Extraterrestrial Intelligence: Friends, Foes, or Just Curious?

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Abstract For over 50 years, scientists involved in the Search for Extraterrestrial Intelligence (SETI) have searched for evidence of alien civilizations, and several messages have been transmitted into space with the intention of communicating with intelligent extraterrestrial beings. In April 2010, the esteemed British astrophysicist Stephen Hawking warned that such attempts could be potentially dangerous. He based his conclusion on historical analogies on Earth, such as the conflict between Native Americans and European settlers, and he reasoned that when a more technologically advanced civilization encountered a less advanced one, the results have often been catastrophic for the weaker party. Although this argument has intuitive appeal, upon closer examination, it appears misguided. Even for technologically-advanced civilizations, interstellar voyages would probably be justified only for major purposes, and plundering the Earth for its resources would be neither practical nor desirable.

Keywords Alien invasion · Analogy · Christopher Columbus · Extraterrestrial intelligence · Extraterrestrial motivations · Fermi Paradox · Interstellar travel · Kardashev scale · SETI · Stephen Hawking · Wormhole

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1 Alone in a Crowded Universe

Popular culture continues to reflect our fascination with extraterrestrial aliens. In May 2012 a new science fiction film—*Battleship*—was released which depicted a confrontation between the U.S. Navy and a fleet of extraterrestrial invaders in the Pacific Ocean. The story begins in 2005, when NASA scientists discover an exoplanet (a planet outside of our solar system) with characteristics similar to Earth. Assuming that there could be intelligent life on the planet, NASA transmits a powerful signal from communications array in Hawaii, which is boosted by a satellite in orbit. Remarkably, the alien recipients of the message are able to mount an interstellar invasion a mere seven years later.

The above scenario, though implausible because it ignores the cosmic speed limit (i.e., the speed of light, which according to Einstein's special theory of relativity, nothing can exceed), nevertheless illustrates the potential perils of attempting to communicate with extraterrestrial aliens.

In 1974, Carl Sagan and Frank Drake created the Arecibo Message, which was beamed into space aimed at the globular star cluster M13 some 25,000 light years away. The first intentional message sent into space, it consisted of 1,679 binary digits that collectively formed an image of the Earth. The message was controversial, as some commentators feared that it was potentially dangerous to announce our position in the cosmos to extraterrestrial aliens who might harbor malicious intentions toward us.

In April 2010, the Discovery Channel broadcasted a documentary in which Stephen Hawking speculated on the existence of extraterrestrial life. In his mind, the multitude of billions of stars and galaxies suggests that life in other solar systems is almost a certainty. Hawking pondered an important question: Could visitors from extraterrestrial civilizations pose a threat to Earth? In the documentary, an armada of massive space ships roams the galaxy as interstellar nomads who, having exhausted all the resources on their home planet, search for other planets to conquer and colonize. He concluded that making contact with aliens is "a little too risky." Moreover, drawing upon the experience on Earth, he mused that "if aliens ever visit us, I think the outcome would be much as when Christopher Columbus first landed in America, which didn't turn out very well for the Native Americans" (Leake 2010).

Hawking is not the first scientist to warn of the potential hazards of alien contact. In his book, *The Third Chimpanzee*, the noted geographer and evolutionary theorist Jared Diamond (2006) offered an essay on the perils of attempting to contact alien civilizations, observing that whenever a more advanced civilization encountered a less advanced one, or species that have evolved from different ecosystems, came into contact with each other, the results have often been catastrophic for the weaker party, including slavery, colonialism or extinction (Brin 2006). He once described the 1974 Arecibo message as suicidal folly, comparing it to the Incan emperor describing the wealth of his kingdom to the gold-crazed Spaniards. Sending out radio signals, he concluded, was "naïve, even dangerous"

(Michaud 2007, 246). Even the late astronomer, Carl Sagan, who was generally sanguine about the prospects of interstellar comity, once counseled that a relatively young civilization such as Earth's should listen quietly, "before shouting into an unknown jungle that we do not understand" (Brin 2006).

While this argument seems reasonable at first blush, upon further reflection I believe such fears are greatly overstated for a straightforward reason related to the physics of interstellar travel.

2 The Methods and Feasibility of Interstellar Space Travel

When considering interstellar travel, two important factors to keep in mind are the vast distances between solar systems and the enormous energy requirements that would be necessary to fuel space vessels that could traverse such distances. The closest solar system, Proxima Centauri, is about 4.2 light years away from Earth. To put that in perspective, if a vessel from Earth could somehow travel at the speed of light, it would take over four years to reach that solar system. According to Einstein's Special Theory of Relativity, interstellar travel is seemingly impossible because no vessel could travel faster than the speed of light, thus it would take centuries or millennia to travel the distances between solar systems. For example, at the speed of the Voyager spacecraft, it would take over 70,000 years to get to Proxima Centauri. However, Einstein's General Theory of Relativity indicates that faster than speed of light travel is theoretically possible by using large amounts of energy to continuously stretch space and time. Theoretically, empty space could warp space faster than light. Inasmuch as only empty space is contracting or expanding, one could exceed the speed of light by this fashion; however, this approach would require enormous amounts of energy and would be feasible only for a very advanced civilization (Kaku 2002).

Another way to avoid the speed of light limit is through the use of a wormhole through which an extraterrestrial civilization could create a shortcut across space and time. A functioning wormhole could serve as a bridge between two different regions of the universe. One could enter the wormhole at one end and emerge out of it moments later in a place thousands of light years from the starting point (Webb 2000; Sagan 1985). Carl Sagan depicted this device as a means of interstellar travel in his novel *Contact* (Davies 2010). The Russian physicist, Sergei Krasnikov once demonstrated that a certain class of wormholes could be created using positive mass-energy matter (Webb 2000). The energy requirements for such a system, though, would be, in a word, massive, and well beyond the scope of our capabilities. Assumedly, practical interstellar space travel could be viable only for very advanced civilizations that have learned how to harness enormous amounts of energy.

3 Kardashev's Civilization Scale

In 1964, the Russian astrophysicist and director of the Russian Space Research Institute, Nikolai Kardashev, first proposed a classification of alien civilization based on their methods of energy extraction. His scale has three categories. A Type I civilization can harness all available energy sources on its planet. A Type II civilization utilizes all the energy from its star. A Type III civilization is able to harness the power not of only its own star, but other stars in its galaxy (Kardashev 1985; Kaku 1994). Such a civilization, as the futurist and string theorist Michio Kaku once mused, would be immortal.

According to Kardashev (1997), energy consumption determines civilizational progress and could one day enable interstellar travel. As Michio Kaku (1997, 18) explained, Kardashev's system of classification is reasonable because it relies upon available supplies of energy. "Any advanced civilization in space will eventually find three sources of energy at their disposal: their planet, their star, and their galaxy. There is no other choice."

How would a civilization advance on this scale? A civilization might advance to Type I status by applying fusion power or by producing antimatter to be used as an energy source. Alternatively, one might be able to harness zero-point energy (Webb 2000). To advance beyond Type I status, Freeman Dyson (1960) theorized that a hypothetical megastructure could be employed to encompass a star as a system of orbiting solar power satellites to capture most of a star's energy output. Constructing such a device—a Dyson sphere—would be a gargantuan engineering undertaking, but theoretically possible. Dyson conjectured that an alien civilization could tear apart planets and asteroids to use as the material to build the necessary structures (Davies 2010).

A Type III civilization might also be able to harness energy by building a device around a spinning black hole, which would release far more energy than a star can through nuclear fusion. By exploiting the law of conservation of angular momentum, the prodigious power of its rotation could be used to extract energy (Davies 2010). Furthermore, an advanced extraterrestrial civilization might be able to tap into the energy released from massive black holes that reside at the center of some galaxies.

Dyson observed that human civilizations have a tendency to constantly increase their energy consumption. Based on this reasoning, eventually civilizations would be compelled to search for more ways to harness energy (Dyson 1960). Currently, our civilization occupies a position that has not quite attained Type 1 status. In 1973, Carl Sagan computed it as 0.7 on the Kardashev scale (Sagan 1973). In order for an extraterrestrial civilization to conduct interstellar travel, most probably it would have to obtain at least a Type II status.

4 Alien Motivations

Why would aliens visit the Earth? As Hawking mused, alien civilization might exhaust their home planet and search for other planets from which to extract resources. Would an alien civilization make the long trip to Earth to plunder our resources? Conceivably, one could envisage a resource war in the sense of trying to grab up all the planets in a galaxy, a recurrent theme in science fiction (the blockbuster 1996 film, *Independence Day*, for example).

Upon closer examination, though, this scenario seems unlikely. It stretches the bounds of credulity to believe that an advanced alien civilization would come all the way to Earth for energy products. It's a safe bet that any civilization capable of traveling such long distances either by way of spacecraft and/or wormholes would not be using oil and other pre-Type I civilization energy sources. What is more, the transportation costs to bring the energy products back to the mother planet would not be economical. Possibly, fusion reactors, or even anti-matter reactors, could be used to fuel such space vessels, in which case hydrogen, or some isotope thereof, would be required (Crawford 1990). However, hydrogen is one of the most abundant chemical elements in the universe and would thus not require interstellar travel to obtain. Possibly, an alien civilization might want to extract minerals from other planets. Yet it would not be practical to come all the way to Earth for minerals. After all, they could more than likely be found on planets in much greater quantities in their own solar system or in nearby solar systems. And it would be far more practical to conduct strip mining on planets on which they would not have to deal with restive denizens, such as earthlings. In short, the rarity of advanced life and the tremendous distances between civilizations suggest that there would be plenty of planets and stars for all those that were capable of exploiting such methods of resource extraction.

Still, others point out that the way in which humans treat other animals is not reassuring. Higher-level mammals, such as dolphins and even chimpanzees, are often mistreated for commercial or experimental reasons (Michaud 2007). Moreover, evolutionary biologists point out that altruism occurs with decreasing intensity as individuals grow more distantly related (Michaud 2007). Perhaps, aliens would crave us as food. There is a good possibility that alien visitors would be descended from carnivores (Kaku 2008). Thus some observers, such as the biologist Michael Archer, fear that aliens would more likely be predatory than benevolent (Michaud 2007). The food scenario has some intuitive appeal. After all, many humans consume animal flesh. In a classic episode of the science fiction program *The Twilight Zone*—"To Serve Man"—seemingly magnanimous aliens called the Kanamits come to Earth and share their advanced technology, which solves the planet's greatest woes, including eradicating hunger, disease, and the need for warfare. Humans are encouraged to take trips to the Kanamits' home planet, which is supposedly a paradise. However, a female code breaker eventually deciphers that a Kanamit book ironically titled *To Serve Man* is actually a cookbook on how to serve humans as meals.

When examined more closely, however, this scenario lacks credibility as well. Presumably a Type II or Type III civilization capable of interstellar travel would also have mastered agricultural engineering and would thus have solved problems in farming and livestock a long time ago. Even on Earth, which has not yet attained Type I civilizational status, there have been marked improvements in nutrition on a global scale. A portion of the human population still suffers from hunger, but there has been a steady reduction in that segment over the years. In fact, more people are obese today than undernourished ("Overweight…" 2006). Although it is certainly reasonable to assume that aliens would consume animal flesh, creating a wormhole just to go to Kentucky Fried Chicken seems rather far-fetched.

Might aliens use humans to help biologically propagate their species? Some scientists, including the co-discoverer of the structure of DNA Francis Crick, have speculated that aliens may have actually "seeded" planets in the universe by sending microbe-laden probes out into space in a process called "directed panspermia" as a way in which to spread the building blocks of life (Webb 2000). In the film *Mars Needs Women*, Martians suffer a genetic deficiency that produces only male offspring. However, a civilization that could travel great distances would almost certainly have mastered bioengineering as well and could ameliorate such a deficiency. Moreover, inasmuch as alien life-forms would probably be based on entirely different DNA and protein molecules, they would probably have no interest in either eating or mating with us (Kaku 2008). This scenario is humorous, but aliens would probably not be so desperate to travel light years to meet species of the opposite sex. That's an awful long way to travel to get a date.

Perhaps an advanced martial extraterrestrial civilization might use Earth as a type of training ground for their warriors. This was the plot of the *Predator* film series, in which alien creatures visit various hot spots and war zones on Earth to hone their martial skills. This could be exciting for members of some alien civilizations. After all, at one time, big game hunting was the province of distinguished gentlemen in the West. The scenario has some plausibility until one considers the frivolousness of such a trip. Would aliens be willing to spend a thousand years in suspended animation for such an excursion? Would aliens create a wormhole just to go big game hunting?

More seriously, territorial motives could inform interstellar colonization. Based on assumptions of terrestrial life, we would assume that life has a natural tendency to expand. Should extraterrestrial life be any different (Webb 2000)? In H.G. Wells' classic novel, *The War of the Worlds*, Martians invade Earth to take over the planet. The novel was written at the height of the British Empire when power was often measured in land (Davies 2010). Eventually, an advanced extraterrestrial civilization would be forced to embark on interstellar travel if it wanted to survive insofar as its sun would have a limited life (Webb 2000). In such a scenario, an extraterrestrial civilization might want to colonize so-called Goldilocks planets, that is, those that that falls within a star's habitable zone and would be roughly in size of the planet Earth so that it could have an atmosphere. Such a planet would avoid overly hot or cold temperatures so that it could retain liquid water on its surface, assumedly a sine qua non for the emergence of life. The so-called "Rare

Earth hypothesis" posits that the existence of such planets is extremely uncommon insofar as a number of unlikely events and conditions would be necessary in order to give rise to such planets. Thus such prime real estate, so the argument goes, would be highly coveted by aliens, not unlike the American continents were for European settlers centuries ago.

The Columbus analogy, though, would probably be inapplicable for alien encounters. Judged by contemporary standards, the Spanish conquistadors were not much more technologically superior to their Native American hosts. The Spaniards coveted the gold of the latter and eventually their territory, both of which were limited commodities that could only be obtained on Earth for both cultures. Moreover, it was foreign diseases for which Native Americans had no immunity which decimated that population, rather than a systematic plan of conquest and genocide. Rather than travel to Earth and subdue humans, it would probably be more feasible for a Type III civilization to artificially create the conditions supportable of life on a much closer planet. This was the scenario of the 1990 film *Total Recall*, starring Arnold Schwarzenegger, in which an alien artifact—a terraforming machine—has the ability to create an oxygen-bearing atmosphere on Mars. Conceivably, a Type III civilization might even be able to reconfigure a planetary system so that more planets orbit inside the Goldilocks zone (Davies 2010). Perhaps out of a sense of magnanimity, an alien civilization would leave our sun and solar system alone and choose to colonize other solar systems. In that sense, settling other planets would not really be imperialism in the classic sense of the term because, as Frank Tipler and John Barrow opined, the planets would just be "dead rocks and gas" (Michaud 2007, 312–312). A technologically sophisticated extraterrestrial civilization may also be accompanied with an advanced ethical development that values other life forms and decide to leave them unmolested (Ghirardi 2010). Finally, if a Type III civilization sought more stars from which to extract energy, it could find a great abundance of more desirable and larger stars instead of our Sun, which is relatively small (Geller 2010).

Some have argued that superior civilizations would seek out and destroy less-advanced civilizations for their own self-defense. The analogue of the Cold War is instructive, as neither superpower was principally concerned about territory, but rather feared the prospect of a preemptive nuclear strike. Preemptive galactic warfare, the cosmologist Edward Harrison argued, would be prudent insofar as a species that has overcome its own self-destructive qualities may view other species bent on galactic expansion as a sort of virus (Archer 1989). Ironically, the 1959 science fiction film *Plan 9 from Outer Space*—often cited as the worst movie ever made—contained such a plot that logically explained hostile alien intentions. In the film, extraterrestrial beings seek to stop humans from developing a doomsday weapon that could destroy the universe. One is reminded of the first test of the atomic bomb at the Trinity site at Los Alamos in New Mexico on July 16, 1945. The Manhattan Project physicist Enrico Fermi offered to take wagers on the probability that the test would destroy either the entire state of New Mexico or wipe out all life on Earth (Rhodes 1986). More recently, some observers of projects such as the Relativistic Heavy Ion Collider (RHIC) on Long Island feared that experiments to create a

miniature black hole could devour our planet (Webb 2000). Conceivably, an alien civilization might seek to cripple another civilization before it developed the capability to retaliate or wreak galactic havoc. The Manhattan Project scientist John von Neumann and the electrical engineer Ronald Bracewell conjectured that extraterrestrial civilizations might send self-replicating robotic probes to explore other solar systems. Some scientists feared that such artificially-intelligent automatons might be programmed to destroy other civilizations (Webb 2000). However, as Gerald O'Neil pointed out, the fact that Earth has yet to be attacked suggests that nobody out there is hostile to us (Michaud 2007). Furthermore, optimists contend that the vast distances between solar systems insulate our planet.

Historical analogies, Carl Sagan once argued, were probably inapplicable to alien and human contact as he found it unlikely that we would face "colonial barbarity" from a technologically more advanced alien civilization. Quarrelsome extraterrestrials, he reasoned, would probably not last long in interstellar space because they would be eliminated by a more powerful species. According to this line of reasoning, those civilizations that lived long enough to perform significant colonization of the Galaxy would be those least likely to engage in aggressive galactic imperialism (Michaud 2007). Moreover, extraterrestrials visiting Earth would assuredly be far more technologically advanced than we, so that the former would have nothing to fear from us. And Earth would not likely have anything that they would need (Michaud 2007).

At our current technological development, we would not be a threat to a Type II or Type III civilization. Moreover, even a military invasion could be problematical for an advanced extraterrestrial civilization. If interstellar travel is exceedingly difficult, then interstellar invasion would even be more challenging (Webb 2000). Keep in mind that Operation Overlord, the Allied invasion at Normandy in World War II—a mere 100 miles across the English Channel—required considerable planning and was not launched until the Allies had already attained near complete superiority in the air and in the sea.

5 Fermi's Paradox: Where Are They?

In 1950, while having lunch with his colleagues at Los Alamos, New Mexico and after a brief discussion about the prospects of extraterrestrial life, Enrico Fermi blurted out, "Where is everybody?" As he reasoned, if technologically advanced civilizations were common in the universe, and assuming many of them had preceded Earth by many tens of thousands of years, then it follows that we should have been visited by now (Webb 2000). This is called the Fermi Paradox, for which there are at least 50 different answers (Crawford 2000). Theoretical physicist and futurist Michio Kaku points out that the transition from a Type 0 to Type I civilization carries a strong risk of self-destruction. Such civilizations may face a Malthusian catastrophe that precludes transition to a higher type. Thus, a short-lived civilization would be unlikely to establish contact. Yet, despite the eons

necessary for a civilization to attain Type III status, when measured by the estimated life of the galaxy, the time necessary for colonization would be relatively short (Webb 2000). According to some estimates, it would take anywhere from 5 million to 60 million years for an advanced extraterrestrial civilization to colonize a galaxy (Webb 2000).

Alas, so far, the SETI project has not yielded any tangible evidence of alien civilizations (Webb 2000).[1] SETI uses scientific methods to scan the galaxy for electromagnetic transmissions from civilizations on other planets. Supposedly, a Type II or Type III civilization would leave a detectable footprint in the galaxy, such as radio transmissions or infrared emissions. According to the Second Law of Thermodynamics, an advanced civilization would generate large quantities of waste heat that could be detected by our instruments (Kaku 1994). Almost certainly a device such as a Dyson sphere would dramatically alter the light spectrum of the enclosed star, and in doing so create a noticeable infrared glow that could be identified by peering astronomers, even on the far side of the galaxy (Davies 2010). Nevertheless, no telltale signs have yet to be detected. Kardashev (1985) countered that alien civilizations have not been found because they have not been properly searched for.

Although we have not detected aliens, they may have detected us. Why then don't they make an effort to communicate? Perhaps they are not interested in us. Michio Kaku (1994) uses the analogy of human contact with ants. When we come upon an anthill, he explains, we do not request to see their leader or bring trinkets to them and offer unparalleled prosperity through the fruits of our technology. Because of astronomical time scales, a civilization capable of visiting Earth could be many millions of years ahead of us and thus might find us uninteresting. Moreover, it would be unlikely that any such advanced civilization would find any resources on Earth that could not be found in numerous other star systems closer to their civilization. As Kaku (2008, 17) points out, the main danger ants would face is not that humans want to invade them or eradicate them. Rather, we might simply "pave them over because they are in the way." In this scenario, the danger would be if Earth got in the way of the aliens' highway.

Others, however, are more sanguine. An advanced civilization would probably be interested in encountering another civilization. Kardashev (1997) speculated that alien civilizations might find it advantageous to unite with others in order to reduce the time delay for communications and other types of activities. The SETI astronomer Jill Tarter (2010) speculated that "rather than exploiting us, they might value and support the natural biodiversity of the galaxy."

[1] That is with the possible exception of the "Wow signal," which after numerous attempts to rediscover, has not been found again. On August 15, 1977, Jerry Ehman, a SETI volunteer at Ohio State University, observed a startling strong signal received by telescope. After circling the indication on a printout, he scribbled "Wow!" in the margin. Some observers consider the message to be the most likely candidate from an extraterrestrial source ever discovered. However, subsequent searches have failed to detect it again. The powerful narrowband spike most likely emanated from a man-made satellite.

Why would aliens visit us? In a word, curiosity. As Frank Drake opined, "Many human societies developed science independently through a combination of curiosity and trying to create a better life, and I think those same motivations would exist in other [alien] creatures" (Kaku 1994, 283). Presumably, members of an extraterrestrial civilization capable of reaching Earth would be highly curious—a quality that would be necessary to practice the science that led to their advanced technological development (Webb 2000). After all, curiosity is a sine qua non of science. On Earth, human scientists are intensely interested in lower life forms, such as insects; it would logically seem to follow that aliens would be interested in other life forms as well. In fact, some scientists have even speculated that our solar system has been cordoned off and functions as a "zoo" in the natural development of our planet is allowed to occur (Webb 2000). Certainly, an alien civilization traveling to Earth would have knowledge of physics that far exceeded our own. Therefore, the aliens might be more interested in areas such as ethics, religion, and art (Webb 2000). One reason they might visit Earth is to practice cosmological anthropology (Kardashev 1985). If that is the case, then alien intentions would probably lean towards altruism rather than hostility.

If extraterrestrial civilizations do exist, their aspirations could differ markedly from our own. Nevertheless, as Robert Forward pointed out, even for technologically-advanced civilizations, interstellar voyages would probably be justified only for major purposes (Michaud 2007). From the perspective of representatives of alien civilization, plundering the Earth for its resources would be neither practical nor desirable. To prepare for the eventuality of alien contact, we must consider alien motives. To that end, the former chairman of the Transmissions from Earth Working Group, Michael Michaud, recommended that the Committee on SETI be broadened beyond astronomers to include philosophers, historians, theologians, etc. (Brin 2006).

New hopes of life in the cosmos emerged in late 2010 when astronomers discovered an exoplanet in the star system Gliese 581, a mere 20 light years away, that is believed to be of similar size to Earth and that may reside in a habitable zone in its solar system. Contact with intelligent sentient beings would be of monumental significance and could have numerous scientific, political, and theological implications (Michaud 2007). Understandably, based on certain episodes of human history, some people view this proposition with trepidation. Despite the potential dangers, however, more than likely we need not worry.

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