# 1AC v4 – King RR

### 1AC – Plan

#### Plan – The appropriation of outer space through the production of orbital debris by private entities is unjust.

#### Orbital debris is

NASA.gov 21 [NASA – 5/26/21. “Space Debris and Human Spacecraft.” <https://www.nasa.gov/mission_pages/station/news/orbital_debris.html>] Justin

Orbital Debris

Space debris encompasses both natural meteoroid and artificial (human-made) orbital debris. Meteoroids are in orbit about the sun, while most artificial debris is in orbit about the Earth (hence the term “orbital” debris).

Orbital debris is any human-made object in orbit about the Earth that no longer serves a useful function. Such debris includes nonfunctional spacecraft, abandoned launch vehicle stages, mission-related debris, and fragmentation debris.

#### The aff interprets enforcement as an OUF (Orbital Use Fee). Proportionality in relation to the space industry solves best without harming it and any other solution only worsens the threat – models.

Rao et al 20. Akhil, Matthew Burgess, and Daniel Kaffine \*Department of Economics, Middlebury College, Middlebury \*\*Cooperative Institute for Research in Environmental Sciences, University of Colorado, Environmental Studies Program, and Department of Economics \*\*\*Department of Economics. 2020 [PNAS, “Orbital-use fees could more than quadruple the value of the space industry,” <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7293599/>] Justin

The space industry’s rapid recent growth represents the latest tragedy of the commons. Satellites launched into orbit contribute to—and risk damage from—a growing buildup of space debris and other satellites. Collision risk from this orbital congestion is costly to satellite operators. Technological and managerial solutions—such as active debris removal or end-of-life satellite deorbit guidelines—are currently being explored by regulatory authorities. However, none of these approaches address the underlying incentive problem: satellite operators do not account for costs they impose on each other via collision risk. Here, we show that an internationally harmonized orbital-use fee can correct these incentives and substantially increase the value of the space industry. We construct and analyze a coupled physical–economic model of commercial launches and debris accumulation in low-Earth orbit. Similar to carbon taxes, our model projects an optimal fee that rises at a rate of 14% per year, equal to roughly $235,000 per satellite-year in 2040. The long-run value of the satellite industry would more than quadruple by 2040—increasing from around $600 billion under business as usual to around $3 trillion. In contrast, we project that purely technological solutions are unlikely to fully address the problem of orbital congestion. Indeed, we find debris removal sometimes worsens economic damages from congestion by increasing launch incentives. In other sectors, addressing the tragedy of the commons has often been a game of catch-up with substantial social costs. The infant space industry can avert these costs before they escalate.

In 2017, 466 new satellites were launched—more than double the previous year’s launches and more than 20% of all active satellites in orbit in 2017 (1, 2). Rapid space industry growth is projected to continue, driven largely by commercial satellites (Fig. 1). This growth is driving buildup of debris in low-Earth orbit, currently including over 15,000 objects (3). Collision risk from debris is costly; collisions damage or destroy expensive capital assets that are difficult or impossible to repair. Debris buildup could eventually make some low-Earth orbits economically unviable and other orbits difficult or impossible to access (4). In the worst case—although uncertain and occurring over long time sshorizons—debris growth could become self-sustaining due to collisions between debris objects, a tipping point called Kessler Syndrome (4, 5).

Proposed solutions have so far largely been technological and managerial, aimed at mapping, avoiding, and removing debris (6, 7). These include end-of-life deorbit guidelines and “keep out” zones for active satellites and nets, harpoons, and lasers to deorbit debris (6). However, with open access to orbits, reducing debris and collision risk incentivizes additional satellite launches, which eventually restore the debris and risk. For instance, if firms were willing to tolerate a 0.1% annual risk of satellite loss before a technological improvement in debris removal, they will be willing to launch more satellites until the 0.1% annual risk of satellite loss was restored.

Thus, the core of the space debris problem is incentives, not technology. Since satellite operators are unable to secure exclusive property rights to their orbital paths or recover collision-related costs imposed by others, prospective operators face a choice between launching profitable satellites, thereby imposing current and future collision risk on others, or not launching and leaving those profits to competitors. This is a classic tragedy of the commons problem (1, 3, 8, 9). It can be economically efficiently addressed via incentive-based solutions, such as fees or tradable permits per year in orbit, analogous to carbon taxes or cap and trade (8, 10–12). Incentives should target objects in orbit—rather than launches—because orbiting objects are what directly imposes collision risk on other satellites (13). We quantify the economic benefits of implementing such incentives to correct the underlying open-access problem.

We use a coupled physical–economic model combining rich physical dynamics with satellite economics to quantify the benefits of an internationally harmonized “orbital-use fee” (OUF) relative to a business as usual (BAU) open-access scenario and relative to a scenario with active debris removal. An OUF is a type of Pigouvian tax—a well-known economic instrument for addressing externality problems (14). Our model accounts for the effects of each scenario on satellite launch decisions (Materials and Methods and SI Appendix). While we focus on an OUF for analytical convenience, it is conceptually equivalent to other mechanisms for pricing orbits, such as tradable permits.

Our physical model of satellite and debris evolution in orbit obeys relevant accounting identities and utilizes reduced form approximations of physical processes validated in other works (15, 16). We fit and calibrate the model using data on collision risk and orbital debris from the European Space Agency (ESA) (17) and data on active satellites from the Union of Concerned Scientists (UCS) (2) (Materials and Methods and SI Appendix). The ESA dataset covers 1958 to 2017, and the UCS dataset covers 1957 to 2017. Our physical model assumes runaway debris growth (Kessler Syndrome) cannot occur, which likely leads our model to understate the benefits of OUFs (Materials and Methods). Our economic model assumes that satellites are launched and operated to maximize per satellite private profits, net of any fees, subject to collision risk. We calibrate the model by fitting the BAU scenario (no fees or debris removal) to historical industry data and launch trends (1, 2) (Materials and Methods and SI Appendix).

We project future launch rates to 2040 under the BAU scenario using our fitted model and published projections of future growth of the space economy (18). The projections in ref. 18 were developed by projecting how the industries constituting the space sector—telecommunications, imaging, etc.—would grow from 2017 to 2040 under different assumptions on their individual profitability over time, then aggregating up to obtain projections for the space sector. We then calculate launch rates that would maximize the long-run value of the industry, and we calculate the time series of OUFs that would incentivize these optimal launch rates. The industry value is measured as net present value (NPV)—the long-run value of the entire fleet of satellites in orbit, accounting for both the financial costs of replacing satellites due to natural retirement and collisions as well as the opportunity cost of investing funds in satellites rather than capital markets. For instance, an NPV of $1 trillion in 2020 means the sum total of the stream of net benefits, looking from 2020 into the future and accounting for the timing of the net benefits, is $1 trillion.

Although our models are deliberately simplified for tractability, they are based on previously validated approaches to orbital object modeling (15, 16), and our calibrations allow us to reproduce observed trends and magnitudes in the growth of orbital debris and satellite stocks as well as the calculated collision risk (Fig. 3). Nonetheless, our projections should be interpreted as order of magnitude approximations that can be refined as needed by more detailed models. In these respects, our approach mirrors integrated assessment modeling approaches that have been useful in developing solutions to other natural resource management problems (e.g., ref. 19).

RESULTS

We project that shifting from open access to the optimal series of OUFs in 2020 would increase the NPV of the satellite industry from around $600 billion under BAU to around $3 trillion—a more than 4-fold increase (4.18- to 6.49-fold increases in 95% of parameter sets randomly drawn from their calibrated distributions) (Fig. 2D). Assuming a 5% market rate of return, an increase of $2.5 trillion in NPV would be equivalent to annual benefits of approximately $120 billion in perpetuity. The large immediate increase in NPV that we project in each OUF scenario, relative to BAU (Fig. 2A), comes primarily from the immediate effect of reducing launch activity while the satellite and debris stocks are suboptimally high (SI Appendix).

Based on our calculations (Materials and Methods), the optimal OUF starts at roughly $14,900 per satellite-year in 2020 and escalates at roughly 14% per year (aside from some initial transition dynamics) to around $235,000 per satellite-year in 2040. Rising optimal price paths are common in environmental pricing such as carbon taxes (20), although declining optimal price paths are also possible (21). The rising price path in this case partly reflects the rising value of safer orbits (resulting in rising industry NPV) (Fig. 2A) from the OUF. For comparison, the average annual profits of operating a satellite in 2015 were roughly $2.1 million. The 2020 and 2040 OUF values we describe amount to roughly 0.7 and 11% of average annual profits generated by a satellite in 2015.

Forgone NPV from the satellite industry in 2040—which is the cost of inaction under BAU—escalates from around $300 billion if optimal management begins in 2025 to around $700 billion if optimal management begins in 2035. Without OUFs, losses remain substantial even when active debris removal (implemented in the model as removal of 50% of debris objects in orbit each year) is available. In a best-case analysis where we assume debris removal is costless (i.e., it requires no payments nor additional satellites to implement), debris removal can only recover up to 9.5% of the value lost under open access. (The satellite industry’s willingness to pay for debris removal is not easily calculable in our model [SI Appendix, section 1.9.2].) At worst, debris removal can exacerbate orbital congestion via a rebound-type effect, causing additional losses on the order of 3% of the value already lost from open access (Fig. 4 and SI Appendix). The inability of debris removal to induce efficient orbit use is driven by open-access launching behavior and underscores the importance of policies to correct economic incentives to launch satellites.

DISCUSSION

The costly buildup of debris and satellites in low-Earth orbit is fundamentally a problem of incentives—satellite operators currently lack the incentives to factor into their launch decisions the collision risks their satellites impose on other operators. Our analysis suggests that correcting these incentives, via an OUF, could have substantial economic benefits to the satellite industry, and failing to do so could have substantial and escalating economic costs.

Escalating costs of inaction are a common feature of the tragedy of the commons, evident in several other sectors in which it went unaddressed for lengthy periods (22). For example, tens of billions of dollars in net benefits are lost annually from open-access or poorly managed fisheries globally (23). Similarly, open access to oil fields in the United States at the turn of the century drove recovery rates down to 20 to 25% at competitively drilled sites, compared with 85 to 90% potential recovery under optimal management (24). Open access to roadways—somewhat analogous to orbits—is estimated to create traffic congestion costs in excess of $120 billion/y in the United States alone (25). In contrast, there is still time to get out ahead of the tragedy of the commons in the young space industry.

The international and geopolitically complex nature of the space sector poses challenges to implementing orbital-use pricing systems, but these challenges need not be insurmountable. Theory suggests countries could each collect and spend OUF revenues domestically, without losing economic efficiency, as long as the fee’s magnitude was internationally harmonized (20). Engaging in such negotiations would be in the economic interests of all parties involved (26). An example of such a system is the Vessel Day Scheme (VDS) used by the Parties to the Nauru Agreement (PNA) to manage tuna fisheries. Under the VDS, PNA countries each lease fishing rights within their waters, using a common price floor (27). The European Union’s Emissions Trading System provides an example of an internationally coordinated tradable permit system (28). Notably, each of these pricing programs is built on a preexisting international governance institution (the Nauru Agreement and the European Union).

An OUF could also be built within existing space governance institutions, such as the Outer Space Treaty (29). For example, Article VI states that countries supervise their space industries, which provides a framework for OUFs to be administered nationally. Article II prohibits national appropriation of outer space but does not prohibit private property rights, potentially allowing for tradable orbital permitting.

### 1AC – Advantage

#### The space sector is trending towards privatization – that drives feedback loops of technology creating cascading collisions.

BERNAT 20. Pawel @ Military University of Aviation. 11/4/20. [SAFETY ENGINEERING OF ANTHROPOGENIC OBJECTS, “ORBITAL SATELLITE CONSTELLATIONS AND THE GROWING THREAT OF KESSLER SYNDROME IN THE LOWER EARTH ORBIT,” Volume 4, PDF] Justin

The second decade of the 21st century has brought a dynamic and somewhat surprising development of the space industry. Since 1972 – the Apollo 17 crew mission to the Moon, the humankind has not left the safe environment of Earth’s orbit, and for years the global space sector has been progressing in slow but steady pace run by a few largest space agencies like American NASA, European ESA, Japanese JAXA, and Chinese CNSA. The most significant achievement of the “old ways” of managing outer space exploration is the International Space Stations (ISS) that has facilitated more than 20 years of continuous crewed operations.

The situation started to change at the turn of the century when new generations of private entrepreneurs began to invest in and develop space technologies like rocket boosters, spaceships, and what most important for the subject of the paper – satellites and their constellations. This new shift is known among the space industry as “Space 2.0”, and its emergence is dated around 2000-2002 when the companies like SpaceX, Blue Origin, and Virgin Galactic were established. (Pyle, 2019). The real change, however, came in 2012 when the first SpaceX commercial mission was successfully launched to the ISS (NASA, 2012).

Since then, the participation of the private sector in the space industry has skyrocketed, especially in the United States. Today, SpaceX is the only entity that provides reusable rockets (first stage and fairings) that is capable of vertical launch and landing. Their current flagship rocket – Falcon 9 has carried out 23 successful missions in 2020 (SpaceX, 2020) and another four are planned for December of that year (Weitering, 2020). Moreover, thanks to Crew Dragon spaceship developed by the company, Americans have regained this year the capacity of sending astronauts from their own soil after nine years of buying the seats on Russian Soyuz capsule. SpaceX is now in the process of building a communication satellites constellation that will be addressed and analyzed in the paper.

Nowadays, in the space industry, we witness a very productive cybernetic feedback look between the development of space technologies, the democratization of those technologies, and a substantial reduction of prices. The latter is even more significant if we compare the cost of launching cargo into orbit now and 20 years ago – Falcon 9 is over ten times cheaper than Space Shuttle (Jones, 2018). This, of course, directly translates into the mass and number of objects that we are able to put in the orbit viably. Once the constellations consisting of thousands of satellites were unthinkable, but in the current environment, they become a reality.

Space 2.0 also has brought new threats and challenges in the sphere of national and international security. The increase in launch capacity, among other factors, has led to progressive militarization and weaponization of space and new arms race (Bernat, 2019), which has also contributed to the growing numbers of orbiting objects.

The goal of the paper is to present the argumentation that the threat posed by the cascading collisions in the Earth’s orbit (Kessler syndrome) is becoming more severe due to the construction of orbital satellite constellations; the threat that presents a real danger for people during their EVAs and orbital infrastructure, which may bare immediate consequences for safety and security systems on Earth. In order to provide the theoretical context for the above claim, the following issues will be presented and discussed: (1) space debris, (2) the Kessler syndrome, (3) orbital debris models, (4) the legal issues related to space debris and mitigation actions against their proliferation, and (5) the planned and being currently developed orbital satellite constellations and how they contribute to the growing threat of the Kessler syndrome.

#### Privatization exponentially increases debris – lack of regulations spikes it – models.

BERNAT 20. Pawel @ Military University of Aviation. 11/4/20. [SAFETY ENGINEERING OF ANTHROPOGENIC OBJECTS, “ORBITAL SATELLITE CONSTELLATIONS AND THE GROWING THREAT OF KESSLER SYNDROME IN THE LOWER EARTH ORBIT,” Volume 4, PDF] Justin

5. Orbital satellite constellations and the growing threat of the Kessler syndrome

Space 2.0 – the new era of space exploration that we witness now in the 21st century means, in words of Buzz Aldrin, “moving human enterprise into space” (Pyle, 2019, p. xiv). The process of commercialization of outer space has already begun and is not limited to private companies providing technologies and services for national or international space agencies, as it was in the past. On the contrary, private companies from the space sector have now matured to carry out their own independent projects.

As for 2020, SpaceX is a company that serves as the best example – it launches satellites to the orbit, both for state and private contractors, it successfully realized two crew missions to the International Space Station, and is in the process of constructing Starlink satellite constellation that will provide high-speed internet access across the planet.

Each satellite weighs around 260 kg, is equipped with an ion propulsion system, autonomous collision avoidance system, and orbits Earth at approximately 540-560 km altitude (Starlink, 2020). At the beginning of November 2020, more than 860 Starlink satellites were orbiting the Earth (Jewett, 2020). Immediate plans include launching 12,000 satellites, but they assume a potential later extension to 42,000 (Henry, 2019a). Of course, SpaceX has employed, at least declaratively, all necessary measures to keep the space clean – the satellites are equipped with the deorbiting system, and in the event of inoperability of the propulsion system (Starlink, 2020). The orbital collisions are, however, inevitable. As it was shown before, the possibility of collisions grows with the number of orbital objects. Bastida Virgili with the team compared (2016, p. 154-155) orbital debris environment development without and with a large hypothetical constellation consisting of merely 1080 satellites, distributed across 20 orbital planes at 1,100 km altitude (Fig. 5).

Chart, line chart

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Figure 5. Comparison of long term evolution of the number of objects in LEO with and without the constellation (Virgili et al., 2016, p. 155)

It has to be noted that although SpaceX’s Starlink is the only constellation that is being built in orbit, it is not the only one planned. There are at least a few initiatives aiming at the same goal – to construct internet infrastructure at the Earth’s orbit. The planned Kuiper Systems LLC, which is a subsidiary of Amazon and intends to place 3,236 broadband satellites in the LEO, is one of Starlink’s biggest competitors (Henry, 2019b). Now, there is even a rivalry between the two companies because Kuiper’s lowest orbital shell is planned to be 590 km, with a tolerance of 9 km either above or below (Cao, 2020), which is the altitude of Starlink satellites. Moreover, the race for space in orbit is now at the beginning.

The outer space is vast. It increasingly becomes more cluttered with both operational satellites and space debris. The threat of collisions increases and no institution or body has enough power to license, coordinate and regulate what is sent to the orbit. The UNOOSA has not such power. National states decide what the companies from the space industry can launch to space. In the United States, which is most advanced in the area of private constellations, it is the Federal Aviation Administration (FAA) that issues the appropriate approvals. The race to put broadband internet satellites bears similarities to the gold rush – there are no rules, at the global level, apart from first-come, first-served.

#### Models are rigorous.

Virgili et al. 16 – Bastida, J.C. Dolado, H.G. Lewis, J. Radtke, H. Krag, B. Revelin, C. Cazaux b , C. Colombo, R. Crowther, M. Metz. 4/26/16. [Act Astranautica “Risk to space sustainability from large constellations of satellites,” <https://sci-hub.se/10.1016/j.actaastro.2016.03.034>.] Justin

1.3. Simulation approach and result analysis A Monte Carlo (MC) approach was used to simulate the evolution of the object population over a period of 200 years under different post-mission disposal requirements, with four different tools (MEDEE – Modelling the Evolution of Debris on Earth's Environment [9], LUCA – Long Term Utility for Collision Analysis [10], DAMAGE – Debris Analysis and Monitoring Architecture to the Geosynchronous Environment [11] and DELTA – Debris Environment Long Term Analysis [12]). For analysis purposes, the effective number of objects was used where the contribution to the population by each object was weighted by the proportion of the orbital period spent in LEO. In a first step, four different evolutionary models performed an analysis of two reference scenarios. One scenario considered only the evolution of the background population and non-constellation traffic. The second scenario augmented the first with the addition of the representative constellation, with the requirement that 90% of the constellation satellites achieved post-mission disposal to orbits with remaining lifetimes of 25 years. The manoeuvres performed at the mission end to meet the disposal requirement are assumed to be impulsive (i.e. instantaneous) and result in an eccentric orbit with the apogee near the original (constellation) altitude and the perigee at an altitude such that the effects of atmospheric drag would cause the orbit to decay within 25 years. Two of the models considered an apogee remaining at the operational constellation altitude, while the other two reduced the apogee by 50 km. The purpose of these scenarios is to provide a cross-comparison of the models in terms of their predictions of the total object population, which take into account the effects of the constellation. As the distribution of the MC results for the models is of the same nature and the results are independent, a bootstrapping [20] approach is used to derive the mean, the standard deviation and the confidence levels at 95% of the combined results of all the MC runs from the four models (cf. Fig. 1), although not all the models performed the same number of MC runs (see Table 1). The main source of variation inside a particular model's MC runs included the randomness in collision activity, while the different models used their own solar activity forecast.

#### Debris is exponentially increasing and current models underestimate the risk. The aff is our best shot making it try-or-die.

Shen & Blake 2/24/22 [Zili Shen, Internally citing James Blake \* I am a Ph.D. student in Astronomy at Yale University. My research focuses on ultra-diffuse galaxies and their globular cluster populations. Since I came to Yale, I have worked on two "dark-matter-free" galaxies NGC1052-DF2 and DF4 \*\* Department of Physics and Centre for Space Domain Awareness, University of Warwick, Coventry. “How not to bury ourselves under space trash.” astrobites. <https://astrobites.org/2022/02/24/space-sustainability/>] Justin

What’s wrong with having some stuff orbiting the Earth, you might ask? Like my trash analogy, the problem is that they block our way to space. Fragments as small as 10 cm can kill a satellite mission. Unlike my trash analogy, if enough space junk accumulates, they can produce more fragments on their own. Several bands of LEO are already at risk of what’s called a runaway collisional cascade. This happens when space junk collide with each other and fall apart, their fragments going on to seeding more collisions, generating more debris, and restarting the cycle. On the other hand, space debris in high altitude orbits (like GSO) don’t experience much atmospheric drag, and will stay up there for centuries. From this you probably gathered that most of these debris are either abandoned satellites or their fragments. Even though these objects were originally launched by humans, cataloging and tracking them are a huge challenge.

What’s up there?

Since the first manmade satellite was launched in 1957, space agencies have been keeping track of bodies orbiting the Earth. By mass, 98% of those are satellites and rocket bodies, but we know very little about the remaining 2%, millions of small debris. These small debris elude radars and optical telescopes used in ground-based surveys, but they can still cause mission-fatal damage to a satellite. With limited data, NASA and ESA cannot accurately estimate the risk from orbital debris. Their models don’t even agree on the number of expected debris because there is no good observational constraint for very small fragments.

Fig. 2: Number of tracked objects in Low-Earth Orbit (LEO) and Geo-synchronous orbit (GSO). Modified from Fig.2 of the paper.

Fig. 2 shows a breakdown of what we do know about objects in LEO and GSO. In LEO (left panel) , the most numerous objects are debris. These come from fragmentation events, or “break-ups,” most commonly due to propulsion-related subsystems exploding. In other words, when leftover fuel gets heated up in space, it can blow the satellite to pieces. Other sources of debris include intentional anti-satellite tests (in which countries develop technology to destroy each other’s satellites) and a small number of accidental satellite collisions. In GSO (right panel), a large number of objects are “unknown” because GSO is significantly farther away from Earth and has historically received less attention. To quote Dr. Blake, the author of today’s paper, “monitoring the mess of near-Earth space cannot solve the problem entirely, especially while the bulk of the dangerous debris population remains invisible and uncatalogued.” Now that I’ve alerted you to the grave danger we face, how do we make sure that future humanity can still go to space?

What can be done?

Like any environmental problem, the best solution is prevention. To prevent leftover fuel from exploding, satellite operators are now advised to “passivate” the spacecraft at the end of the mission. That means dumping out residual fuel and discharging batteries while they still control the spacecraft. The other safe disposal measures after the mission ends are to have the satellite re-enter the atmosphere or move into unused high-altitude orbits. Even though these prevention measures are the best way forward, they are (un)surprisingly hard to enforce. The authors says, “despite an apparent consensus that [anti-satellite weapon] tests represent irresponsible and reckless behaviour, legally binding and internationally recognised regulations are still lacking.” The level of adherence to the above safety guidelines remain concerningly low. Given that prevention is a “legal quagmire,” we can also try to remove debris that is already up there. Everything from harpoons to nets and tentacles have been used to collect orbital debris, but there’s no one-size-fits-all solution. Imagine how hard it is to capture metal shards tumbling at high speed without creating more debris.

Looking towards the future

Small satellites have flourished in recent years as LEO satellite constellations proved commercially lucrative. These satellites are not only a problem for astronomers but also a huge issue for the existing surveillance infrastructure. Dr. Blake says, “the problem is one that affects all operators in space, truly global in nature… [and] warrants a cross-sector, cross-disciplinary approach.” As astronomers, we can help society keep a watchful eye and ensure that the future of space flight is sustainable. If you want to learn more about space sustainability, Dr. Blake recommends the GNOSIS project.

#### Current regulatory guidelines fail – answers neg turns.

Boley and Byers 21. Aaron Boley is at the Department of Physics and Astronomy, The University of British Columbia, Vancouver, Canada and Michael Byers is at the Department of Physics and Astronomy, The University of British Columbia, Vancouver, Canada. 5/20/21. [Nature, “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth,” <https://www.nature.com/articles/s41598-021-89909-7>] Justin

Companies are placing satellites into orbit at an unprecedented frequency to build ‘mega-constellations’ of communications satellites in Low Earth Orbit (LEO). In two years, the number of active and defunct satellites in LEO has increased by over 50%, to about 5000 (as of 30 March 2021). SpaceX alone is on track to add 11,000 more as it builds its Starlink mega-constellation and has already fled for permission for another 30,000 satellites with the Federal Communications Commission (FCC)1 . Others have similar plans, including OneWeb, Amazon, Telesat, and GW, which is a Chinese state-owned company2 . Te current governance system for LEO, while slowly changing, is ill-equipped to handle large satellite systems. Here, we outline how applying the consumer electronic model to satellites could lead to multiple tragedies of the commons. Some of these are well known, such as impediments to astronomy and an increased risk of space debris, while others have received insufcient attention, including changes to the chemistry of Earth’s upper atmosphere and increased dangers on Earth’s surface from re-entered debris. Te heavy use of certain orbital regions might also result in a de facto exclusion of other actors from them, violating the 1967 Outer Space Treaty. All of these challenges could be addressed in a coordinated manner through multilateral law-making, whether in the United Nations, the Inter-Agency Debris Committee (IADC), or an ad hoc process, rather than in an uncoordinated manner through diferent national laws. Regardless of the law-making forum, mega-constellations require a shif in perspectives and policies: from looking at single satellites, to evaluating systems of thousands of satellites, and doing so within an understanding of the limitations of Earth’s environment, including its orbits.

Tousands of satellites and 1500 rocket bodies provide considerable mass in LEO, which can break into debris upon collisions, explosions, or degradation in the harsh space environment. Fragmentations increase the cross-section of orbiting material, and with it, the collision probability per time. Eventually, collisions could dominate on-orbit evolution, a situation called the Kessler Syndrome3 . Tere are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraf and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the long-term evolution of debris suggest that LEO is already in the protracted initial stages of the Kessler Syndrome, but that this could be managed through active debris removal4 . Te addition of satellite mega-constellations and the general proliferation of low-cost satellites in LEO stresses the environment further5–8 .

[Omitted Figures 1 and 2]

Results

The overall setting. Te rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defnes NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with efects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph.

Although the volume of space is large, individual satellites and satellite systems have specifc functions, with associated altitudes and inclinations (Fig. 2). Tis increases congestion and requires active management for station keeping and collision avoidance9 , with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, afer failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency

When completed, Starlink will include about as many satellites as there are trackable debris pieces today, while its total mass will equal all the mass currently in LEO—over 3000 tonnes. Te satellites will be placed in narrow orbital shells, creating unprecedented congestion, with 1258 already in orbit (as of 30 March 2021). OneWeb has already placed an initial 146 satellites, and Amazon, Telesat, GW and other companies, operating under diferent national regulatory regimes, are soon likely to follow.

Enhanced collision risk. Mega-constellations are composed of mass-produced satellites with few backup systems. Tis consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also considerable discarded equipment. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of de-orbiting satellites will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difcult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb megaconstellations as fled (and amended) with the FCC (see “Methods”). Te large density spikes show that some shells will have satellite number densities in excess of n = 10−6 km−3 .

Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some companies might be less-thanfully transparent about events13 in LEO.

Despite the congestion and trafc management challenges, FCC flings by SpaceX suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the flings do not account for untracked debris6 , including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 afer one year. Tus, if at any time there are 230 pieces of untracked debris decaying through the 550 km orbital shell, there is a 50% chance that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if subsequent fragmentation events lead to similar amounts of debris within that orbital shell, a runaway cascade of collisions could occur.

Fragmentation events are not confned to their local orbits, either. Te India 2019 ASAT test was conducted at an altitude below 300 km in an efort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. A major fragmentation event from a single satellite could afect all operators in LEO.

#### Fragmentation leads to speedy debris – that’s laws of physics.

Aerospace.org n.d. [As an independent, nonprofit corporation operating the only FFRDC for the space enterprise, The Aerospace Corporation performs objective technical analyses and assessments for a variety of government, civil, and commercial customers. “SPACE DEBRIS 101.” AEROSPACE. <https://aerospace.org/article/space-debris-101>] Justin

Can you see space debris coming at you?

It is very unlikely that you would see space debris. Relative to a person in orbit, space debris is moving about ten times faster than a bullet, and the vast majority of debris is as small as or smaller than a bullet. No one can see a bullet coming, let alone an object moving ten times faster.

What is an on-orbit collision like?

It looks more like an explosion of each object, as if they passed through each other and exploded on the other side. A hyper-velocity collision like those at orbital speed doesn’t behave like collisions that we are used to seeing. The objects are moving so fast that they travel through each other faster than the shock waves can travel. The shock waves in the structures of each object then shatter them into fragments of varying sizes and, in the process, give each fragment a boost in a different direction. Each one of these fragments is then in a different orbit than the original object and will move away according to the laws of orbital motion. With thousands of fragments, each moving in slightly different directions, it looks a lot like an explosion.

Do breakups look like the movies?

For dramatic purposes, movies, TV, and commercials tend to show space breakups at a much slower speed than they would happen at in real life. A breakup in space, especially a collision, can involve a lot of energy, and the pieces are flung away at extremely high speeds. Since there is no air to slow the pieces down the fragments would all fly away from one another and rapidly disappear from view. For many breakups, a softball-sized fragment would fly the length of the space station (a little less than a football field) in less than half a second. If you were watching it from nearby, you would see a flash, and the object that broke up would just disappear and be gone. It would be very unlikely for you to see pieces drifting away. Similarly, a low orbit space collision is unlikely to look much like a car crash — the speeds are much too high. The collisions would look like explosions to a nearby observer.

#### Rivalrous orbits create space conflict and turn good satellites.

Samson 22 – Victoria Samson is the Washington office director for the Secure World Foundation, an organization that focuses on space sustainability, and she has over 20 years of experience in military space and security issues. Previously, Ms. Samson was a senior analyst for the Center for Defense Information. She also was a senior policy associate at the Coalition to Reduce Nuclear Dangers, a consortium of arms control groups. Earlier, she was a researcher at Riverside Research Institute, where she worked on war-gaming scenarios for the Missile Defense Agency. 1/17/22. [Bulletin of the Atomic Scientists, “The complicating role of the private sector in space,” DOI: 10.1080/00963402.2021.2014229] Justin

At this exact moment, we are seeing the increasing dominance of commercial actors in space – specifically the rise of mega-constellations, or large numbers of small satellites flying in formation to provide global coverage for a variety of governmental and commercial uses, including both communications and Earth observation. Consequently, the fundamental nature of space is changing, to one of a domain dominated by commercial actors. This change will have major consequences for international stability, both in terms of how it demonstrates that the old governance structure for space is being left behind – and how it highlights Russia’s declining rank in global space powers. Certain orbits may be effectively taken over by a handful of entities, and there will be competition for useful portions of the electromagnetic spectrum. With eyes on the sky everywhere, there will be little or no room for state secrets – for better or worse. This is happening at the same time that Russia’s space identity is floundering, which may further upset the stability of the domain of space.

As of November 2021, there are roughly 4,800 active satellites in orbit around Earth, around 1,850 of which belong to just one entity: SpaceX’s Starlink mega-constellation (Thompson 2021). This change has happened very quickly, as Starlink satellites just began to be launched in May 2019 (O’Callaghan 2019). This is only the first wave of the megaconstellations as well. While it is hard to say exactly how many satellites will be launched as part of this new use of space, there are requests or plans for mega-constellations that could mean well over 100,000 new satellites could potentially be in low Earth orbit. While not all of these satellites will be launched, even a small fraction of that proposed number will fundamentally shift the situation so that the major actors in space will no longer be nation-states (as has been the case to date) but the private sector, changing the timbre of the space domain.

This leads to challenges in discussing space security issues: Space is a shared, international domain; if we cannot include all the stakeholders in the discussions, we will not come to complete solutions to the problems. But first, some background.

A little history

The commercial sector is not new to space. Commercial entities have been active in space for decades now; in fact, it was a dispute over what should be the extent of their role in space that shaped part of the 1967 Outer Space Treaty. Article VI of that treaty notes:

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities . . .. The activities of nongovernmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. (Outer Space Treaty 1967)

This was a compromise between the United States and the USSR, in which the latter argued that there was no such thing as commercial space. Having language requiring state actors to carry out “authorization and continuing supervision” gave the United States the flexibility it wanted to develop a commercial space sector while ensuring that there would still be national oversight.

A lack of coordination

One way in which the rise of these mega-constellations may complicate international security in space is through concerns about these satellites hampering access to certain orbits. While slots in geosynchronous Earth orbit are set by the International Telecommunication Union, there is no international entity coordinating orbital slots at low Earth orbit. This means that, given the potentially tens of thousands of satellites that could be launched given company plans, certain orbits could be de facto ceded to a handful of entities – in defiance of Article II of the Outer Space Treaty, which says that space “is not subject to national appropriation.” Consequently, this could lead to strife or competition over certain orbits.

It is possible that, given the number of satellites that companies are asking the United States’ Federal Communications Commission for broadcasting rights to, certain orbits may reach their carrying capacities – meaning that they are at the maximum number of satellites that can be operated, as defined by physical and radiofrequency interference aspects. This could lead to disputes over which country has the right to use certain orbits, or, alternatively, resentment when one country’s commercial sector essentially takes over a particular orbit

Competition over parts of the electromagnetic spectrum is another possible path for international security issues to arise from mega-constellations. Satellites are only as good as their ability to receive and communicate information, which requires spectrum; if one or a few entities from one country use up all the readily accessible spectrum for specific capabilities at certain orbits, that could possibly lead to confrontation as well. For the most part, the companies launching mega-constellations are largely based in the West, which can shape the global perception of their effects and intent – although there have been some plans for at least one Chinese company to launch a mega-constellation of potentially 13,000 satellites, and the South Koreans have expressed interest in their own mega-constellation.

#### Triggers space escalation and nuclear war.

Perez 21 – Veronica Delgado-Perez is a Staff Writer at The International Scholar. 12/14/21 – Note, doesn’t say date but most recent cited event is 2021, correct if I’m wrong. [The International Scholar, “Argument | The Commercialization of Space Risks Launching a Militarized Space Race,” <https://www.theintlscholar.com/periodical/12/14/2020/analysis-commercialization-space-risk-international-law-military-space-race>] Justin

With new actors on the game stage, conflicts of interest may arise. There is a risk that each actor adopts a kind of short-term Realist approach to space policy — one which is driven by self-interest in reaping the greatest benefits of extraterrestrial exploration and commercialization while controlling access to others. If unmitigated, states may choose to militarize outer space to gain a strategic edge over competitors and adversaries.

This process has already begun. Under the Trump administration, the Pentagon established the U.S. Space Force as a new branch of the Armed Forces to protect the country and allied interests in space. Already, Delta 4 — one of the U.S. Space Force’s missions — conducts strategic and theater missile warnings, manages weapon systems, and provides information to missile defense forces. The measure shows that for the U.S., outer space is not only a domain of scientific exploration but has the potential to become increasingly securitized.

With the impending expiration of the Strategic Arms Reduction Treaty (START) between the U.S. and Russia on February 5, 2021, a number of security dilemmas could arise. If the world’s two largest nuclear powers do not edge toward extending the treaty, Washington and Moscow risk returning to the era of unrestricted expansion of launch platforms and strategically-deployed nuclear warheads — potentially with the aid of military infrastructure in space.

Although President-elect Biden has expressed his interest in negotiating an extension of New START, how Moscow and Washington might proceed remains an open question. Bilateral progress towards a new arms-control regime would require establishing limits on the number and range of long- and mid-range missiles, establishing measures to limit the expansion of traditional missile deployment to space, and banning the deployment of nuclear weapons and weapons of mass destruction in outer space.

#### That destroys astronomical research AND creates a host of logistical problems.

Blake 2/16/22 [James Blake \* Department of Physics and Centre for Space Domain Awareness, University of Warwick, Coventry. “Looking out for a sustainable space.” Astronomy & Geophysics Journal. <https://arxiv.org/pdf/2202.06994.pdf>] Justin

Numerous studies have highlighted the negative effects that large LEO constellations are likely to have on ground- and space-based astronomical observations across a range of wavelengths (Hainaut & Williams 2020; Levchenko et al. 2020; McDowell 2020). Satellite streak contamination in astronomical imaging is by no means a new issue, but the vast numbers and low altitudes involved in maintaining LEO constellations look set to exacerbate the problem, particularly for wide-field systems such as the upcoming Vera C. Rubin Observatory, which will look to study large parts of the sky at any one time, thus resulting in a high probability of field contamination (Massey et al. 2020). An example of a contaminated wide-field image is provided in Figure 6.

While the lowest-altitude constellations are likely to be the brightest, those in higher-altitude bands will perhaps be of greater concern to astronomers; low-altitude satellites will spend much of the night eclipsed in the Earth’s shadow, while satellites in the upper bands of the LEO region will remain visible for larger portions of the night. This will be the case for nodes of the OneWeb constellation, now part-owned by the UK government. OneWeb satellites reside in altitude bands around 1200 km, to take advantage of a local minimum in the debris population. Seitzer (2020) has recommended that constellation operators take precautions to keep their satellites faint, and opt for altitude bands below roughly 600 km, to best combat the issue.

To add to the logistical challenges associated with monitoring a sky that is getting busier every year, surveillance networks may soon be tasked with tracking and cataloguing objects far beyond the ‘high-altitude’ GSO region, namely those in the cislunar domain. The expansion of launch traffic into cislunar space in the wake of NASA’s Artemis programme will undoubtedly pose problems for existing SDA architectures (Bolden et al. 2020): the increased range will result in diminished signal-to-noise, calling for more sensitive instruments; the much larger volume of space in need of monitoring will necessitate a more extensive array of ground- and space-based SDA capabilities; and observations will often be obstructed by the Moon, or eclipsed in shadow, calling for more sophisticated algorithms for object detection and orbital state prediction with sparse or diminished information (Yanagisawa & Kurosaki 2012; Virtanen et al. 2016; Hickson 2018; Nir et al. 2018; Pirovano et al. 2020). It is likely that a variety of astronomical techniques developed for data reduction, classification, fusion, tracking, and association, may prove transferable when applied to many of the upcoming challenges for SDA, from cislunar surveillance to the monitoring of rendezvous and proximity operations for on-orbit servicing and ADR missions.

#### Astronomical research solves every existential threat.

Harvard 17 [Harvard & Smithsonian. No exact date but most recent image cited is from 2017. “How can astronomy improve life on earth?.” Center for Astrophysics. <https://www.cfa.harvard.edu/big-questions/how-can-astronomy-improve-life-earth>] Justin

Our Work

The need for extremely precise instrumentation in astronomy can often be transferred into the medical field. Beyond pure research, which benefits humanity through various technological applications, some laboratories at the Center for Astrophysics pursue research that’s more directly beneficial.

High-energy and neutron optics laboratories design mirrors for the next generation of space-based telescopes. But with a simple modification, these optics can accurately aim high-energy particles for radiation treatment, focusing on destroying tumors while leaving surrounding tissue unharmed. Engineers are working on mirrors that can both focus neutrons from across the Universe, as well as those from a radioactive source sitting in the same room.

Work on nuclear magnetic resonance, which can be used to study molecular physics, can also be used to scan the human body. When used for imaging, this is known as magnetic resonance imaging, or MRI. Scientists at the CfA are developing an open-access, low-magnetic-field human MRI instrument, that can be used for molecular imaging and the study of traumatic brain injury.

On the other side of the coin, astrophysics sometimes adapts technology from the medical field. The complicated debris leftover after a supernova explosion, known as a supernova remnant, can be hard to visualize. We only have our vantage point and cannot travel around the remnant to view the intricacies of its structure. But by measuring how fast the material is traveling, and whether it’s traveling towards us or away, we can create a 3D map of the material’s motion. Supernova researchers are putting this data into medical imaging software originally designed for brain scans to get a 3D model that can be viewed in 360 degrees. To take it one step further, the models can then be 3D printed, allowing you to hold a dead star in your hand.

The Center for Astrophysics | Harvard & Smithsonian sets the standard for astronomical discovery. By pursuing scientific research, our scientists never know what might be the next big breakthrough. New detector technology means better lighter cameras. Astronomical data analysis software can be reconfigured to make cars safer. Novel techniques in radio astronomy paved the way for wireless internet. We don’t know what we are going to find, but we will never know if we don’t look.

How Curiosity Drives Ingenuity

Understanding our Universe is not an easy task. It requires an incredible amount of focused effort among worldwide collaborations of dedicated experts, the constant development of new technology at great expense, and theoretical modelling that pushes the boundaries of science. Even without any guarantee of success, such an undertaking has its benefits.

Astronomy is continually innovating and progressing. Seemingly by accident, scientific and technological developments in astronomy have worked their way into our daily lives. For example, the device you’re currently reading this text on is very likely to involve components and systems that saw their first application in astronomy.

Computers, satellites and the smartphones they service, Global Positioning System (GPS), energy-efficient solar panels, digital camera sensors, airport security scanners, portable X-ray machines, and Magnetic Resonance Imaging (MRI) scanners are just a few of technological advances that are the legacy of astronomy, and that benefit us all on Earth. None of these would have happened if we hadn’t first been dedicated to simple human curiosity about what may be out in the far reaches of our Universe. As it has been throughout our history, the impulse to explore is still one of the greatest wellsprings of human ingenuity.

Protecting the Planet In 1859, the Sun launched an enormous magnetized mass of plasma at the Earth, shorting electrical lines, starting electrical fires and knocking out telegraph communication. The northern lights could be seen as far south as Mexico. If such a solar event hit the Earth today, it is estimated to cause damage measured in the trillions of dollars. Coronal mass ejections (CMEs), like the 1859 event, are giant eruptions of charged particles that threaten satellites, astronauts, and our electrical grid. A suite of CFA missions and instruments are monitoring the Sun, giving us warning of incoming CMEs, allowing time to prepare and protect people and our highly susceptible electronic and communication systems. The X-ray Telescope (XRT) aboard the Hinode spacecraft observes flares, CMEs, and the source of the highly charged flow of particles from the Sun, known as the solar wind. The Atmospheric Imaging Assembly (AIA), developed by scientists at the Center for Astrophysics | Harvard & Smithsonian (CfA), aboard the Solar Dynamics Observatory (SDO) takes fast, multi-wavelength images of the full sun. This allows scientists to watch monitor features at different temperatures and levels of the solar atmosphere. The Parker Solar Probe, will race through the Sun’s atmosphere, collecting material and measuring the solar wind at its source. It will eventually orbit seven times closer than any previous satellite, and withstand temperatures of 2,500 degrees (1,377 degrees Celsius). The Solar Wind Electrons Alphas and Protons (SWEAP) Investigation, developed by CfA scientists and engineers, is the set of instruments on the spacecraft that will directly measure the properties of the plasma in the solar atmosphere during these encounters. A special component of SWEAP is a small instrument that will look around the protective heat shield of the spacecraft directly at the Sun. This will allow SWEAP to sweep up a sample of the atmosphere and touch the Sun, our star, for the first time. Our Sun makes life on Earth possible, but is still an unpredictable, sometimes volatile star. By learning more about our Sun, astronomers can warn us about incoming solar storms and predict the next big eruption. Space Watch

Though the Solar System has certainly cleaned up its act in the 66 million years since an asteroid wiped out the dinosaurs, there have since been a couple of near misses that are too close for comfort.

The Minor Planet Center, located at the Center for Astrophysics, is tasked by the International Astronomical Union to collect and circulate positional measurements of minor planets like asteroids and comets. The Center calculates the motions of newfound objects and alerts observers when an object that might impact the Earth is detected. The orbit calculation and announcement of newly discovered Near-Earth Asteroids (NEOs) is a critically important job, ensuring that we won’t suffer the same fate as the dinosaurs.

Benefits Beyond the Balance Sheet

Astronomy has a unique ability to unite humans. Simply by asking big questions about the Universe and our place in it, we see ourselves as we are: together, voyaging through a singular moment in time on one very special but relatively minuscule planet among the vastness of space.

The sense of wonder inspired by humanity’s quest for knowledge of our Universe has its own important applications. In education, we see the teaching of astronomy at the primary or secondary level leading students to pursue careers in STEM (science, technology, engineering, and math). In international relations, we see astronomy as a scientific field that transcends borders and promotes collaboration between global teams in unified pursuit of knowledge. In our culture, we see the impact of keystone scientific discoveries creating a more informed and scientifically literate society.

And let’s not forget that astronomy offers us a glimpse into our shared future. Will our species be able to spread across the cosmos, to colonize other planets, and to preserve our heritage and legacy through the ages? If so, it will only be through the study of astronomy.

#### Debris triggers miscalculated war.

Robert Farley 22, Now a 1945 Contributing Editor, Dr. Robert Farley is a Senior Lecturer at the Patterson School at the University of Kentucky. Dr. Farley is the author of Grounded: The Case for Abolishing the United States Air Force (University Press of Kentucky, 2014), the Battleship Book (Wildside, 2016), and Patents for Power: Intellectual Property Law and the Diffusion of Military Technology (University of Chicago, 2020). 1/9/22. [19 Fourty Five, “Does A Space War Mean A Nuclear War?,” <https://www.19fortyfive.com/2022/01/does-a-space-war-mean-a-nuclear-war/>] Justin

The recent Russian anti-satellite test didn’t tell the world anything new, but it did reaffirm the peril posed by warfare in space. Debris from explosions could make some earth orbits remarkably risky to use for both civilian and military purposes. But the test also highlighted a less visible danger; attacks on nuclear command and control satellites could rapidly produce an extremely dangerous escalatory situation in a war between nuclear powers. James Acton and Thomas Macdonald drew attention to this problem in a recent article at Inside Defense. As Acton and MacDonald point out, nuclear command and control satellites are the connective tissue of nuclear deterrence, assuring countries that they’re not being attacked and that they’ll be able to respond quickly if they are.

For a long time, these strategic early-warning satellites were akin to a center of gravity in ICBM warfare. Nuclear deterrence requires awareness that an attack is underway. Attacks on the monitoring system could easily be read as an attempt to ~~blind~~ an opponent in preparation for general war, and could themselves incur nuclear retaliation. Thus, the nuclear command and control satellites are critical to the maintenance of nuclear deterrence. They make it possible to distribute an order from the chief of government to the nuclear delivery systems themselves. Consequently, their destruction might lead to hesitation or delay in performing a nuclear launch order.

It was only later that the relevance of satellites for conventional warfare became clear. Satellites could reconnoiter enemy positions and, more importantly, provide communications for friendly forces. Indeed, the expansion of the role of satellites in conventional warfare has complicated the prospect of space warfare. States have a clear reason for targeting enemy satellites which support conventional warfare, as those satellites enable the most lethal part of the kill chain, the communications and recon networks that link targets with shooters. Thus, we now have a situation in which space military assets have both nuclear and conventional roles. In a conflict confusion and misperception could rapidly become lethal. If one combatant views an attack against nuclear command and control as a prelude to a general nuclear attack, it might choose to pre-empt.

Nuclear powers have dealt with problems in this general category for a good long while; would a conventional attack against tactical nuclear staging areas represent an escalation, for example? Would the use of ballistic missiles that can carry either conventional or nuclear weapons trigger a nuclear response? Do attacks against air defense networks that have both strategic and tactical responsibilities run the risk of triggering a nuclear response? There’s also the danger that damage to communications networks designated for conventional combat could force traffic onto the nuclear control systems, further confusing the issue.

#### No limited nuclear wars – extinction.

Webber 19 – Dr Philip Webber has written widely on nuclear issues and is Chair of Scientists for Global Responsibility (SGR) – a membership organisation promoting responsible science and technology. We will all end up killing each other and one nuclear blast could do it. 5/18/19. [METRO.UK “We will all end up killing each other and one nuclear blast could do it,” <https://metro.co.uk/2019/05/18/we-will-all-end-up-killing-each-other-and-one-nuclear-blast-could-do-it-9370115/>] Recut Justin

The nuclear armed nations have inadvertently created a global Doomsday machine, built with 15,000 nuclear weapons.

Most (93%) have been built by Russia and in the US, 3,100 of them are ready to fire within hours.

Pre-programmed targets include main cities as well as a range of military and civilian targets across the world primarily in the UK, Europe, US, Russia and China but also in Japan, Australia and South America.

One nuclear blast, one mistake, one cyber attack could trigger it.

But first a reminder about the incredible destructive power of a nuclear weapon. Modern nuclear warheads are typically 20 times larger than either of the two bombs that obliterated Hiroshima and Nagasaki at the end of the Second World War. What just one nuclear warhead can do is unimaginable. We’ve drawn some of the key features to scale against cityscapes in the UK for a Russian SS-18 RS 20V (NATO designation ‘Satan’) 500kT warhead. US submarines deploy a similar weapon – the Trident II Mk5, 475kT warhead. A deafening, terrifying noise will be created, like an intense thunder that lasts for 10 seconds or longer.

After a blinding flash of light bright destroying the retina of anyone looking, and a violent electromagnetic pulse (EMP) knocking out electrical equipment several miles away, a bomb of this size quickly forms an incandescent fireball 850 metres across.

This is about the same height as the world’s tallest building, the Burj Khalifa. Drawn against the London Canary Wharf financial district or the Manchester skyline, the huge fireball dwarfs one Canary Sq. (240m), the South Tower Deansgate (201m) and the Beetham Tower Hilton, (170m). The fireball engulfs both city centres completely, melting glass and steel and forms an intensely radioactive 60m deep crater zone of molten earth and debris. A devastating supersonic blast wave flattens everything within a radius of two to three km, the entire Manchester centre, an area larger than the City of London, with lighter damage out to eight km. Most people in these areas would be killed or very seriously injured.

The fireball quickly rises forming an enormous characteristic mushroom shaped cloud raining highly radioactive particles (fallout). It rises to 60,000 ft (18,000m) – twice the altitude of Everest – and is 15 miles, 24km across.

This is one warhead. There are 10 such warheads on each of Russia’s 46 missiles (460 in total) and 48 on each of eight US Trident submarines (384 in total). In reality, in a nuclear conflict all of these warheads and a further 956 ready-to-fire are likely to be launched.

Whilst this scale of destruction is horrific and hundreds of millions of people would be killed in a few hours from a combination of blast, radiation and huge fires, there are also terrible longer-term effects.

Scientists predict that huge city-wide firestorms combined with very the high-altitude debris clouds would severely reduce sunlight levels and disrupt the world’s climate for a decade causing drought, a prolonged winter, global famine and catastrophic impacts for all life on earth and in the seas due to intense levels of UV with the destruction of the ozone layer.

But even at the level of a few hundred nuclear warheads, the consequences of a nuclear war would be extremely severe across the world far beyond the areas hit directly. A nuclear conflict between India and Pakistan with ‘only’ 100 small warheads would kill hundreds of millions and cause climate damage leading to a global famine. The sheer destructive nature of nuclear explosions combined with long lasting radiation, means that nuclear weapons are of no military use. ‘Enemy’ territory would be unusable for years because of intense radiation – especially when nuclear power stations and reprocessing plants are hit.

Even if your own country is not hit, radiation and climate damage will spread across the globe. No one escapes the consequences.

But the nuclear nations argue that they build and keep nuclear weapons to make sure that they are never used. After all no one would be stupid enough to actually launch a nuclear weapon facing such terrible retaliation? It sounds obvious. If you threaten any attacker with terrible nuclear devastation of course they won’t attack you. That might be true most of the time. It is very unlikely that any country would launch a nuclear attack deliberately. But there are two very major problems. First, a terrorist organisation with a nuclear weapon cannot be deterred in this way. Secondly, there are several ways in which a nuclear war can start by mistake. A report by the prestigious Chatham House in 2014 documents 30 instances between 1962 and 2002 when nuclear weapons came within minutes of being launched due to miscalculation, miscommunication, or technical errors. What prevented their use on many of these occasions was the intervention of individuals who, against military orders, either refused to authorise a nuclear strike or relay information that would have led to launch. Examples include a weather rocket launch mistaken for an attack on Russia, a US satellite misinterpreting sunlight reflecting off clouds as multiple missiles firings, a 42c chip fault creating a false warning of 220 missiles launched at the United States. Such risks are heightened during political crises.

The risk of mistake is very high because, in a hangover from the Cold War, the USA and Russia each keep 900 warheads ready to fire in a few minutes, in a ‘launch on warning’ status, should a warning of nuclear attack come in.

These nuclear weapons form a dangerous nuclear stand-off – rather like two people holding guns to each other’s heads.

With only a few minutes to evaluate a warning of nuclear attack before warheads would strike, one mistake can trigger disaster. A similar nuclear stand-off exists between India and Pakistan.

### 1AC – FW

#### The meta-ethic is moral naturalism. Non-natural moral facts are epistemically inaccessible

Papineau 7 [David, Academic philosopher. He works as Professor of Philosophy of Science at King's College London, having previously taught for several years at Cambridge University and been a fellow of Robinson College, Cambridge, “Naturalism”. [http://plato.stanford.edu/entries/naturalism/](http://plato.stanford.edu/entries/naturalism/))]

Moore took this argument to show that moral facts comprise a distinct species of non-natural fact. However, any such non-naturalist view of morality faces immediate difficulties, deriving ultimately from the kind of causal closure thesis discussed above. If **all physical effects are due to a limited range of natural causes, and if moral facts lie outside this range, then it follow that moral facts can never make any difference to what happens in the physical world** (Harman, 1986). At first sight **this** may seem tolerable (perhaps moral facts indeed don't have any physical effects). But it **has** **very awkward epistemological consequences.** For beings like us, **knowledge of the spatiotemporal world is mediated by physical processes involving our sense organs and cognitive systems. If moral facts cannot influence the physical world, then it is hard to see how we can have any knowledge of them.**

#### No a priori reason—evidence proves.

**Schwartz** “A Defense of Naïve Empiricism: It is Neither Self-Refuting Nor Dogmatic.” Stephen P. Schwartz. Ithaca College. pp.1-14.

The empirical support for the fundamental principle of empiricism is diffuse but salient. Our common empirical experience and experimental psychology offer evidence that humans do not have any capacity to garner knowledge except by empirical sources. The fact is that we believe that there is no source of knowledge, information, or evidence apart from observation, empirical scientific investigations, and our sensory experience of the world, and we believe this on the basis of our empirical a posteriori experiences and our general empirical view of how things work. For example, we believe on empirical evidence that humans are continuous with the rest of nature and that we rely like other animals on our senses to tell us how things are. If humans are more successful than other animals, it is not because we possess special non-experiential ways of knowing, but because we are better at cooperating, collating, and inferring. In particular we do not have any capacity for substantive a priori knowledge. There is no known mechanism by which such knowledge would be made possible. This is an empirical claim.

#### Thus, the standard is maximizing expected wellbeing. Pleasure and pain *are* intrinsic value and disvalue – everything else *regresses* – robust neuroscience.

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

#### Prefer:

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

#### 2] No intent-foresight distinction for states.

Enoch 07 Enoch, D [The Faculty of Law, The Hebrew Unviersity, Mount Scopus Campus, Jersusalem]. (2007). INTENDING, FORESEEING, AND THE STATE. Legal Theory, 13(02). doi:10.1017/s1352325207070048 https://www.cambridge.org/core/journals/legal-theory/article/intending-foreseeing-and-the-state/76B18896B94D5490ED0512D8E8DC54B2

The general difficulty of the intending-foreseeing distinction here stemmed, you will recall, from the feeling that attempting to pick and choose among the foreseen consequences of one’s actions those one is more and those one is less responsible for looks more like the preparation of a defense than like a genuine attempt to determine what is to be done. Hiding behind the intending-foreseeing distinction seems like an attempt to evade responsibility, and so thinking about the distinction in terms of responsibility serves 39. Anderson & Pildes, supra note 38. I will use this text as my example of an expressive theory here. 40. See id. at 1554, 1564. 41. For a general critique, see Mathew D. Adler, Expressive Theories of Law: A Skeptical Overview, 148 U. PA. L. REV. 1363 (1999–2000). 42. As Adler repeatedly notes, the understanding of expression Anderson & Pildes work with is amazingly broad, so that “To express an attitude through action is to act on the reasons the attitude gives us”; Anderson & Pildes, supra note 38, at 1510. If this is so, it seems that expression drops out of the picture and everything done with it can be done directly in terms of reasons. 43. This may be true of what Anderson and Pildes have in mind when they say that “expressive norms regulate actions by regulating the acceptable justifications for doing them”; id. at 1511. http://journals.cambridge.org Downloaded: 03 Aug 2014 IP address: 134.153.184.170 Intending, Foreseeing, and the State 91 to reduce even further the plausibility of attributing to it intrinsic moral significance. This consideration—however weighty in general—seems to me very weighty when applied to state action and to the decisions of state officials. For perhaps it may be argued that individuals are not required to undertake a global perspective, one that equally takes into account all foreseen consequences of their actions. Perhaps, in other words, individuals are entitled to (roughly) settle for having a good will, and beyond that let chips fall where they may. But this is precisely what stateswomen and statesmen—and certainly states—are not entitled to settle for.44 In making policy decisions, it is precisely the global (or at least statewide, or nationwide, or something of this sort) perspective that must be undertaken. Perhaps, for instance, an individual doctor is entitled to give her patient a scarce drug without thinking about tomorrow’s patients (I say “perhaps” because I am genuinely not sure about this), but surely when a state committee tries to formulate rules for the allocation of scarce medical drugs and treatments, it cannot hide behind the intending-foreseeing distinction, arguing that if it allows45 the doctor to give the drug to today’s patient, the dxeath of tomorrow’s patient is merely foreseen and not intended. When making a policy-decision, this is clearly unacceptable. Or think about it this way (I follow Daryl Levinson here):46 perhaps restrictions on the responsibility of individuals are justified because individuals are autonomous, because much of the value in their lives comes from personal pursuits and relationships that are possible only if their responsibility for what goes on in the (more impersonal) world is restricted. But none of this is true of states and governments. They have no special relationships and pursuits, no personal interests, no autonomous lives to lead in anything like the sense in which these ideas are plausible when applied to individuals persons. So there is no reason to restrict the responsibility of states in anything like the way the responsibility of individuals is arguably restricted.47 States and state officials have much more comprehensive responsibilities than individuals do. Hiding behind the intending-foreseeing distinction thus more clearly constitutes an evasion of responsibility in the case of the former. So the evading-responsibility worry has much more force against the intending-foreseeing distinction when applied to state action than elsewhere.

#### 3] Only consequentialism explains degrees of wrongness—if I break a promise to meet for lunch, that is not as bad as breaking a promise to not kill. Only consequences explain why which is intuitive. Outweighs—a) parsimony—metaphysics relies on long chains of questionable claims that make conclusions less likely b) hijacks—intuitions are inevitable since every framework must take some starting point.

#### Impact calc –

#### 1] Extinction outweighs:

#### A] Structural violence- death causes suffering because people can’t get access to resources and basic necessities

#### B] Mathematically outweighs.

MacAskill 14 [William, Oxford Philosopher and youngest tenured philosopher in the world, Normative Uncertainty, 2014]

The human race might go extinct from a number of causes: asteroids, supervolcanoes, runaway climate change, pandemics, nuclear war, and the development and use of dangerous new technologies such as synthetic biology, all pose risks (even if very small) to the continued survival of the human race.184 And different moral views give opposing answers to question of whether this would be a good or a bad thing. It might seem obvious that human extinction would be a very bad thing, both because of the loss of potential future lives, and because of the loss of the scientific and artistic progress that we would make in the future. But the issue is at least unclear. The continuation of the human race would be a mixed bag: inevitably, it would involve both upsides and downsides. And if one regards it as much more important to avoid bad things happening than to promote good things happening then one could plausibly regard human extinction as a good thing.For example, one might regard the prevention of bads as being in general more important that the promotion of goods, as defended historically by G. E. Moore,185 and more recently by Thomas Hurka.186 One could weight the prevention of suffering as being much more important that the promotion of happiness. Or one could weight the prevention of objective bads, such as war and genocide, as being much more important than the promotion of objective goods, such as scientific and artistic progress. If the human race continues its future will inevitably involve suffering as well as happiness, and objective bads as well as objective goods. So, if one weights the bads sufficiently heavily against the goods, or if one is sufficiently pessimistic about humanity’s ability to achieve good outcomes, then one will regard human extinction as a good thing.187 However, even if we believe in a moral view according to which human extinction would be a good thing, we still have strong reason to prevent near-term human extinction. To see this, we must note three points. First, we should note that the extinction of the human race is an extremely high stakes moral issue. Humanity could be around for a very long time: if humans survive as long as the median mammal species, we will last another two million years. On this estimate, the number of humans in existence in the The future, given that we don’t go extinct any time soon, would be 2×10^14. So if it is good to bring new people into existence, then it’s very good to prevent human extinction. Second, human extinction is by its nature an irreversible scenario. If we continue to exist, then we always have the option of letting ourselves go extinct in the future (or, perhaps more realistically, of considerably reducing population size). But if we go extinct, then we can’t magically bring ourselves back into existence at a later date. Third, we should expect ourselves to progress, morally, over the next few centuries, as we have progressed in the past. So we should expect that in a few centuries’ time we will have better evidence about how to evaluate human extinction than we currently have. Given these three factors, it would be better to prevent the near-term extinction of the human race, even if we thought that the extinction of the human race would actually be a very good thing. To make this concrete, I’ll give the following simple but illustrative model. Suppose that we have 0.8 credence that it is a bad thing to produce new people, and 0.2 certain that it’s a good thing to produce new people; and the degree to which it is good to produce new people, if it is good, is the same as the degree to which it is bad to produce new people, if it is bad. That is, I’m supposing, for simplicity, that we know that one new life has one unit of value; we just don’t know whether that unit is positive or negative. And let’s use our estimate of 2×10^14 people who would exist in the future, if we avoid near-term human extinction. Given our stipulated credences, the expected benefit of letting the human race go extinct now would be (.8-.2)×(2×10^14) = 1.2×(10^14). Suppose that, if we let the human race continue and did research for 300 years, we would know for certain whether or not additional people are of positive or negative value. If so, then with the credences above we should think it 80% likely that we will find out that it is a bad thing to produce new people, and 20% likely that we will find out that it’s a good thing to produce new people. So there’s an 80% chance of a loss of 3×(10^10) (because of the delay of letting the human race go extinct), the expected value of which is 2.4×(10^10). But there’s also a 20% chance of a gain of 2×(10^14), the expected value of which is 4×(10^13). That is, in expected value terms, the cost of waiting for a few hundred years is vanishingly small compared with the benefit of keeping one’s options open while one gains new information.

#### 2] Calc indicts fail: A] Ethics- it would indict everything cuz they use events to understand how ethics have worked B] Reciprocity- they are NIBs that create a 2:1 skew where I have to answer them to access offense while they only have to win one C] Internalism- asking why we value life is nonsensical since it’s intrinsic and we just do.

### 1AC – Underview

#### 1] 1AR theory is legit – anything else means infinite abuse – drop the debater, competing interps, and the highest layer – 1AR are too short to make up for the time trade-off – no RVIs – 6 min 2NR means they can brute force me every time.