# AC – commercial nukes

## Plan

#### I affirm: The appropriation of outer space by nuclear command and control satellites by private entities is unjust.

#### Thus the plan: States ought to ban appropriation of outer space by nuclear command and control satellites by private entities.

#### Space congestion violates non-appropriation.

Steer ’20 [Why Outer Space Matters for National and International Security, Dr. Cassandra Steer, <https://www.law.upenn.edu/live/files/10053-why-outer-space-matters-for-national-and>, January 8 2020, Dr. Cassandra Steer is a Mission Specialist with the Australian National University Institute of Space (InSpace), and a lecturer at the Australian National University College of Law specialising in space law, space security and international law. Dr. Steer has more than a decade of international experience teaching at universities in Australia, Europe, North America and South America, and brings a comparative perspective to all her research and teaching. Dr. Steer was formerly Acting Executive Director at the University of Pennsylvania’s Center for Ethics and Rule of Law, where her major focus was the design and delivery of a high level international conference on “The Weaponization of Outer Space: Ethical and Legal Boundaries”. Previously she has held positions as Executive Director of Women in International Security - Canada, Executive Director of the McGill Institute of Air and Space Law, and Senior Lecturer at the University of Amsterdam. She has a degree in philosophy (UNSW); a degree in International and European Law, a degree in Dutch Law, and a PhD in International Criminal Law, all from the University of Amsterdam. In 2011 Dr Steer was a Fulbright Scholar at Cornell Law School, and she has been a Visiting Scholar at McGill Faculty of Law, University of British Columbia Law School, and the Universidad Torcuato Di Tella in Buenos Aires.] [SS]

Negotiated during the Cold War between the two competing superpowers, the 1967 Outer Space Treaty (OST)39 is the framework treaty for all space activities. Space had become the newest domain in which U.S. and Soviet competition for technological and political dominance played out. Both States tested nuclear and electro-magnetic pulses in space in the early years.40 Very quickly, both realized that the effects of the tests were impossible to contain or control in space due to the unique physical environment, and that they were bringing under threat their own satellites. Despite their competitive relationship, the two States were willing to negotiate an important series of general principles in what amounts to a constitutional document for space activities. The importance of the OST can be seen in its first two articles. Article I guarantees freedom of access to and use of space for all. Article II establishes the non-appropriation principle: “Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” But as recent events indicate, although the OST remains important and relevant in terms of providing restraints and limits on State behavior in space, it cannot prevent States from contesting each other’s capabilities in the space environment. This is especially true given the degree to which modern militaries are dependent on space systems for their daily operations during both peacetime and conflict. Space has become a truly contested environment. According to Article IV of the OST, “the Moon and other celestial bodies shall be used…exclusively for peaceful purposes”; the placement of nuclear weapons or other weapons of mass destruction in orbit around the Earth is prohibited; and the establishment of military bases on the Moon or any other “celestial body,” meaning any natural body in space, is prohibited. With the approval of a budget for the new U.S. Space Command, it appears that military contest in space is on the rise, which may bring under threat the “peaceful purposes” principle of the OST. While Article IV may appear to be far-reaching, it should be noted that it does not reserve the use of space itself for exclusively peaceful purposes, which may be an important but disconcerting loophole in years to come. The preamble of the OST does mention that “space” shall be used for “peaceful purposes” but does not reiterate the all-important adjective “exclusively.” It must be remembered, too, that preambles of treaties are not in themselves binding. They do, however, provide context for interpreting the clauses of a treaty.41 Moreover, the general understanding of the meaning of “peaceful purposes” is that it only prohibits aggressive purposes and does not prohibit other military purposes such as intelligence or even defense against an act of aggression.42 In an age of cross-domain warfare, the ability to target or compromise an adversary’s systems and the fear that adversaries may wish to reciprocate have raised tensions. They have also led to changes in domestic space policies and strategies by all key States and to an escalatory cycleof developing counterspace technologies, or a range of ways in which to target or interfere with each other’s space-based assets. In 2018, Secure World Foundation released a report that details the counterspace capabilities of several countries. The report highlights the growing concern for weaponization against space systems as well as the weaponization of space itself.43 Another way in which space may become more contested in the near future is with respect to commercial rights. The non-appropriation principle mentioned above has come under threat recently, as some see a $5 trillion potential in the space resources mining industry. 44 This industry seeks to extract heavy metals for use in computers and smartphones and, more importantly, to mine the base ingredients that will provide energy and water for future human inhabitants of space stations. These companies have lobbied for national legislation because they saw legal uncertainty surrounding their investments due to the OST prohibitions. In 2015, Congress adopted the Commercial Space Launch Competitiveness Act, which in the eyes of many international lawyers breached the OST. 45 The actstates that any U.S. citizen, which includes U.S. registered companies, shall be entitled to “possess, own, transport, use, and sell (any) asteroid resource or space resource obtained in accordance with applicable law,”46 and also promises to protect the landing rights of any U.S. citizen who first lands on an asteroid. Both promises go against the non-appropriation principle and the freedom of use principle. Luxembourg followed suit in 2017 with the Space Resources Act but went a step further, offering similar legal protection to any corporation with a registered office in Luxembourg,47 thus encouraging a kind of “forum shopping.” There is no doubt that in the near future a legal regime will be needed to support this new industry. However, the steps taken by the United States and Luxembourg have only served to create an even more contested legal environment. The race to access precious resources in space is not only commercially driven; it also is competitive between nation States. In January 2019, China was the first country to successfullyland a rover on the dark side of the moon.48 The Japanese space agency JAXA successfully landed a probe on an asteroid twice in 2019 to collect and analyze subsurface materials. 49 And recently, a spacecraft built by Israeli company SpaceIL crashed upon reaching the moon, which may have been a disappointment to the company and to the nation of Israel. Reaching the moon was an achievement, however. The Israeli Space Agency was providing technical support and is already making plans with SpaceIL for the next attempt.50 While these activities are ostensibly benign and done in the name of scientific exploration, there is historically a high risk of conflict whenever this kind of competition for resources and technological advancement exists. As human activity extends into space, we must recognize this risk and seek ways to regulate our own behavior. c) Space is competitive Space mining is still a technology that is a few decades from being realized. But there are some companies specializing in all things space that have become household names such as SpaceX, Blue Origin, and OneWeb. Although Elon Musk’s company may be most famous for claiming to take us to Mars in the next decades, SpaceX has already pushed many former technological limits in important ways. In 2018, SpaceX successfully launched the Falcon Heavy rocket,51 the largest operational rocket today. This rocket will be able to carry many more satellites in a single launch mission than any competing rocket system, and SpaceX already has a contract to shuttle cargo and soon people to and from the International Space Station (ISS).52 This is important because commercial entities have a much higher risk profile than governments and are able to push the boundaries of technology much faster. Until recently, the United States was paying Russia millions of dollars per launch to shuttle its astronauts and supplies to and from the ISS. Now, a commercial company registered in the United States may soon be doing thatThe competition created by these advances in technology has a positive upward spiral in terms of what is becoming possible in space travel. Both SpaceX and Blue Origin, SpaceX’s main competitor, have been successful at testing launch vehicles that can launch then re-enter Earth’s atmosphere, land at a designated point, and be used again for multiple space flights.53 Falcon 9 will purportedly be able to launch 10 times without any refurbishment.54 This is an incredible feat, and one that redefines what is possible for rocket and spacecraft design. Currently we discard every single rocket and spacecraft that is suitable for human spaceflight after a single flight—the equivalent of discarding every airplane after a single use, except that the costs are much higher. If commercial entities can use a single rocket for multiple flights and to push technological limits in satellite systems, satellite tracking, and human spaceflight, governments may be more inclined to outsource both their civil (NASA) and military space programs to these entities. This makes space a highly competitive sector and brings with it a range of complex issues when it comes to national security and international law, as discussed below in Section III. Beyond these major players, there is an increasing number of commercial entities entering the space market today with offers of services to governments and individuals that are used every day, adding to the competition in space. TV broadcasting, telecommunications, and Internet remain traditional competitive commercial sectors that are dependent on space-based technologies. The most commercially valuable orbits for these services are geostationary, meaning that a satellite orbits the Earth at 36,000km altitude, at the same rate as the spin of the Earth, so that it appears to be stationary above one point on the ground. But the number of orbital slots is limited. Remember that objects are moving at a very high speed in orbit, so this is not about how much “space” there is in space to fill with satellites but rather about how many slots can be assigned within an orbital trajectory to ensure that space traffic management is possible and that the signals being sent from each satellite do not interfere with each other. This is the work of ITU, described above. However, ITU’s task will become even more complicated in the near future, as commercial players such asOneWeb,55 Starlink,56 and others prepare to launch constellations of hundreds or even thousands of satellites in LEO to provide a similar kind of continual Internet or television coverage as those larger satellites in GEO. Lower costs of required technology and the need to launch into GEO result in new competitors to the traditional players that have dominated GEO and new challenges for ITU as well as for space traffic management in general. Beyond these traditional services, more complex services have become critical to our 21st century existence. This includes monitoring climate change, including weather forecasting, multispectral imaging of crops, disaster relief, and ocean temperatures and currents, as well as monitoring the rate of polar ice cap melts. More complex space-enabled defense technologies have also become integral to defense operations, such as missile detection, hypersonics, Radio Frequency interference, protected communications, GPS-guided weapons, and many other precision timing activities. With this increase in space-based services, access to and use of the most valuable orbital slots have become more competitive. Because not all countries have the wherewithal to develop space programs, not all countries have equal access to these commercially valuable orbits and to the technologies offered from space. This may well be in contravention of Article I of the OST, which declares that “outer space…shall be free for exploration and use by all States without discrimination of any kind.” Moreover: “The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all [people] ~~mankind~~.” It is unclear what the legal effect is of the phrase “province of all mankind.” It is an emotive turn of phrase, and it suggests that space is intended to be a global commons. However, it is not a legalterm of art.57 There is, therefore, not much enforceability in this article, which has left some developing countries feeling that they are once again cut out of international competition where the rules are set (and often broken) by the biggest players. For this reason, in 1997 the UN General Assembly adopted the “Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries” (otherwise known as the “Space Benefits” Declaration).58 While General Assembly resolutions are not binding, this declaration represents an important political signal that developing countries are fully cognizant of the competitive nature of space operations, both commercially and militarily, and of the impact upon their economies and their security if they are excluded from these activities. This congestion, contestation, and competition in space explain the recent upsurge of attention towards issues of national and international security in the space domain. Understanding the rising tensions requires consideration of the international legal framework that applies to outer space, as discussed in the next section. III. The Legal Framework Applicable to Military Uses of Outer Space National and international security activities are bound by domestic and international laws, and activities in outer space are no different. There are five core space treaties, all of which were drafted and negotiated within a short period of time, between 1965 and 1979, under the auspices of the UN Committee on the Peaceful Uses of Outer Space (COPUOS): the OST, the Astronaut Agreement (sometimes known as the “Return and Rescue” Agreement),59 the Liability Convention,60 the Registration Convention,61 and the Moon Agreement.62 The geopoliticalconditions of the Cold War are what informed these negotiations as much as the technological advances of the space race, a historical and political factor that needs to be kept in mind. But many other branches of international law apply to activities in outer space and are relevant for space security, as discussed below. A. The Five Core Space Treaties and Public International Law As already mentioned, the OST is a framework treaty provides key general principles and outer limits to behavior in space. The key ones have been discussed above such as nonappropriation principle, the peaceful purposes principle, the freedom of access to and use of space, and the prohibition on the placement of nuclear weapons or military bases in orbit around the Earth or on the Moon. However, it is important to note that Article III of the OST states that activities in outer space “shall be in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security.” Thus the entire body of public international law, including the law of treaties, State responsibility, international environmental law, the law of armed conflict, human rights law, and any other branch of international that may have relevance in space, is applicable.63 As a result, there are clear legal restraints on military activities in outer space based on the legal restraints applicable in any other domain.

## Advantage

#### Commercial nuclear command and control coming now.

Strout ’19 [Can commercial satellites revolutionize nuclear command and control? By Nathan Strout, <https://www.c4isrnet.com/battlefield-tech/c2-comms/2019/07/12/can-commercial-satellites-revolutionize-nuclear-command-and-control/>, July 12 2019] [SS]

During a speech June 26, Air Force Chief of Staff Gen. David Goldfein said that the service — which oversees both the United States’ ground-based intercontinental ballistic missiles, as well as strategic bombers capable of delivering nuclear warheads — was open to the idea of using private sector satellites. “Whether it’s Silicon Valley or commercial space, there’s unlimited opportunities ahead right now for us in terms of how we think differently on things like nuclear command and control,” said Goldfien. “I, for one, am pretty excited about it.” The military has increasingly turned to the commercial sector to expand its capabilities more cost efficiently. For instance, the National Reconnaissance Office — the agency in charge of the nation’s spy satellites — announced that it was looking to expand the amount of satellite imagery it buys from commercial companies. The Air Force has also expressed interest in developing a hybrid architecture for satellite communications, which would see war fighters able to switch between commercial and military satellites as they move through coverage areas. RELATED How the NRO learned to stop worrying and love the commercial imagery The National Reconnaissance Office is dipping its toe into the world of commercial data, awarding three study contracts that will put it on track to start purchasing commercial satellite imagery. By Nathan Strout According to Goldfein, there’s no reason that commercial capabilities could not similarly be applied to nuclear C2. “The work that we’re doing in connecting the force and building a network force around the services in the conventional side has equal applications to the nuclear command and control side, because at the end of the day what we need is resilient capable architecture that keeps the commander in chief connected,” said Goldfien. “So one of the areas that I think we’re going to be able to leverage significantly is the rapid and exciting expansion of commercial space in bringing low-Earth orbit capabilities that will allow us to have resilient pathways to communicate.” Currently, the military relies primarily on the Advanced Extremely High Frequency System for the nuclear sector. With four satellites in orbit and a fifth to be launched later this month, AEHF provides highly secure, anti-jamming communications for the military and national leaders like the commander in chief. It wasn’t clear in Goldfein’s comments whether he was interested in using commercial capabilities to augment, replace or work as a backup to AEHF and other military satellite systems. He did note that the sheer volume of satellites in some commercial constellations provides increased survivability for the network. “We want to get to a point both in conventional and unconventional, or conventional and nuclear, where if some portion of the network is taken out, our answer ought to be, ‘Peh, I’ve got five other pathways. And you want to take out 1,000 satellites of my constellation, of which I have five? Knock yourself out.’ That’s what I see is going to be a significant way that we’re going to be able to leverage,” said Goldfein. The possibility of lowering costs is another major incentive to turning to the commercial sector to begin providing the communications necessary. “What we want to eventually get to is the reversal of the cost curve. Right now it actually costs us more to defend than it takes to shoot. And we want to reverse that so it actually costs them more to shoot than it takes for us to defend,” explained Goldfien. Goldfein pointed to commercial launches as an area where competition had helped drive down costs. “Increased access to affordable launch and smaller payloads that are more capable has caused this rapid expansion of commercial capabilities in space,” he said. “That may be one of the most exciting developments that we have going forward, because industry is going to help us solve many of these problems.”

#### Space race is expanding private sector investment. Space is shifting to cheapsats – US investments are modeled globally.

Grest ’20 [New Space Advantage or Threat for the Military? By Lieutenant Colonel Heiner Grest, DEU AF, JAPCC, <https://www.japcc.org/new-space-advantage-or-threat-for-the-military/>, 2019/2020 Issue of JAPC Journal 29, Lieutenant Colonel Heiner Grest (DEU AF) is currently serving in the C4ISR+S Branch as a Space SME. In 1982 he began his military career as a conscript. In previous appointments he has been working in various command and staff positions in the area of Surface-Based Air and Missile Defence as well as in different national staff positions. He was deployed to the NATO mission in Afghanistan at ISAF HQ. Lieutenant Colonel Grest holds a diploma in business administration from the Bundeswehr University Hamburg.] [SS]

In the early 2000s, a paradigm shift for Space took place. Private actors started to invest heavily in the United States (US) Space sector. Ten years later, major changes occurred worldwide, especially in the two main areas – Space economy and Space technology. Private companies discover Space as a new investing opportunity at their own risk, looking to provide specific Space-based services that have the economic potential to generate substantial financial returns. Modern forms of financing (Crowd Funding, Venture Capital Investments) and business models have been increasingly applied. The headline ‘Space, the final Economic Frontier’ is an accurate characterization of the shifting development direction of Space.1 The trend to smaller satellites (mini, micro, nano, pico, femto2) is the most significant aspect of the technological area. A forecast of expected launches into the Low Earth Orbit (LEO)3 until 2030 shows, that 68% will be small satellites weighing one to 15kg and an additional 25% weighing 16 to 75kg.4 Standardized interfaces and form factors, as well as the use of industry, certified Commercial Off-The-Shelf (COTS) components and pre-qualified parts and systems are common characteristics. Rapid design times of less than one year, paired with shorter mission lifetimes of up to seven years and quick-launch capabilities (newly specified spaceports like ‘Spaceport America’, ‘Mojave Air and Space Port’, ‘Mid-Atlantic Regional Spaceport’) at affordable cost are additional attributes of ‘New Space’. Short delivery times, serial production, a high degree of standardization and lower prices are the results of the previously mentioned changes in Space economy and Space technology areas. Access to Space is easier for an increasing number of countries, organizations and companies. This entails a massive expansion of Space protagonists. More actors from nations and commercial organizations mean more opportunities and more competition. This leads to a new ‘Space Race’ for scientific and technological advantages as well as social and economic challenges. These ‘big steps’ of improvements in Space-based services are a consequence of shorter and quicker decision processes in civilian companies compared to governmental and military organizations. Additionally ‘New Space’, ‘Industry 4.0’ and in particular the Information Technology (IT)-sector (Smart Manufacturing, Industrial Internet of Things, or Cloud Computing) are heavily interacted and dependent on each other. ‘Old Space’ was mainly a research area. ‘New Space’ is characterized by a technological approach of innovation and products, as well as new business models with a high degree of commercialization and decentralization. It is a highly dynamic and visionary process that opens up new commercial areas beyond the traditional aerospace sector. Public funding is still a significant source for large Space programmes, but in the area of small satellites, private funding is rapidly growing.

#### Commercial satellites used for nuclear command and control are coming now – commercial sats uniquely increase risk of extinction via: hacking, spoofing, on the ground interference, foreign parts, miscalc, collisions, and more.

Thompson ’19 [Using Commercial Satellites To Control Nuclear Weapons Is A Bad Idea -- But It's Being Discussed Loren Thompson, 6/23/19, <https://www.forbes.com/sites/lorenthompson/2019/07/23/using-commercial-satellites-to-control-nuclear-weapons-is-a-bad-idea-but-its-being-discussed/?sh=2faaac131dfa>] [SS]

Next month marks the 70th anniversary of the day in 1949 when U.S. intelligence discovered the Soviet Union had conducted its first successful test of a nuclear weapon. From that day forward, most Americans have understood that nuclear war would likely be the worst fate that could ever befall our republic. With the collapse of the Soviet Union and the appearance of new threats, though, the sense of urgency about nuclear security has waned. The infrastructure supporting nuclear deterrence has decayed to a point where all three legs of the strategic “triad”—land-based missiles, sea-based missiles and long-range bombers—need to be replaced. Meanwhile, the architecture used to command and control nuclear forces has changed little since the Reagan era. Against this backdrop, the Chief of Staff of the U.S. Air Force said something curious at a meeting of the Mitchell Institute on June 26. The institute recently produced a report focused on the need to modernize technology for nuclear command and control. General David Goldfein opined that ongoing efforts to network the Air Force were as relevant to control of nuclear forces as conventional forces. In particular, he mentioned the “rapid and exciting expansion of commercial space” as a trend that might facilitate the creation of resilient links for communicating with nuclear forces. I was unaware of the chief’s comments until I saw a story by Mandy Mayfield of National Defense Magazine entitled, “Air Force Wants To Utilize Commercial Satellites For Nuclear Command, Control.” The Air Force is responsible for most of the 200 systems comprising the nuclear command and control system, so General Goldfein’s thoughts have to be taken seriously even if they are just random musings. One advantage to having bombers like this B-52 in the nuclear force is that if circumstances change,... [+] the plane and its weapons can be recalled or retargeted. But that depends on having a command and control system that can communicate with the bomber. One advantage to having bombers like this B-52 in the nuclear force is that if circumstances change,... [+] WIKIPEDIA This particular idea is dangerous. Commercial satellites lack virtually all of the security features that would be necessary to assure control of the nuclear arsenal in a crisis. First of all, they are not survivable against a wide array of threats that China and Russia have begun posing to U.S. orbital assets, ranging from kinetic attacks to electronic jamming to electromagnetic pulse. Second, they are susceptible to cyber intrusion via their ground stations that could impede their performance. Third, they frequently contain foreign components, including in-orbit propulsion technology made in Russia, which might be manipulated in a crisis or simply become unavailable during wartime. Air Force planners presumably know all this, so why would General Goldfein suggest relying on commercial satellites to execute the military’s most fateful decisions? Perhaps for the same reason that the Army is backing into reliance on commercial satellites for its next-generation battlefield networks. There are so many commercial constellations in operation that it seems unlikely America’s enemies could shut them all down in wartime, and they are a lot cheaper to use than orbiting dedicated military satcoms with the requisite capacity and redundancy. “Resilience” has become the watchword for modernizing military space activities, and one way of creating resilience is to proliferate the pathways available for vital communications to a point where adversaries can’t keep up with all the possible options available to U.S. commanders. The same logic is leading technologists to propose large numbers of cheap satellites in low-earth orbit as an adjunct to existing military satcoms. These “cheapsats” wouldn’t be anywhere near as capable as the secure communications assets that Washington has placed in geostationary orbits, but there would be so many that links could be sustained even in highly stressed circumstances, such as the “trans-attack” phase of a nuclear war. Or at least, so the reasoning goes. There’s a lot of technological ferment within the Air Force and Army these days, and it isn’t all high-caliber. Planners understand that command and control networks need to be modernized with an eye to greater resilience and functionality, and that they will have to operate during a new era of great-power military competition. So the threats to their effectiveness likely will be diverse and demanding. Maybe a lot of low-cost nodes could be more resilient than a handful of high-end systems. Maybe. But the idea of relying on commercial satellites for command and control of nuclear forces takes this reasoning a step too far, because market forces preclude any of the hardening and other protective features that might be required in dedicated military birds. For instance, an adversary might suppress much of the space-based commercial capability by detonating a handful of nuclear weapons in space. There would be only modest blast and heat effects in the vacuum of space, but the resulting electromagnetic pulse would travel thousands of miles until it was captured by conductive material like antennas on commercial satcoms, potentially frying delicate electronic equipment. Even if this scenario did not unfold, think of all the ways an adversary like China might seek to interfere with commercial satellites through their ground stations and uplinks, such as insertion of malware via hacking and jamming of signals. Military satcoms have been configured to counter these kinds of exploits while withstanding nuclear effects such as scintillation. But it would cost an arm and a leg to build commercial satellites with such features so nobody does. Their reliability in wartime is thus highly suspect. It isn’t hard to see where General Goldfein might have been coming from with his remarks at the Mitchell Institute. The packet-switching protocol that underpins the Internet was originally conceived, at least in part, to fashion a more resilient way of sustaining connectivity than the traditional circuit-switched telecom system. It would have functioned better in a nuclear war. But the Internet was created under military oversight and today’s commercial satcoms were not. We can’t even guarantee the security of the supply chain from which key components are obtained. So let’s not get too carried away with all the fashionable talk about networking the Air Force. Yes it’s a revolution, but when it comes to command and control of nuclear weapons, we need to be real careful about how we define progress.

#### Increases in satellite numbers increases risk of hacking.

Culpan ’21 [Tim Culpan November 2, 2021, The Next Big Hack Could Come From the Stars, <https://www.bloomberg.com/opinion/articles/2021-11-02/satellites-vulnerable-as-the-next-big-hack-could-come-from-the-stars>] [SS]

But space risk isn’t limited to military or government systems. The advent of commercial operators such as Elon Musk’s SpaceX, Blue Origin LLC, and Orbital Sciences Corp., 1 the entry of more nations into the space race — including China and India — and the development of lighter, cheaper satellites means the number of objects flying overhead will continue to rise. In fact, half of the more than 4,000 operational satellites are for commercial rather than government or military use, and 94% of those launched last year were categorized as small, meaning less than 600 kilograms. One likely trend is for companies to deploy satellites for their own use as part of a global virtual private network, allowing them to bypass telecom operators and even government curbs. And just as a greater number of internet-connected computers increased the number of hacks on land, so too comes the inevitability that more networks in orbit will be breached either directly or through the ground stations used to track and communicate with them. “What that’s going to mean is a proliferation of cybertech to protect those networks,” Chuck Beames, chairman of York Space Systems LLC, told the NIST conference. While companies will rush to cash in on this new goldrush in space, 30 years of internet history shows us that businesses and governments may not truly take security seriously until a massive hack occurs and satellites are breached or lost. Beames, a former space and intelligence officer in the U.S. Air Force, likens the current rapid pace of growth in the satellites industry to the U.S. program that landed the first humans on the moon. “At least in the Apollo era we knew we were going to the moon,” he said. “Here, we really don’t know; here it is more of a ~~wild, wild west~~ than ever.”

#### More cheapsats don’t work – increases risk of hacking.

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

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

#### Cost cutting drives cyber vulnerabilities.

Verco 21, Edward. "Satellites are Cyber Insecure: We Need Regulation to Avoid a Disaster." ANU Journal of Law and Technology 2.2 (2021): 57-94. (a law graduate of the University of Adelaide and a lawyer admitted to practice in the Supreme Court of South Australia. He is currently employed as a Contracts Management Associate at Lockheed Martin Australia, and his research areas of interest include regulation in the space and cybersecurity sectors, as well as the defence industry in general.)//Elmer

C Perilous Commercial Practices The perilous actions of many commercial entities compound the cyber vulnerabilities of satellites. Malicious actors target satellites as commercial entities favour lower operational costs over increased cybersecurity spending.65 This vulnerability is particularly evident in smallsats as the low-cost, ‘off-the-shelf’ technology required for production correlates directly to the absence of onboard cybersecurity services.66 It is also suggested that as the cost of developing smallsats decreases, their complexity and cost to harden for cybersecurity increases.67 Therefore, adequate cybersecurity often out-costs the satellites themselves.68 Even for companies with intentions to implement adequate cybersecurity, it often becomes uncommercial and hence not sufficiently achieved.69 Therefore in practice, many private commercial entities, knowingly or otherwise, develop their satellites as vulnerable to cyberattacks.70 Many cybersecurity non-specialists and satellite enthusiasts in the commercial sector simply do not appreciate the cyber-related risks associated with launching smallsats.71 This is partially because smallsat operators traditionally favour innovation over management solutions.72 This reflects the argument that commercial entities recognise a dramatic cyberbreach of a satellite is yet to occur and therefore falsely believe against the essentiality of protecting against hypothetical attacks.73 The increasing volume of satellites in orbit increases the risk associated with the collision of any two satellites, which is also a risk for corporations.74 This information is presented in Table 7 and emphasises the increasing requirement for hardened cybersecurity.

#### Lack of sovereign immunity makes commercial sats a more tempting target.

Dunnmon ’16 [Nuclear Command and Control in the Twenty-First Century: Maintaining Surety in Outer Space and Cyberspace, Jared Dunnmon, 2016, <https://www.jstor.org/stable/resrep23162.5>] [SS]

Jurisdiction and Sovereign Immunity Jurisdiction, which refers to the “authority to prescribe, enforce, and adjudicate,” is allocated for cyber activities to any state “over (a) persons engaged in cyber activities in its territory, (b) cyber infrastructure located on its territory, and (c) extraterritorially, in accordance with international law.” Importantly, national security threats including “any cyber operation that interferes with a state’s military defensive systems (early warning radar and air defense)” constitute a valid justification for extraterritorial action. Further, the Tallinn Manual specifically states that “the fact that a State is capable of taking control of a piece of cyber infrastructure does not affect jurisdiction—specifically, a state can’t take control of [a] commercial drone operated by another state over international waters.” Logically, this should extend to satellites in the internationally accessible space domain as well. Sovereign immunity fundamentally safeguards the right of a government to control its own sys- tems. Specifically, “Sovereign immunity provides that assets controlled by the government of one sovereignty cannot be taken control of by another sovereignty without a violation of sovereignty— this includes vessels, aerial assets, and space assets.” The jurisdictional and sovereign immunity arguments above indicate that any action taken against a satellite owned by a particular country would be generally prohibited outside of wartime. How- ever, the GoE proposed several specific exceptions to this rule. First, in order to enjoy sovereign immunity, a particular platform must be exclusively performing government functions. In particu- lar, the GoE makes the point that satellites with different transponders for commercial and non- commercial traffic do not have sovereign inviolability, meaning that countries could reasonably argue they are not violating U.S. sovereignty by interfering with satellites that perform key NC3 functions, but have other nongovernmental purposes as well.37 Thus, even if broadly accepted, this specific portion of international law would not seem to provide a strong formulaic disincentive to cyber attacks on either dedicated NC3 communications satellites or those (e.g., AEHF) perform- ing multiple functions including NC3. This is particularly true given that the Talllinn Manual only stipulates that a state should not “knowingly allow cyber infrastructure located within its territory or under its exclusive government control to execute operations harmful to another state.” The question of what states should reasonably be expected to know about cyber infrastructure within their borders remains open.38

#### Three internal links to hacking: ground based terror, communication hijacks, and space attacks.

Greenbaum 1/8 [Who is going to stop space terrorists?, Dov Greenbaum, 1/8/22, <https://www.calcalistech.com/ctech/articles/0,7340,L-3926737,00.html>] [SS]

Generally, its thought that there are at least three major types of space terrorism. The first is through attacking the ground-based operations of spacecrafts and their crews. A security breach at a launch site is a real and constant fear, and was portrayed in the science fiction film Contact. In 1972, the Palestinian terror group Black September threatened to murder and kidnap the crew and families of the Apollo 17 mission, and in 2003, NASA increased security around its shuttle launch because of fears that Ilan Ramon might be a target. The second possible manifestation of space terrorism is through the hijacking or jamming of radio communication between satellites and ground. Reportedly, in 2002 and 2004 the Falun Gong group, a religious movement in in China, allegedly hacked transmissions from Chinese satellites. The Sri Lankan militant group, the Tamil Tigers, also successfully did this to an Intelsat communication satellite in 2007. Subsequently, there have also been many other incidences of hacking that allowed rogue groups to access and control satellites in outer space. Hacking a satellite can do more than simply jamming or pirating the legitimate signal; even a small satellite at supersonic speeds can potentially be repurposed into a putative space weapon by an unscrupulous faction, especially in command and control of that satellite isn’t protected and encrypted. A cybersecurity expert even provided a step-by-step hypothetical outline for hacking a Starlink satellite. A third way that terrorists could threaten space resources is through a direct in-space attack on a spacecraft. Arguably, this might be the most difficult to prevent. The Union of Concerned Scientists has thoroughly documented the numerous continuing efforts by nation states, stretching back more than half a century, to develop destructive anti-satellite weapons (ASATs). These were often overt programs: in 1964 U.S. President Lyndon Johnson gave a speech describing American efforts to counter potential bomb-carrying Soviet satellites, effectively publicly launching Program 437, a nuclear ASAT system. There has subsequently been a resurgence in ASAT efforts worldwide since the 2000s, which may or may not include the US Air Force’s secretive X-37B mini shuttle as well as ground-based ASAT lasers.

#### Debris and miscalc leads to extinction via nuclear command and control satellites.

Acton and McDonald ’21 [Nuclear Command-and-Control Satellites Should Be Off Limits, By JAMES ACTON and THOMAS MACDONALD DECEMBER 10, 2021, <https://www.defenseone.com/ideas/2021/12/nuclear-command-and-control-satellites-should-be-limits/187472/>, James M. Acton is a senior associate in the Nuclear Policy Program at the Carnegie Endowment for International Peace in Washington.] [SS]

When Russia blew up an old satellite with a new missile on November 15, it created an expanding cloud of debris that will menace the outer space environment for years to come. Hypersonic fragments from the collision with Moscow’s ground-launched, anti-satellite weapon risk destroying other satellites used for communications, meteorology, and agriculture. They even pose a danger to China’s Tiangong Space Station and the International Space Station, where personnel—including Russia’s own cosmonauts—were forced to don spacesuits and flee into their escape capsules ahead of approaching debris. But the greatest danger that this careless stunt highlighted is to a different potential target: high-altitude satellites used for nuclear command and control. Those critical satellites face the threat of being attacked by co-orbital anti-satellite weapons, that is, other spacecraft with offensive capabilities. Destroying a nuclear command-and-control satellite, even unintentionally, could lead a conventional conflict to escalate into a nuclear war. As such, the United States, China, and Russia have a shared interest in ensuring the security of each other’s high-altitude satellites. Satellites are integral to the United States’ nuclear command-and-control system. They would be the preferred means to transmit a presidential order to use nuclear weapons and would provide the first warning of an incoming nuclear attack. Russia uses satellites for similar purposes, even if it appears not to rely on them quite as much as the United States. While little is publicly known about China’s nuclear command-and-control system, the U.S. Department of Defense has assessed that China is in the process of developing a space-based early-warning system. The most important nuclear command-and-control satellites—those for communications and early warning—are located in high-altitude orbits. Fortunately, most are strung out about 22,500 miles above the equator—far above the debris from Russia’s ground-launched anti-satellite weapon test. These satellites, however, are growing more vulnerable, particularly to co-orbital anti-satellite weapons. Nuclear command-and-control satellites might be attacked deliberately, as the prelude to a nuclear war. In a conventional conflict, if China, Russia, or the United States decided to use nuclear weapons first—or believed that its opponent was about to do so—it might try to degrade the adversary’s nuclear command-and-control system preemptively. China, for example, might attack U.S. early-warning satellites to weaken the United States’ homeland missile defenses. Conversely, the United States might target Chinese communication satellites to interfere with Beijing’s ability to wield its nuclear forces. In a conventional war, however, nuclear command-and-control satellites might be attacked and threatened for altogether different reasons—creating the risk that nuclear war might be triggered inadvertently. The United States, in particular, is deeply reliant on satellites to enable conventional operations. Moreover, most, if not all, nuclear command-and-control satellites also support nonnuclear missions—making them tempting targets even in a purely conventional conflict. For example, some U.S. satellites transmit orders to both U.S. conventional and nuclear forces. Russia might attack these satellites to try to undermine the United States’ ability to prosecute a conventional war, but with the added and unintended effect of degrading the U.S. nuclear command-and-control system. Washington would be hard pressed to determine the intent behind such attacks. It could easily misinterpret them as preparations for a nuclear war and respond accordingly. It might threaten to use nuclear weapons unless its adversary backed off. In fact, the Trump administration’s nuclear policy explicitly threatened the use of nuclear weapons in precisely this circumstance. The Biden administration can and should remove this threat as part of its ongoing Nuclear Posture Review. To make matters worse, it might not take actual attacks against nuclear command-and-control satellites to spark this kind of escalation. Satellites in high-altitude orbits are periodically moved to different positions to optimize their performance. Especially in a conventional conflict, a repositioning operation that led one spacecraft to approach a nuclear command-and-control satellite might appear to the latter’s owner as the beginning of an attack against its nuclear command-and-control system. Once again, the potential consequences could be catastrophic. “Keep-out zones” around high-altitude satellites would be a straightforward way to mitigate these risks. Specifically, the United States, China, and Russia should agree not to maneuver their spacecraft within a certain distance—we propose 430 miles—of one another’s high-altitude satellites. (Exceptions could be made to accommodate occasional repositioning under tightly controlled conditions. Most importantly, the state conducting the maneuver should warn the others at least 24 hours in advance.) In a conflict, if the belligerents had no intention of attacking each other’s high-altitude satellites, they would have strong reasons of self-interest to respect keep-out zones. If a state did seek to launch such attacks, keep-out zones couldn’t stop it from doing so—but they would buy time that the targeted state could use to try to evade the attack. Negotiating keep-out zones during a conflict, when they would be most useful, would be next-to impossible. So, Washington, Beijing, and Moscow shouldn’t wait—they should start negotiating right away.

#### Collisions with nuclear command satellites specifically lead to miscalc and escalation – magnified by Kessler.

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

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

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

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

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

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

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

#### Nuke war causes extinction.

* Checked

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

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

#### Increased space flights wrecks ozone layer.

Larson 16 (Erik J L Larson (PhD in Atmospheric and Oceanic Studies, Postdoctoral fellow in Organismic and Evolutionary Biology at Harvard, Research Scientists at University of Colorado Boulder), Robert W Portmann (Researchesr from Chemical Sciences Division at NOAA), Karen H Rosenlof (NOAA research scientist), David W. Fahey (Directo of the Chemical Science Division at NOAA), John S Daniel (Chemical Sciences Division NOAA), and Martin N Ross (The Aerospace Corporation). “Global atmospheric response to emissions from a proposed reusable space launch system” Earth’s Future. Volume 5. Issue 1. November 16, 2016. Accessed August 12, 2019.)

1 Introduction

It is often assumed that H2‐fueled rocket engines have no impact on the global atmosphere since the only significant emission is H2O. However, in great enough quantities the emissions from these rockets can alter the stratosphere in many ways. H2O emissions can change stratospheric temperatures and alter the photochemistry controlling ozone (O3). Furthermore, rockets burning liquid H2 and oxygen (O2) use an H2‐rich mixture rather than a stoichiometric ratio for enhanced thrust and emit H2 and HOX in the plume in addition to H2O. Enhancements in HOX can catalytically destroy O3 [Crutzen, 1969]. Superheated air in the engine and exhaust plume result in the production of NOx, which also catalytically destroys O3 [Johnston, 1971; Ross et al., 2009; Lee et al., 2010]. NOx is also created in the mesosphere due to the heat produced during rocket reentry [Park, 1976]. Here we use the Whole Atmosphere Community Climate Model (WACCM) [Marsh et al., 2013] and the 2D National Oceanic and Atmospheric Administration/National Center for Atmospheric Research (NOCAR) model [Portmann and Solomon, 2007] to evaluate the potential effects of high Skylon launch rates on the climate and stratospheric O3.

2 Calculating Emissions

Vertical profiles of NOX, H2, and H2O emitted during a Skylon rocket launch and reentry are estimated based on trajectory data from Reaction Engines Ltd. [http://www.reactionengines.co.uk/tech\_docs.html]. Skylon rockets have two combustion phases as they ascend through the atmosphere. The first phase is air breathing from the surface to 28.5 km. During this phase the engines act as H2 burning jet turbines, combusting H2 with ambient air. The main exhaust is H2O, which can be calculated directly from the amount of H2 fuel consumed. During the second phase from 28 to 80 km the engines run in rocket mode, burning H2 and liquid O2. The H2O produced in rocket mode is calculated from the mass of fuel used assuming a 6:1 mass ratio of oxygen to hydrogen; this assumption is made to be consistent with the fact that many rockets burn hydrogen‐rich fuel for greater thrust (stoichiometric ratio for combustion is 8:1) [Colasurdo et al., 1998]. Although the excess H2 likely oxidizes into H2O in the plume due to high temperatures, H2 emissions are also considered in our simulations as a bounding condition. The bounding cases assume either all or none of the excess H2 is oxidized to H2O in the plume. As discussed in the results, the intermediate combustion products HOX and H2O2 were tested with the NOCAR model and found not to be important contributors to O3 destruction. Thus they are not included in WACCM simulations.

H2 and H2O emission profiles (kg/km/flight) are interpolated with 1‐km vertical resolution (Figure 1a). The spike in emissions at 28 km is due to the spacecraft transition into rocket mode. The total amount of H2O produced from a single flight is estimated to be 6 × 105 kg (assuming completely oxidized H2) with about 4 × 105 kg emitted into the stratosphere (above 17 km). The projected 105 flights per year would deposit 4 × 1010 kg of H2O in the stratosphere every year. To get a sense of how large a perturbation this represents, the yearly emissions are compared to the total amount of stratospheric water. Assuming a uniform mixing ratio of 4.5 parts per million by volume (ppmv) of H2O above 100 hPa (17 km), there is 1.5 × 1012 kg of H2O in the stratosphere. The projected 105 flights would emit approximately 3% of the current stratospheric H2O burden every year. Assuming a constant flight frequency and a 3‐year lifetime of the H2O, when emitted above 100 hPa, this would increase globally averaged stratospheric H2O by approximately 9%. The actual steady‐state perturbation of H2O due to these emissions in WACCM above 100 hPa is 10%; however, the local perturbation would be much larger and increase with height.

Estimating a NOX emission profile for the Skylon vehicle is problematic. Several flight phases must be considered: H2 burned with air as a jet fuel, H2 burned with liquid oxygen as a rocket fuel, and heating of air due to aerodynamic interactions. It is important to note that we consider the shock heating of air during reentry as an emission. When air is heated to temperatures exceeding 1800 K, as in a jet engine or behind the shock wave around a spacecraft during reentry, NOX is produced through the extended Zeldovich mechanism [Zeldovich et al., 1947]. This mechanism is exponentially dependent on temperature so that representative temperatures are required in order to calculate the thermally produced NOX. Detailed estimates of the NOX emissions have not yet been calculated by the rocket designers [R. Varvill, 2015, personal communication]. For this study, reliable estimates of NOX emissions from jet and rocket engines are scaled to the Skylon vehicle with the caveat that our estimates have high uncertainty. Lee et al. [2010], using the International Civil Aviation Organization (ICAO) emissions databank, estimated that 14 ± 3 g of NOX are produced for every kilogram of fuel combusted in jet engines. Emissions may be lower at supersonic speeds and are also a function of the temperature difference between high pressure (∼100 atmospheres) liquid H2 and jet fuel. Most of the engines in the ICAO databank use jet fuel with a 2:1 H:C ratio. The higher fuel density must be taken into consideration in the NOX estimates from H2 combustion. For complete combustion in the jet engine air‐burning phase, two hydrogen and one carbon atoms (14 g/mol) react with three oxygen atoms. For a pure H2 fuel at complete combustion, three oxygen atoms will oxidize six hydrogen atoms (6 g/mol). Thus, from a stoichiometric perspective, burning 1 kg of jet fuel requires as much air as 6/14 kg of H2 fuel. Thus 6/14 kg of H2 fuel is assumed here to produce 14 g (11–17) of NOX during the air‐burning phase. Alternatively, using the heat of combustion per fuel mass to scale the NOX production gives consistent results that are within the uncertainty range. The total production of NOX during the air‐burning Skylon ascent is estimated to be 1400 ± 300 kg, although we acknowledge this range does not encompass all the uncertainties in the assumptions.

Zero NOX emission is assumed during the liquid oxygen burning phase of ascent. NOX would only be produced in H2‐fueled rocket engines in significant amounts (>0.01% of total flow) in afterburning reactions, which occur when ambient air is entrained into the hot underoxidized plume [Brady et al., 1997]. Afterburning is generally not a significant factor for rocket engines above the tropopause. Therefore it is assumed that during this phase of flight, at altitudes greater than 28 km, significant NOX production is unlikely.

Finally, NOX is also produced in the shock wave during spacecraft reentry. Using analytic approximations and a numerical integration, Park [1976] calculated that the NOX produced during a Space Shuttle reentry is 4.5–9% of the mass of the spacecraft. Park and Rakich [1980] later updated this value to 17.5 ± 5.3% of the spacecraft mass, with a peak emission at 68 km. While the predicted Skylon mass is comparable to the Space Shuttle mass, the Skylon reentry flight path is different from that of the Shuttle, and this would affect NOX production. Skylon is expected to require more time above 5 km/s during reentry than the Shuttle did, which would tend to produce more NOX. However, these high speeds would occur at a higher altitude than for the Space Shuttle, which would tend to decrease NOX production [Park, 1976]. Given the compensating factors, and in the absence of actual flight data, Skylon is assumed to have the same vertical profile of reentry NOX emission as the Space Shuttle, with the total values scaled by vehicle mass. The estimated total amount of NOX produced during reentry is therefore 9880 ± 2760 kg per flight. This range does not encompass the uncertainty in all the assumptions made, and thus the stated value of NOX production is considered only representative. The estimated altitude profiles of NOX emissions from the ascent and reentry phases are shown in Figure 1b.

Park [1976] compared NOX formation between the Space Shuttle and meteorites based on the total mass entering the top of the atmosphere. Assuming the natural formation rate of upper atmospheric NOX is from 5.7 × 107 kg of meteorites producing their weight in NOX every year [Park, 1976], then 105 Skylon flight reentries would produce a factor of 20 more NOX than natural production from meteorites. Meteorites produce roughly 5× more NOX per mass than the Space Shuttle due to their much higher velocity when entering the atmosphere.

3 Model Descriptions

Table 1 summarizes the simulations that are run and includes the rocket emissions considered in each case. The Community Earth System Model (CESM v1.0.6) using the WACCM model [Marsh et al., 2013] is used to simulate these emissions. WACCM was chosen because the model domain extends higher than most climate models (140 km) and it can include interactive chemistry. Simulations are run with fixed sea surface temperatures and perpetual year 2000 anthropogenic emissions and CO2 concentrations at 1.9 × 2.5° resolution with 66 vertical levels using a hybrid sigma coordinate system. Cases with different emissions and flight frequency are compared to a zero‐emission control case. Vertical emission profiles of H2O, H2, and NOX are included into two model horizontal grid cells spanning the equator. An equatorial launch is assumed because the energy required to put a rocket into orbit increases with launch latitude. Sensitivity tests are also run with the NOCAR model as these tests would be computationally expensive using WACCM. The NOCAR model is used to evaluate the sensitivity of our results to launch location, chlorine and greenhouse gas concentrations, emissions products, and number of launches per year. Including emissions into global model grid cells effectively dilutes the concentration of emissions compared to an actual rocket plume. The size of the equatorial grid cells is roughly 200 × 250 km2, which is about 1000 times larger in area than a rocket plume. The concentrations used in the model are thus 1000 times less than exist in the initial rocket plumes. Another assumption is that the emissions fill the grid cell before any chemical changes take place. Studies such as Lohn et al. [1999] and Ross et al. [1997] have looked into O3 depletion and other atmospheric effects inside rocket plumes. Lohn et al. [1999] found that solid rocket motor exhaust plumes from Titan class rockets destroy all of the O3 in the wake of the rocket. These predictions were verified by in situ plume measurements [Ross et al., 1997]. The ozone‐depleted regions are several square kilometers in size and last about an hour before dissipating to background concentrations. It is expected that plume chemistry will affect the composition and abundance of the rocket emissions that exist at the grid scale after the plume disperses. However, for the Skylon emissions, the amount of excess H2 emitted during rocket mode that is oxidized in the plume versus the amount present at the grid scale is unknown. Thus, the limiting cases are explored, one in which all the excess H2 is immediately oxidized (simulation 4) and one in which it all persists to the grid scale (simulation 5). The sensitivity of two of our assumptions are tested with the NOCAR model; specifically that H2O and H2 are the only relevant HOY species emitted, and secondly, that year 2000 greenhouse gas and chlorine levels are appropriate choices for this study. Some hydrogen will be emitted as HOY species, although it is likely to be very small. Swain et al. [1990] measured H2O2 in hydrogen burning engine exhaust and found it to be undetectable under normal operating conditions and up to 1000 ppmv under extremely inefficient conditions when the fuel to air ratio was around 5. Despite this, we simulate some of the hydrogen emitted as HOX or H2O2 using the NOCAR model. Note that due to the family chemistry scheme in NOCAR, we cannot emit OH directly, but instead emitted an equivalent quantity as HOX, which should produce the same amount of ozone destruction. The H2O2 can be emitted directly because it is long lived. Table 2 displays the global mean total column ozone changes relative to simulation 7 (Table 1) with and without these emissions. Including these emissions, even at relatively high amounts (1% mole fraction), results in essentially no change in O3 loss. The global mean total column ozone loss in these simulations is within 0.05 Dobson Units (DU) of the base case (simulation 7). Thus, these species (OH and H2O2) are not important to include in the WACCM simulations. The WACCM simulations assume year 2000 conditions; however, we note that flights of the Skylon space plane, especially at rates assumed in this paper, are decades away at best. Future levels of greenhouse gases and chlorine are estimated to be much higher and lower, respectively, than in the year 2000 [IPCC, 2013]. Thus, we also test the sensitivity of ozone loss on greenhouse gas and chlorine levels with the NOCAR model. These results are shown in Table 3. Using year 2100 chlorine levels increases the global total column ozone loss by 6% compared to simulation 7. Under a lower chlorine concentration, NOX increases destroy more ozone due to reduced formation of chlorine nitrate. However, water vapor increases induce less ozone destruction from polar stratospheric cloud (PSC) increases due to decreased chlorine. The net effect is increased ozone losses from rocket emissions. Increasing greenhouse gas levels to year 2100 offsets some of this extra loss and the sign of the final change depends on the relative amounts of the three greenhouse gases in the scenario. CO2 increases cause the rocket‐induced change to increase, while CH4 and N2O increases cause it to decrease. However, the changes are relatively small in all cases using the NOCAR model and we consider our WACCM simulations using year 2000 values as representative of any time between now and year 2100.

4 Stratospheric Ozone and Temperature Perturbations

Our base case scenario for 105 flights per year is simulation 7 in Table 1, which includes NOX, H2, and H2O emissions. The components of the emissions are modeled separately in simulations 1–6 to better understand the changes to O3. Plots of the O3 change due to the individual emission components can be found in the supplement. Preliminary WACCM simulations using a different emissions profile than Figure 1 and 104 flights per year did not produce any statistically significant global changes to the atmosphere. At 105 flights per year, as seen in simulation 7, stratospheric NOX concentrations increase by 0.3–3 parts per billion (ppb) and stratospheric H2O increases by 0–3 ppm. At this and higher flight frequencies significant changes occur in the stratosphere as shown in Figure 2.

At 105 flights per year O3 decreases significantly at all latitudes at altitudes above about 25 km and above 20 km at the poles as seen in simulation 7 (Figure 2a). The overlaid hatching (Figure 2a) indicates statistical significance from two different tests. As seen in Table 1, this depletion in O3 is predominantly due to catalytic destruction by NOX [Crutzen, 1970]. Our simulations with just NOX emissions (simulation 1) had almost the same amount of ozone destruction as the simulation with NOX, H2O, and H2 (simulation 7), and much more than simulations without NOX (simulations 4 and 5). Both sources of NOX, air‐breathing ascent and reentry, contribute to the destruction of O3 as seen in simulations 2 and 3. However, the models disagree about the relative contribution from these two emission sources. The NOCAR model attributes more O3 loss than WACCM does to NOX created in the mesosphere during reentry (simulation 2). In addition, including H2 emissions may further reduce total O3 compared to H2O emissions alone in WACCM simulations. Note that including H2 emissions does not exacerbate O3 loss in the NOCAR runs; in fact O3 loss is lessened between simulations 4 and 5. Moreover, assuming H2O emissions alone seems to lead to an increase in O3 in WACCM; however these results are within the range of internal variability.

Below this region of destruction by NOX is a global layer of O3 enhancement between 18 and 24 km (Figure 2a), which can be explained through smog chemistry. The air‐breathing ascent emits NOX throughout the troposphere and in the lower stratosphere at the equator. NOX emissions in the troposphere produce O3 through smog chemistry [Liu et al., 1980], which can also occur in the lowermost stratosphere. In addition ozone increases can occur from the “self‐healing” effect (i.e., increased O3 production from increased UV penetration due to O3 losses above). O3 increases in the tropical tropopause region are not seen in the simulation with only reentry NOX (see Figure S2, Supporting Information). There are other competing processes due to the H2O emissions that affect O3 as well. The emitted H2O radiatively cools the stratosphere by a degree or less below 45 km and 1–3° above (Figure 2c and 2d). Although Figure 2 includes NOX and H2 emissions, similar cooling is present in simulations only considering H2O emissions (see Figure S4). Lower temperatures cause chemical reaction rates between O and O3 to become slower, thereby suppressing O3 loss and causing a positive anomaly below 40 km. Above about 40 km, this effect is more than offset by increased depletion of O3 due to an enhanced HOX catalytic cycle [Crutzen, 1969; Lary, 1997]. This is roughly consistent with modeling efforts of Evans et al. [1998], who found that increased CO2 and H2O in the upper atmosphere lead to net O3 loss above 50 km and production below. They also see some net loss around the tropopause, again roughly consistent with WACCM and the NOCAR model simulation 4, which only assumes H2O emissions (see Figure S4). Similarly, Tian et al. [2009] found that an increase of 2 ppm of H2O in the stratosphere affected O3 both chemically and radiatively. They found that an increased HOX cycle destroys stratospheric O3, while the radiative cooling from increased H2O increases stratospheric O3. However, when cooling exceeds 5 K in their model, the total column O3 at high latitudes decreases rather than increases. Furthermore, Stenke and Grewe [2005] also found that increased stratospheric H2O in their model increased HOX chemistry and destroyed O3; however the enhancement in OH decreased the efficiency of O3 destruction by the NOX cycle. The global total column O3 abundance in simulation 7 decreases by 1.4–1.5 DU (Table 1), with the highest O3 destruction occurring in the Antarctic (Figure 3a), although destruction in the tropics contributes more to the globally averaged total column O3 loss due to the larger area of the tropics. The polar regions are highly variable in WACCM as indicated by the gray shading. The red line in Figure 3 indicates results from the NOCAR model. The NOCAR model has more O3 loss than WACCM at the poles; however, the latitudinal dependencies are similar. NOCAR has annually repeating planetary and gravity wave fluxes in the troposphere, which limits the interannual variability, and thus we do not add uncertainty ranges due to variability. Simulation 8 (Figure 3b) has 3× higher flight frequency than simulation 7 and roughly 3× more O3 loss at most latitudes. However, in the Arctic, simulation 7 (Figure 3a) shows no ozone loss on average, while simulation 8 (Figure 3b) shows 7 DU of ozone loss. This difference is likely a consequence of cooler stratospheric temperatures having a nonlinear effect on O3 destruction [Tian et al., 2009]. Tian et al. [2009] found that chemical and radiative effects of a 2 ppmv increase of H2O lead to net increases in total column O3 in the Arctic. However, when the radiative cooling exceeded 4 K, they found that the total column O3 decreased. This is consistent with our findings from WACCM. Simulation 7 (Figure 3a) has no net O3 loss in the Arctic, however, simulation 8 (Figure 3b), which has a higher flight frequency and cooler stratospheric temperatures (see Figure S7), has significant net loss. The seasonal cycle of O3 destruction in WACCM (Figure 4a) due to constant rocket emissions throughout the year is shown along with the globally averaged O3 anomaly (Figure 4b). The largest O3 depletion occurs in austral spring in the Antarctic. WACCM (Figure 4a) has slight positive O3 anomalies for much of the year in the northern mid latitudes, in the Arctic, and in the Antarctic summer that are not seen in the NOCAR model (see Figure S8). However, the NOCAR global mean total column O3 anomaly is within the uncertainty of the WACCM simulation in all seasons (Figure 4b). Ozone loss in the polar regions has large variability in WACCM simulations (Figure 4c) which leads to the large uncertainty ranges near the poles, as seen in Figure 3.

The relationship between O3 column depletion and rocket launch frequency is quasilinear. Emissions from 105 flights per year decrease O3 by 1.4–1.5 DU, 3 × 105 flights per year decrease O3 by 3.5–3.9 DU, and 1 × 106 flights per year decrease O3 by 11 DU. Results from the NOCAR model agree well with the WACCM results. The NOCAR model also indicates that moving the launch location to any latitude outside the tropics produces similar globally averaged column O3 anomalies, although the maximum anomaly tends to be at the pole in the hemisphere of emissions (not shown). Emissions near the equator have similar maxima at the two poles in the NOCAR model.

#### Ozone depletion causes extinction – empirics

Martin 18 (a Science Reporter for Express.co.uk, Sean, “Ozone layer DECAYING as scientists fear Earth 'heading towards MASS-EXTINCTION'”, via Express, Feb 8, <https://www.express.co.uk/news/science/916405/ozone-layer-destroyed-recovering-mass-extinction-dinosaurs>)

News in January broke that the ozone was on its way to recovering as Earth cuts down on CO2 emissions. However, on closer inspection, scientists now say the ozone layer – the part of the atmosphere which protects us from harmful radiation – is continuing to deplete over major cities, and is only really recovering over Antarctica. Chemicals known as CFCs, which are found in aerosols for example, have been destroying the ozone layer since the 1970s. The Montreal Protocol was agreed in 1987 to phase out CFCs, but researchers say it may be too late.Study co-author Professor Joanna Haigh, co-director of the Grantham Institute for Climate Change and the Environment at Imperial College London, said of the study published in Atmospheric Chemistry and Physics: "Ozone has been seriously declining globally since the 1980s, but while the banning of CFCs is leading to a recovery at the poles, the same does not appear to be true for the lower latitudes. "The potential for harm in lower latitudes may actually be worse than at the poles. “The decreases in ozone are less than we saw at the poles before the Montreal Protocol was enacted, but UV radiation is more intense in these regions and more people live there.” In a separate study, researchers have found a thinning ozone layer could have led to a mass extinction 252 million years ago – meaning a depletion of the protective layer of the atmosphere could be more catastrophic than previously thought. During the Permian-Triassic extinction, 75 percent of land animals and 95 percent of marine life died. At the same time, there was a massive volcanic event occurring in a region known as the Siberian Traps. Scientists state the huge eruption, which lasted for a staggering one million years, virtually destroyed the ozone layer which allowed more UV radiation to pierce Earth. Graduate student Jeffrey Benca of the University of California, Berkeley, said of his research published in Science Advances: "During the end-Permian crisis, the forests may have disappeared in part or fully because of increased UV exposure. “With pulses of volcanic eruptions happening, we would expect pulsed ozone shield weakening, which may have led to forest declines previously observed in the fossil record. "If you disrupt some of the dominant plant lineages globally repeatedly, you could trigger trophic cascades by destabilising the food web base, which doesn't work out very well for land animals." As the ozone layer continues to be destroyed in modern times, scientists warn another catastrophic mass extinction could be on the cards. Co-author Cindy Looy of the Science Advances study said: "Palaeontologists have come up with various kill scenarios for mass extinctions, but plant life may not be affected by dying suddenly as much as through interrupting one part of the life cycle, such as reproduction, over a long period of time, causing the population to dwindle and potentially disappear.”

## Framing

#### Pleasure and pain are intrinsically valuable. people consistently regard pleasure and pain as good reasons for action, despite the fact that pleasure doesn’t seem to be instrumentally valuable for anything.

Moen 16 [Ole Martin Moen, Research Fellow in Philosophy at University of Oslo “An Argument for Hedonism” Journal of Value Inquiry (Springer), 50 (2) 2016: 267–281] SJDI

Let us start by observing, empirically, that a widely shared judgment about intrinsic value and disvalue is that pleasure is intrinsically valuable and pain is intrinsically disvaluable. On virtually any proposed list of intrinsic values and disvalues (we will look at some of them below), pleasure is included among the intrinsic values and pain among the intrinsic disvalues. This inclusion makes intuitive sense, moreover, for there is something undeniably good about the way pleasure feels and something undeniably bad about the way pain feels, and neither the goodness of pleasure nor the badness of pain seems to be exhausted by the further effects that these experiences might have. “Pleasure” and “pain” are here understood inclusively, as encompassing anything hedonically positive and anything hedonically negative.2 The special value statuses of pleasure and pain are manifested in how we treat these experiences in our everyday reasoning about values. If you tell me that you are heading for the convenience store, I might ask: “What for?” This is a reasonable question, for when you go to the convenience store you usually do so, not merely for the sake of going to the convenience store, but for the sake of achieving something further that you deem to be valuable. You might answer, for example: “To buy soda.” This answer makes sense, for soda is a nice thing and you can get it at the convenience store. I might further inquire, however: “What is buying the soda good for?” This further question can also be a reasonable one, for it need not be obvious why you want the soda. You might answer: “Well, I want it for the pleasure of drinking it.” If I then proceed by asking “But what is the pleasure of drinking the soda good for?” the discussion is likely to reach an awkward end. The reason is that the pleasure is not good for anything further; it is simply that for which going to the convenience store and buying the soda is good.3 As Aristotle observes: “We never ask [a man] what his end is in being pleased, because we assume that pleasure is choice worthy in itself.”4 Presumably, a similar story can be told in the case of pains, for if someone says “This is painful!” we never respond by asking: “And why is that a problem?” We take for granted that if something is painful, we have a sufficient explanation of why it is bad. If we are onto something in our everyday reasoning about values, it seems that pleasure and pain are both places where we reach the end of the line in matters of value.

#### **Thus, the standard is maximizing expected well being**

Prefer additionally:

#### **1]outweighs on actor specificity since governments make policies as a whole that benefit and help some people and side constraints freeze action – actor spec outweighs and turns since it’s better than no action, states don’t have wills and intentions since they are not indivuals actors, different agents have different obligations**

2] extinction first

Pummer 15 [Theron, Junior Research Fellow in Philosophy at St. Anne's College, University of Oxford. “Moral Agreement on Saving the World” Practical Ethics, University of Oxford. May 18, 2015] AT

There appears to be lot of disagreement in moral philosophy. Whether these many apparent disagreements are deep and irresolvable, I believe there is at least one thing it is reasonable to agree on right now, whatever general moral view we adopt: that it is very important to reduce the risk that all intelligent beings on this planet are eliminated by an enormous catastrophe, such as a nuclear war. How we might in fact try to reduce such existential risks is discussed elsewhere. My claim here is only that we – whether we’re consequentialists, deontologists, or virtue ethicists – should all agree that we should try to save the world. According to consequentialism, we should maximize the good, where this is taken to be the goodness, from an impartial perspective, of outcomes. Clearly one thing that makes an outcome good is that the people in it are doing well. There is little disagreement here. If the happiness or well-being of possible future people is just as important as that of people who already exist, and if they would have good lives, it is not hard to see how reducing existential risk is easily the most important thing in the whole world. This is for the familiar reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. There are so many possible future people that reducing existential risk is arguably the most important thing in the world, even if the well-being of these possible people were given only 0.001% as much weight as that of existing people. Even on a wholly person-affecting view – according to which there’s nothing (apart from effects on existing people) to be said in favor of creating happy people – the case for reducing existential risk is very strong. As noted in this seminal paper, this case is strengthened by the fact that there’s a good chance that many existing people will, with the aid of life-extension technology, live very long and very high quality lives. You might think what I have just argued applies to consequentialists only. There is a tendency to assume that, if an argument appeals to consequentialist considerations (the goodness of outcomes), it is irrelevant to non-consequentialists. But that is a huge mistake. Non-consequentialism is the view that there’s more that determines rightness than the goodness of consequences or outcomes; it is not the view that the latter don’t matter. Even John Rawls wrote, “All ethical doctrines worth our attention take consequences into account in judging rightness. One which did not would simply be irrational, crazy.” Minimally plausible versions of deontology and virtue ethics must be concerned in part with promoting the good, from an impartial point of view. They’d thus imply very strong reasons to reduce existential risk, at least when this doesn’t significantly involve doing harm to others or damaging one’s character. What’s even more surprising, perhaps, is that even if our own good (or that of those near and dear to us) has much greater weight than goodness from the impartial “point of view of the universe,” indeed even if the latter is entirely morally irrelevant, we may nonetheless have very strong reasons to reduce existential risk. Even egoism, the view that each agent should maximize her own good, might imply strong reasons to reduce existential risk. It will depend, among other things, on what one’s own good consists in. If well-being consisted in pleasure only, it is somewhat harder to argue that egoism would imply strong reasons to reduce existential risk – perhaps we could argue that one would maximize her expected hedonic well-being by funding life extension technology or by having herself cryogenically frozen at the time of her bodily death as well as giving money to reduce existential risk (so that there is a world for her to live in!). I am not sure, however, how strong the reasons to do this would be. But views which imply that, if I don’t care about other people, I have no or very little reason to help them are not even minimally plausible views (in addition to hedonistic egoism, I here have in mind views that imply that one has no reason to perform an act unless one actually desires to do that act). To be minimally plausible, egoism will need to be paired with a more sophisticated account of well-being. To see this, it is enough to consider, as Plato did, the possibility of a ring of invisibility – suppose that, while wearing it, Ayn could derive some pleasure by helping the poor, but instead could derive just a bit more by severely harming them. Hedonistic egoism would absurdly imply she should do the latter. To avoid this implication, egoists would need to build something like the meaningfulness of a life into well-being, in some robust way, where this would to a significant extent be a function of other-regarding concerns (see chapter 12 of this classic intro to ethics). But once these elements are included, we can (roughly, as above) argue that this sort of egoism will imply strong reasons to reduce existential risk. Add to all of this Samuel Scheffler’s recent intriguing arguments (quick podcast version available here) that most of what makes our lives go well would be undermined if there were no future generations of intelligent persons. On his view, my life would contain vastly less well-being if (say) a year after my death the world came to an end. So obviously if Scheffler were right I’d have very strong reason to reduce existential risk. We should also take into account moral uncertainty. What is it reasonable for one to do, when one is uncertain not (only) about the empirical facts, but also about the moral facts? I’ve just argued that there’s agreement among minimally plausible ethical views that we have strong reason to reduce existential risk – not only consequentialists, but also deontologists, virtue ethicists, and sophisticated egoists should agree. But even those (hedonistic egoists) who disagree should have a significant level of confidence that they are mistaken, and that one of the above views is correct. Even if they were 90% sure that their view is the correct one (and 10% sure that one of these other ones is correct), they would have pretty strong reason, from the standpoint of moral uncertainty, to reduce existential risk. Perhaps most disturbingly still, even if we are only 1% sure that the well-being of possible future people matters, it is at least arguable that, from the standpoint of moral uncertainty, reducing existential risk is the most important thing in the world. Again, this is largely for the reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. (For more on this and other related issues, see this excellent dissertation). Of course, it is uncertain whether these untold trillions would, in general, have good lives. It’s possible they’ll be miserable. It is enough for my claim that there is moral agreement in the relevant sense if, at least given certain empirical claims about what future lives would most likely be like, all minimally plausible moral views would converge on the conclusion that we should try to save the world. While there are some non-crazy views that place significantly greater moral weight on avoiding suffering than on promoting happiness, for reasons others have offered (and for independent reasons I won’t get into here unless requested to), they nonetheless seem to be fairly implausible views. And even if things did not go well for our ancestors, I am optimistic that they will overall go fantastically well for our descendants, if we allow them to. I suspect that most of us alive today – at least those of us not suffering from extreme illness or poverty – have lives that are well worth living, and that things will continue to improve. Derek Parfit, whose work has emphasized future generations as well as agreement in ethics, described our situation clearly and accurately: “We live during the hinge of history. Given the scientific and technological discoveries of the last two centuries, the world has never changed as fast. We shall soon have even greater powers to transform, not only our surroundings, but ourselves and our successors. If we act wisely in the next few centuries, humanity will survive its most dangerous and decisive period. Our descendants could, if necessary, go elsewhere, spreading through this galaxy…. Our descendants might, I believe, make the further future very good. But that good future may also depend in part on us. If our selfish recklessness ends human history, we would be acting very wrongly.” (From chapter 36 of On What Matters)

#### 3] use epistemic modesty – multiply probability of the fwk times the magnitude of the impacts A) clash – encourages both substantive and phil debates so that we talk about all the offense B) leads to the net most morality and proves that only beating fwk is not enough to win the debate

4] Role playing as policy makers is key to solving real world problems-so the role of the ballot is to evaluate the hypothetical consequences of the plan and vote for the best hypothetical policy action.. Coverstone[[1]](#footnote-1) :

(Alan H., “Acting on Activism: Realizing the Vision of Debate with Pro-social Impact,” Paper presented at the National Communication Association Annual Conference, 11/17/05)

 After all, if democracy means anything, it means that citizens not only have the right, they also bear the obligation to discuss and debate what the government should be doing**.** Absent that discussion and debate, much of **the motivation for personal political activism is** also **lost**. Those who have co-opted Mitchellâ€™s argument for individual advocacy often quickly respond that nothing we do in a debate round can actually change government policy, and unfortunately, an entire generation of debaters has now swallowed this assertion as an article of faith. The best most will muster is, â€œOf course not, but you donâ€™t either!â€ The assertion that nothing we do in debate has any impact on government policy is one that carries the potential to undermine Mitchellâ€™s entire project. If there is nothing we can do in a debate round to change government policy, then we are left with precious little in the way of pro-social options for addressing problems we face. At best, we can pursue some Pilot-like hand washing that can purify us as individuals through quixotic activism but offer little to society as a whole. It is very important to note that Mitchell (1998b) tries carefully to limit and bound his notion of reflexive fiat by maintaining that because it â€œviews fiat as a concrete course of action, it is bounded by the limits of pragmatismâ€ (p. 20). Pursued properly, the debates that Mitchell would like to see are those in which **the relative efficacy of concrete political strategies** for pro-social change **is debated**. In a few noteworthy examples, this approach has been employed successfully, and I must say that I have thoroughly enjoyed judging and coaching those debates. The students in my program have learned to stretch their understanding of their role in the political process because of the experience. Therefore, those who say I am opposed to Mitchellâ€™s goals here should take care at such a blanket assertion. Â¶ However, **contest debate teaches students to combine personal experience with the language of political power.** Powerfulpersonal **narratives unconnected to** political **power are** regularly **co-opted** by those who do learn the language of power. One needlook no further than the annual state of the Union Address where personal story after personal story is used to support the political agenda of those in power. The so-called **role-playing** that public policy contest debates encourage **promotes**active **learning** ofthe vocabulary and levers of **power** in America**.** Imagining the ability to use our own arguments to influence government action is one of the great virtues of academic debate. Gerald Graff (2003) analyzed the decline of argumentation in academic discourse and found a source of student antipathy to public argument in an interesting place.Â¶ Iâ€™m up againstâ€¦their aversion to the role of public spokesperson that formal writing presupposes. Itâ€™s as if such students canâ€™t imagine any rewards for being a public actor or even imagining themselves in such a role. This lack of interest in the public sphere may in turn reflect a loss of confidence in the possibility that the arguments we make in public will have an effect on the world. Todayâ€™s students lack of faith in the power of persuasion reflects the waning of the ideal of civic participation that led educators for centuries to place rhetorical and argumentative training at the center of the school and college curriculum. (Graff, 2003, p. 57)Â¶ The power to imagine public advocacy that actually makes a difference is one of the great virtues of the traditional notion of fiat that critics deride as mere simulation. **Simulation of success**in the public realm **is**far more **empowering** to students than completely abandoning all notions of personal power in the face of governmental hegemony by teaching students that nothing they can do in a contest debate can ever make any difference in public policy.â€ Contest debating is well suited to rewarding public activism if it stops accepting as an article of faith that personal agency is somehow undermined by the so-called role playing in debate. Debate is role-playing whether we imagine government action or imagine individual action. **Imagining myself starting a socialist revolution** in America **is no less of a fantasy than imagining myself** making a difference **on Capitol Hill.** Furthermore, both fantasies influenced my personal and political development virtually ensuring a life of active, pro-social, political participation. Neither fantasy reduced the likelihood that I would spend my life trying to make the difference I imagined**. One fantasy**actually **does make a greater difference: the one that speaks the language of political power.**The **other** fantasy **disables action by making one a laughingstock** to those who wield the language of power.

#### 5] Debating specific nuclear scenarios is key to stave off actual nuclear war. Harvard Nuclear Study Group 83

(Harvard Nuclear Study Group, 1983 (“Living With Nuclear Weapons,” p. 47, https://www.hup.harvard.edu/catalog.php?isbn=9780674536654)

“The question is grisly, but nonetheless it must be asked. **Nuclear war cannot be avoided simply by refusing to think about it.** Indeed the task of **reducing** the likelihood of **nuclear war should begin with** an effort to **understand how it might start.** **When strategists in Washington** or Moscow **study** the possible origins of **nuclear war, they discuss “scenarios,”** imagined sequences of future events that could trigger the use of nuclear weaponry. Scenarios are, of course, speculative exercises. They often leave out the political developments that might lead to the use of force in order to focus on military dangers. That nuclear war scenarios are even moerre speculative than most is something for which we can be thankful, for it reflects humanity’s fortunate lack of experience with atomic warfare since 1945. But imaginary as they are, **nuclear scenarios can help identify problems not understood** or **dangers not** yet prevented because they have not been **foreseen.”**

# 1AR

1. [MBA(Alan,ActingonActivism,[http://home.montgome... 17-2005).doc)]](http://home.montgomerybell.edu/~coversa/Acting%20on%20Activism%20(Nov%2017-2005).doc)%5D)

   An important concern emerges when Mitchell describes reflexive fiat as a contest strategy capable of â€œeschewing the power to directly control external actorsâ€ (1998b, p. 20). [↑](#footnote-ref-1)