# 1ac r6

## 1ac Shell

### Plan

#### Plan: Mega constellations in low-Earth Orbit by private entities, including but not limited to SpaceX’s Starlink, are unjust.

#### Solvency simply relies on private entities not using megaconstellations, we don’t need other SAs as we fiat private entities not appropriating space as if something is morally unjust it ought not be done.

### Advantage

#### The Kessler syndrome is starting now but private megaconstellations make management impossible

Boley/Byers, 5/20/2021 – University of British Columbia Professors

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Aaron C. Boley & Michael Byers, “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth”, Scientific Reports volume 11, Article number: 10642 (2021), 20 May 2021, <https://www.nature.com/articles/s41598-021-89909-7.pdf>, accessed 12/1/21, sb

Thousands of satellites and 1500 rocket bodies provide considerable mass in LEO, which can break into debris upon collisions, explosions, or degradation in the harsh space environment. Fragmentations increase the cross-section of orbiting material, and with it, the collision probability per time. Eventually, collisions could dominate on-orbit evolution, a situation called the Kessler Syndrome3. There are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraft and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the long-term evolution of debris suggest that LEO is already in the protracted initial stages of the Kessler Syndrome, but that this could be managed through active debris removal4. The addition of satellite mega-constellations and the general proliferation of low-cost satellites in LEO stresses the environment further5,6,7,8. Results The overall setting The rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defines NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with effects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph. Although the volume of space is large, individual satellites and satellite systems have specific functions, with associated altitudes and inclinations (Fig. 2). This increases congestion and requires active management for station keeping and collision avoidance9, with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, after failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency. When completed, Starlink will include about as many satellites as there are trackable debris pieces today, while its total mass will equal all the mass currently in LEO—over 3000 tonnes. The satellites will be placed in narrow orbital shells, creating unprecedented congestion, with 1258 already in orbit (as of 30 March 2021). OneWeb has already placed an initial 146 satellites, and Amazon, Telesat, GW and other companies, operating under different national regulatory regimes, are soon likely to follow. Enhanced collision risk Mega-constellations are composed of mass-produced satellites with few backup systems. This consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also considerable discarded equipment. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of de-orbiting satellites will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difficult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC (see “Methods”). The large density spikes show that some shells will have satellite number densities in excess of n=10−6 km−3. Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some companies might be less-than-fully transparent about events13 in LEO. Despite the congestion and traffic management challenges, FCC filings by SpaceX suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the filings do not account for untracked debris6, including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 after one year. Thus, if at any time there are 230 pieces of untracked debris decaying through the 550 km orbital shell, there is a 50% chance that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if subsequent fragmentation events lead to similar amounts of debris within that orbital shell, a runaway cascade of collisions could occur. Fragmentation events are not confined to their local orbits, either. The India 2019 ASAT test was conducted at an altitude below 300 km in an effort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. A major fragmentation event from a single satellite could affect all operators in LEO. Even if debris collisions were avoidable, meteoroids are always a threat. The cumulative meteoroid flux15 for masses m > 10–2 g is about 1.2 × 10–4 meteoroids m−2 year−1 (see “Methods”). Such masses could cause non-negligible damage to satellites16. Assuming a Starlink constellation of 12,000 satellites (i.e. the initial phase), there is about a 50% chance of 15 or more meteoroid impacts per year at m > 10–2 g. Satellites will have shielding, but events that might be rare to a single satellite could become common across the constellation. One partial response to these congestion and collision concerns is for operators to construct mega-constellations out of a smaller number of satellites. But this does not, individually or collectively, eliminate the need for an all-of-LEO approach to evaluating the effects of the construction and maintenance of any one constellation.

#### Starlink is responsible for HALF of all dangerous space near-collisions – full megaconstellation can make collisions ten times more likely and debris avoidance software doesn’t check

Pultarova, 8/18/2021 – journalist, quoting Europe’s leading space debris expert

Tereza is a London-based science and technology journalist, aspiring fiction writer and amateur gymnast. Originally from Prague, the Czech Republic, she spent the first seven years of her career working as a reporter, script-writer and presenter for various TV programmes of the Czech Public Service Television. She later took a career break to pursue further education and added a Master's in Science from the International Space University, France, to her Bachelor's in Journalism and Master's in Cultural Anthropology from Prague's Charles University. She worked as a reporter at the Engineering and Technology magazine, freelanced for a range of publications including Live Science, Space.com, Professional Engineering, Via Satellite and Space News and served as a maternity cover science editor at the European Space Agency. “SpaceX Starlink satellites responsible for over half of close encounters in orbit, scientist says”, August 18, 2021, <https://www.space.com/spacex-starlink-satellite-collision-alerts-on-the-rise>, accessed 12/1/21, sb

Operators of satellite constellations are constantly forced to move their satellites because of encounters with other spacecraft and pieces of space junk. And, thanks to SpaceX's Starlink satellites, the number of such dangerous approaches will continue to grow, according to estimates based on available data. SpaceX's Starlink satellites alone are involved in about 1,600 close encounters between two spacecraft every week, that's about 50 % of all such incidents, according to Hugh Lewis, the head of the Astronautics Research Group at the University of Southampton, U.K. These encounters include situations when two spacecraft pass within a distance of 0.6 miles (1 kilometer) from each other. Lewis, Europe's leading expert on space debris, makes regular estimates of the situation in orbit based on data from the Socrates (Satellite Orbital Conjunction Reports Assessing Threatening Encounters in Space ) database. This tool, managed by Celestrack, provides information about satellite orbits and models their trajectories into the future to assess collision risk. Lewis publishes regular updates on Twitter and has seen a worrying trend in the data that reflects the fast deployment of the Starlink constellation. "I have looked at the data going back to May 2019 when Starlink was first launched to understand the burden of these megaconstellations," Lewis told Space.com. "Since then, the number of encounters picked up by the Socrates database has more than doubled and now we are in a situation where Starlink accounts for half of all encounters." The current 1,600 close passes include those between two Starlink satellites. Excluding these encounters, Starlink satellites approach other operators’ spacecraft 500 times every week. In comparison, Starlink's competitor OneWeb, currently flying over 250 satellites, is involved in 80 close passes with other operators' satellites every week, according to Lewis' data. And the situation is bound to get worse. Only 1,700 satellites of an expected constellation of tens of thousands have been placed into orbit so far. Once SpaceX launches all 12,000 satellites of its first generation constellation, Starlink satellites will be involved in 90% of all close approaches, Lewis’ calculations suggest. The risk of collision Siemak Hesar, CEO and co-founder of Boulder, Colorado, based Kayhan Space, confirms the trend. His company, which develops a commercial autonomous space traffic management system, estimates that on average, an operator managing about 50 satellites will receive up to 300 official conjunction alerts a week. These alerts include encounters with other satellites as well as pieces of debris. Out of these 300 alerts, up to ten might require operators to perform avoidance maneuvers, Hesar told Space.com. Kayhan Space bases their estimates on data provided by the U.S. Space Surveillance Network. This network of radars and telescopes, managed by the U.S. Space Force, closely monitors about 30,000 live and defunct satellites and pieces of debris down to the size of 4 inches (10 centimeters) and provides the most accurate location data of the orbiting objects. The size of this catalog is expected to increase ten times in the near future, Hesar added, partly due to the growth of megaconstellations, such as Starlink, and partly as sensors improve and enable detection of even smaller objects. The more objects in the catalog mean more dangerously close encounters. "This problem is really getting out of control," Hesar said. "The processes that are currently in place are very manual, not scalable, and there is not enough information sharing between parties that might be affected if a collision happens." Hesar compared the problem to driving on a highway and not knowing that there has been an accident a few miles ahead of you. If two spacecraft collide in orbit, the cloud of debris the crash generates would threaten other satellites travelling through the same area. "You want to have that situational awareness for the other actors that are flying in the neighbourhood," Hesar said. Bad decisions Despite the concerns, only three confirmed orbital collisions have happened so far. Earlier this week, astrophysicist and satellite tracker Jonathan McDowell, who's based at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, found evidence in Space-Track data that the Chinese meteorological satellite Yunhai 1-02, which disintegrated in March this year, was actually hit by a piece of space debris. The worst known space collision in history took place in February 2009 when the U.S. telecommunication satellite Iridium 33 and Russia's defunct military satellite Kosmos-2251 crashed at the altitude of 490 miles (789 kilometres). The incident spawned over 1,000 pieces of debris larger than 4 inches (10 cm). Many of these fragments were then involved in further orbital incidents. Lewis is concerned that with the number of close passes growing, the risk of operators at some point making a wrong decision will grow as well. Avoidance maneuvers cost fuel, time and effort. Operators, therefore, always carefully evaluate such risks. A decision not to make an avoidance maneuver following an alert, such as that made by Iridium in 2009, could, however, clutter the orbital environment for years and decades. "In a situation when you are receiving alerts on a daily basis, you can't maneuver for everything," Lewis said. "The maneuvers use propellant, the satellite cannot provide service. So there must be some threshold. But that means you are accepting a certain amount of risk. The problem is that at some point, you are likely to make a wrong decision." Hesar said that uncertainties in the positions of satellites and pieces of debris are still considerable. In case of operational satellites, the error could be up to 330 feet (100 meters) large. When it comes to a piece of debris, the uncertainty about its exact position might be in the order of a mile or more. "This object can be anywhere in this bubble of multiple kilometres," Hesar said. "At this point, and for the foreseeable future, avoidance is our best recourse. People that say 'I'm going to take the risk', in my humble opinion, that's an irresponsible thing to do." Starlink monopoly Lewis is concerned about the growing influence of a single actor — Starlink — on the safety of orbital operations. Especially, he says, as the spaceflight company has entered the satellite operations world only recently. "We place trust in a single company, to do the right thing," Lewis said. "We are in a situation where most of the maneuvers we see will involve Starlink. They were a launch provider before, now they are the world's biggest satellite operator, but they have only been doing that for two years so there is a certain amount of inexperience." SpaceX relies on an autonomous collision avoidance system to keep its fleet away from other spacecraft. That, however, could sometimes introduce further problems. The automatic orbital adjustments change the forecasted trajectory and therefore make collision predictions more complicated, according to Lewis. "Starlink doesn't publicize all the maneuvers that they're making, but it is believed that they are making a lot of small corrections and adjustments all the time," Lewis said. "But that causes problems for everybody else because no one knows where the satellite is going to be and what it is going to do in the next few days."

#### SpaceX does whatever it wants and refuses to listen to anybody

Silverman, 2021 – The New Republic Staff Writer

Jacob Silverman is a staff writer at The New Republic and the author of Terms of Service: Social Media and the Price of Constant Connection. “Elon Musk Wants to Move Fast and Break Space”, April 19, 2021, <https://newrepublic.com/article/162096/spacex-starlink-satellite-internet-profit-space>, accessed 12/5/21, sb

Late last month, a pair of satellites operated by Starlink and OneWeb—two companies working to launch constellations of small, low-orbiting satellites that beam internet access all over Earth—almost collided, passing within nearly 200 feet of one another. As The Wall Street Journal reported on Monday, this was only the latest near miss: In late 2019, a Starlink satellite passed dangerously close to a European Union weather satellite. Apparently, the EU took the potential collision a lot more seriously than Starlink, which is part of SpaceX, the rocketry firm in Elon Musk’s growing business portfolio. “The agency said it was only able to contact Starlink via email, and the company told it they would take no action, so EU engineers had to initiate a collision avoidance maneuver,” according to the Journal. Space is getting crowded, and experts worry that we might one day face a catastrophic cascade of proliferating space debris, which could in turn knock out satellites, disable GPS service, and generally render space travel and global communications impossible for a generation. “In orbit, a one-centimetre bolt can have the explosive force of a hand grenade upon impact,” noted The New Yorker. While there’s blame to go around—along with a few nascent efforts by governments and NGOs to do something about the problematic buildup of space debris—the latest set of concerns revolves around constellations of low-orbiting satellites that companies like SpaceX are launching in order to provide global broadband internet access. The potential payoff, for customers in difficult-to-reach areas and the corporate tycoons managing these projects, is huge. By some estimates, up to 40 percent of the world’s population lacks internet access. Due to geography, conflict, disinvestment, or poverty, many people remain cut off from existing broadband and wireless networks; satellite internet access could potentially work anywhere—even in moving vehicles, claims Musk. SpaceX has said that satellite internet access is a potentially $1 trillion market. According to Morgan Stanley, if its satellite constellation succeeds, SpaceX’s value could soar to $175 billion. (Wide-eyed analysts speak of Amazon adding four billion customers through its own satellite network.) What we have here is, once again, a public good being distorted through the lens of private industry. And there’s real money to be made. But a growing list of skeptics—some, admittedly, from companies that seek to launch their own competing satellites—is worried that companies like SpaceX are putting up too many satellites too quickly. Other critics say that Starlink satellites risk blocking the view of telescopes, or that the company’s privatization of space-based communications will undermine public connectivity projects. The situation resembles a real estate grab, with competing firms racing to claim as much of space as they possibly can—before governments can apportion rights or coordinate with industry on how to keep an increasingly crowded sky full of functioning satellites. So far, no company has been as aggressive in colonizing space as SpaceX. Benefiting from its growing role as the U.S. government’s preferred rocketry firm, SpaceX exhibits a Zuckerbergian “move fast and break things” approach, brushing off the problem of exploding rockets and even tolerating an initial failure rate for its Starlink satellites as high as 5 percent. When a satellite doesn’t work, the company simply deorbits it, bringing it back toward Earth, where it burns up in the atmosphere. Starlink’s overall failure rate has more recently declined to somewhere in the realm of 3 percent—not bad by industry standards, but when thousands of satellites are deployed, that can add up to a lot of junk and a lot of systemic risk. As one industry observer told Forbes, with a large satellite constellation, “the goal should be a failure rate of … 1 percent or lower and even that will lead to dozens of dead satellites.” At the moment, the Starlink project has at least 1,350 satellites in orbit. There’s talk of building up to 12,000 small satellites for its broadband network (in six years, the company says, the number could be as high as 42,000). OneWeb, a British company, has fewer than 150 satellites in space right now, with its final network projected to cap out around 650. Reports about Jeff Bezos’s Project Kuiper anticipate that it will have more than 3,000 satellites. The Canadian operator Telesat has plans for 300. Russia and China may be working on their own satellite constellations, while an EU official told The Wall Street Journal that developing a ring of internet-beaming satellites was “a strategic priority.” It’s not clear, however, if all of this competition—both between profit-hungry corporations and power-hungry nation-states—will benefit the public, especially when there is potentially more to be gained by building out terrestrial internet infrastructure. Still, a monopoly managed by a global consortium, much like the internet itself, would guarantee more international cooperation, a less crowded sky, and likely a fairer deal for consumers. It would also help mitigate the costs of failure. Last year, three different satellite communications providers went bankrupt in three months. One of them was OneWeb, which received significant investment from SoftBank, a funder of WeWork, Uber, and other money-losing startups (OneWeb has since found new investors). One of the industry’s worst failures was Iridium, a $5 billion satellite network that filed for bankruptcy in 1999. It’s been resurrected in the meantime—SpaceX even launched some of its satellites—but remains unprofitable. In October, Starlink launched a test run of its internet service, calling it a “Better Than Nothing Beta.” While the negative consequences of patchy internet service may be mild for customers who sign up for this trial, this cavalier approach—with a blasé attitude toward safety and mechanical failure—can be found throughout Elon Musk’s empire. (SpaceX and Tesla did not respond to questions about their safety records before publication.) Just last week, a Tesla apparently engaged in self-driving mode—or autopilot, as the company has also called it—crashed with two passengers inside, killing them both in a horrific inferno that took four hours and 32,000 gallons of water to extinguish. (In an echo of the EU/Starlink near miss, firefighters had to call Tesla for help on putting out a lithium battery fire.) While the passengers were clearly acting irresponsibly—no one was behind the wheel to take over in an emergency, as Tesla advises—the mere fact that Tesla has made this feature widely available encourages customers to put their faith, and their lives, in an unproven, unregulated technology. Similarly, while managing the space-junk problem requires close coordination between private firms and a number of government agencies, SpaceX has once again followed Musk’s instinct to go it alone. Starlink has an automated AI avoidance system about which it’s released few details. Critics have said that an automated system isn’t useful when avoiding collisions requires different satellite owners or governments cooperating with one another. If your satellite is programmed to move automatically, how can I anticipate where to send mine without provoking a collision? From unpredictable self-driving vehicles to rockets strewing debris across Texas wetlands to the increasingly busy sky overhead, the world has become Elon Musk’s test lab. Whether you believe in Musk’s solar system–altering mission or not, people are experimenting with his products all around you. The risks apply to nearly all of us, while the rewards will accrue to Musk and his shareholders. Not all blame can be heaped at the fanboy-worshipped feet of Musk. A lack of government investment in new technologies and public infrastructure has rendered NASA and the space program a shadow of itself. The inclusion of broadband investment in the recent Biden stimulus package was long overdue. Self-driving car regulations vary by state. Absent meaningful federal action, there’s little to stop Musk from rolling out Tesla’s autonomous capabilities as a series of incremental patches and upgrades, rather than ensuring that the system is fully tested and secure. In the same way, with satellites becoming cheaper to launch and easily iterated upon, space is his to do with as he pleases. With SpaceX now launching U.S. government satellites and ferrying NASA astronauts—the company was recently chosen to return Americans to the moon—it seems as if the U.S. government has picked its winner. Like most of Elon Musk’s companies, SpaceX/Starlink has benefited enormously from government funding. Last year, the company received $885.5 million in subsidies from the Federal Communications Commission as part of a program to bring internet access to rural areas. Starlink received about 10 percent of all funding the FCC distributed this way; the rest of the $9.2 billion was apportioned among 179 other companies, indicating a strong degree of U.S. government support for Musk’s project. As a professor of aerospace engineering told The Wall Street Journal, “Musk is just doing what’s legal … but legal is not necessarily safe or sustainable.” But who’s going to stop him?

#### Collision with a military satellite risks miscalculation under use it or lose it pressure – that causes global nuclear war

Egeli, 6/25/21 – Izmir University of Economics Political Science and International Relations Assistant Professor

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Scenario 1: What’s Wrong with Our Satellite? Amid increased tensions, perhaps even an imminent military confrontation between two nuclear-armed adversaries, a high-value (for example, early-warning or strategic communication) satellite stops functioning or communicating instantly and inexplicably. SSA sensors do not pick up any anomalies. This may be the outcome of a technical malfunction or a natural phenomenon, such as the impact of a collision with a meteoroid or piece of space debris small enough to have evaded detection. Alternatively, the satellite perhaps becomes the victim of a deliberate, undetected attack. Earth-to-space kinetic, electronic, or directed energy attacks would leave behind some trails. A cyberattack, which is harder to detect and attribute, is a strong possibility. So is a stealthy attack by hostile spacecraft. In fact, the adversary is known to have experimented with ominous small spacecraft that could easily conceal or disguise themselves until conducting a final maneuver to neutralize their targets. The victim would also be aware that, especially at distant GEO and HEO altitudes, SSA is not sufficiently comprehensive to detect and give warning of all suspicious or threatening movements as they happen. As suspicions abound, decision makers are faced with hard choices. Could this perhaps be the harbinger of a wider nuclear or nonnuclear first strike, along with which the attacker is seeking to eliminate the possibility of retaliation by degrading the defender’s capacity to command, control, and communicate with its forces? Should the defender react immediately before the remaining space-enabled NC3 elements are also compromised and its control over nuclear and nonnuclear forces degrades even further? In the absence of a clear-cut picture of what actually has happened, there is a risk that impending decisions will be made on the basis of insufficient and potentially erroneous information, and the climate will be ripe for unfounded presumptions and predispositions. The resulting ultimatums, responses, or counteractions could set off a dangerous cycle of escalation and tit-for-tat actions, whereby reactions and overreactions between adversaries lead to potentially catastrophic consequences. At a minimum, heightened tension in orbit would have the outcome of spilling down to Earth so as to further aggravate an already tense situation.

#### Specifically, space debris causes China miscalc.

Zenko ’14 Micah Zenko, Whitehead Senior Fellow on the US and Americas Programme at Chatham House, 4-16-2014, "Dangerous Space Incidents," Council on Foreign Relations, https://www.cfr.org/report/dangerous-space-incidents?sp\_mid=45655631&sp\_rid=emFjay5iZWF1Y2hhbXBAZ21haWwuY29tS0

A January 2007 direct ascent ASAT test carried out by China against its defunct Fengyun-1C weather satellite instantly increased the amount of space debris in low earth orbit (LEO) by 40 percent. Debris is especially problematic in LEO, where half of the world's 1,100 active satellites operate. Space objects—even flecks of paint—travel as fast as eighteen thousand miles per hour and can cause catastrophic damage to manned and unmanned spacecraft—creating even more debris in the process. The U.S. National Research Council estimates that portions of LEO have reached a "tipping point," with hundreds of thousands of space debris larger than one centimeter stuck in orbit that will collide with other pieces of debris or spacecraft, thus creating exponentially more debris. Significant growth in the quantity or density of space debris could render certain high-demand portions of outer space unnavigable and inutile. Currently, there are no legal or internationally accepted means for removing existing debris. China could also test co-orbital antisatellite systems in which an interceptor spacecraft destroys its target by exploding in close proximity, creating even more debris. For several years, Beijing has conducted a series of close proximity maneuvers with its satellites in LEO; the most recent occurred after a July 20, 2013, launch of three satellites on the same rocket, which have since conducted sudden maneuvers toward other Chinese satellites. Human or operating errors during these maneuvers could inadvertently result in a collision that produces harmful debris. While these maneuvers could eventually be used for civilian purposes, most U.S. officials believe these experiments are primarily intended to demonstrate latent ASAT capabilities. An ASAT test that causes unintended damage to U.S. and ally satellites or an accident in space caused by debris could trigger a major international crisis between the United States and China. The risk is heightened by the fact that both countries have no pre–space-launch notification arrangements, similar to the U.S.-Russia agreement on notifications of intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM) launches. Management of such a crisis could also be hindered by a lack of direct communication between U.S. authorities and the PLA agency that oversees Chinese military space launches.

#### That goes nuclear.

Kulacki ‘16 — Gregory Kulacki, China Project Manager in the Global Security Program at the Union of Concerned Scientists, former Associate Professor of Government at Green Mountain College, former Director of External Studies at Pitzer College, former Director of Academic Programs in China for the Council on International Educational Exchange, holds a Ph.D. in Political Theory from the University of Maryland-College Park, holds graduate certificates in Chinese Economic History and International Politics at Fudan University (Shanghai), 2016 (“The Risk of Nuclear War with China: A Troubling Lack of Urgency,” Union of Concerned Scientists, May, Available Online at <http://www.ucsusa.org/sites/default/files/attach/2016/05/Nuclear-War-with-China.pdf>, Accessed 06-28-2016)

No Technical Exit As long as both sides remain committed to pursuing technical solutions to their unique strategic problems, they are condemned to continue competing indefinitely. But stalemate is not a stable outcome; rather, it is a perpetual high-wire act. Twenty-four hours a day, 365 days a year, the governments of the United States and China are a few poor decisions away from starting a war that could escalate rapidly and end in a nuclear exchange. Lack of mutual trust and a growing sense that their differences may be irreconcilable incline both governments to continue looking for military solutions—for new means of coercion that help them feel more secure. Establishing the trust needed to have confidence in diplomatic resolutions to the disagreements, animosities, and suspicions that have troubled leaders of the United States and the PRC for almost 70 years is extremely difficult when both governments take every new effort to up the technological ante as an act of bad faith. The bilateral dialogues on strategic stability aim to manage the military competition, but they do not seek to end it. Although the two governments work very hard at avoiding conflict, they have yet to find a way out of what Graham Allison called their “Thucydides trap”—the risk of conflict between a rising power and an established power invested in the status quo (Allison 2015). Allison’s warning not to minimize the risks of war is sage advice, even if he does not say how the United States and China can escape the trap he describes. [end page 8] PRC leaders believe it is possible to prosecute a major war without risking a U.S. nuclear attack. The leaders of the United States believe stopping the PRC from prosecuting such a war may depend, in certain contingencies, on a credible threat to use nuclear weapons—a threat U.S. leaders state they are prepared to execute. These mismatched perceptions increase both the possibility of war and the likelihood it will result in the use of nuclear weapons. Well-informed U.S. officials tend to dismiss the possibility that the United States and the PRC could wander into a nuclear war. For example, Admiral Dennis Blair, a former Director of National Intelligence whose final military post was Commander in Chief of the U.S. Pacific Command, assured a large gathering of U.S. arms-control experts that “the chances of a nuclear exchange between the United States and China are somewhere between nil and zero.” J. Stapleton Roy, a former U.S. ambassador to the PRC, wholeheartedly agreed (Swaine, Blair, and Roy 2015). Similarly, PRC military strategists and arms control experts believe that the risk of nuclear war with the United States is not an urgent concern even if that risk may not be zero (Cunningham and Fravel 2015). This lack of urgency is troubling. For example, the United States reportedly told the PRC it would risk military escalation to prevent or stop a proposed PRC island reclamation project in the Scarborough Shoal (Cooper and Douglas 2016). The PRC reportedly responded by committing to move ahead with the project later in 2016 (Chan 2016). This particular contest of wills is part of a steadily increasing number of unresolved diplomatic spats that have escalated to the level of overt military posturing reminiscent of U.S.-Soviet jousting during the Cold War. The United States and the PRC are decades-old enemies, preparing for war and armed with nuclear weapons. Good faith efforts by the leaders of both nations have failed to stop accelerating preparations for war, including new investments in their nuclear forces. Miscommunication, misunderstanding, or poor judgment could spark a conflict that both governments may find difficult to stop. War between the United States and the People’s Republic of China is not inevitable, but failing to acknowledge the risks is certain to make it more likely. Both governments should confront these risks with a greater sense of purpose. Only then will they devote the same measure of creativity, effort, and resources to the diplomacy of reducing those risks as they now spend preparing for war.

#### Nuke war causes extinction AND outweighs other existential risks

**PND 16**. internally citing Zbigniew Brzezinski, Council of Foreign Relations and former national security adviser to President Carter, Toon and Robock’s 2012 study on nuclear winter in the Bulletin of Atomic Scientists, Gareth Evans’ International Commission on Nuclear Non-proliferation and Disarmament Report, Congressional EMP studies, studies on nuclear winter by Seth Baum of the Global Catastrophic Risk Institute and Martin Hellman of Stanford University, and U.S. and Russian former Defense Secretaries and former heads of nuclear missile forces, brief submitted to the United Nations General Assembly, Open-Ended Working Group on nuclear risks. A/AC.286/NGO/13. 05-03-2016. http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/OEWG/2016/Documents/NGO13.pdf

Consequences human survival 12. Even if the 'other' side does NOT launch in response the smoke from 'their' burning cities (incinerated by 'us') will still make 'our' country (and the rest of the world) **uninhabitable**, potentially inducing global famine lasting up to **decades**. **Toon and Robock** note in ‘Self Assured Destruction’, in the Bulletin of Atomic Scientists 68/5, 2012, that: 13. “A nuclear war between Russia and the United States, even after the arsenal reductions planned under New START, could produce a nuclear winter. Hence, an attack by either side could be suicidal, resulting in **self assured destruction**. Even a 'small' nuclear war between **India** and **Pakistan**, with each country detonating 50 Hiroshima-size atom bombs--only about 0.03 percent of the global nuclear arsenal's explosive power--as air bursts in urban areas, could produce so much smoke that temperatures would fall below those of the Little Ice Age of the fourteenth to nineteenth centuries, shortening the growing season around the world and threatening the global food supply. Furthermore, there would be massive ozone depletion, allowing more **ultraviolet** radiation to reach Earth's surface. **Recent studies** predict that agricultural production in parts of the **U**nited **S**tates and **China** would decline by about 20 percent for four years, and by 10 percent for a decade.” 14. A conflagration involving USA/NATO forces and those of Russian federation would most likely cause the deaths of most/nearly all/**all humans** (and severely impact/extinguish **other species**) as well as destroying the delicate interwoven techno-structure on which latter-day 'civilization' has come to depend. Temperatures would drop to below those of the last ice-age for up to 30 years as a result of the lofting of up to 180 million tonnes of very black soot into the stratosphere where it would remain for decades. 15. Though human ingenuity and resilience shouldn't be underestimated, human survival itself is arguably problematic, to put it mildly, under a 2000+ warhead USA/Russian federation scenario. 16. The Joint Statement on Catastrophic Humanitarian Consequences signed October 2013 by 146 governments mentioned 'Human Survival' no less than 5 times. The most recent (December 2014) one gives it a highly prominent place. **Gareth Evans**’ ICNND (International Commission on Nuclear Non-proliferation and Disarmament) Report made it clear that it saw the threat posed by nuclear weapons use as one that at least threatens what we now call 'civilization' and that potentially **threatens human survival with an immediacy that even climate change does not**, though we can see the results of climate change here and now and of course the immediate post-nuclear results for Hiroshima and Nagasaki as well.

#### Collisions with nuclear powered spacecraft radiate the globe.

Zaitsev ‘9 Yuri Zaitsev, academic adviser with the Russian Academy of Engineering Sciences, ‘9, “Russia to develop nuclear-powered spacecraft for Mars mission” http://en.rian.ru/analysis/20091111/156797969.html

Soviet and U.S. nuclear spacecraft programs were marred by a number of accidents.

In April 1964, a U.S. Navy Transit navigation satellite with a radio-isotopic generator onboard failed to reach orbit and disintegrated in the atmosphere, spewing out over 950 grams of plutonium-238. This was more than the total amount of plutonium released during all nuclear explosions by 1964. In January 1978, Kosmos-954, a Soviet Radar Ocean Reconnaissance Satellite (RORSAT) with a nuclear reactor onboard reentered the atmosphere, after the satellite's reactor core failed to separate and boost it into a nuclear-safe orbit, and fell in Canada, contaminating 100,000 sq. km. of its territory. In February 1983, the nuclear-powered Soviet satellite Kosmos-1402 went down in the South Atlantic. The most serious threat involved Cassini-Huygens, a joint NASA/European Space Agency/Italian Space Agency robotic spacecraft mission currently studying the planet Saturn and its many natural satellites, that was launched on October 15, 1997 and which made a gravitational-assist flyby of the Earth on August 18, 1999. The spacecraft, which had a nuclear reactor with 32.7 kg of plutonium-238, passed only 500 km above the Earth. Up to five billion people could have got radiation poisoning had the spacecraft plunged into the atmosphere. On February 10, 2009, the Iridium-33 telecommunications satellite owned by U.S. company Iridium Satellite LLC and its defunct Russian equivalent, the Kosmos-2251 with a nuclear propulsion unit, collided over northern Siberia. This resulted in potentially hazardous space debris. At present, 30 Russian and seven U.S. spacecraft with nuclear systems onboard are orbiting the earth at 800-1,100-km altitudes, where similar collisions can take place. This makes up for about 40 "potential nuclear explosions." If any of these satellites hits a fragment of space junk, it will slow down and eventually re-enter the atmosphere, spewing radiation above the Earth and on its surface.

#### That causes 5 billion deaths.

Grossman ’15 Karl, “NASA's warning - SpaceX crash highlights dangers of nuclear power in space.” professor of journalism at the State University of New York/College of New York. #Dartmouth-JWL.

**That claim of no hazardous consequences *is not true***, as the late Dr. John Gofman, professor at the University of California at Berkeley, long maintained. **Of the three US space nuclear accidents, the most serious was the fall back to Earth in 1964 of a satellite with a SNAP-9A plutonium system onboard.** The satellite and plutonium system disintegrated in the fall, **the plutonium was dispersed worldwide and caused**, in Dr. Gofman's estimation, **an increase in the global lung cancer rate**. Dr. Gofman, an M.D. and Ph.D., co-discoverer of several radioisotopes, and was a pioneer in the earliest experiments with plutonium. A 10% failure rate in space nuclear power missions has also been the case for Russia and, before it, the Soviet Union. The worst Soviet space nuclear accident occurred in the fall in 1978 of Cosmos satellite 954, with an atomic reactor onboard, which disintegrated as it plummeted to Earth, spreading nuclear debris for hundreds of miles across the Northwest Territories of Canada. Despite the study's rosy history of space nuclear power, it also says "it may be prudent to build in more time in the development of schedule for the first launch of a new space reactor. Public interest would likely be large, and it is possible that opposition could be substantial." **The explosion after launch Sunday from the Kennedy Space Center in Florida of a SpaceX Falcon 9 rocket on a mission to deliver supplies to the International Space Station was an event again underlining the danger of using nuclear power on spacecraft**. Officials were warning that "**potentially hazardous debris could wash ashore." What if a radioisotope thermoelectric generator was onboard and plutonium was also dispersed? Or a nuclear reactor or atomic propulsion system, and an array of radioactive poisons rained down in the debris.** US Representative Donna Edwards of Maryland, a member of the House Science, Space & Technology Committee, announced that **"the launch failure this morning shows us once again that space is difficult - it requires near perfection." Inserting nuclear poisons into a danger-prone equation that "requires near perfection" - especially when it is unnecessary - is reckless, and the consequences are potentially devastating. Estimates** in NASA's Final Environmental Impact Statement, for instance, **of the cost of plutonium decontamination if there were an accident** when the Curiosity rover was launched in 2011 to Mars **were put at** $267 million for each square mile of farmland, $478 million for each square mile of forests and **$1.5 billion for each square mile of "mixed-use urban areas".** It was powered with a plutonium-energized RTG, although previously NASA Mars rovers were able to function well with solar power. When the Cassini space probe was sent off to Saturn in 1997 - with three RTGs containing 72.3 pounds of Plutonium-238, the most plutonium ever used on a spacecraft - NASA in its Final Environmental Impact Statement said that if an "**inadvertent reentry**" of Cassini **into the Earth's atmosphere** occurred **causing it to disintegrate and release its plutonium, "5 billion...of the world's population...could receive 99 percent or more of the radiation exposure."** Noting that "**technology frequently goes wrong**", Gagnon of the Global Network Against Weapons and Nuclear Power in Space, says: **"When you consider adding nuclear power into the mix it becomes an explosive combination. We've long been sounding the alarm that nuclear power in space is something the neither public nor the planet can afford to take a chance on."**

#### Starlink generates aluminum oxide upon entry and reentry – that causes a new hole in the ozone and runaway geoengineered warming

Delbert, 2021

Caroline Delbert is a writer, book editor, researcher, and avid reader. “All the Satellites in Space Could Crack Open the Ozone Layer”, https://www.popularmechanics.com/space/satellites/a36651845/satellite-pollution-starlink-ozone/, JUN 17, 2021, accessed 12/1/21, sb

The hole in the ozone layer, Earth’s protective chemical shield that absorbs most of the sun’s ultraviolet rays, has slowly healed over the last few decades since the global ban of chlorofluorocarbons (CFCs). But scientists are now raising the alarm about puncturing a new hole in the ozone layer—this time without any noticeable CGCs in sight. Instead, the surprising cause is deterioration of the aluminum in megaconstellation satellites like SpaceX’s Starlink network. For our purposes, a satellite is a human-made object put into low-Earth orbit (LEO) for a planned lifespan. There are about 5,000 active and defunct satellite sin LEO, with over 40,000 Starlink sats planned in the future, plus satellite projects from national space agencies and private companies around the world, researchers from the University of British Columbia say in their new Scientific Reports study. The human-made distinction may seem obvious, but it hasn’t always been. That’s because, as Space.com reports, scientists spent decades favorably comparing satellite “junk” to the amount of material deposited and burned up in our atmosphere by meteorites. As long as meteorites were so much more of the material by volume while doing almost no harm to the planet, how bad could human-made satellites be? Well, as it turns out, it’s a matter of quality rather than quantity. That’s because meteorites are made of a different constellation of minerals and elements than our custom-manufactured sky robots. “We have 54 tonnes (60 tons) of meteoroid material coming in every day,” lead study author Aaron Boley told Space.com. “With the first generation of Starlink, we can expect about 2 tonnes (2.2 tons) of dead satellites reentering Earth’s atmosphere daily. But meteoroids are mostly rock, which is made of oxygen, magnesium and silicon. These satellites are mostly aluminum, which the meteoroids contain only in a very small amount, about 1 [percent].” Aluminum is key to everything at stake here. First, it burns into reflective aluminum oxide, or alumina, which could turn into an unwitting geoengineering experiment that could alter Earth’s climate. And second, aluminum oxide could damage and even rip a new hole in the ozone layer. Let’s look at each threat separately and try to figure it out. Misadventures in Geoengineering Geoengineering is the umbrella term for technologies that seek to alter the climate or other physical realities about the planet. The major meaning that most people associate with the word is solar geoengineering, an experimental idea to fight climate change. Yes, this includes launching reflective aerosols that will “block the sun” back into space and ostensibly cool the planet, which is what Bill Gates eventually wants to try. But we just don’t know how large-scale geoengineering could affect the planet’s climate. (In the sci-fi flick Snowpiercer, geoengineering has turned Earth into a lifeless iceball whose only survivors must crowd aboard an unceasing train. That’s probably our worst-case scenario.) Aluminum oxide scatters more light than glass, with a refractive index of about 1.76 compared with just 1.52 for glass and about 1.37 for plain aluminum. The researchers write: “Anthropogenic deposition of aluminum in the atmosphere has long been proposed in the context of geoengineering as a way to alter Earth’s albedo. These proposals have been scientifically controversial and controlled experiments encountered substantial opposition. Mega-constellations [of satellites] will begin this process as an uncontrolled experiment.” Another Hole in the Ozone? What, then, of the ozone layer? Once again, aluminum oxide comes to the forefront. As aluminum burns, it can chemically react with ozone in the air to form aluminum oxide, thereby depleting the naturally protective supply of ozone in the atmosphere. The atmosphere can absorb a small amount of these chemicals without ill effect, but with tens of thousands of satellites in play, the quantities will naturally go up. That’s in addition to the ozone damage done by each rocket launch to put satellites into LEO. “Rockets threaten the ozone layer by depositing radicals directly into the stratosphere, with solid-fueled rockets causing the most damage because of the hydrogen chloride and alumina they contain,” the researchers write. While satellites typically dissolve above the stratosphere where most ozone is contained, the particulate can drift down into the stratosphere in order to react there with ozone, scientist Gerhard Drolshagen, an expert on meteoroid material, told Space.com. Aluminum oxide will sink to that level and subsequently cause losses.

#### Ozone depletion causes extinction

Voosen, 2020

Paul Voosen is a staff writer who covers Earth and planetary science. “No asteroids needed: ancient mass extinction tied to ozone loss, warming climate”, 27 MAY 2020, <https://www.science.org/content/article/no-asteroids-or-volcanoes-needed-ancient-mass-extinction-tied-ozone-loss-warming>, accessed 12/5/21, sb

The end of the Devonian period, 359 million years ago, was an eventful time: Fish were inching out of the ocean, and fernlike forests were advancing on land. The world was recovering from a mass extinction 12 million years earlier, but the climate was still chaotic, swinging between hothouse conditions and freezes so deep that glaciers formed in the tropics. And then, just as the planet was warming from one of these ice ages, another extinction struck, seemingly without reason. Now, spores from fernlike plants, preserved in ancient lake sediments from eastern Greenland, suggest a culprit: The planet's protective ozone layer was suddenly stripped away, exposing surface life to a blast of mutation-causing ultraviolet (UV) radiation. Just as the extinction set in, the spores became misshapen and dark, indicating DNA damage, John Marshall, a palynologist at the University of Southampton, and his co-authors say in a paper published today in Science Advances. It's evidence, he says, that "all of the ozone protection is gone." Scientists have long believed—at least before humanity became a force for extinction—that there were just two ways to wipe out life on Earth: an asteroid strike or massive volcanic eruptions. But 2 years ago, researchers found evidence that in Earth's worst extinction—the end-Permian, 252 million years ago—volcanoes lofted Siberian salt deposits into the stratosphere, where they might have fed chemical reactions that obliterated the ozone layer and sterilized whole forests. Now, spores from the end-Devonian make a compelling case that, even without eruptions, a warming climate can deplete the ozone layer, says Lauren Sallan, a paleobiologist at the University of Pennsylvania. "Because the evidence is so strong, it will make people rethink other mass extinction events." The end-Devonian die-off has long sat in the shadow of the Late Devonian extinction 12 million years earlier, one of the planet's largest. Likely driven by volcanoes that emitted gases that drastically cooled and warmed the planet, it killed most corals and many shelled sea creatures. But 10 years ago, work by Sallan and others revealed the end-Devonian was mighty in its own right, wiping out many plants and vertebrates, including most tetrapods, the four-limbed fish that had begun to evolve fingers and toes. Only the five-toed tetrapods survived. "It resets our own evolution," Marshall says. "All these archaic lineages, it kicked them out of the frame." What the end-Devonian lacked was a cause. There was no evidence for volcanism or a giant impact, but one alluring clue was seen in the rapid formation and disappearance of rock deposits associated with glaciers, Sallan says. "Something was really screwed up with climate at that time." Over the past 3 decades, Marshall has explored rocks surviving from this time in eastern Greenland. At the time, this terrain lay far from the arctic, at lower latitudes, locked in the arid interior of a landmass called the Old Red Sandstone Continent. As the climate warmed after the Devonian's last ice age, lakes formed and filled with sediment that slowly turned to mudstone, recording conditions before and during the extinction. In 2017, Marshall exhumed the perfect mudstone in a 6-meter-long drilled core. It captures a startling transformation: Healthy fossilized spores, coated in distinctive symmetrical spikes, suddenly grow misshapen, their spikes dilapidated and uneven. Spores are a common fossil because of their armored coat, but they are vulnerable to UV radiation, much like humans; spores can even develop a "tan" in response to UV. The damage Marshall saw is consistent with such exposure, says Jeffrey Benca, an experimental paleobotanist who has linked such damage to the end-Permian extinction. "What they propose seems quite plausible," he says. Marshall argues that the warming climate drove more powerful summer thunderstorms, which could have injected an ozone-depleting mix of water and salts into the stratosphere. As UV rays killed off forests, nutrient runoff into the sea could have caused blooms of plankton and algae, which would have produced more ozone-destroying salts in a runaway feedback. "It looks like it might be a perfect storm," he says. Marshall's scenario could explain not just the extinction, but also the many natural gas deposits dating from the period, says Sarah Carmichael, a geochemist at Appalachian State University. They formed from decaying organic matter, but no one has explained the needed surge in plankton growth. Nutrient runoff from dead forests could have fertilized the marine life.

#### Starlink is Earth’s first megastructure that has a techno-signature – allows for detection by more advanced Type 1-3 civilizations

Osmanov, 2021 – Free University of Tbilisi Physics Professor

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Here we extrapolate the idea of launching SpaceX’s Starlink satellites and study the possibility of building planetary megastructures (either designed as solid objects or as a web of satellites) by Type-I civilizations and the consequent detection of their techno-signatures. We have shown that the instruments of The Very Large Telescope Interferometer (VLTI) can potentially observe emission pattern of the huge constructions. Efficiency of the spectral variability method has been emphasized and the role of the FAST telescope was discussed.

Subject headings: SpaceX Starlink; SETI; Techno-signatures; Extraterrestrial life; FAST telescope

1. Introduction Last year on May 24 the SpaceX launched the first set of 60 Starlink satellites and up to now the total number is approximately 400 aiming to reach at least 12000 (McDowell 2020) at the end of a decade program announced by Elon Musk. Such a huge number of satellites, distributed over almost the whole surface of the Earth might be considered as the first prototype of a possible megastructure around the Earth, which in principal, might be visible from the cosmos. Similarly, one may search for techno-signatures of alien civilizations.

The discovery of the Tabby’s star (Boyajian et al. 2016) and ”Oumuamua” (Bialy & Loeb 2018) have provoked the revival of the search for extraterrestrial intelligence (SETI). The idea to search for techno-signatures of advanced alien societies have been proposed by Dyson (1960). Assuming that a civilization is advanced enough to build a megastructure around a host star to consume its whole energy, Dyson has concluded that such a huge (having the length-scale of the order of one AU) spherical construction - Dyson sphere (DS) - should be visible in the infrared (IR) spectrum. Civilizations harnessing the host star’s total energy belong to the Type-II societies according to the classification by Kardashev (1964). Type-I civilization is harnessing the total energy coming from the sun to the Earth. Our society is consuming less than the mentioned energy, therefore, an index, K = log10 (P) /10 − 0.6, introduced by Shklovskii & Sagan (1966) for Earthlings is 0.7, where P denotes the average harnessed power in Watts. In the framework of the same classification Type-III is the alien high tech society which is able to use the total energy of the host galaxy.

It is clear that detection of Type-II and TypeIII civilizations is much easier than Type-I because of the much higher total consumed energies. Therefore, a special interest in the Dysonian SETI projects deserve Type-II,III technosignatures and a series of papers are dedicated to identification of DS candidates (Timofeev et al. 2000; Carrigan 2009; Zackrisson et al. 2018). Dyson’s original idea has been extended to hot DSs (Osmanov & Berezhiani 2018, 2019) and the megastructures around pulsars (Osmanov 2016, 2017).

Despite high radiation intensity of TypeII,III technologies compared to Type-I technosignatures, the latter still can be considered seriously in the SETI context. In particular, Kuhn & Berdyugina (2015) studied effects of global warming as detectable biomarkers in Earthlike societies.

Our civilization consumes approximately 1.5 × 1020 ergs s−1 (Kuhn & Berdyugina 2015), which is less than for Type-I society, 1.7 × 1024 ergs s−1 . If one assumes 1% of an average growth rate of industry and the subsequent energy consumption, one can straightforwardly show that our civilization might reach Type-I in ∼ 1000yrs. It is quite probable that in 1000yrs the level of technology will differ from ours, likewise ours is different from the one of middle ages. Therefore, one can assume that Type-I alien society is able to cloak their planet by a sphere-like (or ring-like) structure to harness the total energy emitted from their host star toward the planet.

In this paper we consider the possible observational characteristics of a planetary megastructure partially or completely covering an Earth-like planet located in the habitable zone.

The paper is organized in the following way: in Sec. 2, we introduce main theory and study the techno-signatures of Type-I megaconstructions, obtaining major results and in Sec. 3 we outline them.

#### 420 billion advanced alien civilizations in universe – pessimistic

Lichfield, 2016 – quoting study by University of Rochester Astrophysics Professor

Gideon Lichfield, Quarters Senior Editor, MIT Technology Review Editor-in-chief, “There have probably been trillions of alien civilizations, and yet we may still never see one”, Published June 11, 2016, Last updated on June 13, 2016, <https://qz.com/704687/there-have-probably-been-trillions-of-alien-civilizations-and-yet-we-may-still-never-see-one/>, accessed 12/7/21, sb

\* Adam Frank is an astrophysics professor at the University of Rochester, a co-founder of NPR’s 13.7 Cosmos and Culture blog and the author of “About Time: Cosmology and Culture at the Twilight of the Big Bang.”

Sorry, everybody. We’re just not that special. In more than five decades of scanning the heavens, the search for extraterrestrial intelligence (SETI) has found no sign of alien life. Yet now two American astronomers, in the scientific equivalent of a back-of-the-envelope calculation, are estimating that over the course of its history the universe has seen at least half a trillion technologically advanced species. The paper in Astrobiology by Adam Frank and Woodruff Sullivan notes that, in just the last few years, we’ve gained a much clearer sense of how hospitable the universe is to life. NASA’s Kepler space telescope has identified thousands of planets in our neighborhood of the galaxy, along with their sizes and distances from their stars. From there it’s fairly easy to guess how many may hold liquid water, which is probably essential for complex life. In our Milky Way galaxy alone there are, by this estimate, some 60 billion such “habitable” planets, write Frank and Sullivan. The big remaining unknown is how many of these planets give rise to the kinds of lifeforms that build advanced technology (if nuclear weapons and Oculus Rifts can be called “advanced”). Since Earth is the only one we know of, the guesses vary wildly, but one such civilization per 10 billion habitable planets is generally considered “highly pessimistic,” wrote Frank in the New York Times yesterday (paywall). In astronomy-speak, this means the figure could be 10, 100 or even 1,000 times too low. Using that “pessimistic” proportion, and other numbers from Frank and Sullivan’s paper, I calculated how many alien civilizations should have emerged within various subregions of the universe during its history: Total advanced civilizations in the history of the universe\*

|  |  |  |
| --- | --- | --- |
|  | No. of galaxies | No. of civilizations |
| Milky Way | 1 | 6 |
| Local Group | 30 | 180 |
| Galactic cluster | 300 | 1,800 |
| Supercluster | 3,000 | 18,000 |
| Observable universe | 70,000,000,000 | 420,000,000,000 |

A Frank & WT Sullivan | \* assuming 1 in 10 bln civs/habitable planet

Remember, 420 billion intelligent civilizations is the “pessimistic” estimate. But sadly—or happily, depending on your view of aliens—it doesn’t make us any less alone. Though Frank and Sullivan wisely avoid putting a number on how many alien species are knocking around right now, we can do our own back-of-the-envelope reckoning. A crucial unknown factor is how long a technologically advanced civilization lasts before either going extinct or blasting itself back to the stone age. Judging by the past century of human history, even a thousand years might be optimistic. But let’s be really optimistic and call it a million years. That’s the average lifespan of a mammalian species that doesn’t invent the means of its own destruction. I’m also going to assume that, though the universe is 13.8 billion years old, advanced species didn’t begin to appear until a couple of billion years ago. It took most of the universe’s history to form the kinds of planets, rich in heavier elements, on which creatures like us could evolve. So if there have been 420 billion civilizations in the past 2 billion years, each one lasting a million years, then on average, about 210 million of them have existed simultaneously at any given moment. That may seem like a lot of aliens to talk to. But not in a cosmos as big as ours. The observable universe is an estimated 93 billion light years in diameter. If you sprinkle 210 million civilizations throughout it like raisins in a cake, they’ll be spaced about 125 million light years apart.\* Our own galaxy is only about 100,000 light years wide, so that’s a journey of 1,250 Milky Ways laid end to end before you come to the next intergalactic refueling stop. Even waving hello from a distance is pretty much out of the question, given that the furthest planets we can currently detect are just 25,000 light years away. (For what it’s worth, the SETI people have higher hopes.) Of course, this assumes civilizations are evenly distributed throughout space. In reality, the universe is clumpy, so they’ll be more concentrated in parts. And sheer random luck might have planted one within easy reach of us. Then again, that might be very bad luck indeed. Update: Seth Shostak, senior astronomer at the SETI Institute, has responded to this article saying that “many have guessed” that one in a million habitable worlds would produce advanced intelligence, rather than one in 10 billion. If so, and sticking to the other assumptions, there’d a good chance of at least one other civilization in our own galaxy existing at the same time as ours, meaning it would much closer, and thus more plausibly detectable.

#### Alien civilizations haven’t found us yet, but they’re more advanced and an existential risk to humanity – we shouldn’t attempt to make ourselves known

Buchanan, 2021

Mark Buchanan is a physicist and science writer based in Europe. “Contacting aliens could end all life on earth. Let’s stop trying.”, June 10, 2021 at 10:00 a.m. UTC, <https://www.washingtonpost.com/outlook/ufo-report-aliens-seti/2021/06/09/1402f6a8-c899-11eb-81b1-34796c7393af_story.html>, accessed 12/2/21, sb

In April 2020, the Defense Department released videos recorded by infrared cameras on U.S. Navy aircraft that documented the planes’ encounters with a variety of “unidentified aerial phenomena.” Pilots reported seeing objects flying across the sky at hypersonic speeds and changing direction almost instantaneously, capabilities far beyond that of any known aircraft. What were the pilots seeing? Bizarre atmospheric phenomena? Alien spacecraft? Something else? Several branches of the government have been investigating the events, motivated in part by concern that adversaries such as Russia or China might have made some spectacular technological advance, and later this month, the government plans to publish a report revealing what they know. Reportedly, the government will say there’s no proof of extraterrestrial activity, but that the incidents remain unexplained. Chances are, though, that we should all be grateful that we don’t yet have any evidence of contact with alien civilizations. Attempting to communicate with extraterrestrials, if they do exist, could be extremely dangerous for us. We need to figure out whether it’s wise — or safe — and how to handle such attempts in an organized manner. Some scientific circles have already been debating questions around whether to try to contact other civilizations. It’s a topic of profound importance for the entire planet. For 60 years, scientists have been searching with radio telescopes, listening in for possible signals coming from other civilizations on planets orbiting distant stars. These efforts have largely been organized by the SETI institute in California — the acronym stands for Search for ExtraTerrestrial Intelligence — and so far, they’ve had no success. Getting impatient, some other scientists are now pushing for a more active program — METI, for Messaging ExtraTerrestrial Intelligence — that wouldn’t just listen, but actually send out powerful messages toward other stars, seeking to make contact. The search for aliens has reached a stage of technological sophistication and associated risk that it needs strict regulation at national and international levels. Without oversight, even one person — with access to powerful transmitting technology — could take actions affecting the future of the entire planet. That’s because any aliens we ultimately encounter will likely be far more technologically advanced than we are, for a simple reason: Most stars in our galaxy are much older than the sun. If civilizations arise fairly frequently on some planets, then there ought to be many civilizations in our galaxy millions of years more advanced than our own. Many of these would likely have taken significant steps to begin exploring and possibly colonizing the galaxy. Hence, it’s a profound mystery — known as the Fermi Paradox, after the Italian physicist Enrico Fermi — why we haven’t yet seen any such aliens. Many resolutions of the paradox have been proposed, among them the suggestion that all civilizations, once reaching sufficient technological capacity, eventually destroy themselves. Or perhaps aliens are so alien and unlike humans that we simply cannot interact with them. More alarming is the possibility that alien civilizations are remaining out of contact because they know something: that sending out signals is catastrophically risky. Our history on Earth has given us many examples of what can happen when civilizations with unequal technology meet — generally, the technologically more advanced has destroyed or enslaved the other. A cosmic version of this reality might have convinced many alien civilizations to remain silent. Exposing yourself is an invitation to be preyed upon and devoured. I’ve written about METI in the past, suggesting such activity takes a huge risk for very little gain. But these concerns don’t convince supporters of trying it, who have some counterarguments. Douglas Vakoch of METI International argues that it’s unrealistic to worry about the danger of an alien invasion. We have, after all, been sending radio and television emissions into space for a century, and a civilization far more advanced than our own will probably have already detected these. If they wanted to invade, they already would have. He also argues that, in assessing risks, it’s important not only to consider the risk coming from taking an action, but also from not taking that action. Our world faces a number of potentially existential threats, including global warming and destabilization of the environment, and it’s possible that far more advanced civilizations may have already faced these issues and found solutions. If we don’t send out signals, Vakosh writes, we risk “missing guidance that could enhance our own civilization’s sustainability.” It’s also conceivable, he suggests, that we’re making a spectacular misjudgment — and some super-advanced alien civilization may attack us precisely because we haven’t reached out. For obvious reasons, much of the thinking about these issues has to be rather speculative. The best way forward, perhaps, is to broaden the discussion. If all of humanity is exposed to the possible consequences trying to contact alien civilizations, then more people should be involved in making decisions about what is wise and what isn’t. It shouldn’t be left to a handful of radio astronomers. One vocal critic of the idea of reaching out to aliens proactively — astronomer John Gertz of SETI — has developed proposals to move toward more inclusive public consideration of these activities. What we need, he suggests, are laws and international treaties to govern more explicit contact attempts. Without prior broad agreement from some globally representative body, Gertz says, contacting extraterrestrials should be considered “as the reckless endangerment of all mankind, and be absolutely proscribed with criminal consequences, presumably as exercised at the national level, or administered through the International Court of Justice in The Hague.” Currently, no such prohibitions exist. Some informal protocols for interacting with alien civilizations have been adopted by researchers involved in SETI, but these are far from legally binding governmental regulations. That’s mostly because, up to now, talking about meeting or contacting aliens has seemed widely speculative — if not a little deranged — despite the apparent scientific plausibility of such an event. It’s not easy to weigh the pros and cons of activities around which so much remains unknown. We don’t know if there are any aliens. They might be friendly. They might not be. Given the potential risks involved with trying to make contact, perhaps it would be safer and wiser to just wait — we can always reach out later, and meanwhile, our abilities to do passive listening are rapidly growing more powerful. In 2015, SETI launched a new 10-year program called Breakthrough Listen, funded by a $100 million donation from Israeli-Russian billionaire Yuri Milner. As a result, SETI is now recording more signals than ever before, over a frequency range some tenfold larger, and bringing more computational power to bear on analyzing the recorded signals. It’s impossible to know how close or far from making a discovery we may be, but Gertz estimates that our chances are at least 100 times greater than they used to be. The search is also benefiting from astronomers’ knowledge of exoplanets — planets in orbit around stars other than the sun. Since the first exoplanet was found in 1992, we’ve identified nearly 5,000 more, and the rate of discovery is accelerating. Each one give SETI researchers new promising targets to scrutinize. Personally, all of this makes me dead-set against any experimentation with attempting to contact other civilizations. Why take cosmic risks when we may have a far safer pathway to discovering them, if they’re out there? Of course, even listening comes with some potentially fraught governance issues also: If and when someone really identifies an alien signal, we’ll need to decide if we should reply — and if so, how. Surely such an act — putting all of humanity at risk — ought to be the result of some collective decision. But there’s no mechanism to encourage that now. Any individual or nation could take the human response into their own hands. Both paths — listening for aliens or trying to call them — have reached the stage where they require broader public discussion, with an eye to developing sensible regulation. That’s going to take the efforts of leaders from many nations, presumably coordinated through the United Nations or some similar international body. It should happen now. Or soon. Before it’s too late.

### FW

#### The standard is maximizing expected well-being, or act hedonistic util – Prefer additionally –

#### 1] Death is bad and outweighs – a) agents can’t act if they fear for their bodily security which constrains every ethical theory, b) it destroys the subject itself – kills any ability to achieve value in ethics since life is a prerequisite which means it’s a side constraint since we can’t reach the end goal of ethics without life

#### 2] Actor spec—governments must use util because they don’t have intentions and are constantly dealing with tradeoffs—outweighs since different agents have different obligations—takes out calc indicts since they are empirically denied.

#### 3] Pleasure and pain are intrinsic value and disvalue – everything else regresses. Evolutionary knowledge is reliable – broad consensus and robust neuroscience prove.

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**Pleasure** is not only one of the three primary reward functions but it also **defines reward.** As homeostasis explains the functions of only a limited number of rewards, the principal reason why particular stimuli, objects, events, situations, and activities are rewarding may be due to pleasure. This applies first of all to sex and to the primary homeostatic rewards of food and liquid and extends to money, taste, beauty, social encounters and nonmaterial, internally set, and intrinsic rewards. Pleasure, as the primary effect of rewards, drives the prime reward functions of learning, approach behavior, and decision making and provides the **basis for hedonic theories** of reward function. We are attracted by most rewards and exert intense efforts to obtain them, just because they are enjoyable [10]. Pleasure is a passive reaction that derives from the experience or prediction of reward and may lead to a long-lasting state of happiness. The word happiness is difficult to define. In fact, just obtaining physical pleasure may not be enough. One key to happiness involves a network of good friends. However, it is not obvious how the higher forms of satisfaction and pleasure are related to an ice cream cone, or to your team winning a sporting event. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure [14]. Pleasure as a hallmark of reward is sufficient for defining a reward, but it may not be necessary. A reward may generate positive learning and approach behavior simply because it contains substances that are essential for body function. When we are hungry, we may eat bad and unpleasant meals. A monkey who receives hundreds of small drops of water every morning in the laboratory is unlikely to feel a rush of pleasure every time it gets the 0.1 ml. Nevertheless, with these precautions in mind, we may define any stimulus, object, event, activity, or situation that has the potential to produce pleasure as a reward. In the context of reward deficiency or for disorders of addiction, homeostasis pursues pharmacological treatments: drugs to treat drug addiction, obesity, and other compulsive behaviors. The theory of allostasis suggests broader approaches - such as re-expanding the range of possible pleasures and providing opportunities to expend effort in their pursuit. [15]. It is noteworthy, the first animal studies eliciting approach behavior by electrical brain stimulation interpreted their findings as a discovery of the brain’s pleasure centers [16] which were later partly associated with midbrain dopamine neurons [17–19] despite the notorious difficulties of identifying emotions in animals. Evolutionary theories of pleasure: The love connection BO:D Charles Darwin and other biological scientists that have examined the biological evolution and its basic principles found various mechanisms that steer behavior and biological development. Besides their theory on natural selection, it was particularly the sexual selection process that gained significance in the latter context over the last century, especially when it comes to the question of what makes us “what we are,” i.e., human. However, the capacity to sexually select and evolve is not at all a human accomplishment alone or a sign of our uniqueness; yet, we humans, as it seems, are ingenious in fooling ourselves and others–when we are in love or desperately search for it. It is well established that modern biological theory conjectures that **organisms are** the **result of evolutionary competition.** In fact, Richard Dawkins stresses gene survival and propagation as the basic mechanism of life [20]. Only genes that lead to the fittest phenotype will make it. It is noteworthy that the phenotype is selected based on behavior that maximizes gene propagation. To do so, the phenotype must survive and generate offspring, and be better at it than its competitors. Thus, the ultimate, distal function of rewards is to increase evolutionary fitness by ensuring the survival of the organism and reproduction. It is agreed that learning, approach, economic decisions, and positive emotions are the proximal functions through which phenotypes obtain other necessary nutrients for survival, mating, and care for offspring. Behavioral reward functions have evolved to help individuals to survive and propagate their genes. Apparently, people need to live well and long enough to reproduce. Most would agree that homo-sapiens do so by ingesting the substances that make their bodies function properly. For this reason, foods and drinks are rewards. Additional rewards, including those used for economic exchanges, ensure sufficient palatable food and drink supply. Mating and gene propagation is supported by powerful sexual attraction. Additional properties, like body form, augment the chance to mate and nourish and defend offspring and are therefore also rewards. Care for offspring until they can reproduce themselves helps gene propagation and is rewarding; otherwise, many believe mating is useless. According to David E Comings, as any small edge will ultimately result in evolutionary advantage [21], additional reward mechanisms like novelty seeking and exploration widen the spectrum of available rewards and thus enhance the chance for survival, reproduction, and ultimate gene propagation. These functions may help us to obtain the benefits of distant rewards that are determined by our own interests and not immediately available in the environment. Thus the distal reward function in gene propagation and evolutionary fitness defines the proximal reward functions that we see in everyday behavior. That is why foods, drinks, mates, and offspring are rewarding. There have been theories linking pleasure as a required component of health benefits salutogenesis, (salugenesis). In essence, under these terms, pleasure is described as a state or feeling of happiness and satisfaction resulting from an experience that one enjoys. Regarding pleasure, it is a double-edged sword, on the one hand, it promotes positive feelings (like mindfulness) and even better cognition, possibly through the release of dopamine [22]. But on the other hand, pleasure simultaneously encourages addiction and other negative behaviors, i.e., motivational toxicity. It is a complex neurobiological phenomenon, relying on reward circuitry or limbic activity. It is important to realize that through the “Brain Reward Cascade” (BRC) endorphin and endogenous morphinergic mechanisms may play a role [23]. While natural rewards are essential for survival and appetitive motivation leading to beneficial biological behaviors like eating, sex, and reproduction, crucial social interactions seem to further facilitate the positive effects exerted by pleasurable experiences. Indeed, experimentation with addictive drugs is capable of directly acting on reward pathways and causing deterioration of these systems promoting hypodopaminergia [24]. Most would agree that pleasurable activities can stimulate personal growth and may help to induce healthy behavioral changes, including stress management [25]. The work of Esch and Stefano [26] concerning the link between compassion and love implicate the brain reward system, and pleasure induction suggests that social contact in general, i.e., love, attachment, and compassion, can be highly effective in stress reduction, survival, and overall health. Understanding the role of neurotransmission and pleasurable states both positive and negative have been adequately studied over many decades [26–37], but comparative anatomical and neurobiological function between animals and homo sapiens appear to be required and seem to be in an infancy stage. Finding happiness is different between apes and humans As stated earlier in this expert opinion one key to happiness involves a network of good friends [38]. However, it is not entirely clear exactly how the higher forms of satisfaction and pleasure are related to a sugar rush, winning a sports event or even sky diving, all of which augment dopamine release at the reward brain site. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure. Remarkably, there are pathways for ordinary liking and pleasure, which are limited in scope as described above in this commentary. However, there are **many brain regions**, often termed hot and cold spots, that significantly **modulate** (increase or decrease) our **pleasure or** even **produce the opposite** of pleasure— that is disgust and fear [39]. One specific region of the nucleus accumbens is organized like a computer keyboard, with particular stimulus triggers in rows— producing an increase and decrease of pleasure and disgust. Moreover, the cortex has unique roles in the cognitive evaluation of our feelings of pleasure [40]. Importantly, the interplay of these multiple triggers and the higher brain centers in the prefrontal cortex are very intricate and are just being uncovered. Desire and reward centers It is surprising that many different sources of pleasure activate the same circuits between the mesocorticolimbic regions (Figure 1). Reward and desire are two aspects pleasure induction and have a very widespread, large circuit. Some part of this circuit distinguishes between desire and dread. The so-called pleasure circuitry called “REWARD” involves a well-known dopamine pathway in the mesolimbic system that can influence both pleasure and motivation. In simplest terms, the well-established mesolimbic system is a dopamine circuit for reward. It starts in the ventral tegmental area (VTA) of the midbrain and travels to the nucleus accumbens (Figure 2). It is the cornerstone target to all addictions. The VTA is encompassed with neurons using glutamate, GABA, and dopamine. The nucleus accumbens (NAc) is located within the ventral striatum and is divided into two sub-regions—the motor and limbic regions associated with its core and shell, respectively. The NAc has spiny neurons that receive dopamine from the VTA and glutamate (a dopamine driver) from the hippocampus, amygdala and medial prefrontal cortex. Subsequently, the NAc projects GABA signals to an area termed the ventral pallidum (VP). The region is a relay station in the limbic loop of the basal ganglia, critical for motivation, behavior, emotions and the “Feel Good” response. This defined system of the brain is involved in all addictions –substance, and non –substance related. In 1995, our laboratory coined the term “Reward Deficiency Syndrome” (RDS) to describe genetic and epigenetic induced hypodopaminergia in the “Brain Reward Cascade” that contribute to addiction and compulsive behaviors [3,6,41]. Furthermore, ordinary “liking” of something, or pure pleasure, is represented by small regions mainly in the limbic system (old reptilian part of the brain). These may be part of larger neural circuits. In Latin, hedus is the term for “sweet”; and in Greek, hodone is the term for “pleasure.” Thus, the word Hedonic is now referring to various subcomponents of pleasure: some associated with purely sensory and others with more complex emotions involving morals, aesthetics, and social interactions. The capacity to have pleasure is part of being healthy and may even extend life, especially if linked to optimism as a dopaminergic response [42]. Psychiatric illness often includes symptoms of an abnormal inability to experience pleasure, referred to as anhedonia. A negative feeling state is called dysphoria, which can consist of many emotions such as pain, depression, anxiety, fear, and disgust. Previously many scientists used animal research to uncover the complex mechanisms of pleasure, liking, motivation and even emotions like panic and fear, as discussed above [43]. However, as a significant amount of related research about the specific brain regions of pleasure/reward circuitry has been derived from invasive studies of animals, these cannot be directly compared with subjective states experienced by humans. In an attempt to resolve the controversy regarding the causal contributions of mesolimbic dopamine systems to reward, we have previously evaluated the three-main competing explanatory categories: “liking,” “learning,” and “wanting” [3]. That is, dopamine may mediate (a) liking: the hedonic impact of reward, (b) learning: learned predictions about rewarding effects, or (c) wanting: the pursuit of rewards by attributing incentive salience to reward-related stimuli [44]. We have evaluated these hypotheses, especially as they relate to the RDS, and we find that the incentive salience or “wanting” hypothesis of dopaminergic functioning is supported by a majority of the scientific evidence. Various neuroimaging studies have shown that anticipated behaviors such as sex and gaming, delicious foods and drugs of abuse all affect brain regions associated with reward networks, and may not be unidirectional. Drugs of abuse enhance dopamine signaling which sensitizes mesolimbic brain mechanisms that apparently evolved explicitly to attribute incentive salience to various rewards [45]. Addictive substances are voluntarily self-administered, and they enhance (directly or indirectly) dopaminergic synaptic function in the NAc. This activation of the brain reward networks (producing the ecstatic “high” that users seek). Although these circuits were initially thought to encode a set point of hedonic tone, it is now being considered to be far more complicated in function, also encoding attention, reward expectancy, disconfirmation of reward expectancy, and incentive motivation [46]. The argument about addiction as a disease may be confused with a predisposition to substance and nonsubstance rewards relative to the extreme effect of drugs of abuse on brain neurochemistry. The former sets up an individual to be at high risk through both genetic polymorphisms in reward genes as well as harmful epigenetic insult. Some Psychologists, even with all the data, still infer that addiction is not a disease [47]. Elevated stress levels, together with polymorphisms (genetic variations) of various dopaminergic genes and the genes related to other neurotransmitters (and their genetic variants), and may have an additive effect on vulnerability to various addictions [48]. In this regard, Vanyukov, et al. [48] suggested based on review that whereas the gateway hypothesis does not specify mechanistic connections between “stages,” and does not extend to the risks for addictions the concept of common liability to addictions may be more parsimonious. The latter theory is grounded in genetic theory and supported by data identifying common sources of variation in the risk for specific addictions (e.g., RDS). This commonality has identifiable neurobiological substrate and plausible evolutionary explanations. Over many years the controversy of dopamine involvement in especially “pleasure” has led to confusion concerning separating motivation from actual pleasure (wanting versus liking) [49]. We take the position that animal studies cannot provide real clinical information as described by self-reports in humans. As mentioned earlier and in the abstract, on November 23rd, 2017, evidence for our concerns was discovered [50] In essence, although nonhuman primate brains are similar to our own, the disparity between other primates and those of human cognitive abilities tells us that surface similarity is not the whole story. Sousa et al. [50] small case found various differentially expressed genes, to associate with pleasure related systems. Furthermore, the dopaminergic interneurons located in the human neocortex were absent from the neocortex of nonhuman African apes. Such differences in neuronal transcriptional programs may underlie a variety of neurodevelopmental disorders. In simpler terms, the system controls the production of dopamine, a chemical messenger that plays a significant role in pleasure and rewards. The senior author, Dr. Nenad Sestan from Yale, stated: “Humans have evolved a dopamine system that is different than the one in chimpanzees.” This may explain why the behavior of humans is so unique from that of non-human primates, even though our brains are so surprisingly similar, Sestan said: “It might also shed light on why people are vulnerable to mental disorders such as autism (possibly even addiction).” Remarkably, this research finding emerged from an extensive, multicenter collaboration to compare the brains across several species. These researchers examined 247 specimens of neural tissue from six humans, five chimpanzees, and five macaque monkeys. Moreover, these investigators analyzed which genes were turned on or off in 16 regions of the brain. While the differences among species were subtle, **there was** a **remarkable contrast in** the **neocortices**, specifically in an area of the brain that is much more developed in humans than in chimpanzees. In fact, these researchers found that a gene called tyrosine hydroxylase (TH) for the enzyme, responsible for the production of dopamine, was expressed in the neocortex of humans, but not chimpanzees. As discussed earlier, dopamine is best known for its essential role within the brain’s reward system; the very system that responds to everything from sex, to gambling, to food, and to addictive drugs. However, dopamine also assists in regulating emotional responses, memory, and movement. Notably, abnormal dopamine levels have been linked to disorders including Parkinson’s, schizophrenia and spectrum disorders such as autism and addiction or RDS. Nora Volkow, the director of NIDA, pointed out that one alluring possibility is that the neurotransmitter dopamine plays a substantial role in humans’ ability to pursue various rewards that are perhaps months or even years away in the future. This same idea has been suggested by Dr. Robert Sapolsky, a professor of biology and neurology at Stanford University. Dr. Sapolsky cited evidence that dopamine levels rise dramatically in humans when we anticipate potential rewards that are uncertain and even far off in our futures, such as retirement or even the possible alterlife. This may explain what often motivates people to work for things that have no apparent short-term benefit [51]. In similar work, Volkow and Bale [52] proposed a model in which dopamine can favor NOW processes through phasic signaling in reward circuits or LATER processes through tonic signaling in control circuits. Specifically, they suggest that through its modulation of the orbitofrontal cortex, which processes salience attribution, dopamine also enables shilting from NOW to LATER, while its modulation of the insula, which processes interoceptive information, influences the probability of selecting NOW versus LATER actions based on an individual’s physiological state. This hypothesis further supports the concept that disruptions along these circuits contribute to diverse pathologies, including obesity and addiction or RDS.

#### Extinction first –

#### 1 – Forecloses future improvement – we can never improve society because our impact is irreversible

#### 2 – Turns suffering – mass death causes suffering because people can’t get access to resources and basic necessities

#### 3 – Moral obligation – allowing people to die is unethical and should be prevented because it creates ethics towards other people

#### 4 – Objectivity – body count is the most objective way to calculate impacts because comparing suffering is unethical

#### 5 – Moral uncertainty – if we’re unsure about which interpretation of the world is true – we ought to preserve the world to keep debating about it