# 1AC

### Plan

#### Plan: Private entities ought not appropriate outer space via Large Satellite Constellations in Lower Earth Orbit

To clarify, private entities are the actors of the plan – no treaty or alteration of international law would enforce a prohibition on large satellite constellations

A standardized definition of an LSC based on orbital collision risk would be provided by an impartial 3rd party – candidates include the ITU or UNCOPUOS

Takaya et al 18 “The Principle of Non-Appropriation and the Exclusive Uses of LEO by Large Satellite Constellations” Yuri Takaya-Umehara [Visiting researcher at the University of Tokyo since April 2017. She was affiliated to the Kobe University to provide a course on space law to post-graduate students (2011-2017). She chairs a working group on the formulation of global norms in space law organized by the Keio University since 2018. She obtained her Ph.D. degree at the IDEST of Paris XI University in France, LL.M. at the Leiden University in the Netherlands.] Quentin Verspieren [Ph.D. in public policy @ The University of Tokyo, Assistant Professor of Space Policy @UTokyo, General Manager, Global Strategy @ArkEdge Space Inc., Associate Research Fellow @ESPI] Goutham Karthikeyan [The University of Tokyo & Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (ISAS-JAXA)] 2018 https://www.researchgate.net/publication/328094878\_The\_Principle\_of\_Non-Appropriation\_and\_the\_Exclusive\_Use\_of\_LEO\_by\_Large\_Satellite\_Constellations SM

* LSC = large satellite constellations
* Outlines “L”SC thresholds

By investigating expected large satellite constellation projects and by reviewing existing interpretations of international space law, this paper argues that the exclusive use of specific LEO orbits by a large constellation of satellite could constitute a violation of the non-appropriation principle by means of occupation and by means of use, drawing a parallel between orbits as resources and the exploitation of tangible mineral resources in space. Based on this, the important question to be raised is what constitutes an exclusive use of a specific orbit. In other words, an important hurdle in the concrete evaluation of whether a planned or established constellation potentially violates the non-appropriation principle through an exclusive use of LEO resides in the lack of clear definition on what can be considered an exclusive use. While the authors claim that legal issue can be clearly solved in abstracto, it naturally shifts towards a regulatory challenge.

This regulatory challenge consists in first defining qualitatively what is the exclusive use of an orbit before translating this definition into measurable, technical rules. In this paper, the authors define an exclusive use of an orbit by a state40 as any use that would prevent/hinder the usage of the same orbit by any other state. Translating this definition into an applicable regulation could consist in defining a threshold of orbital collision risk or a threshold of density of satellites along an orbit based on its altitude, shape, relative velocity of neighbouring objects, etc. It is however not the purpose of this space law paper. What is more appropriate here is to think about which organization or forum would be in charge of elaborating this technical definition. Serious candidates could be the ITU, with excellent track-record in dealing with the use of the GEO region but which would have to review its “first come, first served” principle, or the UNCOPUOS, aiming for the widespread adoption of a new piece of international law. Moreover, even if its rules suffer from a low implementation rates, the IADC would be an appropriate discussion platform thanks to its very deep technical focus.

6. Conclusion

The various announced projects of LSC, also called mega-constellations, push existing regulations and practices to their limit, forcing researchers and practitioners around the world to rethink the applicability of existing space law principles to this new trend. In this paper, the authors, after providing background information on current LSC plans as well as recalling the legal status of the LEO region, investigate whether the deployment of an LSC having an exclusive use of an orbit constitutes a violation of the nonappropriation principle as stated in OST Article II. This paper concludes that:

The exclusive use of an orbit by an LSC constitutes a violation of the non-appropriation principle by means of occupation due to the innate nature of orbit being a specific location in space that can be occupied, but most notably by means of use, considering orbits as “limited natural resources” and invoking parallels with the exploitation of natural resources in outer space;

ITU’s “first come, first served” principle is reaching its limits with current LSC projects and should be re-evaluated;

The main challenge ahead is not legal but technical and regulatory and consists in defining precisely what can constitute an exclusive use of an orbit and in translating such definition into a clear regulation or code of conduct.

#### Privatization is driving uncontrolled satellite internet constellations that profit at the expense of cooperation and sustainability – perpetuates internet inequality.

Song and Bloom 20 “Big Tech is leading the new space race. Here's why that's a problem” Steve Song is a Fellow with the Mozilla Foundation where he works to promote policy and regulation that will increase equitable and affordable access to communication in rural and underserved regions of the world. Peter Bloom is a community digital defense activist and the founder and General Coordinator of Rhizomatica, an international non-profit that helps communities build their own communications infrastructure. He is a former Shuttleworth Foundation fellow and was named an Innovator under 35 by MIT Technology Review and appeared on Foreign Policy's 100 Leading Global Thinkers list in 2015. November 14, 2020 <https://www.salon.com/2020/11/14/big-tech-is-leading-the-new-space-race-heres-why-thats-a-problem/> SM

Big Tech is leading the new space race. Here's why that's a problem

New satellite tech could bring billions more online. But will Big Tech bring their extractive ethos into space?

The coronavirus pandemic has made having a stable and reliable internet connection a matter of extreme urgency, as people all over the world struggle to work, access education, and participate in society while staying safe. Yet universal affordable access is far from being achieved; indeed, half of the world still lacks access to the Internet, despite sustained efforts from governments and corporations.

One popular proposal for ubiquitous connectivity comes from Low Earth Orbit (LEO) satellite constellations. LEO boosters claims that such satellites will have the ability to deliver high-speed broadband anywhere on the planet. These satellites provide internet access from space, and require placing thousands of satellites into orbit at a much closer proximity to Earth than traditional satellites.

The prospect of a globe-encircling mesh of broadband communication satellites has attracted the interest and investment of billionaires ranging from Bill Gates in the 1990s to Elon Musk and Jeff Bezos today. Currently there are at least four major LEO initiatives from the US and Europe, including Starlink (SpaceX), Project Kuiper (Amazon), OneWeb, and Telesat. China has announced at least three LEO constellations, and Russia one. The size and scope of these projects are massive. To put current LEO satellite ambitions in context: the current total number of satellites of any kind orbiting Earth is just over 2,500. Starlink, who already have nearly 900 satellites in orbit, recently petitioned the US communications regulator for permission to launch a total of 12,000 satellites. Not to be outdone, OneWeb recently applied for permission to launch 48,000 satellites.

So what's not to love?

While the goal of these companies to ensure broadband anywhere and everywhere is laudable, the technology and the approach to connectivity are not free from concerns. Recent history, especially the development of the Internet itself, has shown us that simply having the capability to build something doesn't necessarily make it a good idea. The Silicon Valley ethos of "move fast and break things," perhaps valid in developing small applications, becomes irresponsible when the consequences of failure may be catastrophic and irreversible. Criticism of LEO constellations to date have focused on practical concerns around a variety of issues, including: the economic viability of the constellations, the occlusion of the night sky from astronomers, wireless interference between different constellations, and the potential chain reaction of collisions from a single error in satellite trajectory, leaving near-space an inaccessible junkyard of debris.

Beyond that, LEO constellations have deeper and longer-term implications that have yet to find their way into mainstream public debate. For one, LEO constellations are part of a larger process in which space exploration is being redefined and reframed in military and commercial terms. Closer to Earth, LEO constellations raise important concerns around the potential for the further entrenchment of a global internet oligopoly that increases inequality and disempowers citizens.

The scramble for space

Over the past seven decades, as our ability to explore beyond our planet has evolved, national security interests in space have aligned with commercial ones to an extent that they are nearly indistinguishable today. In the United States, private space launch companies like SpaceX and United Launch Alliance are major recipients of government contracts and now provide the bulk of US launch capacity for both scientific and military missions. While close ties between the defense and aerospace industries is nothing new, we are in a decidedly new phase of this relationship due to technological advancement, new policy priorities and the rise of private actors.

As commercial launch capacity has increased and space exploration technologies have advanced, the decades-old agreements around how we treat space and recognize our solar system as a commons for the benefit of all humanity are beginning to unravel. One clear example of this is the White House's recent "Executive Order on Encouraging International Support for the Recovery and Use of Space Resources," which emphasizes that "the United States does not view outer space as a 'global commons'" and refers to the Moon Agreement as "a failed attempt at constraining free enterprise."

It is necessary to better understand the deep ties of LEO companies to the hegemonic designs of national governments on near space. Recently, in exchange for $28 million USD, Starlink provided the services of its satellites for live-fire demos with the US Air Force to test its Advanced Battle Management System and lay the groundwork for a military Internet of Things. Speaking after the latest live-fire demo, William Roper, Air Force acquisition chief, opined that "the military needs to be ready to play a strategic role because we need communications in many areas of the world that there are no commercial providers . . . we can be the stability case for companies like SpaceX and others who want to sell communications worldwide."

SpaceX's connections to the military-industrial complex were made clear in comments by SpaceX president Gwynne Shotwell in 2018, who stated that her company would be willing to launch a space weapon to protect the US, in contravention of established space norms. Only weeks ago, SpaceX signed a contract with the Pentagon to jointly develop a rocket that can deliver up to 80 tons of cargo and weaponry anywhere in the world in just one hour.

The Internet, too, from its very inception until today, has proven to be a useful tool for pursuing military and security objectives. Of these, surveillance remains at the heart of Silicon Valley's highly profitable business model of manipulating our attention and preferences for the sake of profit. This profit model facilitates the designs of space-obsessed billionaires like Jeff Bezos who make it no secret that their ultimate goal and passion is the human colonization of other planets in our solar system. In general terms, with material and economic support from taxpayers through defense spending, the profits from the colonization of our data-bodies are being invested in the militarization, privatization and colonization of space.

Telecommunications: driving inequality or empowering citizens?

The telecommunications sector has always been a battleground for regulation. While the early days of the Internet seemingly teemed with competition and diversity, power and control has ultimately become concentrated with the growth of giant internet companies that now dominate our online life. The consequences of unregulated, technology-fueled expansion of globalization and inequality can now be seen in almost every aspect of life.

Digital technology plays a critical role in amplifying inequality, highlighting the need to reframe how we approach network technology development. Some governments and citizen groups understand the connection between economic mobility and tech skills development.

One great example of this comes from Broadband for the Rural North (B4RN), a cooperative in Northern England, that delivers 1 gigabit-per-second fiber-optic capacity to homes in a region deemed economically unviable by the incumbent telecommunications giant. B4RN's ability to build and sustain an affordable internet service at speeds many times that of commercial offerings is based upon the investment they make in both community engagement and the development of local capacity. Contrast this with the prospect of a broadband service from a LEO constellation, in which the role of the citizen is that of a consumer only. It is also worth noting that B4RN's profits are reinvested locally, while revenues from LEO constellations are beamed straight out of the country.

The failure to invest in alternatives that build local capacity replicates itself at the national level as well. LEO constellations have the potential to further abstract Internet service to a supra-national level in a manner that disempowers not just individuals but nation-states themselves in terms of domestic expertise and infrastructure. Investment and deployment costs for LEO constellations are so "astronomical," and in many cases so tied to national/military investment and subsidies, that only a small handful of corporations/countries will be capable of owning and managing their own constellation. This is likely to open up a new front in the ongoing wrangling by geo-political power blocs over the future of the Internet.

Furthermore, it is far from clear that LEO constellations have either the capacity or the economic model to deliver on their claims of providing affordable connectivity to the unserved in most parts of the world. Consider that the half of the world's population that remains unconnected to the Internet are the most economically disadvantaged. As such, most people will not be direct consumers of LEO services but will instead need to rely on a telco building infrastructure and using LEO as backhaul—a scenario which already exists with conventional satellite services. A further concern is that LEO constellations may ultimately create a disincentive to investment in rural connectivity, based on the assumption by service providers and governments that LEO constellations will address that gap.

It is troubling that companies like Amazon and Google (the third largest shareholder in SpaceX), which already wield tremendous power and influence over society, are vying to expand their dominance by becoming global internet service providers with support from taxpayers via subsidies and military spending. With their hands in essentially every layer of the communication stack, it will prove challenging to regulate or even know about the data they harvest and how those are used to competitive advantage in other areas of their businesses.

At the time of their emergence, both space exploration and the Internet served as beacons of hope and of potential transcendence for humanity—one of shared imagination and resources, and of cooperation in human development. In both cases, that hope has been dimmed in a quest for profit and geo-political power. If we want to recover a sense of shared purpose as a species, the question as to "who gets to put their satellites into low earth orbit?" is more important than we might think. Is space for everyone, or just a few huge corporations and global superpowers? This is the question we ask when we ask who gets to park their satellites in orbit.

There is an opportunity to return to the spirit of internationalism that infused the early days of space exploration in which space was held as a shared resource to be protected and guarded from exploitation. Similarly, here on Earth, we see successful efforts to manage Internet infrastructure as a commons in contrast to Silicon Valley's model of surveillance capitalism. Recognizing that individual and collective empowerment and agency are as important as the actual infrastructure itself is the key to a more egalitarian Internet. LEO satellite networks may deliver connectivity (although many doubts remain), but they are less likely to empower people and move us toward a more equitable world. The development of a healthy Internet that actually benefits humanity involves not just the end result of affordable access, but also the process through which people gain that access.

#### Constellations couldn’t support more than 1 user for every 10 km2 – only useful in extremely remote areas.

Ogutu and Oughton 21 “A Techno-Economic Cost Framework for Satellite Networks Applied to Low Earth Orbit Constellations: Assessing Starlink, OneWeb and Kuiper” Osoro B. Ogutu and Edward J. Oughton [O. Ogutu is with the Department of Geography and Geoinformation Science, George Mason University; E. Oughton is an assistant professor with the Department of Geography and Geoinformation Science, George Mason University] August 2021 <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9568932> SM

At maximum network density, each Starlink satellite covers approximately 101,000 km2, OneWeb 708,000 km2 and Kuiper 157,000 km2. At a subscriber density of 0.05 users per km2, the corresponding number of subscribers per satellite for Starlink, OneWeb and Kuiper are 5,000, 35,400 and 7,900 respectively. Since the aggregate capacity is shared among the subscribers, Starlink provides the highest mean capacity followed by Kuiper and OneWeb as shown in Figure 4. Therefore, an increase in population density (and logically a higher subscriber density) leads to a drastic decrease in mean capacity.

We also plot the potential cost in Figure 5. The NPV for a single satellite asset over the study period was estimated at US$ 0.6 million, US$ 5.6 million, and US$ 3 million for Starlink, OneWeb and Kuiper, respectively. Thus, the NPV cost per user for each constellation can then be plotted, which logically reduces as each subscriber density increases. Starlink incurs the least cost per user over the study period (2020–2025) that ranges US$ 100-US$ 10 for the subscriber density range of 0.005–1.0 (km2). Kuiper records the largest cost per user ranging between US$ 400 and US$ 30 for the same subscriber density range. The important caveat to these estimates is that there would be a major impact on the capacity available for each subscriber at the maximum adoption rate, due to increased contention. Hence, active constellations such as Starlink have already begun limiting adoption in high demand areas, to ensure QoS can be guaranteed to existing customers, ensuring the available broadband services remain competitive against competing technologies.

Figure 3 illustrates population density globally by sub-national region for population deciles ranging from below 5 people per km2, to over 45 people per km2. These decile boundaries were selected because we know a priori that higher density areas will be less suitable for LEO broadband constellations, and that they will be focusing on the bottom 5% of the market not currently served by conventional terrestrial broadband services using either fixed or wireless technologies.

We can see large parts of Asia (India, China etc.) will be unsuitable, along with most of mainland Europe (e.g. Germany, Italy) and central America (e.g. Mexico). However, the constellations can choose to limit the number of subscribers in such regions to provide relatively higher speeds and ensure QoS. In the USA, the West and South West have large areas which could be suitable, along with much of Canada, Australia and New Zealand.

In South America large parts of the Amazon may also have low enough population density to be suitable, as well as much of the Sahara region in Africa, although whether incomes would enable the purchasing of such services would be a main concern.

Therefore, to explore the suitability of these constellations we use a 1% adoption rate among the local population to explore capacity per user in the busiest hour of the day. Generally, Starlink provides impressive capacity for remote regions with global coverage thanks to its high asset density. In regions with very low population density Starlink provides a mean of over 90 Mbps per user, such as in parts of Canada, the West and South West of the USA, Central and South America, Sahara Africa, South-west Africa, Australia, Russia and remote parts of Asia. Kuiper performs similarly, with only slightly reduced performance. However, OneWeb offers generally lower capacity per user, although still reaching impressive peak rates in areas with very low population density.

SECTION VII.Discussion

In this paper a generalizable techno-economic assessment model was developed for satellite broadband constellations. The approach was used to estimate the capacity and related costs for three LEO constellations, including Starlink, OneWeb and Kuiper. The open-source codebase is provided to help boost scientific reproducibility, as well as support other engineers or business analysts working in this research area. The method consisted of a mix of engineering simulation, cost estimation and Geographical Information System (GIS) techniques, combined to provide new insight into the per user capacity and cost. Such analytics are very useful to help narrow the broadband availability gap in rural and remote areas by providing geospatial insight on the suitability of these technologies. The results demonstrate the connectivity opportunities and constraints of different LEO systems, as well as their viability. This section now revisits the research questions posed in the introduction of the paper. The first research question was articulated as follows:

A. How Much Capacity can be Provided by Different LEO Broadband Constellations?

The findings support existing theory whereby the capacity provided by the constellation is a function of the number of satellites. Fewer satellites result in a larger coverage area and vice versa. Unlike GEO, a satellite located at LEO will also have a shorter path length. As more satellites are added into the constellation, the coverage area per satellite reduces. Furthermore, the instantaneous number of satellites available to a ground user increases. We find that for network densities of 5,040, 720 and 3,240 satellites for Starlink, OneWeb and Kuiper respectively, the estimated coverage areas equate to 101,000, 708,000 and 157,000 km2.

The variation in the FSPL due to the orbital altitude and network density among the three constellations results in different received power. To compensate for high path loss, Kuiper and OneWeb opt for high receiver antenna gain, transmitted power and diameter. In contrast, the ultra-dense network and low orbital altitude enables Starlink to maintain large minimum elevation angles for its users compared to the other three systems, leading to superior QoS. This explains the constellation’s Business-to-Consumer (B2C) approach as users can easily connect to its satellites with minimum engineering requirements. In contrast, the limited capacity demonstrated in this analysis for OneWeb suggests why a more enterprise-focused approach is being adopted to provide Business-to-Business (B2B) global connectivity services, ranging from cellular backhaul to logistics for emergency services redundancy.

B. What is the Potential Capacity Per User From Different Constellations?

Related to the previous question, the per user capacity is therefore also positively correlated with the increase in the number of satellites for each constellation. The highest mean user capacity is achieved with the lowest subscriber densities, which occur in the most rural and remote regions where network contention is at its lowest. For instance, with 1 user every 10 km2 (0.1 users per km2) the best performing constellation (Starlink) records a very modest mean per user capacity of 24.94 ± 0.72 Mbps. This is worse for Kuiper and OneWeb with 10.30 ± 0.25 Mbps and 1.01 ± 0.02 Mbps, respectively. Hence, this explains why LEO broadband providers have been making a strong business case for the usage of satellites in the final 3 percent of customers in the hardest-to-reach rural and remote regions of the USA, Canada, United Kingdom, Australia and New Zealand (among other countries) due to their competitive advantage in these challenging deployment situations. While the aggregate speeds estimated are impressive, each satellite asset can easily become saturated, especially in higher populated urban and suburban areas, meaning SNOs will have to strictly manage spatial adoption rates. There is no doubt that the potential speeds per user which could be provided are highly desirable (and indeed revolutionary) for users who have struggled to gain a decent broadband connection from traditional providers. The potential services available would be more than adequate to enable intensive applications such as High Definition (HD) video streaming without buffering (providing QoS was well managed).

C. What is the Potential Cost Per User as Subscriber Penetration Increases?

The largest capital expenditure costs are incurred by rocket launches, building ground stations and acquiring spectrum. As more satellites are launched, the cost per user would increase, partly due to the rising operating costs, but this would ensure a better QoS for each user terminal thanks to smaller coverage areas with fewer shared spectrum resources. With more satellites in each constellation, the ground station energy requirements, maintenance, continual engineering and staff costs increase. At a low subscriber density, high capacity per user is available but the cost could be prohibitively expensive for some. In contrast, at a high subscriber density, the cost of broadband connectivity services is much more affordable but there is a major trade-off in QoS, with only very modest speeds being delivered.

The results open a question on whether LEO constellations could break into the urban broadband market given that MNOs and other operators can offer the services at a lower cost per user. While acquiring a segment of the urban market cannot be ruled out, the possibility of succeeding in developed countries where constellations such as Starlink are testing their products is low (driven by the need to limit the number of active users). Consequently, LEO broadband systems are more likely to play a significant role in providing global communications for niche industrial activities which require substantial mobility with high reliability. For example, maritime, rail, aviation and integration into other supply chain IoT architectures, thanks to LEO pole-to-pole coverage. Furthermore, LEO systems might also have a useful niche in delay sensitive applications such as monitoring offshore solar and wind farms in smart grid applications, thanks to the lower latency they can achieve relative to other technologies such as GEO. Alternatively, LEO broadband constellations can present a viable cost-effective solution for developing countries with growing urban centers that are yet to enjoy decent cellular and fiber infrastructure availability. However, this very much depends on the necessary spectrum being allocated in appropriate bands by each telecommunications regulator.

D. Which Parts of the World are LEO Constellations Most Suitable for?

The performance of the three constellations in areas of different population density shows a general trend. Regions with low population density generally experience higher capacity per user with Starlink and Kuiper providing superior speeds.

The simulation of possible geographical areas of adoption indicates that most parts of Central Asia, Middle East, South East Asia, South America, Sub-Saharan Africa and Eastern Europe are less suitable for LEO constellations with quite low capacity provided (below 10 Mbps) using the modeling parameters explored.

These results are arrived at by only considering population density. Future research should recognize the roles of adoption factors such as disposable income, perceived relevance of the Internet, literacy and cellular network penetration, as these may affect the number of people who can actually afford to pay for broadband services.

SECTION VIII.Conclusion

Connecting the global population who are still unable to access a decent broadband service remains a key part of the United Nation’s Sustainable Development Goals (specifically Target 9.c).

Motivated by these developments, the framework applied in this paper introduces a techno-economic modeling approach for the integrated assessment of data capacity and investment cost per user by constellation. The model presents the engineering and economic simulation results using a single framework, unlike other approaches where this may be undertaken by two separate groups of professionals (engineers and business analysts). This theoretical model allows for estimation of the constellation capacity based on the known engineering parameters filed with local or global regulatory authorities such as Federal Communication Commission (FCC) and ITU. Using the information publicly available from such organizations, and estimation based on financial statements filed by publicly traded GEO, MEO and LEO broadband companies, the values can be imputed in the model to approximate the capacity and cost of delivering satellite Internet. The model has been tested for three different constellations with varying number of simulated satellites to derive the per user capacity and costs. The codebase for the model is fully open-source and available from the online repository, enabling anyone to access and further enhance the capability developed [71]. Future research could include addressing the issue of non-linearity in the multiple access of satellite resources, which would improve on existing simplifications. Moreover, as the modeling approach is generalizable for satellite constellations, the framework can be further adapted for other planned constellations, such as Telesat.

The results of the model reveal that at the 95% confidence level, mean aggregate capacity speeds of 11.72 ± 0.04 Gbps, 3.43 ± 0.01 Gbps and 7.53 ± 0.03 Gbps are achievable for Starlink, OneWeb and Kuiper, respectively. The current anticipation associated with the benefits of LEO broadband constellations is very high, but success will depend on maintaining relatively low spatial subscriber densities, preferably below 0.1 users per km2 (so less then 1 user per 10 km2), otherwise the services provided may offer little benefit against other terrestrial options. For example, the model has shown that at 0.1 users per km2, only a mean per user capacity of 24.94 ± 0.72 Mbps, 1.01 ± 0.02 Mbps and 10.30 ± 0.25 Mbps can be achieved by Starlink, OneWeb and Kuiper respectively in the busiest hour of the day.

### Adv – Collisions

#### Satellite internet constellations accelerate collision risks – more close encounters and less transparency means bad decisions are inevitable.

Pultarova 21 “SpaceX Starlink satellites responsible for over half of close encounters in orbit, scientist says” Tereza Pultarova [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.], August 18, 2021 <https://www.space.com/spacex-starlink-satellite-collision-alerts-on-the-rise> SM

SpaceX Starlink satellites responsible for over half of close encounters in orbit, scientist says

Starlink satellites might soon be involved in 90% of close encounters between two spacecraft in low Earth orbit.

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.

Chart, line chart

Description automatically generated

A graph showing the growing number of close encounters in space involving Starlink satellites as plotted by Professor Hugh Lewis using data from the Socrates database. (Image credit: Hugh Lewis)

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.

**Chart, line chart

Description automatically generated**

A graph showing the number of close encounters between Starlink satellites and spacecraft of other operators plotted by Professor Hugh Lewis based on data from the Socrates database. (Image credit: Hugh Lewis)

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."

#### LEO collisions due to constellations take out ISR and other military assets – debris cascades into different altitudes and triggers Kessler Syndrome.

Wong 19 “Congested Outer Space: Increased Deployment of Small Satellite Constellations Could Hamper Military Space Operations” 2019 Arthur Wong [Strategic Development of Forces Division, SHAPE. Prior to working at SHAPE he has worked at NATO HQ, within the Defence Investment Division on interoperability for NATO’s multinational battlegroups.] <https://www.japcc.org/congested-outer-space/> SM

Since the production of a large number of small satellites in a factory environment will lower the cost of the overall programme, companies such as SpaceX, Amazon and OneWeb have been creating a satellite constellation within the LEO and Medium Earth Orbit (MEO).8, 9 OneWeb is a new company which plans to create an initial constellation of 648 satellites to provide global satellite internet broadband services. Each satellite weighs approximately 150 kg and will be programmed to operate in 20 different orbital planes at an altitude of 1,200 km.10 Creating a large constellation within the LEO could mitigate transmission delays and latency due to their closer range to ground stations while allowing users to send and receive data in a timely manner. The first six of the 648 satellites were launched in early 2019 with more launches scheduled to occur throughout this year.

Both SpaceX and Amazon have also announced their intention of creating a separate constellation for internet communication systems. SpaceX satellite constellations, named Starlink, will be the largest constellation ever built when it is completed. The constellations consist of nearly 12,000 satellites in more than 20 different orbital planes.11 The altitude of Starlink will range between 550 km to 1,150 km. SpaceX aims to have a minimum of 2,200 satellites in the next five years and achieve initial commercial operation by 2020.12 Amazon’s version of constellation, named Kuiper, has also been seeking approval from the Federal Communications Commission (FCC) to launch more than 3,200 satellites between 590 km to 630 km in the LEO.13

Space Debris Threat Increases in the LEO

The usage of cube satellite has provided positive impacts in various fields, ranging from environmental studies to offering worldwide internet access in rural areas through communication constellations. However, the current space environment is becoming congested. Hundreds of satellites have already been scheduled to launch each year before the construction of the constellation programme by OneWeb, SpaceX and Amazon. To further worsen the space debris situation in the LEO, direct-ascent Anti-Satellite Testing (ASAT) was conducted in recent years and more debris will be created through such testing. During the Chinese ASAT in 2007, some debris from the collision was blasted outward away from the Earth, causing a potential threat to satellites above the altitude where the ASAT testing occurred.14 Nine years after the incident happened, there are still more than 3,000 traceable pieces in orbit.

In 2009, two satellites collided at a speed of 10 km/s at an altitude of 800 km. This was the first time a collision had happened between two satellites. The incident created more than 1,000 pieces of debris larger than 10 cm. Such activity could initiate a chain reaction, creating more collisions from the initial impact. This phenomenon is known as the Kessler Syndrome.15

From early 2019, there were approximately 34,000 pieces of debris larger than 10 cm (similar to the size of a cube satellite) and more than 900,000 pieces of debris ranging from one cm to 10 cm in size. Objects that are smaller than one cm in size are expected to be more than 100 million within the LEO.16 Despite the small size of the space debris, they are travelling at a speed of more than seven km/s. At this speed, tiny objects could harm any large satellite orbiting in the LEO. While satellites can increase their physical hardening to protect the on-board instruments from impact, some satellites cannot be hardened due to the size and dimensional constraints. Furthermore, hardened materials would also increase the overall cost of the satellite.

Constellation in the Making Could Impact Space-Based Military Assets

The previous examples revealed the congestion of the LEO. With companies continuing to launch thousands of small satellites, the chances of a collision in space will continue to increase. This will hinder space-based Intelligence, Surveillance and Reconnaissance (ISR) support to provide valuable information to military operations. A majority of the ISR assets are orbiting in the LEO. NATO relies on space-based assets to assist its operations. Increasing the number of spacecraft in the LEO could raise problems and threats to military assets as well as access to space assets to support operations. If the orbital path of these smaller objects were not tracked by the Space Operation Centre regularly, larger satellites or manned-space stations could be penetrated by the non-propulsion satellites, making them a potential kinetic kill vehicle.

Most satellites within the 600 km region of the LEO are affected by the atmospheric drag, which is helping to bring down some of the obsolete satellites. However, satellites orbiting above 800 km are less likely to be affected by the atmospheric drag, making cube satellites or small satellites without propulsion systems difficult to deorbit once they have reached the EOL.17, 18 The altitude for some of the OneWeb, Starlink and Kuiper constellations is planned to be above the atmospheric drag region. Despite this, Starlink satellites will have propulsion system for orbital manoeuvre and EOL deorbiting, tracking the full constellation with 12,000 satellites could be challenging for the company and the Combined Space Operations Center (CSpOC).19 Additionally, there is the possibility of losing contact with satellites before they reach their EOL. Envisat, an 8,210 kg satellite that is currently drifting at an altitude of 785 km, poses a collision threat with other satellites. Envisat was expected to decommission in 2014 but the European Space Agency (ESA) lost contact with the satellite in 2012.20 If no interaction will be made with the Envisat, it is expected to stay in orbit for the next 150 years.21

#### Collisions with early warning satellites causes miscalc and goes nuclear – magnified by the Kessler effect

Blatt 20 [Talia, joint concentration in Social Studies and Integrative Biology at Harvard, specialization in East Asian geopolitics and security issues] “Anti-Satellite Weapons and the Emerging Space Arms Race,” Harvard International Review, May 26, 2020, <https://hir.harvard.edu/anti-satellite-weapons-and-the-emerging-space-arms-race/> TG

Despite their deterrent functions, ASATs are more likely to provoke or exacerbate conflicts than dampen them, especially given the risk they [pose](https://thebulletin.org/2019/06/arms-control-in-outer-space-the-russian-angle-and-a-possible-way-forward/) to early warning satellites. These satellites are a crucial element of US ballistic missile defense, capable of [detecting missiles](https://www.globalsecurity.org/space/world/japan/warning.htm) immediately after launch and tracking their paths.

Suppose a US early warning satellite goes dark, or is shut down. Going dark could signal a glitch, but in a world in which other countries have ASATs, it could also signal the beginning of an attack. Without early warning satellites, the United States is much more susceptible to nuclear missiles. Given the strategy of counterforcing—[targeting](https://www.belfercenter.org/sites/default/files/files/publication/isec_a_00273_LieberPress.pdf) nuclear silos rather than populous cities to prevent a nuclear counterattack—the Americans might believe their nuclear weapons are imminently at risk. It could be [twelve hours](https://books.google.com/books?id=ET8lDwAAQBAJ&pg=PA1&lpg=PA1&dq=%22Protecting+Space+Assets%22+johnson-freese&source=bl&ots=6Oq0IdeBjw&sig=ACfU3U1G6Hj8QdP4JlCRNxA6i5XplZwHyg&hl=en&sa=X&ved=2ahUKEwj1n-jT2YzpAhUugnIEHUuMCu4Q6AEwA3oECAkQAQ#v=onepage&q=%22Protecting%20Space%20Assets%22%20johnson-freese&f=false) before the United States regains satellite function, which is too long to wait to put together a nuclear counterattack. The United States, therefore, might move to mobilize a nuclear attack against Russia or China over what might just be a piece of debris shutting off a satellite.

Additionally, accidental warfare, or strategic miscalculation, is uniquely likely in space. It is [much easier](https://books.google.com/books?id=VyXTDwAAQBAJ&pg=PA339&lpg=PA339&dq=space+offense+dominant&source=bl&ots=Mw0bgJ51qf&sig=ACfU3U3DeZiEHpr9nfszlCbJZIoyyssIpg&hl=en&sa=X&ved=2ahUKEwjrs-WD3IzpAhVulHIEHbL0AE4Q6AEwCXoECAoQAQ#v=onepage&q=space%20offense%20dominant&f=false) to hold an adversary’s space systems in jeopardy with destructive ASATs than it is to [sustainably defend](https://www.cnas.org/publications/commentary/the-us-military-should-not-be-doubling-down-on-space) a system, which is expensive and in some cases not technologically feasible because of limitations on satellite movement. Space is therefore [considered](https://books.google.com/books?id=VyXTDwAAQBAJ&pg=PA339&lpg=PA339&dq=space+offense+dominant&source=bl&ots=Mw0bgJ51qf&sig=ACfU3U3DeZiEHpr9nfszlCbJZIoyyssIpg&hl=en&sa=X&ved=2ahUKEwjrs-WD3IzpAhVulHIEHbL0AE4Q6AEwCXoECAoQAQ#v=onepage&q=space%20offense%20dominant&f=false) offense-dominant; offensive tactics like weapons development are prioritized over defensive measures, such as [improving GPS](https://www.politico.com/story/2018/04/06/outer-space-war-defense-russia-china-463067) or making satellites more resistant to jamming.

As a result, countries are left with poorly defended space systems and rely on offensive posturing, which increases the risk that their actions are perceived as aggressive and incentivizes rapid, risky counterattacks because militaries cannot rely on their spaced-based systems after first strikes.

There are several hotspots in which ASATs and offensive-dominant systems are particularly relevant. Early warning satellites [play](https://www.politico.com/story/2018/04/06/outer-space-war-defense-russia-china-463067) a central role in US readiness in the event of a conflict involving North Korea. News of North Korean missile launches comes from these satellites. Given North Korea’s [history](https://www.bbc.com/news/world-asia-pacific-11813699) of nuclear provocations, unflinchingly hostile rhetoric towards the United States and South Korea, and diplomatic opacity, North Korea is always a threatening, unknowable adversary, but recent developments have magnified the risk. With the health of Kim Jong-un [potentially in jeopardy](https://apnews.com/f5d302ae65b03838173e40848223b771), a succession battle or even civil war on the peninsula [raises the chances](https://www.express.co.uk/news/world/1273890/Kim-Jong-un-dead-North-Korea-nuclear-weapon-news-latest-death-US) of loose nukes. If the regime is terminal, traditional MAD risk calculus will become moot; with nothing to lose, North Korea would have no reason to hold back its nuclear arsenal. Or China [might decide](https://foreignpolicy.com/2020/04/28/kim-jong-un-china-north-korea/) to seize military assets and infrastructure of the regime. If the US does not have its early warning satellites because they have been taken out in an ASAT attack, the US, South Korea, and Japan are all in imminent nuclear peril, while China could be in a position to fundamentally reshape East Asian geopolitics.

The South China Sea is another hotspot in which ASATs could risk escalation. China [is developing](https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china-anti-access-area-denial-coming-soon/) Anti-Access Area Denial (A2/AD) in the South China Sea, a combination of long range radar with air and maritime defense meant to deny US freedom of navigation in the region. Given the disputed nature of territory in the South China Sea, the United States and its allies do not want China to successfully close off the region.

#### Independently causes cyberwar and satellite hacking which escalates.

Falco 19 “Opinion: Our satellites are prime targets for a cyberattack. And things could get worse.” Gregory Falco [Gregory Falco is a cyber research fellow at Harvard University’s Belfer Center and a postdoctoral security researcher at the Massachusetts Institute of Technology’s Computer Science and Artificial Intelligence Laboratory. He is the founder and chief executive of NeuroMesh, a tech security company.] May 7, 2019 <https://www.washingtonpost.com/opinions/our-satellites-are-prime-targets-for-a-cyberattack-and-things-could-get-worse/2019/05/07/31c85438-7041-11e9-8be0-ca575670e91c_story.html> SM

One minute. That’s how long it took me last month to demonstrate to a major broadcasting company and production team how to access and restart a leading satellite Internet provider’s control system. Five minutes is how long it took me to demonstrate how to gain full control of it.

Hackers are always improving their ability to break into our digital infrastructure. Yet the computer systems running our satellites haven’t kept up, making them prime targets for an attack. This makes our space assets a massive vulnerability — and it could get much worse if we’re not careful.

This past weekend, SpaceX won approval from the Federal Communications Commission to increase the number of low-flying satellites as part of its Starlink project so that they can provide faster Internet access to the world. Unfortunately, access will be faster for both legitimate users and hackers alike. The FCC does not require applicants to publicly demonstrate how they will secure these satellites or the Internet they plan to provide. SpaceX, like other private space companies, has shared virtually no information about its cybersecurity efforts or plans.

This is extremely disconcerting, considering the potential ramifications of a satellite being hacked. The most mundane outcome is that the satellite will no longer function, but the other extreme is for an attacker to break into a satellite and take over any thrusters (which SpaceX has insisted its satellites will have) and then propel the satellite into critical infrastructure and military satellites in other orbits. In other words, attackers could possibly use the hacked satellite as a kinetic weapon.

There has long been a void of attention to securing space infrastructure, ranging from space-faring rovers to satellite ground-control systems that manage all the space-based assets. Virtually no policy or oversight agency exists concerning securing space assets — something I’ve discussed with government leadership to little avail. While the FCC regulates communications, it should not necessarily be responsible for all things space security. Perhaps the new Space Development Agency could be.

This leaves space security in the hands of the private sector, which is exploiting the recent ease of access to space. The advent of small satellites known as CubeSats offers the chance to launch a satellite into orbit for as little as $30,000 . And because the government wants to encourage economic activity in this area, requirements to do so are extremely light. This leaves those who are creating the satellites responsible for the cybersecurity of their assets, which is not usually part of the rocket scientist’s traditional skill set.

As a space cybersecurity researcher, I am excited about the renewed interest in space from both the commercial and exploratory perspectives. But we need to be strategic about the security of these space systems. Unlike “Internet of things” devices such as baby monitors, which we purchase for less than $100 and discard or sell once a new model comes out, satellites often remain in orbit for much longer and are less dispensable. So if we don’t consider the cybersecurity of the space asset now, we’ll likely be dealing with the ramifications of that for several years to come. The lack of government intervention in satellite security does not mean that we can ignore cybersecurity as an issue.

Private space companies such as SpaceX, OneWeb and Blue Origin need to join the conversation about cybersecurity and help consumers understand that they are taking it seriously (if they are). (Blue Origin’s founder and owner, Jeff Bezos, also owns The Post.) Right now, there are several job openings for information security analysts at private space companies, indicating that they are likely hurting for talent and are behind in figuring out their security. This isn’t surprising given that space is hard, and traditional IT experts don’t have the right skill sets for a space cybersecurity job. Space systems have unique requirements that are more akin to an industrial control system, such as an energy smart meter, than to an email server.

Private space companies need to start a dialogue with the security research community about their particular challenges so that we can help. They should also be transparent with the FCC that they need help in securing their infrastructure. The last thing we need is for China or Russia to take over SpaceX’s satellites and wreak havoc on our space assets.

#### Empirics prove it’s possible and likely by state and nonstate actors – especially true given private sector cost cutting.

Akoto 20 “Hackers could shut down satellites -- or turn them into weapons” February 13, 2020 William Akoto [a postdoctoral research fellow at the University of Denver.] <https://www.upi.com/Top_News/Voices/2020/02/13/Hackers-could-shut-down-satellites-or-turn-them-into-weapons/4091581597502/> SM

Feb. 13 (UPI) -- Last month, SpaceX became the operator of the world's largest active satellite constellation. As of the end of January, the company had 242 satellites orbiting the planet with plans to launch 42,000 over the next decade. This is part of its ambitious project to provide Internet access across the globe. The race to put satellites in space is on, with Amazon, U.K.-based OneWeb and other companies chomping at the bit to place thousands of satellites in orbit in the coming months.

These new satellites have the potential to revolutionize many aspects of everyday life -- from bringing Internet access to remote corners of the globe to monitoring the environment and improving global navigation systems. Amid all the fanfare, a critical danger has flown under the radar: the lack of cybersecurity standards and regulations for commercial satellites, in the United States and internationally. As a scholar who studies cyber conflict, I'm keenly aware that this, coupled with satellites' complex supply chains and layers of stakeholders, leaves them highly vulnerable to cyberattacks.

If hackers were to take control of these satellites, the consequences could be dire. On the mundane end of scale, hackers could simply shut down satellites, denying access to their services. Hackers could also jam or spoof the signals from satellites, creating havoc for critical infrastructure. This includes electric grids, water networks and transportation systems.

Some of these new satellites have thrusters that allow them to speed up, slow down and change direction in space. If hackers took control of these steerable satellites, the consequences could be catastrophic. Hackers could alter the satellites' orbits and crash them into other satellites or even the International Space Station.

Commodity parts

Makers of these satellites, particularly small CubeSats, use off-the-shelf technology to keep costs low. The wide availability of these components means hackers can analyze them for vulnerabilities. In addition, many of the components draw on open-source technology. The danger here is that hackers could insert back doors and other vulnerabilities into satellites' software.

The highly technical nature of these satellites also means multiple manufacturers are involved in building the various components. The process of getting these satellites into space is also complicated, involving multiple companies. Even once they are in space, the organizations that own the satellites often outsource their day-to-day management to other companies. With each additional vendor, the vulnerabilities increase as hackers have multiple opportunities to infiltrate the system.

Hacking some of these CubeSats may be as simple as waiting for one of them to pass overhead and then sending malicious commands using specialized ground antennas. Hacking more sophisticated satellites might not be that hard either.

Satellites are typically controlled from ground stations. These stations run computers with software vulnerabilities that can be exploited by hackers. If hackers were to infiltrate these computers, they could send malicious commands to the satellites.

History of hacks

This scenario played out in 1998 when hackers took control of the U.S.-German ROSAT X-Ray satellite. They did it by hacking into computers at the Goddard Space Flight Center in Maryland. The hackers then instructed the satellite to aim its solar panels directly at the sun. This effectively fried its batteries and rendered the satellite useless. The defunct satellite eventually crashed back to Earth in 2011. Hackers could also hold satellites for ransom, as happened in 1999 when hackers took control of the U.K.'s SkyNet satellites.

Over the years, the threat of cyberattacks on satellites has gotten more dire. In 2008, hackers, possibly from China, reportedly took full control of two NASA satellites, one for about two minutes and the other for about nine minutes. In 2018, another group of Chinese state-backed hackers reportedly launched a sophisticated hacking campaign aimed at satellite operators and defense contractors. Iranian hacking groups have also attempted similar attacks.

Although the U.S. Department of Defense and National Security Agency have made some efforts to address space cybersecurity, the pace has been slow. There are no cybersecurity standards for satellites and no governing body to regulate and ensure their cybersecurity. Even if common standards could be developed, there are no mechanisms in place to enforce them. This means responsibility for satellite cybersecurity falls to the individual companies that build and operate them.

As they compete to be the dominant satellite operator, SpaceX and rival companies are under increasing pressure to cut costs. There is also pressure to speed up development and production. This makes it tempting for the companies to cut corners in areas like cybersecurity that are secondary to actually getting these satellites in space.

#### Interconnectedness and surface area

Graczyk et al 21, Rafal, Paulo Esteves-Verissimo, and Marcus Voelp. "Sanctuary lost: a cyber-physical warfare in space." arXiv preprint arXiv:2110.05878 (2021). (University of Luxembourg, Interdisciplinary Center for Security, Reliability and Trust (SnT) - CritiX group)//Elmer

NewSpace is on course of enabling satellites to become interconnected, creating orbital networks with many nodes and numerous points of entry that are eventually connected to the Internet. It leads to the creation of (mega-)constellations (i.e., formations of spacecrafts cooperating in achieving a common goal, typically for telecommunication but also for real-time Earth observation and similar activities [36]), which on the one hand enables operators and users to utilize the greater potential of these new services and increases the availability and robustness against accidental faults. At the same time, NewSpace approach, and use of large constellations in particular, also increases the attack surface, making it harder to defend and maintain control on the system. The trend of increasing the size of satellite constellation along with simplifying and miniaturizing the satellites themselves starts to spill into the traditional space industry [37], and most likely will become even more significant in the future.

#### Nuke war causes extinction – Ice Age, famines, and war won’t stay limited

Edwards 17 [Paul N. Edwards, CISAC’s William J. Perry Fellow in International Security at Stanford’s Freeman Spogli Institute for International Studies. Being interviewed by EarthSky. How nuclear war would affect Earth’s climate. September 8, 2017. earthsky.org/human-world/how-nuclear-war-would-affect-earths-climate] Note, we are only reading parts of the interview that are directly from Paul Edwards -- MMG

In the nuclear conversation, what are we not talking about that we should be?

We are not talking enough about the climatic effects of nuclear war. The “nuclear winter” theory of the mid-1980s played a significant role in the arms reductions of that period. But with the collapse of the Soviet Union and the reduction of U.S. and Russian nuclear arsenals, this aspect of nuclear war has faded from view. That’s not good. In the mid-2000s, climate scientists such as Alan Robock (Rutgers) took another look at nuclear winter theory. This time around, they used much-improved and much more detailed climate models than those available 20 years earlier. They also tested the potential effects of smaller nuclear exchanges. The result: an exchange involving just 50 nuclear weapons — the kind of thing we might see in an India-Pakistan war, for example — could loft 5 billion kilograms of smoke, soot and dust high into the stratosphere. That’s enough to cool the entire planet by about 2 degrees Fahrenheit (1.25 degrees Celsius) — about where we were during the Little Ice Age of the 17th century. Growing seasons could be shortened enough to create really significant food shortages. So the climatic effects of even a relatively small nuclear war would be planet-wide. What about a larger-scale conflict? A U.S.-Russia war currently seems unlikely, but if it were to occur, hundreds or even thousands of nuclear weapons might be launched. The climatic consequences would be catastrophic: global average temperatures would drop as much as 12 degrees Fahrenheit (7 degrees Celsius) for up to several years — temperatures last seen during the great ice ages. Meanwhile, smoke and dust circulating in the stratosphere would darken the atmosphere enough to inhibit photosynthesis, causing disastrous crop failures, widespread famine and massive ecological disruption. The effect would be similar to that of the giant meteor believed to be responsible for the extinction of the dinosaurs. This time, we would be the dinosaurs. Many people are concerned about North Korea’s advancing missile capabilities. Is nuclear war likely in your opinion? At this writing, I think we are closer to a nuclear war than we have been since the early 1960s. In the North Korea case, both Kim Jong-un and President Trump are bullies inclined to escalate confrontations. President Trump lacks impulse control, and there are precious few checks on his ability to initiate a nuclear strike. We have to hope that our generals, both inside and outside the White House, can rein him in. North Korea would most certainly “lose” a nuclear war with the United States. But many millions would die, including hundreds of thousands of Americans currently living in South Korea and Japan (probable North Korean targets). Such vast damage would be wrought in Korea, Japan and Pacific island territories (such as Guam) that any “victory” wouldn’t deserve the name. Not only would that region be left with horrible suffering amongst the survivors; it would also immediately face famine and rampant disease. Radioactive fallout from such a war would spread around the world, including to the U.S. It has been more than 70 years since the last time a nuclear bomb was used in warfare. What would be the effects on the environment and on human health today? To my knowledge, most of the changes in nuclear weapons technology since the 1950s have focused on making them smaller and lighter, and making delivery systems more accurate, rather than on changing their effects on the environment or on human health. So-called “battlefield” weapons with lower explosive yields are part of some arsenals now — but it’s quite unlikely that any exchange between two nuclear powers would stay limited to these smaller, less destructive bombs.

### Adv – Ozone

#### Mega-constellations destroy the ozone layer.

Pultarova 21 “Air pollution from reentering megaconstellation satellites could cause ozone hole 2.0” Tereza Pultarova [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.], June 7, 2021 <https://www.space.com/starlink-satellite-reentry-ozone-depletion-atmosphere> SM

* Aaron Boley -- an associate professor of astronomy and astrophysics at the University of British Columbia, Canada

The aluminum from re-entering satellites also has a potential to damage the ozone layer, a problem well known to humanity, which has been successfully solved by widespread bans on the use of chlorofluorocarbons, chemicals used in the past in aerosol sprays and refrigerators.

In their paper, Boley and his colleague Michael Byers cite research by their counterparts from the Aerospace Corporation, a U.S. non-profit research organization, which identified local damage to the planet's ozone layer triggered by the passage of polluting rockets through the atmosphere.

"We know that alumina does deplete ozone just from rocket launches themselves because a lot of solid-fuel rockets use, or have, alumina as a byproduct," Boley said. "That creates these little temporary holes in the stratospheric ozone layer. That's one of the biggest concerns about compositional changes to the atmosphere that spaceflight can cause."

The ozone layer protects life on Earth from harmful UV radiation. The depletion of ozone in the stratosphere, the second lowest layer of the atmosphere extending between altitudes of approximately 7 to 40 miles (10 to 60 kilometers), led to an increased risk of cancer and eye damage for humans on Earth.

Gerhard Drolshagen, of the University of Oldenburg, Germany, who has published papers about the effects of meteoroid material on Earth, told Space.com that reentering satellites usually evaporate at altitudes between 55 and 30 miles (90 and 50 km), just above the ozone-rich stratosphere. However, he added, the particles created as a result of the satellites' burning will eventually sink to the lower layers.

Boley said that as the alumina sinks into the stratosphere, it will cause chemical reactions, which, based on existing knowledge, will likely trigger ozone destruction.

Drolshagen, who wasn't involved in the recent study, agreed that because "satellites are mostly made of aluminum, the amount of aluminum deposited in the atmosphere will certainly increase."

Concerns about the effects of aluminium oxides on the atmosphere have been cited by U.S. telecommunications operator Viasat in its request to the US Federal Communications Commision to suspend launches of SpaceX's Starlink megaconstellation until a proper environmental review of its possible impacts is conducted.

Learning from past mistakes

In their study, Boley and his colleagues looked only at the effects of the first generation of the Starlink megaconstellation, which is expected to consist of 12,000 satellites. More than 1,700 of these have already been launched. As a result of SpaceX's activities (and to a lesser extent those of other constellation operators), the number of active and defunct satellites in low Earth orbit, the region of space below the altitude of 620 miles (1,000 km), has increased by 50% over the past two years, according to the paper.

"The problem is that there are now plans to launch about 55,000 satellites," Boley said. "Starlink second generation could consist of up to 30,000 satellites, then you have Starnet, which is China's response to Starlink, Amazon's Kuiper, OneWeb. That could lead to unprecedented changes to the Earth’s upper atmosphere."

Megaconstellation operators, inspired by the consumer technology model, expect fast development of new satellites and frequent replacement, thus the high amount of satellites expected to be burning in the atmosphere on a daily basis.

"Humans are exceptionally good at underestimating our ability to change the environment," said Boley. "There is this perception that there is no way that we can dump enough plastic into the ocean to make a difference. There is no way we can dump enough carbon into the atmosphere to make a difference. But here we are. We have a plastic pollution problem with the ocean, we have climate change ongoing as a result of our actions and our changing of the composition of the atmosphere and we are poised to make the same type of mistake by our use of space."

#### Ozone hole recovering now but depletion causes extinction.

Browne 20 “Scientists warn erosion of ozone layer could lead to a modern mass extinction event” EDWARD BROWNE May 28, 2020 <https://www.express.co.uk/news/science/1287983/ozone-layer-global-warming-mass-extinction-dinosaurs-Southampton> SM

Scientists warn erosion of ozone layer could lead to a modern mass extinction event

AN unexplained mass extinction event that occurred 359 million years ago may have been caused by erosion of the ozone layer, a UK study has found.

It could have alarming implications for the way our current world is headed, regarding rising global temperatures. Researchers from the University of Southampton have been investigating an extinction event that occurred at the end of the Devonian geological period.

During their study, they found evidence that plant spores from around the time had been damaged by UV radiation, suggesting that the Earth’s ozone layer was not providing sufficient protection from the sun’s deadly rays.

While it is already known that ozone depletion could lead to an extinction event, the scientists were alarmed by the reason behind why the ozone depletion seemed to have occurred.

The researchers discovered that this particular ozone erasure could have been linked to global warming, which the scientists described as a “new mechanism for mass extinctions.”

Mass extinction events have occurred a number of times in Earth’s past, with known causes being asteroid impacts and large-scale volcanic eruptions, Phys.org reports.

Many will associate the asteroid impact event as the one that led to the extinction of the dinosaurs.

The extinction event that the Southampton scientists were studying came after a period of rapid global warming after an ice age, Phys.org continues.

As part of their study, the researchers collected rocks from sites in Greenland as well as Bolivia in order to study any clues about what Earth conditions may have been like way back 360 million years ago.

Indeed, these rocks held some clues as to what had been happening around the time of the Devonian period.

The researchers found that the rocks contained plant spores – which plants use to reproduce – that had been preserved within them for hundreds of millions of years.

They discovered that some of these spores appeared to have been damaged by something, noting that they had “malformed sculpture and pigmented walls”.

This sort of damage is similar to what would occur if the spores had been hit by high levels of ultraviolet light – also called UV rays – that are given off by the sun.

The researchers explained: “This indicates the temporary loss of the global protective ozone layer.”

This is because the ozone layer absorbs some of the UV light – a particular type called UBV – that travels from the sun to the Earth.

The US Environmental Protection Agency (EPA) notes that UVB light has been linked to skin cancer and can cause harm to crops and marine life.

The ozone layer is a part of Earth’s atmosphere located in the stratosphere between 9 and 18 miles up.

Professor Marshall, lead researcher for the team, said that “current estimates suggest we will reach similar global temperatures to those of 360 million years ago,” according to phys.org.

He added that this raises the possibility of another collapse in the ozone layer, which could have disastrous consequences for all life on Earth, including us.

In the study’s abstract, the team said: “ozone loss during rapid warming is an inherent Earth system process with the unavoidable conclusion that we should be alert for such an eventuality in the future warming world.”

As well as global warming, human activity is associated with the depletion of the Earth’s vital ozone layer.

Scientists have reported that a large ozone hole over the Antarctic is slowly beginning to recover amid international efforts to limit the amount of ozone-depleting substances belched out by mankind.

### FW – Tiny

#### The introspective connection between pain and pleasure and phenomenal conceptions of intrinsic value and disvalue is irrefutable – everything else regresses – robust neuroscience proves.

Blum et al. 18 Kenneth Blum, 1Department of Psychiatry, Boonshoft School of Medicine, Dayton VA Medical Center, Wright State University, Dayton, OH, USA 2Department of Psychiatry, McKnight Brain Institute, University of Florida College of Medicine, Gainesville, FL, USA 3Department of Psychiatry and Behavioral Sciences, Keck Medicine University of Southern California, Los Angeles, CA, USA 4Division of Applied Clinical Research & Education, Dominion Diagnostics, LLC, North Kingstown, RI, USA 5Department of Precision Medicine, Geneus Health LLC, San Antonio, TX, USA 6Department of Addiction Research & Therapy, Nupathways Inc., Innsbrook, MO, USA 7Department of Clinical Neurology, Path Foundation, New York, NY, USA 8Division of Neuroscience-Based Addiction Therapy, The Shores Treatment & Recovery Center, Port Saint Lucie, FL, USA 9Institute of Psychology, Eötvös Loránd University, Budapest, Hungary 10Division of Addiction Research, Dominion Diagnostics, LLC. North Kingston, RI, USA 11Victory Nutrition International, Lederach, PA., USA 12National Human Genome Center at Howard University, Washington, DC., USA, Marjorie Gondré-Lewis, 12National Human Genome Center at Howard University, Washington, DC., USA 13Departments of Anatomy and Psychiatry, Howard University College of Medicine, Washington, DC US, Bruce Steinberg, 4Division of Applied Clinical Research & Education, Dominion Diagnostics, LLC, North Kingstown, RI, USA, Igor Elman, 15Department Psychiatry, Cooper University School of Medicine, Camden, NJ, USA, David Baron, 3Department of Psychiatry and Behavioral Sciences, Keck Medicine University of Southern California, Los Angeles, CA, USA, Edward J Modestino, 14Department of Psychology, Curry College, Milton, MA, USA, Rajendra D Badgaiyan, 15Department Psychiatry, Cooper University School of Medicine, Camden, NJ, USA, Mark S Gold 16Department of Psychiatry, Washington University, St. Louis, MO, USA, “Our evolved unique pleasure circuit makes humans different from apes: Reconsideration of data derived from animal studies”, U.S. Department of Veterans Affairs, 28 February 2018, accessed: 19 August 2020, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6446569/>, R.S.

**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.

#### Evolution proves the reliability of phenomenal introspection – when we introspect on data from our eyes or ears, such as whether one sees or smells food or a predator, we use the same part of the brain that introspects on hedonic tones and identifies their moral relevance.

#### Thus, the standard is consistency with hedonic act utilitarianism.

### Method

#### Focus on large scale catastrophes is good and they outweigh – appeals to social costs, moral rules, and securitization play into cognitive bias and flawed risk calculus – 2020 is living proof

Weber 20 (ELKE U. WEBER is Gerhard R. Andlinger Professor in Energy and the Environment and Professor of Psychology and Public Affairs at Princeton University.), November-December 2020 Issue, "Heads in the Sand," Foreign Affairs, <https://www.foreignaffairs.com/articles/2020-10-13/heads-sand> mvp

We are living in a time of crisis. From the immediate challenge of the COVID-19 pandemic to the looming existential threat of climate change, the world is grappling with massive global dangers—to say nothing of countless problems within countries, such as inequality, cyberattacks, unemployment, systemic racism, and obesity. In any given crisis, the right response is often clear. Wear a mask and keep away from other people. Burn less fossil fuel. Redistribute income. Protect digital infrastructure. The answers are out there. What’s lacking are governments that can translate them into actual policy. As a result, the crises continue. The death toll from the pandemic skyrockets, and the world makes dangerously slow progress on climate change, and so on.

It’s no secret how governments should react in times of crisis. First, they need to be nimble. Nimble means moving quickly, because problems often grow at exponential rates: a contagious virus, for example, or greenhouse gas emissions. That makes early action crucial and procrastination disastrous. Nimble also means adaptive. Policymakers need to continuously adjust their responses to crises as they learn from their own experience and from the work of scientists. Second, governments need to act wisely. That means incorporating the full range of scientific knowledge available about the problem at hand. It means embracing uncertainty, rather than willfully ignoring it. And it means thinking in terms of a long time horizon, rather than merely until the next election. But so often, policymakers are anything but nimble and wise. They are slow, inflexible, uninformed, overconfident, and myopic.

Why is everyone doing so badly? Part of the explanation lies in the inherent qualities of crises. Crises typically require navigating between risks. In the COVID-19 pandemic, policymakers want to save lives and jobs. With climate change, they seek a balance between avoiding extreme weather and allowing economic growth. Such tradeoffs are hard as it is, and they are further complicated by the fact that costs and benefits are not evenly distributed among stakeholders, making conflict a seemingly unavoidable part of any policy choice. Vested interests attempt to forestall needed action, using their money to influence decision-makers and the media. To make matters worse, policymakers must pay sustained attention to multiple issues and multiple constituencies over time. They must accept large amounts of uncertainty. Often, then, the easiest response is to stick with the status quo. But that can be a singularly dangerous response to many new hazards. After all, with the pandemic, business as usual would mean no social distancing. With climate change, it would mean continuing to burn fossil fuels.

But the explanation for humanity’s woeful response to crises goes beyond politics and incentives. To truly understand the failure to act, one must turn to human psychology. It is there that one can grasp the full impediments to proper decision-making—the cognitive biases, emotional reactions, and suboptimal shortcuts that hold policymakers back—and the tools to overcome them.

AVOIDING THE UNCOMFORTABLE

People are singularly bad at predicting and preparing for catastrophes. Many of these events are “black swans,” rare and unpredictable occurrences that most people find difficult to imagine, seemingly falling into the realm of science fiction. Others are “gray rhinos,” large and not uncommon threats that are still neglected until they stare you in the face (such as a coronavirus outbreak). Then there are “invisible gorillas,” threats in full view that should be noticed but aren’t—so named for a psychological experiment in which subjects watching a clip of a basketball game were so fixated on the players that they missed a person in a gorilla costume walking through the frame. Even professional forecasters, including security analysts, have a poor track record when it comes to accurately anticipating events. The COVID-19 crisis, in which a dystopic science-fiction narrative came to life and took everyone by surprise, serves as a cautionary tale about humans’ inability to foresee important events.

Not only do humans fail to anticipate crises; they also fail to respond rationally to them. At best, people display “bounded rationality,” the idea that instead of carefully considering their options and making perfectly rational decisions that optimize their preferences, humans in the real world act quickly and imperfectly, limited as they are by time and cognitive capacity. Add in the stress generated by crises, and their performance gets even worse.

Because humans don’t have enough time, information, or processing power to deliberate rationally, they have evolved easier ways of making decisions. They rely on their emotions, which serve as an early warning system of sorts: alerting people that they are in a positive context that can be explored and exploited or in a negative context where fight or flight is the appropriate response. They also rely on rules. To simplify decision-making, they might follow standard operating procedures or abide by some sort of moral code. They might decide to imitate the action taken by other people whom they trust or admire. They might follow what they perceive to be widespread norms. Out of habit, they might continue to do what they have been doing unless there is overwhelming evidence against it.

Not only do humans fail to anticipate crises; they also fail to respond rationally to them.

Humans evolved these shortcuts because they require little effort and work well in a broad range of situations. Without access to a real-time map of prey in different hunting grounds, for example, a prehistoric hunter might have resorted to a simple rule of thumb: look for animals where his fellow tribesmen found them yesterday. But in times of crisis, emotions and rules are not always helpful drivers of decision-making. High stakes, uncertainty, tradeoffs, and conflict—all elicit negative emotions, which can impede wise responses. Uncertainty is scary, as it signals an inability to predict what will happen, and what cannot be predicted might be deadly. The vast majority of people are already risk averse under normal circumstances. Under stress, they become even more so, and they retreat to the familiar comfort of the status quo. From gun laws to fossil fuel subsidies, once a piece of legislation is in place, it is hard to dislodge it, even when cost-benefit analysis argues for change.

#### Evaluate the plan before discourse---focusing on their theory and requiring the Aff to defend every assumption collapses global progress

David A. Lake 14. University of California, San Diego, USA. “Theory is dead, long live theory: The end of the Great Debates and the rise of eclecticism in International Relations.” European Journal of International Relations 19(3) 567–587

More important, as Kuhn (1970) first argued, progress is only possible within paradigms. OEP and democratic peace theory, described above, made progress only through sets of shared assumptions and common epistemologies and ontologies that allowed theory to be extended to new topics, additional hypotheses to be deduced, and propositions confronted with evidence according to agreed-upon standards. Were researchers in each area forced to defend their methodological, epistemological, and ontological assumptions at every turn, progress within the approach would have been severely hampered. As these research programs have developed, they have been increasingly challenged by accumulated anomalies, as expected, and will either be revised or superseded by some future theory. Although I have not reviewed research in the postpositivist approach in similar detail in this article, and others are undoubtedly better qualified to address this question, I see similar progress in the feminist security studies program from the early works of Enloe (1990) that opened the political space to include women, to Tickner’s (1992) agenda-setting work, to more recent and substantive applications that reveal and highlight the ways in which gender deeply structures world politics (see Sjoberg, 2010; Sjoberg and Via, 2010; Towns, 2010). This too would have been even more difficult if researchers were forced to debate first principles at every turn. Within both positivist and post-positivist approaches, progress occurs within paradigms according to their own criteria for evaluating that progress. This suggests letting each paradigm develop on its own in its own fashion.

In the end, I prefer progress within paradigms rather than war between paradigms, especially as the latter would be inconclusive. The human condition is precarious. This is still the age of thermonuclear weapons. Globalization continues to disrupt lives as countries realign their economies on the basis of comparative advantage, production chains are disaggregated and wrapped around the globe, and financial crises in one country reverberate around the planet in minutes. Transnational terrorism threatens to turn otherwise local disputes into global conflicts, and leave everyone everywhere feeling unsafe. And all the while, anthropomorphic change transforms the global climate with potentially catastrophic consequences. Under these circumstances, we as a society need all the help we can get. There is no monopoly on knowledge. And there is no guarantee that any one kind of knowledge generated and understood within any one epistemology or ontology is always and everywhere more useful than another. To assert otherwise is an act of supreme intellectual hubris.

This is not a plea to let a hundred, a thousand, or ten thousand intellectual flowers bloom. Scholars working in cloistered isolation are not likely to produce great insights, especially when the social problems besetting us today are of such magnitude. All knowledge must be disciplined. That is, knowledge must be shared by and with others if it is to count as knowledge. Positivists and post-positivists are each working hard to improve and clarify the standards of knowledge within their respective paradigms. This is an important turn for both, as it will facilitate progress within each even as it raises barriers to exchange across approaches. So, if not a thousand flowers, it is perhaps better for teams of scholars to tend a small number of separate gardens, grow what they can best, and share when possible with the others and, especially, the broader societies of which they are part.

Do not mourn the end of theory, if by theory we mean the Great Debates in International Relations. Too often, the Great Debates and especially the paradigm wars became contests over the truth status of assumptions. Declarations that ‘I am a realist’ or pronouncements that ‘As a liberal, I predict …’ were statements of a near quasi-religious faith, not conclusions that followed from a falsifiable theory with stronger empirical support. Likewise, assertions that positivism or post-positivism is a better approach to understanding world politics are similarly blinding. The Great Debates were too often academic in the worst sense of that term. Mid-level theory flourished in the interstices of these debates for decades and now, with the waning of the paradigm wars, is coming into its own within the field. I regard this as an entirely positive development. We may be witnessing the demise of a particular kind of grand theory, but theory — in the plural — lives. Long may they reign.

#### No chance any grab for power succeeds - leftist hackers get bodied by the NSA – reform is all we’ve got

Fredrik deBoer 16, Limited-Term Lecturer, Introductory Composition at Purdue Program, 3/15/16, “c’mon, guys,” http://fredrikdeboer.com/2016/03/15/cmon-guys/

I could be wrong about the short-term dangers, and the stakes are incredibly high. But in the end we’re left with the same old question: what tactics will actually work to secure a better world?

In a sharp, sober piece about the meaning of left-wing political violence in the 1970s, Tim Barker writes “If you can’t acknowledge radical violence, radicals are reduced to mere victims of repression, rather than political actors who made definite tactical choices under given political circumstances.” The problem, as Barker goes on to imply, is those tactical choices: in today’s America they will essentially never break on the side of armed opposition against the state. The government knows everything about you, I’m sorry to say, your movements and your associations and the books you read and the things you buy and what you’re saying to the people you communicate with. That’s simply on the level of information, before we even get to the state’s incredible capacity to inflict violence. Look, the world has changed. The relative military capacity of regular people compared to establishment governments has changed, especially in fully developed, technology-enabled countries like the United States. The Czar had his armies, yes, but the Czar’s armies depended on manpower above and beyond everything else. The fighting was still mostly different groups of people with rifles shooting at each other. If tomorrow you could rally as many people as the Bolsheviks had at their revolutionary peak, you’re still left in a world of F-15s, drones, and cluster bombs. And that’s to say nothing of the fact that establishment governments in the developed world can rely on the numbing agents of capitalist luxuries and the American dream to damper revolutionary enthusiasm even among the many millions who have been marginalized and impoverished. This just isn’t 1950s Cuba, guys. It’s just not. In a very real way, modern technology effectively lowers the odds of armed political revolution in a country like the United States to zero, and so much the worse for us. This isn’t fatalism. It doesn’t mean there’s no hope. It means that there is little alternative to organization, to changing minds through committed political action and using the available nonviolent means to create change: a concert of grassroots organizing, labor tactics, and partisan politics. Those things aren’t exactly likely to work, either, but they’re a hell of a lot more plausible than us dweebs taking the Pentagon. Bernie Sanders isn’t really a socialist, but he’s a social democrat that moves the conversation to the left, and if people are dedicated and committed to organizing, the local, state, and national candidates he inspires will move it further to the left still. You got any better suggestions? Listen, commie nerds. My people. I love you guys. I really do. And I want to build a better world. Not incrementally, either, but with the kind of sweeping and transformative change that is required to fix a world of such deep injustice. But seriously: none of us are ever going to take to the barricades. And it’s a good thing, too, because we’d probably find a way to shoot in the wrong direction. I can’t dribble a basketball without falling down. American socialism is largely made up of bookish dreamers. I love those people but they’re not for fighting. And even if you have a particular talent for combat, you’re looking at fighting the combined forces of Google, Goldman Sachs, and the defense industry. Violence is hard. Soldiering is hard. In an era of the NSA and military robots, it’s really, really hard. “Should we condone revolutionary violence?” is dorm room, pass-the-bong conversation fodder, of precisely the moral and intellectual weight of “should we torture a guy if we know there’s a bomb and we know he knows where it is and we know we can stop it if we do?” It’s built on absurd hypotheticals, propped up by the power of anxious machismo, and undertaken to no practical political end. It’s understandable. I get it, I really do. But it’s got nothing to do with us. The only way forward is the grubby, unsexy work of building coalitions and asking people to climb on board.

#### Apocalyptic images challenge dominant power structures – they contest the implausibility of inequitable structures producing catastrophe and generate imagination of futures of social justice outside of current narratives

Jessica Hurley 17, Assistant Professor in the Humanities at the University of Chicago, “Impossible Futures: Fictions of Risk in the Longue Durée”, Duke University Press, <https://read.dukeupress.edu/american-literature/article/89/4/761/132823/Impossible-Futures-Fictions-of-Risk-in-the-Longue>

* Squo power structures (i.e. what the K criticizes) paint themselves as stable/inevitable to project their power and maintain dominance
* Questioning that stability thru extinction narratives questions squo world orders bc it calls into ques the idea of squo world stability which allows us to envision alternative worlds/future i.e. one where it fails and causes extinction
* Justifies extinction focus and preventing extinction in the name of changing those squo structures

If contemporary ecocriticism has a shared premise about environmental risk it is that genre is the key to both perceiving and, possibly, correcting ecological crisis. Frederick Buell’s 2003 From Apocalypse to Way of Life: Environmental Crisis in the American Century has established one of the most central oppositions of this paradigm. As his title suggests, Buell tells the story of a discourse that began in the apocalyptic mode in the 1960s and 70s, when discussions of “the immanent end of nature” most commonly took the form of “prophecy, revelation, climax, and extermination” before turning away from apocalypse when the prophesied ends failed to arrive (112, 78). Buell offers his suggestion for the appropriate literary mode for life lived within a crisis that is both unceasing and inescapable: new voices, “if wise enough….will abandon apocalypse for a sadder realism that looks closely at social and environmental changes in process and recognizes crisis as a place where people dwell” (202-3). In a world of threat, Buell demands a realism that might help us see risks more clearly and aid our survival.¶ Buell’s argument has become a broadly held view in contemporary risk theory and ecocriticism, overlapping fields in the social sciences and humanities that address the foundational question of second modernity: “how do you live when you are at such risk?” (Woodward 2009, 205).1 Such an assertion, however, assumes both that realism is a neutral descriptive practice and that apocalypse is not something that is happening now in places that we might not see, or cannot hear. This essay argues for the continuing importance of apocalyptic narrative forms in representations of environmental risk to disrupt conservative realisms that maintain the statusquo. Taking the ecological disaster of nuclear waste as my case study, I examine two fictional treatments of nuclear waste dumps that create different temporal structures within which the colonial history of the United States plays out. The first, a set of Department of Energy documents that use statistical modeling and fictional description to predict a set of realistic futures for the site of the Waste Isolation Pilot Plant in New Mexico (1991), creates a present that is fully knowable and a future that is fully predictable. Such an approach, I suggest, perpetuates the state logics of implausibility that have long undergirded settler colonialism in the United States. In contrast, Leslie Marmon Silko’s contemporaneous novel Almanac of the Dead (1991) uses its apocalyptic form to deconstruct the claims to verisimilitude that undergird state realism, transforming nuclear waste into a prophecy of the end of the United States rather than a means for imagining its continuation. In Almanac of the Dead, the presence of nuclear waste introjects a deep-time perspective into contemporary America, transforming the present into a speculative space where environmental catastrophe produces not only unevenly distributed damage but also revolutionary forms of social justice that insist on a truth that probability modeling cannot contain: that the future will be unimaginably different from the present, while the present, too, might yet be utterly different from the real that we think we know.¶ Nuclear waste is rarely treated in ecocriticism or risk theory, for several reasons: it is too manmade to be ecological; its catastrophes are ongoing, intentionally produced situations rather than sudden disasters; and it does not support the narrative that subtends ecocritical accounts of risk perception in which the nuclear threat gives rise to an awareness of other kinds of threat before reaching the end of its relevance at the end of the Cold War.2 In what follows, I argue that the failure of nuclear waste to fit into the critical frames created by ecocriticism and risk theory to date offers an opportunity to expand those frames and overcome some of their limitations, especially the impulse towards a paranoid, totalizing realism that Peter van Wyck (2005) has described as central to ecocriticism in the risk society. Nuclear waste has durational forms that dwarf the human. It therefore dwells less in the economy of risk as it is currently conceptualized and more in the blown-out realm of deep time. Inhabiting the temporal scale that has recently been christened the Anthropocene, the geological era defined by the impact of human activities on the world’s geology and climate, nuclear waste unsettles any attempt at realist description, unveiling the limits of human imagination at every turn.3 By analyzing risk society through a heuristic of nuclear waste, this essay offers a critique of nuclear colonialism and environmental racism. At the same time, it shows how the apocalyptic mode in deep time allows narratives of environmental harm and danger to move beyond the paranoid logic of risk. In the world of deep time, all that might come to pass will come to pass, sooner or later. The endless maybes of risk become certainties. The impossibilities of our own deaths and the deaths of everything else will come. But so too will other impossibilities: talking macaws and alien visitors; the end of the colonial occupation of North America, perhaps, or a sudden human determination to let the world live. The end of capitalism may yet become more thinkable than the end of the world. Just wait long enough. Stranger things will happen.¶

#### We should use debate to hash out what alternative foreign policies look like

#### Scenario planning is more effective than pure resistance AND there is a unique opening for ideas to take hold---our method provides necessary preparation.

Loren Dejonge Schulman 18, Deputy Director of Studies and Leon E. Panetta Senior Fellow at the Center for a New American Security., 12-4-2018, "Policy Roundtable: The Future of Progressive Foreign Policy – Texas National Security Review," Texas National Security Review, https://tnsr.org/roundtable/policy-roundtable-the-future-of-progressive-foreign-policy/#\_ftn75

In his essay on what a progressive national security agenda should look like, Van Jackson proposes to stretch the common progressive position of anti-militarism to a more realist platform of military “sufficiency.” In doing so, he brings attention to a serious gap in current defense politics. The stilted and superficial dialogue that passes for national security debate in American politics includes an active constituency for a “military first” (or military friendly) foreign policy, reflexively applying military tools to problems abroad and inflating defense spending. There is also a weaker constituency, most present outside government, for a “military last” or “anti-militarist” policy, which would cut defense spending and end wars with similar reflexivity. Outside the apolitical “blob” of Washington, there is little interest in publicly debating the prudence or effectiveness of these agendas. The left, regardless of its broader “theory of security,” could fill some of this vacuum — and it is better situated to do so than conventional wisdom might suggest.70 Democrats Drowning at the Water’s Edge For the last two decades, there has been little political opportunity to question America’s role in the world. With some exception, relevant defense and security policies have been open to even less scrutiny. Questions about the ethical or effective application of force, the size of the defense budget, the success of a given military strategy, the utility of specific weapons platforms, and the return on investment from security cooperation are, at best, diversions. Anyone who attempts to challenge the status quo risks being greeted with political attacks about lacking patriotism or not supporting American troops.71 But at a time of frequent missteps abroad on the part of the Trump administration, the space to question America’s foreign policy traditions may be widening

. The inability to pose legitimate questions about security policy is a particular flavor of political correctness, and because of it, the Democratic Party has all but disappeared in defense policy and politics.72 The last two years have seen more than a dozen pieces on the left’s lack of branded national security ideas.73 Michael Walzer has attributed this gap to an intentional abstention: The default position of the left is that “the best foreign policy is a good domestic policy.”74 Jackson highlights modest resourcing and under-representation as justifications for the left’s notable lack of a “theory of security” and the general subsuming of the debate under a big-tent “third way” liberalism. Traditional Democrats in the national security community (including me) have bristled at these criticisms, but would be hard-pressed to offer a distinctive and coherent political viewpoint. Some see the Democratic Party’s lack of a defined national security policy as something to celebrate. Declaring that politics “stops at the water’s edge” of national security is a winning Bingo option at any think tank event. But this dictum stifles debate about the national interest and the proper application of national resources. Consequently, there are moral and political questions on defense and interventions abroad that have no meaningful forum. This gap is particularly felt on Capitol Hill, where in the past security-minded Democrats have found political safe-harbor in a Republican-lite national security agenda — essentially blank-check support for Republicans on defense with, at most, a raised eyebrow from time to time. These policy positions require little analytical effort or political capital, and let Democrats occasionally posture as morally superior by emphasizing “non-military tools” of foreign policy. The opposite alternative of a more rigid pacifism and anti-militarism, though common in the grassroots progressive community, has no consistently organized political presence on the Hill and thus also escapes thorough interrogation.75 For those outside the Beltway, opposition to all things military offers the refuge of principle without critical justification or analysis. For many Democrats, the Obama model was a strangely tolerable middle ground: a bipartisan budget mess made while a “responsible” president ramped up security interventions in enough secrecy to avoid nagging scrutiny or self-examination. Re-Politicizing Defense Despite the valiant efforts of some individuals, there is no political home for responsible defense debate, oversight, and accountability.76 Yet, with determination, the left might find a real foothold in defense policy — without compromising progressive values. To be clear: There is substantial work to be done on figuring out what cohesive view of America’s role in the world the left can tolerate and advance. There is even greater work to be done on determining how to renew, reuse, and reform international institutions.77 But any such agendas would be well served by embracing a set of principles that make clear-eyed debate and evaluation of defense policy and execution an asset, not an unforgiveable sin. Critical analysis of defense affairs is too often left to the technocratic and comparatively powerless “blob,” which can write a mean op-ed or tweet, but has limited ability to engage the American people on its will and interests. And although Congress has willfully declawed itself so that it cannot maintain meaningful oversight of national security,78 its ability to stage and amplify policy debate for the American people is without parallel, and it has tremendous latent potential to restore greater balance in civil-military relations. Congress’s absence and the associated de-politicization of national security affairs is costly. For instance, the American public is deeply ambivalent about the 17-year conflict in Afghanistan and generally ignorant of the widespread activities of the war on terror.79 This is unsurprising: Congress, too, is disaffected, often ignorant of where the U.S. military is even engaged,80 and has made little headway into questioning or shaping this intervention. The most substantive and serious debate about executive war authorities and the effectiveness of U.S. counterterrorism strategy has resulted in little more than a reauthorization proposal that still failed to move forward.81 Too many examples of political leaders’ stand-off or superficial approach to defense policy and execution abound. Military superiority is generally viewed as sacrosanct, placed on “so high a pedestal as to render real debate meaningless.”82 That reverence infantilizes defense budget debates. Thanking troops for their service is a politicized ritual that divorces politicians and their constituents from the intent and costs of that service. With decisions on the needs of the U.S. military and sustaining legacy systems openly linked to the economies of congressional districts, it’s understandable that skeptics of utilizing military tools have been unwilling to evaluate their merits. These must all change. While, at its worst, the political right treats the use of force abroad as a metric of patriotism and the size of the force as the measure of one’s love of America, the political left ought to draw from its skepticism toward intervention and its faith in institutions to advance a more rational and accountable approach to national security. For years, Robert Farley has highlighted that “progressives consistently underestimate the importance of discussions about military doctrine and technology,”83 taking what Michael Walzer calls “shortcuts”84 in their critiques of defense policy that relieve them from contributing to key debates. Instead of excusing themselves, the left should instead propose legitimate questions about major shifts in force employment and development: Will it work? What are its goals? What is the U.S. national security apparatus learning? Why didn’t it work? Were U.S. objectives wrong? What did America change when it didn’t work? Will America do it again? What could be improved? What should America do now? Joining the Conversation Jackson’s notion of what a progressive “wager” on national security might look like in practice is useful, filling the gap between the “Republican-lite” default and the stubbornness of anti-militarism. But the left’s diversity of thought can accommodate a wider playing field of potential alternative approaches to security than even he proposes. A true pacifist movement on the Hill and on the campaign trail, dedicated to the advancement of non-military approaches but premised on analysis and logical arguments, would be a serious advancement in national security and should be welcomed by the most ardent military advocates. Likewise, a more prudent middle ground approach — one that is skeptical of, but open to, military might and intervention and demands a better return on investment of national security tools — should play a more prominent political role. The full range of the left’s national security spectrum should forcefully engage in oversight of the rationale for and quality of American forces and interventions abroad. The left should therefore consider adopting a series of principles on defense matters — including criteria for the use of force — that apply to the military-friendly and anti-militarist left alike. In practice, this means acknowledging that there are valid political positions on matters of defense that lie somewhere in between “yes, and” and “no never” and that trivializing them is harmful to America’s national security. There are alternatives to today’s counterterror strategy and it would not be an insult to the military to debate them. It’s entirely legitimate to study whether the military is equipped to face today’s threats without being accused of retreating from the world or starting with an artificial budget cut. It’s sensible to consider whether the planned growth of ground forces, a 350-ship Navy, or a 386-squadron Air Force are the right investments or political benchmarks.85 These questions involve choices and values and should not be avoided under the umbrella of a supposed technocratic bipartisan agreement. Just as important, it’s essential that the left avoid becoming a caricature of itself that promotes simplistic and superficial positions that set rigid, unserious standards. The left may not agree on the size or purpose of the military, but it can agree America should strive for informed oversight and accountability. The bumper sticker of such principles is simple: Ask informed questions,86 illuminate and demand accountability for failures, encourage fresh thinking, and bring the American people into the discussion without fear. That this is so simple is an embarrassment to the present state of the “debate.” In detail, these principles should include: Building the right force driven by security interests, not an inherently smaller force driven by an allergy to size. Arguing that the U.S. military is too large without clarifying what it should be expected to do and how is, at best, a lazy and an ill-informed reaction to sticker shock. There are valid questions — and a range of plausible answers — about the appropriate mission and scope of America’s forces, and a worthwhile dialogue to be had on where risks in force structure should reside. Exploring fully how threat assessments impact military roles, missions, and investments. A rigid antipathy to conflict and intervention, or to the military itself, leaves the left out of conversations that determine how and where America spends its blood and treasure, and precludes the defense establishment from tackling questions important to the left (e.g., what does a world of accelerating climate change require of the U.S. military?). The left’s absence from attempts to set the analytic agenda for defense policy is dangerous. Engaging in more practical conversations about how military capabilities might be used, where, and why. Military platforms carry within them assumptions about the nature of U.S. strategy and interests that are poorly articulated in today’s defense authorizing environment. Most detailed political debate today emphasizes the cost of military platforms, or their associated acquisition processes, or, for legacy systems, the industrial base. As Robert Farley noted in 2011, “Analysts, institutions, and politicians tend to respond to the arguments they see, rather than those that they don’t.”87 Recruiting, retaining, and promoting the military and civilian skill sets and imagination necessary for today’s and tomorrow’s security challenges. The mish-mash of human capital and talent management processes of today’s Department of Defense, paired with a legacy focus on capacity, the booming costs of military personnel, a growing civil-military divide, and a growing gap in the military’s high-technical skills, spell a looming disaster for future military manpower. The left must treat this as a strategic priority rather than a mere bureaucratic matter. Increasing transparency to the public on the manner, costs, risks, intent, and success or failure of military interventions. As I wrote with Alice Friend, the current approach of military secrecy and unwillingness to pursue an “airing of grievances” about past strategic and operational failure “assumes that domestic support for U.S. military engagements can be sustained in an information vacuum. It draws on a reservoir of public faith in the military while also limiting the public’s ability to make an informed decision. This is a losing gamble.”88 The left should reset this dynamic. Deliberately connecting debates on America’s capabilities and political investments in preventing and resolving conflicts to the more mature debates on how to prepare to fight the nation’s wars. Diplomacy, development, economics, and intelligence demand modernization just as military forces do, and they need to be far better at measuring and communicating their value. The left should push the political dialogue on these matters beyond mere talking-points. Ensuring that any military action America does engage in has clear goals, is limited in scope, is sustainable for the duration, and is assessed in terms of fully-burdened costs to the military, the broader national security community (intelligence analysts, diplomats, aid workers, contractors, and more), U.S. allies, and local populations. Exploring these matters is not pedantic or risky in the face of threats. It is the only responsible option, and the left should force these discussions. Sustaining engaged and thoughtful interest, oversight, and civil skepticism of all military and non-military intervention activities abroad. The beginning of an intervention should not be the high point of political energy. It is shameful that the progress of the war in Afghanistan, the viability of the U.S. counterterrorism strategy, the occasional airstrikes in Syria, and much more escape serious oversight. Advancing civil-military relations with respectful skepticism of military employment; unconditional support for service members, families, and veterans; and resolve to right wrongs of past failures. The left — in all its forms — should embrace the necessity of active participation and serious debate beyond the water’s edge. That’s how to make national security more democratic, transparent, and therefore accountable. What could be more progressive than that?