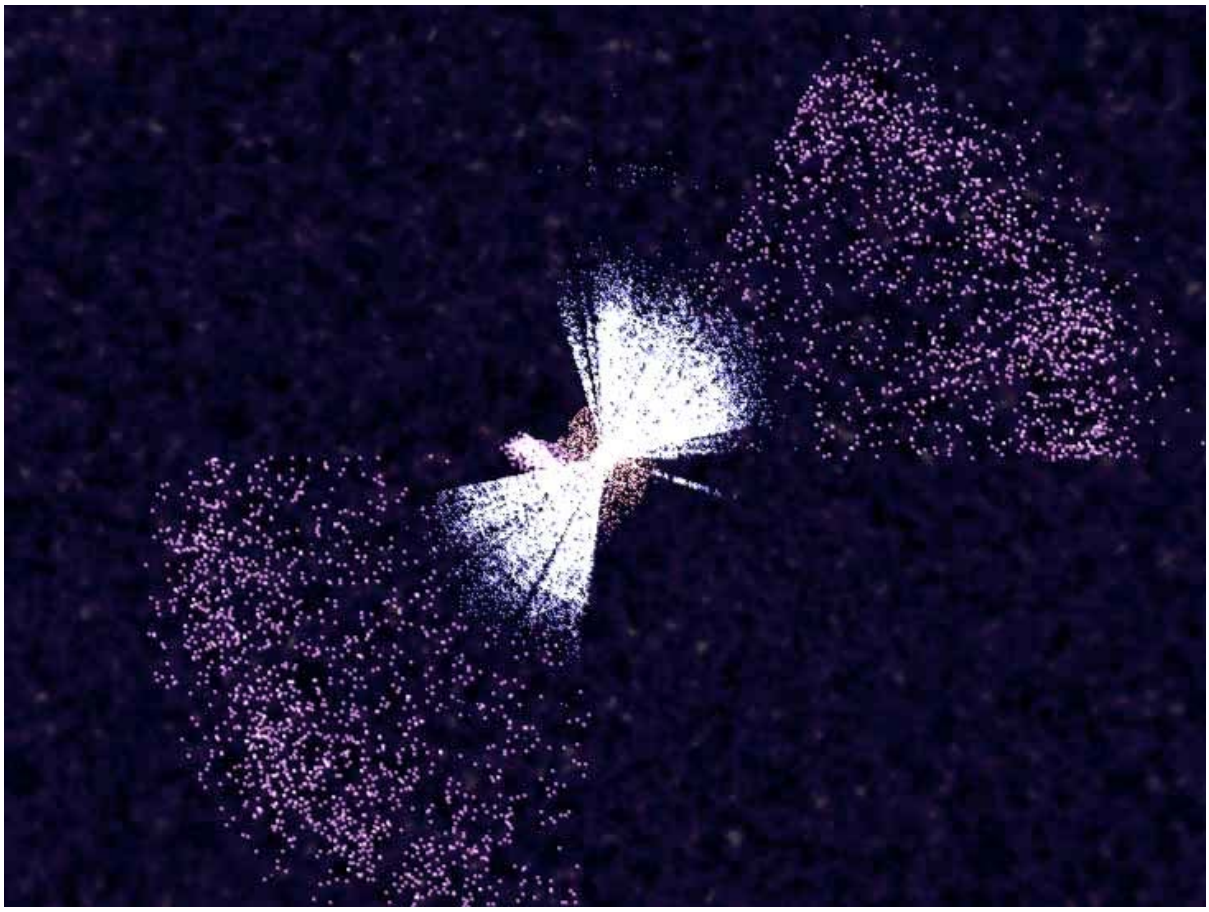

Figure 4. The Digital Universe Atlas visualized within SCISS' Uniview. Image Credit: NASA/American Museum of Natural History.

Conclusion

As our species navigates the labyrinth of choices before us to deal with the causes and consequences of accelerating global changes, it is wise to recall Albert Einstein's purported admonition that "we cannot solve our problems with the same thinking we used when we created them." The scale, complexity, and uncertainty of these issues will continue to pose significant challenges for efforts to communicate them. Expanding frames of reference to provide new perspectives on their potential causes, consequences, and solutions is critical. Given the deeply ingrained beliefs and practices that shape perceptions of the world, exploring innovative and even unconventional methods is essential if the latticework of paradigmatic influences underlying many current approaches is to be discerned and more effective strategies developed.

The *World View* project seeks to inspire new perspectives on global change issues by inducing shifts in perception at personal, global, and cosmic scales. Rather than overwhelming participants with fragmented facts and figures relating the immensity of the challenges confronting our global community, it attempts to intellectually and emotionally engage them using guided, interactive, and immersive visualizations of artistically-rendered scientific datasets. These techniques are designed to enhance awareness of the extraordinary life-giving systems within which humanity is embedded as well as the encultured, embodied, and enacted processes through which they are perceived. By illuminating both ecological principles and perceptual paradoxes, this project strives to inspire participants to collectively imagine ways of more consciously participating in the necessary transformation of humanity's relationship with our home planet.[5]

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Biography

David McConville is a media artist and theorist whose work explores the how transcalar visualizations impact perceptions of the world. He is co-founder of The Elumenati (http://www.elumenati.com), an immersive environment design and engineering firm with clients ranging from art festivals to space agencies. He is currently a PhD candidate in the Planetary Collegium (http://www.planetary-collegium.net) and a Director of the Buckminster Fuller Institute (http://www.bfi.org).

Notes

1 Iris photograph from Rankin's *Eyescapes*, http://www.rankin.co.uk, *The Blue Marble* from NASA's *Visible Earth*, *http://visibleearth.nasa.gov*, Cosmic Microwave Background map from NASA's *WMAP Mission*, http://map.gsfc.nasa.gov.

2 Additional resources concerning ecological literacy and principles can be found at the Center for Ecoliteracy at http://www.ecoliteracy.org.

3 More on Indigenous research and education can be found at the Indigenous Education Institute at http://www.indigenouseducation.org.

4 Descriptions of the integral ecology framework are available through the Integral Ecology Center at http://www.integralecology.org.

5 For examples of initiatives that are based on these principles, see the Buckminster Fuller Institute's Idea Index at http://www.ideaindex.org and the Biomimicry Institute at http://www.biomimicryinstitute.org.