

All in the Mind

Idealism from a Scientific Worldview

Consciousness touches reality only through the mind. Everything known to modern science indicates that this meeting of reality and consciousness results from a chain of causation. The external world generates signals that reach us through various media. The signals are extracted from their media by the various senses and transmitted through the nervous system to the brain. The brain unconsciously reorganizes the nerve impulses, fuses the information from the various senses, and sends the resulting impression to the mind to be presented to consciousness as reality. All consciousness can know of reality is what the mind represents as being real. A major function of the brain is exactly to perform this interface. The brain creates mind the same sense that the heart creates circulation.

But we know that the brain has the capacity to generate impressions that don't arise from external reality. People experience this normally in dreams and abnormally in hallucinations. This has led philosophers to wonder whether all that we consider to be real might not actually be a mental construct with no more connection to an external reality than dreams or hallucinations. This notion that reality is actually no more than a mental idea is called *idealism*.

The scientific worldview is completely incompatible with idealism. It fundamentally assumes that there exists an external reality that can be sensed by the capabilities that come packaged with the notion of self. One cannot even approach science without having rejected the idealism hypothesis. Yet it is intellectually unsatisfying to do so without a defensible reason. This essay provides an argument for rejecting idealism so that we can embrace the scientific worldview with confidence.

Point of origin.

As a foundation for our reasoning, let's begin by rejecting radical skepticism – the belief that you can never really know anything. This is, of course, the *sine qua non* of all intellectual activity. Second, let us accept that self exists. Rene Descartes did a good job settling this with his observation that even an evil demon intent on deceiving us could not deceive us about the existence of self, because it needs a self to deceive. He summarized this in his statement: "I think, therefore I am," or in Latin, "*Cogito ergo sum*." To ground our discussion, we must add one more assumption: that this thinking self includes the capability to interact with reality, whether reality is external or mental. If reality is external, that capability is our senses. If it is mental, that capability is whatever generates our delusion, perhaps even something like Descartes' demon.

We seek to resolve whether reality is external or mental. Because these are the only two options, we cannot undertake this – or any – intellectual enterprise without assuming one or the other. I propose to assume that external reality exists then use it to examine idealism as an hypothesis. Turning the logic around, assuming idealism then treating external reality as an hypothesis, can lead to only two outcomes: 1) radical skepticism, which I

have rejected, or 2) finding inconsistencies at the fringes of current knowledge. This second outcome can always be answered with the acknowledgement of some shortfall in current knowledge and the assertion that this shortfall will be repaired in time. This is certainly the experience of human history: all identified shortfalls in knowledge of external reality have been repaired over time, although new ones have emerge as old ones are resolved.

Because the approach has an unavoidable bias, I don't offer it as an irrefutable proof; I am only aiming for a compelling reason to reject the idealism hypothesis.

The natural (as opposed to abstract) component of external reality is best addressed through science. From the scientific worldview, the idealism hypothesis has two, related problems. The first is the sensory argument: our several natural and artificial senses produce a coherent view of reality even though they function through completely separate (orthogonal) modalities. The second is the theoretic consistency argument: the explanations that rationalize sensory observations all accord with each other at the most profound levels.

What you sense is what you get.

Let me begin with the sensory argument. Nature provided us with multiple senses that address perceived reality through very different modalities.

- Vision uses electromagnetic radiation.
- Hearing uses acoustic vibrations.
- Touch uses physical contact with an object, sometimes combined a knowledge of exactly how our limbs are placed (our kinesthetic sense).
- Smell detects airborne chemicals.
- Taste detects chemicals dissolved in a liquid, generally saliva.

These sensing modalities are largely orthogonal; orthogonal means the means and media have nothing in common with each other. The exception is that smell and taste both sense the same chemicals, though smell is a remote sense where taste is a contact sense. They use qualitatively different sensing cells and different neural pathways.

Each sense has a threshold of signal strength below which it can detect nothing, and another threshold above which it cannot distinguish differences between different signals. For example, we cannot hear a sound that is too quiet, but if the sound is extremely loud, our hearing saturates, and we can't tell how loud it is. The difference between these two thresholds is called the sense's dynamic range.

Each sense can only detect a signal in a certain range. Vision can only sense electromagnetic radiation of certain wavelengths. Hearing can only sense vibrations of certain frequencies. This limitation in the sense's inherent ability is called its bandwidth.

Each sense can only discriminate between qualities sensed to a certain level of fineness. Our fingertips cannot distinguish the temperature difference between two items that are only a hundredth of a degree different. Our eyes cannot distinguish items that are

separated by one hundredth of a degree in angle. This resolution limitation is called the sense's precision.

Different senses perceive the same quality of an object through orthogonal modalities. For example, we discern shape through both vision and touch, though they operate through orthogonal modalities. We can discern motion through both vision and audition, though their modalities are completely orthogonal. If reality were mental rather than external, one could expect occasional small lapses of coherence. In a mental reality, there's no necessary reason that the shape we think we discern through vision should exactly cohere with that through touch, or the motion we think we discern through vision coheres with that through hearing. In general we find that there is an extremely high coherence across sensory modalities.

There are a few lapses, however. To rule out a mental origin of any apparent incoherence, we must fully explain it in terms of an external reality. Some lapses are apparent to one observer but not another. For example, a person may have an hallucination. An hallucination is certainly a case of a brain-generated reality being interpreted as an external reality. If hallucinations were common or normal, that would establish the idealistic hypothesis. However scientists have been largely able to explain hallucinations in terms of an external reality: a brain pathology. Because they are abnormal, rare, and explainable in terms of an external reality, they do not support the idealistic hypothesis.

Some apparent lapses in sensory coherence arise from deliberate deception or illusion. Careful investigation can also explain these in terms of an external reality, and therefore they do not support the idealistic hypothesis.

Another whole category of incoherence traces to some limitation of the sense's bandwidth, dynamic range, or precision. To more rigorously explore sensory information, people have built artificial sensors with more capabilities than our natural senses. These have allowed us to explain all remaining incoherence in terms of an external reality.

For example, correlation of natural touch and vision tells us that some hot objects glow and some do not. Such an inconsistency might arise from an incoherence in mental reality or it might trace to a limitation in our natural senses. So we developed artificial sensors for temperature that work through an entirely different principle than our natural senses. Artificial temperature sensors generally depend on the thermal expansion of a material, while our natural temperature sensors depend on the distortion or denaturing of a complex molecule in the touch receptor. An artificial sensor seeks to bring the quality sensed within the dynamic range, bandwidth, and precision available to a natural sense without distorting the property sensed. For example, a thermometer magnifies a material's thermal expansion so that we can sense it with our natural vision; a thermocouple's temperature signal must be amplified and interpreted by a machine in order to be brought into a visual format. The artificial and natural sensors cross-calibrate each other so that we understand the limitations of the natural sensor. The same approach

is used for the sensation of glow. Infrared sensors are capable of turning an invisible, infrared glow into visual wavelengths available to natural vision. Once the natural senses have been artificially augmented, we can clearly perceive that all hot objects do glow, but some glow in wavelengths that the eye does not see. There is no unresolved incoherence that might force us to accept the idealistic hypothesis. Once artificial sensors have established that there is indeed a coherence between heat and glow, we do not have to accept a mental reality to explain it.

At this point in the history of humanity, all the natural senses have been enormously enhanced through artificial means. Artificial sensors encompass all the bandwidth we know about in every known modality across a huge dynamic range with extreme precision. We have even created artificial sensors for qualities that we cannot sense naturally – magnetism, for example. Once we have broad enough bandwidth, adequate dynamic range, and adequate precision, we can discern *no incoherence whatsoever* in characteristics of objects sensed through different modalities. This extraordinarily rich coherence of natural and augmented sensory information across orthogonal modalities is easily explained by the existence of an external reality; indeed, an actual physical object is the most plausible explanation for this coherence among the different senses/sensors. This undermines the idealistic hypothesis

The puzzle pieces all fit.

The second basis for rejecting the idealistic hypothesis is the theoretic consistency argument: the theories that explain what we observe with our natural and augmented senses all accord with each other at the most profound levels. This line of argument is much more compelling, but because it ultimately rests on the reality of sensation, it cannot be put forward without sensory argument I just provided.

When Kepler discovered his laws of planetary motion, he marveled, “I feel carried away and possessed by an unutterable rapture over the divine spectacle of heavenly harmony... I write a book for the present time, or for posterity. It is all the same to me. It may wait a hundred years for its readers, as God has also waited six thousand years for an onlooker.” The underlying principles that describe observed reality are nowise intuitive. On the contrary, they are at least obscure and often counterintuitive. Yet their perfection is stunning! Those of us who with a deep enough understanding of science to have glimpsed some part of the grand scheme of physical reality cannot help but marvel, as Kepler did, at its sublimity. It cannot be, it is simply not possible, that such complex, integrated perfection is a construct of the human mind.

The course of scientific understanding has often been held back by the prejudices of the human mind. Such a simple thing as the rotation of the earth is contradicted by our senses and therefore resisted by the mind. Some people insist on rejecting the theory of evolution, despite its overwhelming empirical and theoretical support, because it contradicts their prejudices. Truly revolutionary theories, such as relativity and quantum mechanics, are so counterintuitive that only people who immerse themselves in years of

study can truly embrace them. Prejudices are so deeply engrained in the human mind that scientists often snuffle to each other: “Science makes progress one funeral at a time.”

Again and again, we see compelling evidence that the mind has no control over what reality presents for interpretation. Again and again, neat theoretical constructs about how the universe works are overthrown when some new piece of obscure information presents itself to our attention. Again and again, scientists have scrambled to discredit that information in order to maintain their constructs, and frequently they have failed.

For example, people were convinced that the earth was the center of the universe and the stars were fixed, until they encountered irrefutable evidence that it merely one object in billions slave to the laws of gravitation. People were convinced that at least the universe was static, until they encountered irrefutable evidence that it was expanding. People were convinced that the universe was expanding but at a decreasing rate, until they encountered irrefutable evidence that it was expanding at an increasing rate. On each occasion, the observation emerged in contradiction to all the pervious habits of the mind. If reality were purely mental, we would have expected our observations to confirm our mental prejudices, not contradict them.

When each such failure of our mental prejudices was finally explained theoretically, and when the new theory was integrated with other, related theories, humanity’s fresh understanding of reality revealed a structure that is yet more sublime and perfect than what it replaced. There has never been a time in the history of science (excepting works in progress) when some newly validated theory could not be rationalized with all the other valid theories to increase our appreciation of how profoundly perfect the universe is. This is analogous to the sensory coherence argument. In the same way that the evidence of senses is absolutely coherent, the theories that explain those observations are absolutely consistent.

But finally, neither the counterintuitive nature of new discoveries nor the absolute consistencies of our theories argues most strongly against the idealistic hypothesis. The deep, compelling perfection of the theoretic structures of the universe is, in my view, incompatible with the idealistic hypothesis. Nothing I can extrapolate from my understanding of the mind allows it to be the source of this sublimity. The human mind struggles to even comprehend what is presented to it; the proposition that the human mind could generate it is not plausible.

The demon astronomer.

For the sake of completeness, I suppose I must address what I consider to be the rather silly argument of the evil demon. This argument proposes that there exists some supernatural creature intent on deceiving us. Let us borrow Descartes’ demon, a creature powerful enough to manipulate the mind with perfect fluency and malicious enough to want to deceive. (But we ignore his *cogito*, which disproves his demon.) In order to deceive the best efforts of humanity, this demon would have to be a darn good mathematician. If it wanted to deceive us into believing that the meanderings of the

planets across the heavens where under the influence of gravitation, it would have to not only author this dummy law of gravitation, it would then have to precisely calculate where to present the images of the planets such that they behaved appropriately to the gravitational force not only of the sun, but also of each other, their own moons, the asteroids, and the larger Kuiper planetoids, because all these influences can be detected by us with careful observations. Now, this mathematics is not extremely difficult; any PhD in astronomy could turn the crank on these equations, and we'll grant the demon at least the intelligence of your commoner garden variety PhD astronomer.

The far more difficult problem would be calculating the motion of the stars in the galaxy. The stars all interact with each other according to simple gravitational laws, but because they interact with *all* the stars, direct calculations of the simultaneous equations become intractable. You would need as many simultaneous equations as there are stars raised to the power of the number of stars (divided by two). So if there were only a billion stars, you would need to solve a billion to the billionth power simultaneous equations. I have to believe this level of computation would be impossible even for our demon.

But let's suppose the demon has a computer that can run these multiple calculations simultaneously. Now, a classical Von Neumann computer would also bog down trying to solve that many simultaneous equations, but let's assume the demon is clever enough to reject the Von Neumann architecture in favor of one more appropriate to the job, a so-called neural computer or connection machine. Instead of modeling the universe as 1's and 0's shifting through binary registers, a neural computer models the stars in its nodes: their masses are represented as the numerical value stored in the node. It models their distances as connection delays within the computer: the longer the distance, the longer the connection delay. A relatively simple optimization routine can then replace the intractable computation problems of solving all those simultaneous equations. Basically, a neural computer would create an abstract model of this dummy galaxy that the demon could then use to position the stars in humanity's mental heaven so that it appears to faithfully follow the laws of gravitation.

Of course, the gravitational effect of the normal, hot matter of stars is not enough to determine the behavior of all the stars to within humanity's ability to measure it. That behavior is also influenced by cold, normal matter (dust), dark matter, and apparently something called dark energy. Although we humans don't know what dark energy is or exactly how it functions, the demon is going to have to include it in its model if it's going to continue to deceive humanity once we do figure it out. So the demon has to come up with a dummy theory of dark energy and get that programmed into the calculations.*

Now, a neural machine works well for lumped masses like stars, but it really isn't appropriate for modeling dispersed masses like dust and dark matter. It can, however, be adapted to the task if each particle of dust is modeled as a lumped mass. Since galactic matter can be very dilute, this has to include the possibility of modeling particles down to

* This would have to be an enormously mischievous demon. It might have kept humanity deceived without dark matter and dark energy. One has to wonder why it would want to invent these complications, which just make its job of deceiving humanity that much harder.

the size of atoms, or even ions such as free electrons. Yes, that would work, but the magnitude of the computation grows from “merely” the number of stars in the galaxy to the number of discrete particles of any size. But at least the demon can still use the simple, optimization computation instead of simultaneous equations.

Then we consider that the radiation pressure of stars has a small but detectable effect on the dust and even some stars, especially in the galactic bulge. Like gravitation, this would require intractably large numbers of simultaneous equations to solve directly or on a Von Neumann computer but can be adequately modeled on a neural computer. However, the node coded with the gravitational properties of any given particle cannot also be coded with the radiative properties of that particle – they are distinct values. Calculating the radiative effect require functionally a separate neural computer with its nodes representing the radiative properties of each particle. Then the computation would require a third machine to ensure gravitation and radiation fields interact appropriately.

And to be even more precise, the calculation would have to include more than just mass and radiation. It must also consider any electrostatic forces, any magnetic properties, cosmic particle interactions, etc. Each set of properties would have to be represented in a separate neural computer, and to achieve the necessary precision, each particle would have to be individually modeled as a node. Then more machines would be needed to model the interaction among the different properties. Only a computer with this complexity would produce calculations that would reliably deceive humanity.

Now if the demon wanted to simplify this really messy computational architecture, it could change each node into something that does not merely *represent* the particle’s properties as a mathematical quantity but actually *has* those properties at the appropriate value. Then to maintain the proper scaling for all of the properties’ effects, instead of representing the distances between particles by connection delays between nodes, it would separate them by the actual distance. Such a computer would more simply and faithfully model the behavior of the galaxy, but it would also *become* the galaxy.

So here is my *reductio ad absurdum*: the simplest computer able to produce these calculations for the demon with full fidelity would be the galaxy itself!

I’ve used the galaxy as the example, but the same argument applies to the human brain, molecules in a cell, an ecosystem, the weather, nuclear dynamics in a star, the immune system, the formation of galaxies after the Big Bang, etc. No complex system can be perfectly modeled without a system of the same or greater complexity.

In short, the simplest perfect model of physical reality is physical reality itself. A demon would have to create physical reality in order to know precisely how to deceive us. But then the demon becomes unnecessary. So delete the demon and what you have is physical reality as we find it. Q.E.D.

What difference does it make?

We would certainly not like to be deceived about the nature of reality. Yet if the deception is clever enough and thorough enough that we cannot possibly discern it using the most sophisticated, collective knowledge of humanity, it is fair to ask what difference it would make if we really are deceived. If the universe really exists only as a construct within our mental apparatus, a universe as complex and sublime as the one we credit with an external existence, well then, that universe *does* exist. The distinction between an external universe and a mental universe is only important if the latter limits us in a way the former does not. A flawless deception is, I think, no deception at all. It's merely an alternate statement of reality.

What finally matters is not what exists, but what we do with the reality we're presented.