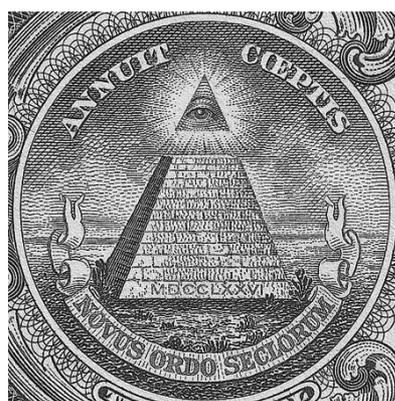


## Guest editorial

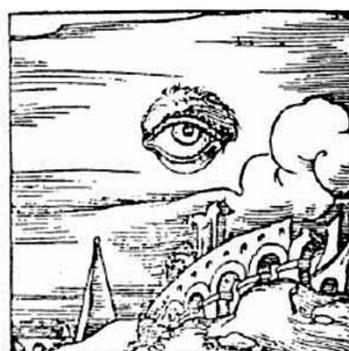
### The All Seeing Eye?

Did you know that you are probably a believer in the ALL SEEING EYE? The odds are that I'm right—why? Well, the bulk of mainstream vision literature blindly relies on the ALL SEEING EYE. It is written all over papers, albeit between the lines. Understandably so, for scientists resent being exposed as 'believers'. The ALL SEEING EYE concept is inconsistent, and at odds with empirical scientific facts, as is painfully obvious when made explicit. But alternatives are sadly lacking. Small wonder it remains implicit 'background' (Searle, 1985).

The ALL SEEING EYE has been with us since the dawn of time. 'God's Eye' in churches reminds youngsters that no sin goes unpunished.<sup>(1)</sup> The 'Eye of Providence' appears in the Great Seal of the United States,<sup>(2)</sup> and on the dollar bill. The ALL SEEING EYE can perhaps be traced to the Eye of Horus of Egyptian mythology. In Hinduism it appears as the 'third eye' of Shiva.



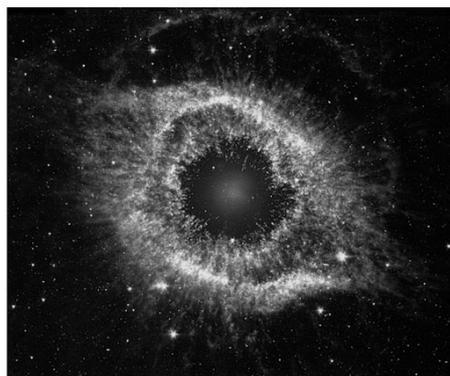
(a)



(b)



(c)



(d)

**Figure 1.** (a) The Eye on the dollar bill, (b) the Eye of God (alchemical woodcut), (c) Wedjat (Eye of Horus), and (d) the cosmic eye (Helix Nebula).

<sup>(1)</sup> God's Eye is often prominently displayed, sometimes implemented as a circular window, clearly an 'Eye of the World'. The Internet generation has replaced God's Eye with Ceiling Cat ([https://encyclopediadramatica.se/Ceiling\\_Cat](https://encyclopediadramatica.se/Ceiling_Cat)).

<sup>(2)</sup> This occurred in 1782. A booklet by the Department of State Bureau of Public Affairs, "The Great Seal of the United States", with many interesting details, may be downloaded from the Internet.

It has cosmic connotations. The Maha-parinibbana Sutta refers to Buddha as the ‘Eye of the World’. Astronomers dubbed the Helix Nebula ‘The Eye of God’, a modern *cosmic eye* (figure 1). Religious connotations are irrelevant to science; thus, I prefer the neutral term *ALL SEEING EYE*. A ‘definition in functional terms’, if you want.

Here’s the dope on the *ALL SEEING EYE*:

- the *ALL SEEING EYE* is Ever Watchful;
- the *ALL SEEING EYE* escapes nothing;
- the *ALL SEEING EYE* sees things as they Really Are;
- the *ALL SEEING EYE* makes no mistakes, and never hallucinates;
- the *ALL SEEING EYE* sees The World As It Really Is.

In contradistinction, we are not perfect, or we wouldn’t be here. We fail to see everything there is, and we often are mistaken in what we believe to see. We occasionally hallucinate. Sadly, our human eyes are not of the *ALL SEEING* kind.

The *ALL SEEING EYE* is the Gold Standard in seeing. We see *correctly*—‘veridically’ is the official term—to the extent that we manage to emulate the *ALL SEEING EYE*. To the extent that we miss out on this, we live in a state of blindness. To the extent that we deviate from it, we dwell in a state of illusion. Each equally embarrassing.

Granted the *ALL SEEING EYE*, it follows that The World exists externally to you, independently of your vision. There’s always the *ALL SEEING EYE* to keep an eye on it, even when you’re asleep. There is a unique way The World really is; it is the way the *ALL SEEING EYE* sees it. The *ALL SEEING EYE* is so addictive because it solves many problems even before they even pop up.

The *ALL SEEING EYE* belief neatly ties in with naive notions of *objectivity*. ‘Objective facts’ are states of affairs as seen by the *ALL SEEING EYE*. The exploits of scientists are aimed at views that approximate the *ALL SEEING EYE*’s view as closely as possible. This is what science is about.

Perhaps remarkably, the *ALL SEEING EYE* is a *belief*, so it is not mentioned in scientific writings, but is written between the lines. Try virtually any textbook to check! Although you are in the best of company if you fall for this silly story, the *ALL SEEING EYE* is a *delusion*.

Worse than merely silly, the idea of *ALL SEEING EYE* is deeply *wrong*. It is a major obstacle on the road to the understanding of perception. In reading science texts, you should constantly be aware of implicit references to the *ALL SEEING EYE* delusion.

My personal heroes in science have never fallen for the *ALL SEEING EYE* delusion. Okay, some did, slightly, but they steered clear of the worst. I’ll finish this editorial by discussing a few examples illustrating both sides of the coin. These could be multiplied ad infinitum. I mention a few authors—most of them safely dead—without picking on anybody.

Here’s my first example. The concept of *affordance* is usually associated with James Gibson.<sup>(3)</sup> It is actually due to Jakob von Uexküll.<sup>(4)</sup> von Uexküll was a biologist, who enjoyed a certain popularity among behaviorists. He launched innovative ideas like the perception–action cycle, or the reafference principle, decades before their ‘official’ introduction.<sup>(5)</sup>

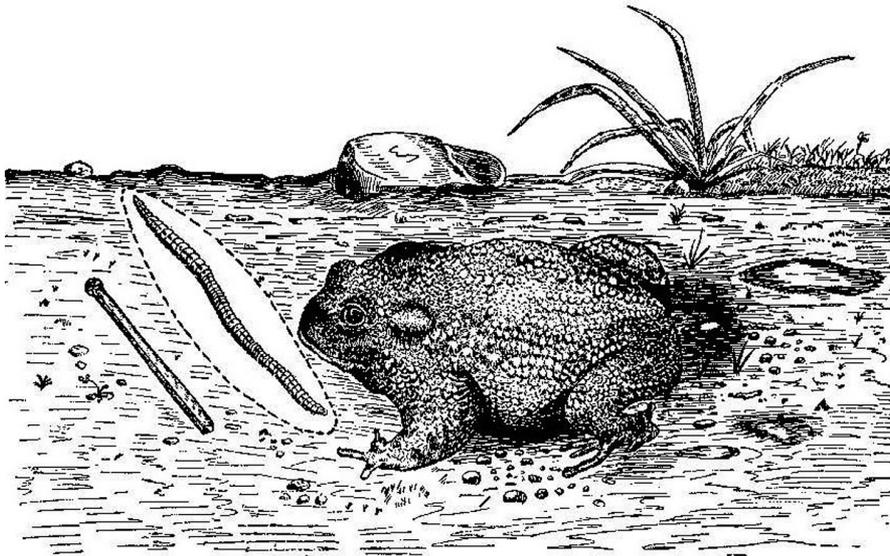
<sup>(3)</sup>James Gibson (1904–79) was an American psychologist who became well known through his *The Perception of the Visual World* of 1950. Affordances are discussed in his *The Senses Considered as Perceptual Systems* of 1966.

<sup>(4)</sup>von Uexküll (1864–1944) was a German marine biologist. He may be considered the founder of modern behavioral biology, for which Karl von Frisch, Konrad Lorenz, and Niko Tinbergen shared a Nobel Prize in 1973. His writings (von Uexküll, 1921, 1926, 1956/2011) strongly influenced modern philosophers such as Martin Heidegger (died 1976) and Maurice Merleau-Ponty (died 1961). His heir in biology is Rupert Riedl (died 2005).

<sup>(5)</sup>The reafference principle was introduced by Erich von Holst and Horst Mittelsteadt in 1950 (von Holst & Mittelsteadt, 1973/1950). They never mention von Uexküll, who introduced his ‘neuer Kreis’ decades before them.

He is well known for his concept of *Umwelt*—that is, all an animal may sense or do. von Uexküll holds that we will never know what it is like to be another animal—that is, to share its awareness of qualities and meanings. He speculates that the nexus of perception–action and refference loops might acquire a ‘functional tone’, which might again influence the state—think of goals—of the animal. The animal is oblivious of The World Out There, but the nexus turns into a ‘mirror world’. It is the animal’s *Umwelt* ‘toned’ with quality and meaning. Is there empirical backing for this?

von Uexküll mentions that a toad, after having found and eaten some worms, will readily try to acquire, and eat, a dropped matchstick (figure 2). He speculates that the toad has acquired a ‘seek image’, which is what we call an affordance. The matchstick now has the affordance ‘catchable, edible long thing’. Likewise, if you need something to ward off an aggressive dog, hand-sized, heavy things may gain the affordance ‘throwable’. Just another seek image. Now enter Gibson. He holds that a stone of the right size has the affordance of being throwable, even in the absence of any observer. His affordance is like a property of the stone, much like its weight, or shape. This is quite unlike von Uexküll, who holds that a stone can indeed appear throwable—namely, to a person looking for something to throw. Here, the affordance is not a property of the stone, but of an observer in a certain state. Gibson’s notion derives from his reliance on the ALL SEEING EYE delusion, whereas von Uexküll’s derives from an understanding of mirror worlds.

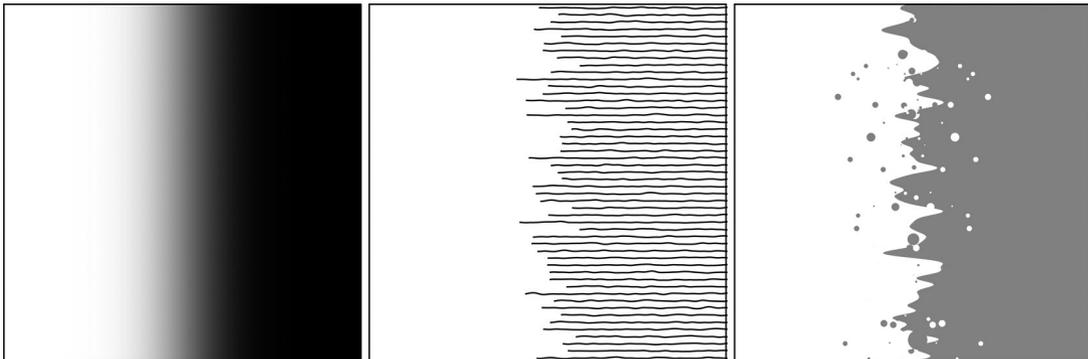


**Figure 2.** A toad projecting the ‘seek image’ (*Suchbild*) of a worm on a matchstick dropped on the ground. The matchstick acquires the affordance ‘catchable, edible’. The affordance grows when the toad successfully eats a few worms, and dwindles when the matchstick proves to be inedible. The matchstick *in itself* has no intrinsic property ‘affordance’. It is only the toad’s mirror world that counts. In this world the matchstick *is* the affordance.

The mirror world is what my renowned colleague Donald Hoffman (2009) refers to as ‘user interface’. Don’s ideas provide—like von Uexküll’s mirror world, and *Umwelt*—a scientifically respectable alternative to the ALL SEEING EYE delusion. As Don eloquently describes, the objects in your visual awareness are like the icons of a graphical user interface. You are never aware of the world ‘out there’; on the contrary, an efficient user interface *screens* the user from the—irrelevant—complexity out there. Efficient action and ‘veridicality’ don’t go together. You would never be able to finish even a one-line e-mail if you had to deal with the complexity of the operating system or the hardware in the box. You only deal with the

icons on the desktop. Where would the buck stop otherwise? At quark–gluon plasmas, or space–time foam at the Planck scale? The line has to be drawn *somewhere*, and that is what von Uexküll’s *Umwelts* are about. Don strengthens his case by proving that evolution does not optimize veridicality, but the fitness provided by apt user interfaces. The objects of the interfaces are template-like Gestalts, qualities, and meanings.<sup>(6)</sup> Whatever there might be ‘out there’ is irrelevant to biological organisms. Only evolutionary fitness counts.<sup>(7)</sup>

Here’s another example. After David Hubel and Torsten Wiesel’s groundbreaking work,<sup>(8)</sup> there has been much talk of ‘edge detectors’, ‘line detectors’, and so forth.<sup>(9)</sup> These offer good examples of the ALL SEEING EYE delusion. Look at paintings and drawings and you will find that ‘edges’ and ‘lines’ are inventions—or constructions—of the artist (figure 3). You won’t find them in photographs. That is to say, a such-and-such detector will give a response on *every* pixel, so you need to set some arbitrary threshold. Setting such thresholds—overall, or ‘adaptive’—is an art. The image processing algorithm doesn’t *detect* feature such-and-so so much as it *defines* it. You may appreciate this as you run such an algorithm on images of different scales, or compare the nature of ‘edges’ in fore and background. If edge detectors can be said to ‘compute’ anything at all, it is a directional derivative at some scale. This has multifarious potential uses (Koenderink, 1990), edge construction being one. Edges, and so forth, belong to the mirror world. Yet edge detection, and its numerous descendants, have become the bread and butter of theoretical vision science since David Marr’s (1982) book. Here, the ALL SEEING EYE delusion gives rise to a cottage industry of visual cortex models that start out on the wrong foot.



**Figure 3.** Some representations of a straight, vertical edge, as they might be used in the visual arts. What would the output of your favorite ‘edge detector’ be like? The ‘edge thickness’ could be *anything*. So could the edge ‘style’.

<sup>(6)</sup>The Gestalts make good examples, as do various illusions that stubbornly stay in visual awareness even when the ‘illusion’ is pointed out to you. Striking examples of idiosyncratic templates are described by Koenderink, van Doorn, De Ridder, and Oomes (2010), Koenderink, van Doorn, and Todd (2009), and Pont et al. (2012).

<sup>(7)</sup>Of course, no species evolves in isolation—it is the whole biosphere that evolves. According to von Uexküll, the spider and the fly ‘sing a duet’ in the harmony of the biosphere. *Homo Sapiens* contributes a single voice to the overall harmony. von Uexküll’s philosophy of life is best picked up from his novel *Der Stein von Werder* (1940; see also Cheung, n.d.).

<sup>(8)</sup>The Nobel Prize in Physiology or Medicine 1981 was divided, one half awarded to Roger Sperry “for his discoveries concerning the functional specialization of the cerebral hemispheres”, the other half jointly to Hubel and Wiesel “for their discoveries concerning information processing in the visual system.”

<sup>(9)</sup>On the topic of ‘edges’, it may prove an eye-opener to look for ‘edge quality’ in books on ‘how to paint’. Formal aspects are treated in Koenderink (1984, 1990).

After a lecture on the topic, people ask me if I *really think* that “the world doesn’t exist”. I ask “what *their* world is like?” They often emulate Samuel Johnson’s kicking of a stone<sup>(10)</sup> in one way or other. Almost all nonphysicists, including most philosophers, believe that ‘The World’ is defined by physics, although they haven’t the faintest notion of what the ‘physical world’ is like. It was lucidly described by Sir Arthur Eddington in the early 1930s. His *The Nature of the Physical World* (1928) is as actual as ever. In a nutshell, the physical world is constructed from pointer readings—numbers on a scale—glued together with tentative formalism. Physics claim to fame is its success in predicting potential pointer readings. As a member of the physics community, I proudly share in the credit. Anything beyond that is ‘mere mental paint’, as philosophers tell us (Block, 2003).

Strip off the mental paint, and you get behaviorism, and—to a large extent—its heir, cognitive science. These are proper sciences because the psyche is ignored, and non-invasive physiology remains. Psychology proper cannot be reduced to pointer readings, whereas physiology can because it is a subbranch of physics. This is mere basic ontology.

According to Eddington, the real stuff the world is made of is exactly the mental paint. He speaks of ‘mind stuff’. No use to ask what the paint ‘covers’. This means that *your world is exactly the way you see it*. Isn’t that nice? On the other hand, when the world is composed of mental paint, then there have to be numerous worlds, of great diversity, because the mental paints of man, squids, bats, sharks, and electric eels can hardly coincide. Their Umwelts only partly overlap.<sup>(11)</sup> Many people abhor this consequence. Is there no way the world ‘really is’, then? No. The universe of realities is infinitely richer than the universe of physics.

The very notion of veridicality itself, so often invoked in vision studies, is void. Strictly speaking, veridicality applies to the description of an external observer (WATCHER, say) who watches both the subject–agent and its environment. The WATCHER has to approximate the ALL SEEING EYE sufficiently for the purposes of the experiment. This implies that the WATCHER knows more of the environment than the agent possibly can. This often implies pointer readings: for instance, electrical measurements in the study of electroreception in sharks, caliper gauges in the study of human acuity, and so forth. Then perception may sometimes be called ‘veridical’ relative to the knowledge of the WATCHER. This is a very tricky business, because human WATCHERS lack the ALL SEEING EYE. They too are only directly aware of their user interfaces—even when using instruments. This offers interesting opportunities for infinite regress. *Who WATCHES the WATCHER?* Only Big Brother has the ALL SEEING EYE.

Your mental paint is far more crucial to your biological fitness than an in-depth study of string theory—feel free to substitute your own preference—will ever be. In the final instance, science is constructed on the basis of human awareness, and shared discursive thought. Attempts to invert this ontology are doomed from the start. An implication is that the foundation of psychology is experimental phenomenology (Albertazzi, 2013), not psychophysics (Fechner, 1860) proper.

So what’s the upshot of all this?

<sup>(10)</sup>In Boswell’s *Life of Johnson* (1986) we read:

“After we came out of the church, we stood talking for some time together of Bishop Berkeley’s ingenious sophistry to prove the nonexistence of matter, and that every thing in the universe is merely ideal. I observed, that though we are satisfied his doctrine is not true, it is impossible to refute it. I never shall forget the alacrity with which Johnson answered, striking his foot with mighty force against a large stone, till he rebounded from it—‘I refute it *thus*’.”

The incident occurred in 1763.

<sup>(11)</sup>Thus, the consequences of this change of perspective—according to Immanuel Kant in a “Copernican Revolution in Philosophy”—are tremendous (1787, Preface to the second edition of the *Critique of Pure Reason* and a heavy revision of the first edition of 1781). von Uexküll regarded himself as an immediate follower of Kant.

Whoever claims to be a believer faces a choice. No doubt, the majority can't live without its trusty ALL SEEING EYE. They might at least try to view both sides of the mirror (Lorenz, 1977). It would imply a major advance, because the 'scientific meaning' of so many empirical results depends critically on the perspective.

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