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Perspectives on altering our perceptions of water

"The challenges we face with water are largely a consequence of how we perceive it in postmodern industrialized societies. Despite the myriad ways that water connects us to the world, our management and engineering of it seldom reflects that realization. Whereas expanding our perceptions of water may appear to be a relatively simple task, there are biological and behavioral factors that complicate our capacity and inclination to do so. Given the complex processes and systems that govern water in nature, our mimicking its patterns could supplement our comprehending or predicting them. "

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- West Marrin (https://www.interaliamag.org/author/wmarrin/)
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Reflection (photo: Richard Bright)

More than a decade ago, I wrote a book entitled *Altered Perceptions: Addressing the Real Water Crises*, which attempted to trace some of the prevailing perceptions of water held by those living in postmodern developed nations [1]. The book began with diverse of interpretations of ancient understandings and progressed through twenty-first century viewpoints. The intent was to question whether our postmodern perceptions of water (principally as a natural resource and commodity) have contributed to our predominantly self-imposed issues with water. I asked whether supplementing our technical, scientific, utilitarian and aesthetic views of water might actually assist in reframing our relationship to water, whether we interpret it as problematic, adequate or irrelevant. Our eagerness to solve water issues frequently comes at the cost of truly understanding them and of questioning the biases, assumptions or causal inferences that are inherent in solutions, which themselves can create as many problems as they solve.

I proposed in the book's introduction that our greatest challenge with water might be our perceiving it in a more expanded and interconnected manner, as we continue to utilize it to sustain us and other life forms on the planet. I noted that we have a variety of access points from which to expand or shift our perceptions (e.g., personal experience, spiritual practices, art works, ancient traditions) beyond the scientific, economic, and geopolitical ones that dominate today's developed, industrialized world. For people whose everyday survival is dependent on collecting enough water of adequate quality, the perception of water is obviously different. Water has historically transcended cultures, languages and philosophies in connecting humans to each other and their environment. In fact, water continues to be a focus for bringing people together, whether to fight over it, preserve it, or better understand it. This article explores why altering our collective perceptions may be a greater challenge than I presumed when writing the book.

THE INTERCONNECTIVITY OF WATER

Water serves to connect us through our bodies, our planet and the universe. Many ancient philosophers viewed water as the original substance out of which everything is created and to which everything eventually returns. As one of the four fundamental Elements, all of manifestation was believed to represent a unique form of water, which served as a mediator and creational medium linking the seen and unseen realms. From a scientific perspective, water mediates processes on scales ranging from the molecular to the cosmic. Water is essential to the structure and function of biomolecules such as proteins and DNA, and water in the form of oceans, clouds and atmospheric vapor is the major controller of long-term climate and short-term weather on earth. Even a strange type of water ice (amorphous) present in the depths of outer space may have combined and delivered to earth a few simple compounds that served as life's first biomolecules [2]. Water's ability to perform these diverse planetary and cosmic functions is facilitated, to a great extent, by its complex dynamic network.

Underlying water's placid façade is a molecular network that interchanges connections (chemical bonds) among adjacent network components (water molecules) trillions of times per second. During this endless re-shuffling, molecules alter their connections based on prior network configurations. Systems theorists posit that networks composed of simple components (e.g., water molecules), when appropriately connected, display adaptive or responsive properties [3]. In such a system, there is no need for a central processing unit because the passage of local connectivity to a broader (nonlocal) coherence is accomplished via a set of switching, or shuffling, rules. Many of water's behaviors may be traced to a network that swaps connections among molecules and, in doing so, displays long-range coordination while being held together by short-range chemical (hydrogen) bonds.

On a more practical basis, it is worth recalling that earth is truly a water planet and that recognizing and respecting water's critical roles in processes such as climate change, energy selection, food production, economic stability, human health, and global conflict is not only wise, but mandatory. Natural systems encompassing or sculpted by water are typically energy-efficient, produce minimal wastes, and achieve multiple goals. By contrast, human designs frequently ignore or override nature's designs in the form of technologies and management schemes that alter water's cycles, flows and distribution.

There are numerous examples of well-intended water solutions addressing a single issue that eventually created unanticipated problems. On the east coast of the USA, groundwater pumping schemes and surface water impoundments designed to augment water availability have inadvertently increased nuisance floods by causing slight, but measureable, changes in land elevations that coincided with rising sea levels [4]. When these water management actions were initiated, neither climate change nor land subsidence would likely have been considered as issues. Similarly, irrigation systems and the pollutants they transport have impacted the ecological balance of critical aquatic ecosystems, which are ultimately responsible for providing water of sufficient quality to be transported [5].

Water also intersects two other common necessities for modern humans, namely food and energy. The water-energy-food nexus specifically calls out the interdependence among these three resources. It is water that permits the cultivation of food crops and the exploitation of energy sources that power postmodern societies. An example of this interdependence was observed during the 2008 food crisis, which was attributed to a combination of higher energy prices, lower crop yields (due to drought), and conversion of agricultural land from food to fuel (ethanol) crops [6]. Addressing any one of these factors, without considering the effects on the others, was observed to create a situation whereby one factor improved at the expense of the others and, as such, there was little or no net progress in alleviating the interconnected crises.

Interestingly, one of the approaches to dealing with the nexus includes systems science, which investigates and describes the organization of human creations and nature as a single entity consisting of elements that possess distinct attributes. Dynamic interactions among system elements are modeled as spatial and temporal relationships, or patterns, describing the behavior of a system. Whereas resources and energy are cycled through the system, the focus is on describing system organization, interacting elements, and relationships with the environment. The dynamics governing a system's behavior are characterized by limited predictability, sudden transitions, emergent properties and nonlinear causality—all of which challenge our brain's pattern recognition abilities that favor continuity, reductionism, linear causes, and simplification over complexity.

A WORLD PERCEIVED AS PATTERNS

Scientist and writer Philip Ball recently examined why the natural world looks to us the way it does [7]. Intriguingly, he noted that all natural patterns originate from a seemingly limited array of possibilities, occur over a wide range of spatial and temporal scales, and are produced by diverse natural phenomena. He asked whether this similarity in patterns produced by dissimilar processes (e.g., gravity, heat, erosion, biological evolution) is coincidental or whether pattern development is a result of some underlying mechanism. He surmises that there is no formal law of pattern formation (in the scientific sense), but rather a recipe for formation that accounts for non-equilibrium conditions, nonlocal events, and thresholds for changing form [7]. Patterns in water are both spatial and temporal, as exemplified by the shape of and interval between waves, respectively.

Natural patterns arise most often from the breaking of symmetry, rather than from the creation of symmetry as a human might do when designing a pattern [7]. Symmetry is the property of an object such that changing its position relative to a viewer results in its appearing the same (e.g., the spinning of a sphere). In essence, breaking something uniform into an array of non-uniform pieces creates patterns that we observe in the natural world. The resulting patterns cannot be explained on the basis of their parts (e.g., water's molecules or atoms), but instead by properties that emerge exclusively from an entire system (e.g., water's molecular network). Our identifying the source of symmetry breaking is often difficult, as is assigning a unique cause to patterns.

Ball observed that people attempt to make sense of a complex and often-confusing world by looking for similarity, predictability and continuity as patterns [7]. Although more methodical, science does essentially the same thing. Science's lowest common denominator is patterns, such that the form and function of patterns in nature reveal broader truths about the natural world [8]. As the language of science, mathematics is commonly used to explain the relationships among those patterns. The belief that nature's patterns are created by intelligent design may have arisen from the way that humans create patterns in art and design, rather than the way that patterns most often appear in nature.

Systems theorist Andrew Coward noted that a pattern (temporal or spatial) does not have to repeat exactly or in its entirety to be recognized as such [9]. Patterns are composed of a set of elements that are patterns themselves (i.e., subpatterns) and different combinations of subpatterns can create the same pattern (i.e., there is no unique set of subpatterns for every pattern). Only a sufficient number of element repetitions in a portion of the pattern are required for human recognition, and elements need not always repeat in exactly the same way [9]. So, the question then becomes, what exactly are patterns and do they exist in the real world or only in our brains?

An artist and computer scientist attempted to answer this question by looking at different uses of the word throughout history [10]. They note the Oxford Dictionary indicates that the word "pattern" originates from Middle English as something serving as a model. Do patterns serve as models to impose artificial order on a world seemingly replete with chaotic interactions, novel events and complex systems that require simplification for humans to make predictions and decisions? Patterns do influence how we perceive and interpret the world, and artists often incorporate visual or auditory patterns in their works that elicit various responses from people.

HOW WE PERCEIVE WHAT WE PERCEIVE

Neuroscientist Bruce Hood noted that our perception is organized by brain mechanisms that look for patterns [11]. We do so by organizing inputs according to unlearned rules that amount to guesses (projections) about what exists in a world where inputs are often cluttered, ambiguous and missing. He also posits that we seek patterns and even fill in their missing parts to give them order and cause, as well as to avoid attributing them to chance or coincidence. Interpreting a sequence of events is accomplished by grouping them together in a causal manner [11]. In doing so, we perceive sequences of patterns in terms of post hoc cause-and-effect relationships and then unconsciously confabulate explanations for the assumed causal mechanisms.

It turns out that pattern recognition is not just something that the brain does well, but may be the brain's only function [9]. Neuroscientist Mark Mattson posited that the brain's superior pattern processing (SPP) serves as the basis of human intelligence, language, invention and imagination [12]. SPP is the result of evolutionary advancements in the brain's pattern processing ability that permitted humans to adapt quickly to changes in their environment. Psychologist Donald Hoffman maintains that our brains provide us with just enough sensory information to optimally guide our actions or decisions and, in the process, hide the structural and causal complexity of the world [13]. Thus, accurate perceptions are selected against (evolutionarily) in favor of simplified perceptions that expedite adaptive behaviors designed more for survival than comprehension.

For linear systems or nonlinear systems whose behavior can be reasonably reduced to a linear approximation, our inferring causality has some value. For the vast majority of nonlinear systems in the real world, assuming simple causes and linear behaviors is a substantial limitation [14]. Perceiving simple or linear relationships in a world that is mostly complex and nonlinear represents an inherent bias for a brain that relies heavily on linear patterns of ideas for logic and reasoning. Encountering something too complex to be approached or comprehended as a whole (i.e., patterns that cannot be discerned), we break it up to see whether its components yield recognizable patterns.

Patterns are further abstracted as words, ideas and mathematics that require more time, energy and effort for our brains to process. Anthropologist Gregory Bateson noted that our naming, labeling and quantifying things produces images based on unacknowledged assumptions and interpretations of subjective experience [15]. He maintains that there is no objective experience and that our brain-manufactured models are what we ultimately relate to in life, as opposed to the things themselves. He noted that we define something by what it supposedly is, rather than by its relationship to other things. This defining then restricts our perceiving the world as complex systems or interconnected networks. Given these apparent limitations, can the brain somehow perceive the world differently?

IS THERE ANOTHER WAY TO PERCEIVE?

Some philosophers and so-called enlightened or awakened humans maintain that knowledge gained from conventional learning is incomplete, limited and fragmented to the point that it could never produce a coherent understanding of the natural world [16]. Accordingly, thought and its accumulated knowledge (as memory) are hallmarks of an abstracted self that perceives itself as separate from the very world it desires to know. Moreover, the desire or intention to acquire knowledge of the world necessarily induces a separation, thus fostering a mode of learning that inevitably leads to misunderstandings about what actually exists. This view contrasts with the notion that, given sufficient time, we humans could accumulate enough knowledge through observation and thought to understand the universe—including water.

Philosopher Jiddu Krishnamurti claimed that our constant thinking, judging, reacting, reviewing the past and anticipating the future distorts our perception of the present reality [16]. Krishnamurti was interesting in that he embraced no religion, deity, doctrine or technique and posited that our conditioning (responsible for beliefs, assumptions and prejudices) skews our view of the world and ourselves. He claimed that anything initiated by the self precludes one's ability to accurately perceive reality and, instead, spoke of a choiceless awareness in which one does not elect to be aware (as an experiencer). One essentially becomes the experience itself, with no thoughts, labels or agent (a self) that experiences. By contrast, our abstracted patterns are inaccessible via experience [17].

As I noted in the book, there seem to be few so-called awakened or enlightened humans who have attained a perception of the world that eludes most of us—regardless of our spiritual practices. Desiring, striving and anticipating are hindrances to enlightenment, which Krishnamurti described as an accident to which some people are more prone. What kind of accident transforms an otherwise pattern-seeking and confabulating brain? Are a few brains functionally unique initially, rendering them more accident-prone eventually? Neuroscientists have demonstrated that our familiar sense of a separate self can be inhibited by magnetically stimulating a portion of the right temporal cortex, whereas various drugs and brain injuries can lead to out-of-body sensations and to purportedly profound realizations about and perceptions of reality. Could drugs and direct brain stimulation or desensitization make someone more accident-prone or substitute for spiritual practices?

It is worth noting that a subjective approach to recognizing our brain's interpretational tricks and conditioned responses is generally considered to be a key in recognizing that our observations, assumptions and proofs are neither objective nor provide accurate representations of the world. Based on observations or deductions made under specific circumstances (e.g., discrete realms of space and time), abstract patterns as equations or axioms have become the metric by which we assess what could or could not exist. Alfred Korzybski famously observed that "the map is not the territory," but we nowadays use some of our most abstract maps to define and qualify the reality of the territory.

APPROACHING WATER DIFFERENTLY

As a result of the brain's ability to adapt, learn quickly and abstract patterns that are recognized, interpreted and projected, we have developed water technologies and adopted perceptions that made our lives more convenient, predictable and safe. As great an evolutionary achievement as this has been, it was accompanied by some not-so-obvious consequences. Many of our water technologies, regardless of how logically conceived, were based on simplified causal assumptions that were unable to identify or project potential impacts on complex aquatic ecosystems and hydrologic cycles.

Although scientific instruments can detect aspects of the water that our senses cannot, it is our subjective brains that interpret what these instruments detect. Our interpretation of reality is based on abstractions selected (evolutionarily) to enhance survival, which is achieved by dividing, separating and labeling the world in sufficiently simple terms. As I noted in *Altered Perceptions*, our relationship to water is now predominantly representational. In accumulating ever more knowledge and personal experience, we have relied on greater levels of abstraction that may have lead us further from reality and life in the present moment. Philosopher Alan Watts noted that our concept of reality, which links together ostensibly distinct events via causality, differs from a view of reality as a single interconnected happening that is the present moment [18].

Besides pattern recognition, the human brain is particularly adept at imitation and mimicry as a means of learning [17]. Perhaps an approach to designing water-related technologies and management strategies that utilizes these abilities is worth considering. The practice of hydromimicry is related to the better-known one of biomimicry, which is the process of applying biological designs or processes to human solutions. By analogy, hydromimicry is based on emulating water's natural patterns (spatial and temporal) in devising such solutions [19]. Examples include mimicking natural wetlands in designing artificial ones to treat pollutants, emulating spatial patterns in watersheds to minimize storm damage, imitating water vortices to design efficient impellers, adapting the soil water cycle of native plants for food crops, using natural material to mimic glacier growth for water supply, and imitating water transport in trees for heat transfer technologies.

Imitating water in human designs is certainly not new, as many ancient cultures used familiar watershed features in designing their irrigation systems and waterways. Based on the connectivity of all natural waters, as described by New Zealand's Maori people, engineer Kepa Morgan developed a rating scheme for natural and recycled water as weighted averages among environmental and human factors [20]. His decision-making process ensures that water and watersheds are stable before considering human uses. This approach may be contrasted with many of today's management practices, whereby water is exploited for human uses to the point that watersheds and aquatic ecosystems are damaged. Stormwater irrigation of public spaces, rainwater harvesting from roofs, and gray water irrigation of gardens are considered to be acceptable, but using water to transport human wastes and relocating water to other watersheds are not [20].

The manipulation of and effects on water have become a concern with respect to geoengineering, which seeks to modify specific global processes in order to counteract climate change. Not surprisingly, geoengineering is based on countless assumptions about the behavior and response of highly complex and interconnected planetary systems [19]. Given the link between the water cycle and nearly every aspect of global climate change, could geoengineering be considered a form of hydromimicry? Pumping carbon dioxide into aquifers or ocean basins is not hydromimicry. Launching sulfur into the atmosphere or iron onto the sea surface may emulate natural processes (e.g., volcanoes, upwelling) that affect the water cycle but they do not mimic it. Capturing carbon dioxide from the air resembles ocean uptake and spraying seawater into the air may constitute artificial ocean spray. A few geoengineering schemes appear to imitate water's observed processes, but do they also emulate its interconnectivity and nature-derived wisdom?

The human brain is also adept at creating patterns through projection, which is used by artists and musicians to create their works. Whereas this projection process differs from the way that most patterns are created in nature, it is one that is particularly impactful for people. The arts present people with more recognizable patterns (often unconsciously) than do the highly abstracted jargon and mathematics used by scientists. Renditions of even nature's most intricate patterns (e.g., fractals produced by complex nonlinear processes) consistently attract the preferences of people who are unfamiliar with fractals and cannot explain their attraction [21]. As a scientist, I have collaborated with artists to assist me in conveying messages to others and in averting my own biased perceptions of water and its issues. Perhaps art has been underutilized as a means of perceiving water inasmuch as it can bypass some of aforementioned intellectual traps.

SHIFTING PERCEPTIONS OF WATER?

As mentioned in the introduction, my earlier suggestions about shifting our perceptions of water were probably more idealistic than realistic; however, one of my suppositions was that knowing more about water or managing it more cleverly would not, by itself, be sufficient to meet the challenges we currently face. While we apparently have some flexibility in how we can perceive something, our brain operates unconsciously and automatically according to the mandates of evolution, environment and unrecognized beliefs and assumptions that underlie our perceptions. With a limited ability to process and truth seek highly abstract renditions of nature and a near absence of reverence for water (aside from a few rituals that are more mechanical than meaningful), we are left with a scientific curiosity, a presumed human right, and a commodity or resource at the center of recurrent clashes among politicians, industries, and environmentalists. This is not a platform from which we are likely to alter our collective perception of water.

As previously discussed, water connects us to each other, our fellow species, and the planet. Even a brain that struggles to grasp the interconnectivity of water is mostly water, serving as a component of the complex neural network from which its thoughts and perceptions emanate. However, many of these interconnections are not perceived to be relevant to our immediate survival and, while perhaps eventually relevant, water continues to be perceptually divided on the basis of its location, quality, quantity, access, usability and pertinent institutions. This separation or fragmentation serves to conceal water's interconnectivity and the dependence of our anthropocentric systems on it. If or when the water-related demise of those systems endangers our survival or we become more prone to accidental awakenings, how might our current perceptions of water shift?

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