Facts, not Fiction

Restoring Confidence In Evidence-Based Science

By Avi Loeb on November 19, 2020

*T*he widespread availability of an FDA-approved vaccine for COVID-19 will not ensure its consumption by the public. This is reflective of a broad cultural problem—there is a deep undercurrent of mistrust, especially of elites, running through American society today—but it also echoes a cultural problem in the world of science, specifically.

Americans of all stripes have come to regard scientists as part of the elite, in part because they have sequestered themselves in an ivory tower, saturated with ambition for academic honors and consumed with sterile intellectual gymnastics. Much of current scientific culture focuses on nuances whose sole purpose is to garner their researchers higher academic status by impressing colleagues, rather than serving the public's interest or carrying any practical relevance for our daily life.

This state of affairs is particularly apparent in my field: the world of physics. For instance, in theoretical physics, a phalanx of untestable notions—about the multiverse, hypothesized extra dimensions, the idea that we live in a simulation, and the argument that there is no

need for experimental evidence to justify the string theory strategy in unifying quantum mechanics and gravity—occupy centerstage. At the same time, there is a taboo on an open discussion of certain common-sense questions, such as whether there are other intelligent civilizations in outer space and whether our civilization is the smartest kid on the galactic block.

"The surest way to corrupt a youth is to instruct him to hold in higher esteem those who think alike than those who think differently", wrote the philosopher Friedrich Nietzsche in his book *The Dawn of Day*, published in 1881. And indeed, the psychological pressure on physicists to conform with fashionable trends promotes a herd mentality in which young scientists today feel obligated to work on far-fetched ideas promoted by senior colleagues just in order to secure jobs, thereby perpetuating the problem. These young scientists learn from the examples set by their elders, who often react to original thought with violent pushback and bullying. I know, because I have been the subject of such assaults.

When the first interstellar object, `Oumuamua, was glimpsed passing through our solar system in October of 2017, scientists quickly agreed that it was weird on half-a-dozen counts: it had a flattened shape with extreme proportions never seen before among comets or asteroids, an unusual initial velocity, and a shiny appearance; it lacked a cometary tail, but nevertheless it exhibited a push away from the Sun not explainable by gravity. However, despite these anomalies, the mainstream scientific community immediately declared business as usual and decreed the object to have been an unusual asteroid or comet—albeit one that was unlike any asteroid or comet seen before. The response

brought to mind a kid who has encountered many cats at home and, upon visiting the zoo and seeing an elephant, simply assumes it to be an unusual cat. Such naivete is charming in a child; it is less tolerable in a scientist.

We ought to hold ourselves to a higher standard, I felt—so several months after ‘Oumuamua was first sighted, I suggested that its weirdness may imply that it was a product of an alien technology, possibly a thin sail pushed by sunlight. (Our own civilization has dreamed of such a perfect spacefaring technology for decades, and I had recently helped to design a prototype of one for the Breakthrough Starshot Initiative, an effort—supported by earthbound innovators and dreamers such as Mark Zuckerberg, Yuri Milner, Sergey Brin, and Anne Wojcicki—to reach our closest neighboring star within our lifetimes.)

In fact, another object showing evidence for push by sunlight with no cometary tail was discovered in September 2020 by Pan STARRS. It was initially given an astronomical label, 2020 SO, before it was identified as a stray rocket booster from a 1966 mission to the Moon that is still bound to the Sun. `Oumuamua moved much faster—on an escaping trajectory from the Sun, implying that it must have originated from interstellar space.

When I spend time on vacation near a beach, I enjoy studying natural seashells but every so often I encounter a plastic bottle which is artificially made. Whatever its purpose, if artificial in origin, ‘Oumuamua would represent “a message in a bottle”: the first evidence that we are not alone.

I first articulated this hypothesis in a commentary that I published in *Scientific American;* I subsequently quantified it in a scientific paper with my postdoc, Shmuel Bialy. Although far from the most speculative thing I have ever published—indeed, in comparison to some of my research on dark matter, the paper was rather tame—it generated quite a fuss. It was accepted for publication within a few days of its submission to *The Astrophysical Journal Letters*. It became the only paper I know of to have been quoted verbatim on both CNN and Fox News, and to have inspired a new brand of wine ("*Cuvée `Oumuamua*" by Bonny Doon). And judging by my inbox, it has stirred a great deal of interest in people far beyond the rarefied halls of academia.

But my idea also generated an impulsive pushback within the scientific mainstream. Some scientists expressed a strong opinion on Twitter based on prejudice without studying the evidence. It would have been better if they had followed the advice of basketball coaches: "keep your eyes on the ball and not the audience". After all, by siding with the mainstream during Galileo Galillei's days, we would have given justification to placing him in house arrest rather than looking through his telescope. This would clearly be in contradiction to our current support of evidence-based science.

At the same time that conservative scientists argue for "business as usual" regarding `Oumuamua, other reputable scientists admit that the object is weird and suggest "never seen before" explanations for it—each of which requires an imaginative leap much greater than the one necessitated by the lightsail hypothesis. For example, a recent suggestion was

that `Oumuamua may be a hydrogen iceberg, but this explanation faces the problem that such an object is likely to evaporate during its long interstellar journey. Another recent proposal, that it is an elongated fragment from the gravitational disruption of a bigger object by a star, faces the shortcoming that such disruptions are rare and that `Oumuamua's shape was inferred to be pancake-like based on its light curve. Another suggestion, that `Oumuamua is pushed by sunlight because it is a porous dust bunny which is a hundred times less dense than air, raises severe doubts about its ability to survive through a tumultuous interstellar trip for millions of years.

The mainstream orthodoxy contradicts itself by claiming that `Oumuamua is not unusual and at the same time endorsing these notions that it could be explained by "never-seen-before" natural mechanisms. One cannot escape the impression that these exotic explanations are promoted simply to avoid a discussion on the possibility that `Oumuamua might be of artificial origin.

Why is the study of alternative explanations for the anomalies of `Oumuamua any different from the search for radical explanations for possible anomalies (involving cores instead of cusps in the centers of galaxies or unusually cold hydrogen during the cosmic dark ages) tied to the unknown nature of the dark matter? Given that between a quarter and half of all stars we examined host an Earth-like planet with a surface temperature that can support liquid water and the chemistry of life-as-we-know-it, the proposition that we are not alone is rather conservative, and should have been endorsed by the mainstream by now. Yet our scientists—and our elected leaders—would prefer not to look under this particular rock. In

1993, Congress halted federal funding to the Search for Extraterrestrial Intelligence (SETI), even though only a tiny fraction of all possible technological signatures of extraterrestrial civilizations had been searched for at that point. Territories that remain unexplored today include industrial pollution of planetary atmospheres, artificial lights, solar cells or mega-structures in space.

It seems obvious to me that space archaeology—a burgeoning field of research concerned with the search for extraterrestrial technological relics—should be funded as generously as the search for, say, the faddish Weakly Interacting Massive Particles (WIMPs), which were thought to be the constituents of dark matter. The physicists Guiseppe Cocconi and Philips Morrison wrote of SETI in 1959: "The probability for success is difficult to estimate, but if we never search, the chance of success is zero". To that I would add: when you are not ready to find exceptional things, you will never discover them.

Yet my colleagues at the forefront of the search for extraterrestrial intelligence seem to have forgotten this fundamental scientific principle. In contrast to its cool reception in the scientific community, SETI hits a nerve in the general public. There lies a paradox: the public pays taxes that support science and is more eager to know the answer to the question: "are we alone?" than: "are WIMPs the dark matter?", not to speak about supporting speculative notions of "extra dimensions" or the "multiverse", which have no reality check to their credit.

Ironically, indeed, the reason that physicists enjoy freedom is that their blue-sky mainstream used had practical impact. The stable funding of physics stemmed from Vannevar Bush's vision of "The Endless Frontier" after the demonstrated relevance of the Manhattan Project to society. Why would the mainstream scientific community shy away from the public's interests and focus on esoteric questions that have little relevance to the layperson? Are scientists supposed to hide behind the opaque technical walls of a self-sustained bubble and ignore the public that funds their research?

Previous generations of physicists understood that when evidence is incomplete, we have to live with scientific uncertainty and consider multiple interpretations of the available data. I fear that physicists today, like their oft-disparaged counterparts in the SETI community, have forgotten this important principle. Nowhere in science is this failure clearer, in my opinion, than in the scientific community's response to the half-dozen anomalies displayed by the first interstellar object that we have discovered.

A scientist must go where the evidence is—but too often, our scientists do not. I do have hope for the future, however. My optimism stems from raising my young daughters, who have no inhibitions in exploring the truth; this is why they learned so much over the short term of their childhood. Perhaps scientists should behave more like kids. Mistakes are an inevitable part of our learning experience as students of mother nature, humbled by the fact that its splendor often exceeds our imagination.

I am practicing what I preach by preparing to confront my own mistakes. Starting in 2023 the *Legacy Survey of Space and Time* (LSST) on the Vera C. Rubin Observatory will survey the sky for new objects. If we find another weird object like `Oumuamua on its way towards us, we could send a spacecraft to take a close-up photo of it and identify its nature. Let my hypothesis about ‘Oumuamua be judged according to the evidence from this research, rather than by the popularity contest that guides so much of modern science.

Science is a never-ending work in progress. We show integrity by entertaining multiple possible interpretations of evidence to the public. The new generation of innovators should not be held hostage by the mistakes of the past. After standing in line at the bank, I never hear the cashier saying that I am not allowed to cash my check because the customer ahead of me had an overdraft. We should examine each case based on its own merit.

Scientists could regain the public’s trust by being straightforward about the inevitable roller-coaster of trial and error associated with innovation—whether it be the search for a vaccine for COVID-19 or the search for technological signatures of other civilizations. Rather than pretending to know the outcome in advance, we should admit what we do not know and study all possible interpretations, so that the public will believe our robust conclusions when new evidence brings clarity.

ABOUT THE AUTHOR

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(Credit: Nick Higgins)