



Viewpoint

A direct communication proposal to test the Zoo Hypothesis



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ARTICLE INFO

Article history:

Received 3 March 2016

Accepted 16 June 2016

Available online 26 July 2016

Keywords:

Active SETI

Astrobiology

Fermi's Paradox

Messaging to extraterrestrial intelligence

METI

ABSTRACT

Whether we are alone in the universe is one of the greatest mysteries facing humankind. Given the >100 billion stars in our galaxy, many have argued that it is statistically unlikely that life, including intelligent life, has not emerged anywhere else. The lack of any sign of extraterrestrial intelligence, even though on a cosmic timescale extraterrestrial civilizations would have enough time to cross the galaxy, is known as Fermi's Paradox. One possible explanation for Fermi's Paradox is the Zoo Hypothesis which states that one or more extraterrestrial civilizations know of our existence and can reach us, but have chosen not to disturb us or even make their existence known to us. I propose here a proactive test of the Zoo Hypothesis. Specifically, I propose to send a message using television and radio channels to any extraterrestrial civilization(s) that might be listening and inviting them to respond. Even though I accept this is unlikely to be successful in the sense of resulting in a response from extraterrestrial intelligences, the possibility that extraterrestrial civilizations are monitoring us cannot be dismissed and my proposal is consistent with current scientific knowledge. Besides, issuing an invitation is technically feasible, cheap and safe, and few would deny the profound importance of establishing contact with one or more extraterrestrial intelligences. A website has been set up (<http://active-seti.info>) to encourage discussion of this proposal and for drafting the invitation message.

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1. Introduction

Are we alone in the universe? Or are there other intelligent species in our galaxy? This is one of the greatest mysteries facing humankind. Given the >100 billion stars in our galaxy, many have argued that it is statistically unlikely that life, including intelligent life, has not emerged anywhere else [1,2]. This premise led to the search for extraterrestrial intelligence or SETI, which is now over 50 years old, and was spearheaded by the Cocconi & Morrison (1959) paper and the early observations using radio telescopes by pioneers like Frank Drake [3,4]. In spite of its thus far negative results, our search for extraterrestrial signals has barely just begun and recent advances make this effort ever more timely. Extrasolar planets are now being discovered at a rapid pace and the capacity and sensitivity of instruments for surveying the skies has been improving dramatically. For example, the Allen Telescope Array and the planned Square Kilometre Array promise unprecedented performance for SETI and for astronomical observations [5–7]. Moreover, for practical reasons, SETI has not traditionally focused on frequencies in which our civilization is more luminous but rather on

primarily detecting deliberate “beacons” by other civilizations that presumably wish to signal their existence. The new generation of radio observatories will allow frequencies used for telecommunications on Earth to be surveyed as part of SETI in much greater detail [8], even if the effectiveness of such searches depends on many unknowns such as how long civilizations are “radio loud” [7]. Therefore, although there is still debate regarding the best search strategies, and funding for SETI is limited, SETI remains one of the greatest scientific enterprises of our time [3,4].

1.1. Fermi's Paradox and SETI

The Milky Way is >13 billion years old and our Solar System less than half as old, suggesting that any extraterrestrial civilizations in older star systems are widely assumed to be much older and more advanced than ours [2,3,9–11]. The estimated time for an intelligent civilization to colonize, or at least explore, the 100,000 light year diameter galaxy is <100 million years [9]. This could involve probes, including self-replicating von Neumann probes, though there is some debate (depending on exploration strategies) regarding how long it would take to explore the galaxy [12,13]. Be that as it may, one would expect older intelligent species to have reached us by now, and others have for long discussed the idea that

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extraterrestrial probes may already be in our solar system monitoring human civilization [1]. The lack of any sign of extraterrestrial intelligences, even though on a cosmic timescale extraterrestrial civilizations would have enough time to cross the galaxy, is known as Fermi's Paradox [14].

Many hypotheses have been put forward to explain this mysterious "Great Silence", including various barriers to the formation and survival of civilizations and of life itself [15]. Perhaps very few systems harbor planets suitable for life or interstellar space travel is very challenging even for advanced civilizations. While any of these explanations might turn out to be true, given our current knowledge, it is reasonable to assume that intelligent life can exist on other star systems, and interstellar travel does not violate the laws of physics and can be assumed to be practicable [16]. One additional important consideration is that the Earth has distinguishing biosignatures of life (e.g., atmospheric oxygen, water and methane in extreme thermodynamic disequilibrium) that are detectable across large distances [17]. As such, even if star travel is expensive and dangerous, and even if there are many systems to explore, the Earth has had a unique biosignature for >2 billion years [18]. Assuming that life is rare in the universe, the Earth must be a prime target for study by extraterrestrial civilizations. Therefore, an extraterrestrial civilization in our galaxy, even if modestly more advanced than ours, would likely be aware of life on our planet long enough to have reached us by now. Fermi's Paradox has thus profound implications for SETI, with historically some authors even arguing that we should abandon it, though given how little we know about the universe this appears premature [14].

1.2. The Zoo Hypothesis and Active SETI

Since there is no way to reliably predict the capabilities and motivations of alien civilizations, it cannot be excluded that they exist yet do not behave the way we would. One possible explanation for Fermi's Paradox is the Zoo Hypothesis, first proposed by John Ball (1973). The Zoo Hypothesis states that one or more extraterrestrial civilizations know of our existence and can reach us, but have decided not to disturb us or even make their existence known to us [19]. Many authors have debated the Zoo Hypothesis and its variants, such as the related Interdict Hypothesis [9]. The rationale behind these hypotheses is that extraterrestrial civilizations, perhaps in agreement as part of a "Galactic Club", will only contact us when we reach one or more technological, intellectual or social milestones. The possibility that extraterrestrial civilizations are lurking within the solar system or its neighborhood, perhaps observing us from the asteroid belt or from the Kuiper Belt, has been equally discussed by numerous experts. For example, it has been suggested that extraterrestrial intelligences may be observing us while deciding whether to help us or destroy us [20] or that maybe they are ignoring us without concern as to whether we detect them or not [21]. More recently, simulations have been performed addressing the Zoo Hypothesis, and in particular whether hegemony can be established in the galaxy to enforce our isolation, since all it takes is for a single discordant extraterrestrial civilization to establish contact. Results have been inconsistent, however: For example, Hair (2011) has argued that the first successful civilization in the galaxy could influence all subsequent civilizations to establish a dominant cultural hegemony [22], yet Forgan (2011) has questioned these results [23].

In the context of the Zoo Hypothesis and its variants, since the 1970's many have argued that extraterrestrial intelligences monitoring us might wait for us to initiate contact and thus that we should attempt to communicate with them, but no practical way of doing this has been put forward [11]. Active SETI, also called messaging to extraterrestrial intelligence or METI, is the attempt to

send messages to extraterrestrial civilizations. It has been extremely controversial within the SETI community since the first historical *Arecibo Message* was sent in 1974 aimed at a distant star cluster [10]. The major concern is that sending interstellar messages could reveal our location to potentially hostile extraterrestrial civilizations. This has not stopped various Active SETI attempts, though, including the more recent *Cosmic Calls* messages and the *Teen Age Message* [reviewed in [10]]. One notable attempt related to the Zoo Hypothesis was made in the form of the Invitation to ETI website (<http://ietl.org/>) led by the late Allen Tough. The idea behind this website was for it to act as an invitation to extraterrestrial civilizations already observing humankind to contact us (e.g., by e-mail). Its assumption, however, is that such alien civilizations monitoring us can access and interact with our Internet, which is highly dubious (or unproven at best) since this would require a connection (i.e., transmitting and receiving data) with a computer on Earth. Therefore, there is an unmet need to develop an Active SETI protocol in the context of the Zoo Hypothesis.

2. An Active SETI proposal to test the Zoo Hypothesis

I propose here a proactive test of the Zoo Hypothesis. Specifically, I propose to send a message to any extraterrestrial intelligence(s) that might already be observing us and inviting them to respond. My aim is to attempt to bring forward the communication with extraterrestrial civilizations by stating that we are ready to engage with them at a high level. The rationale is that, assuming the Zoo Hypothesis is true, extraterrestrial civilizations must be observing human civilization, which must involve monitoring our radio leakage as this is readily detectable at long distances (i.e., from outside the solar system) [24]. My assumption is also that it is possible to influence the decision-making process of extraterrestrial civilization(s), by initiating contact or perhaps (as detailed below in Section 2.3, the exact content of the invitation message is still to be determined) by asking for their assistance. Because we frequently regard past human societies (even from a recent past) as primitive, it is certainly possible that a more advanced species would still consider present human values and social structure as unfit for any sort of communication. After all, future human generations are likely to regard our thinking now as incorrect and even backwards. It is also possible that extraterrestrial intelligences consider certain aspects of our biology as unsuitable for engaging with them, like our short lifespans that could prevent them from communicating with the same individual if communications take a long time by human standards. That said, and in spite of the unlikelihood of the many assumptions underlying my proposal (starting with the Zoo Hypothesis itself), I believe this is a worthwhile endeavor since it can be achieved with very modest resources (see Section 2.2 below). Besides, the prospect of being successful, no matter how unlikely this is, is tantalizing since establishing contact with extraterrestrial intelligences would forever change humanity. The act of sending such a message will, by itself, energize SETI and force us to more profoundly consider the prospect of communicating with extraterrestrial civilizations.

2.1. Potential drawbacks of establishing contact with extraterrestrial intelligences

Opposition to direct communication efforts is mostly based on concerns related to costs and the potential dangers of revealing ourselves [10,11,25,26]. Many authors have pointed out that we have good reasons to believe that extraterrestrial intelligences would be capable of destroying our civilization [25], or at least pose considerable risks [27]. (Neal (2014) argues that we should

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