# 1AR

### 1AR – T Can’t Spec App

#### Counterinterp: affs can specify a subset of appropriation

#### Subsets prove a generic statement

Cimpian et al 10 (PhDs – Andrei, Amanda C. Brandone, Susan A. Gelman, Generic statements require little evidence for acceptance but have powerful implications, Cogn Sci. 2010 Nov 1; 34(8): 1452–1482)

Generic statements (e.g., “Birds lay eggs”) express generalizations about categories. In this paper, we hypothesized that there is a paradoxical asymmetry at the core of generic meaning, such that these sentences have extremely strong implications but require little evidence to be judged true. Four experiments confirmed the hypothesized asymmetry: Participants interpreted novel generics such as “Lorches have purple feathers” as referring to nearly all lorches, but they judged the same novel generics to be true given a wide range of prevalence levels (e.g., even when only 10% or 30% of lorches had purple feathers). A second hypothesis, also confirmed by the results, was that novel generic sentences about dangerous or distinctive properties would be more acceptable than generic sentences that were similar but did not have these connotations. In addition to clarifying important aspects of generics’ meaning, these findings are applicable to a range of real-world processes such as stereotyping and political discourse. Keywords: generic language, concepts, truth conditions, prevalence implications, quantifiers, semantics Go to: 1. Introduction A statement is generic if it expresses a generalization about the members of a kind, as in “Mosquitoes carry the West Nile virus” or “Birds lay eggs” (e.g., Carlson, 1977; Carlson & Pelletier, 1995; Leslie, 2008). Such generalizations are commonplace in everyday conversation and child-directed speech (Gelman, Coley, Rosengren, Hartman, & Pappas, 1998; Gelman, Taylor, & Nguyen, 2004; Gelman, Goetz, Sarnecka, & Flukes, 2008), and are likely to foster the growth of children’s conceptual knowledge (Cimpian & Markman, 2009; Gelman, 2004, 2009). Here, however, we explore the semantics of generic sentences—and, in particular, the relationship between generic meaning and the statistical prevalence of the relevant properties (e.g., what proportion of birds lay eggs). Consider, first, generics’ truth conditions: Generic sentences are often judged true despite weak statistical evidence. Few people would dispute the truth of “Mosquitoes carry the West Nile virus”, yet only about 1% of mosquitoes are actually carriers (Cox, 2004). Similarly, only a minority of birds lays eggs (the healthy, mature females), but “Birds lay eggs” is uncontroversial. This loose, almost negligible relationship between the prevalence of a property within a category and the acceptance of the corresponding generic sentence has long puzzled linguists and philosophers, and has led to many attempts to describe the truth conditions of generic statements (for reviews, see Carlson, 1995; Leslie, 2008). Though generics’ truth conditions may be unrelated to property prevalence (cf. Prasada & Dillingham, 2006), the same cannot be said about the implications of generic statements. When provided with a novel generic sentence, one often has the impression that the property talked about is widespread. For example, if we were unfamiliar with the West Nile virus and were told (generically) that mosquitoes carry it, it would not be unreasonable to assume that all, or at least a majority of, mosquitoes are carriers (Gelman, Star, & Flukes, 2002). It is this paradoxical combination of flexible, almost prevalence-independent truth conditions, on the one hand, and widespread prevalence implications, on the other, that is the main focus of this article. We will attempt to demonstrate empirically that the prevalence level that is sufficient to judge a generic sentence as true is indeed significantly lower than the prevalence level implied by that very same sentence. If told that, say, “Lorches have purple feathers,” people might expect almost all lorches to have these feathers (illustrating generics’ high implied prevalence), but they may still agree that the sentence is true even if the actual prevalence of purple feathers among lorches turned out to be much lower (illustrating generics’ flexible truth conditions). Additionally, we propose that this asymmetry is peculiar to generic statements and does not extend to sentences with quantified noun phrases as subjects. That is, the prevalence implied by a sentence such as “Most lorches have purple feathers” may be more closely aligned with the prevalence that would be needed to judge it as true. Before describing our studies, we provide a brief overview of previous research on the truth conditions and the prevalence implications of generic statements. 1.1. Generics’ truth conditions Some of the first experimental evidence for the idea that the truth of a generic statement does not depend on the underlying statistics was provided by Gilson and Abelson (1965; Abelson & Kanouse, 1966) in their studies of “the psychology of audience reaction” to “persuasive communication” in the form of generic assertions (Abelson & Kanouse, 1966, p. 171). Participants were presented with novel items such as the following: Altogether there are three kinds of tribes—Southern, Northern, Central. Southern tribes have sports magazines. Northern tribes do not have sports magazines. Central tribes do not have sports magazines. Do tribes have sports magazines? All items had the same critical feature: only one third of the target category possessed the relevant property. Despite the low prevalence, participants answered “yes” approximately 70% of the time to “Do tribes have sports magazines?” and other generic questions similar to it. Thus, people’s acceptance of the generics did not seem contingent on strong statistical evidence, leaving the door open for persuasion, and perhaps manipulation, by ill-intentioned communicators. A similar conclusion about the relationship between statistical prevalence and generics’ truth conditions emerged from the linguistics literature on this topic (e.g., Carlson, 1977; Carlson & Pelletier, 1995; Dahl, 1975; Declerck, 1986, 1991; Lawler, 1973). For example, Carlson (1977) writes that “there are many cases where […] less than half of the individuals under consideration have some certain property, yet we still can truly predicate that property of the appropriate bare plural” (p. 67), as is the case with “Birds lay eggs” and “Mosquitoes carry the West Nile virus” but also with “Lions have manes” (only males do), “Cardinals are red” (only males are), and others. He points out, moreover, that there are many properties that, although present in a majority of a kind, nevertheless cannot be predicated truthfully of that kind (e.g., more than 50% of books are paperbacks but “Books are paperbacks” is false). Thus, acceptance of a generic sentence is doubly dissociated from the prevalence of the property it refers to—not only can true generics refer to low-prevalence properties, but high-prevalence properties are also not guaranteed to be true in generic form.

#### Debate solves arbitrary linguistic intuitions—we all interpret the rez to allow spec and determine the most predictable interp based on pragmatic checks like clash and limits. Floor not a ceiling—a sufficiently predictable interp of the topic means division of ground is more important.

#### \*\*Jurisdiction is nonsense since judges vote for non-T affs without any consequences

#### 1] Clash – forces in-depth research which leads to nuanced debates about the implications of various forms of appropriation – sats, mining, and space col are distinct

#### 2] Aff Ground and no TVA – no advantage applies to all PICs cuz each form of appropriation has a different purpose – PICs moot TVAs and are worse than plans cuz negs have generics like NCs and Ks but affs have none vs PICs

#### 3] Functional limits and generics – solvency advocates, timeframe restricts impact scenarios, and small affs lose to Ks, NCs, or innovation + regulation

#### 4] Overlimiting – their model means there’s one aff on the 5 month TOC topic which kills late-topic innovation

#### 5] Terminal defense – the caselist is 4 major types – mining, satellites, space col, and tourism – if you can’t prep 4 affs you should lose

#### \*\*Aff RVIs for skew – A] time crunched 1AR needs to split the 2N and protect the 2AR from a 6 minute collapse, B] deters reading friv shells to split the 1ar which reduces time for topic ed

#### \*\*Reasonability—voting neg requires sacrificing substance which means abuse on T has to outweigh the abuse of voting on T.

### 1AR – Innovation DA

#### Impact is bunk – no terminals to any of the laundry list but zero warrant of what is coming now or how extinction happens—no new 2nr imapct evidence—1ar strategy was premised off the impact ev being awful.

#### We’ll impact turn the disad—primacy creates all the problems it aims to solve.

Ashford, PhD, 19

(Emma, PoliSci@UVA, Fellow@CATO, Power and Pragmatism: Reforming American Foreign Policy for the 21st Century, in New Voices in Grand Strategy, 4, CNAS)

Humility is a virtue. Yet in the last quarter century, American policymakers have been far more likely to embrace the notion of America as the “indispensable nation,” responsible for protecting allies, promoting democracy and human rights, tamping down conflicts, and generally managing global affairs. Compare this ideal to the U.S. track record – endless Middle Eastern wars, the rise of ISIS, global democratic backsliding, a revanchist Russia, resurgent China, and a world reeling from the election of President Donald Trump – and this label seems instead the height of hubris. Many of the failures of U.S. foreign policy speak for themselves. As the daily drumbeat of bad news attests, interventions in Iraq and Libya were not victories for human rights or democracy, but rather massively destabilizing for the Middle East as a whole. Afghanistan – despite initial military successes – has become a quagmire, highlighting the futility of nation- building. Other failures of America’s grand strategy are less visible, but no less damaging. NATO expansion into Eastern Europe helped to reignite hostility between Russia and the West. Worse, it has diluted the alliance’s defensive capacity and its democratic character. And even as the war on terror fades from public view, it remains as open-ended as ever: Today, the United States is at war in seven countries and engaged in “combating terrorism’ in more than 80.1 To put it bluntly: America’s strategy since the end of the Cold War – whether it is called primacy or liberal internationalism – may not be a total failure, but it has not been successful either. Many have tried to place blame for these poor outcomes.2 But recrimination is less important than understanding why America’s strategy has failed so badly and avoiding these mistakes in future. Much of the explanation is the natural outcome of changing constraints. Iraq and Libya should not be viewed as regrettable anomalies, but rather the logical outcome of unipolarity and America’s liberal internationalist inclination to solve every global problem. It’s also a reliance on flawed assumptions – that what is good for America is always good for the world, for example. Support for dangerous sovereignty-undermining norms adds to the problem; just look at the Responsibility to Protect (R2P), which has proved not to protect populations or stabilize fragile states, but to provoke chaos, encourage nuclear proliferation, and undermine the international institutions. Perhaps, if nothing else had changed, a form of watered-down liberal internationalism that foreswore interventionism and drew back from the war on terror might have been possible.3 But international politics are undergoing a period of profound transformation, from unipolarity to regional or even global multipolarity. Primacy – and the consistent drumbeat of calls in Washington to do more, always and everywhere – is neither sustainable nor prudent. Nor can we fall back on warmed-over Cold War–era strategies better suited to an era of bipolar superpower competition.

#### Empirics go neg – most qualified studies disprove hegemonic stability theories.

Fettweis 17 –Christopher J. Fettweis is an American political scientist and the Associate Professor of Political Science at Tulane University. “Unipolarity, Hegemony, and the New Peace, Security Studies” 26:3, 423-451; EG)

Even the most ardent supporters of the hegemonic-stability explanation do not contend that US influence extends equally to all corners of the globe. The United States has concentrated its policing in what George Kennan used to call “strong points,” or the most important parts of the world: Western Europe, the Pacific Rim, and Persian Gulf.64 By doing so, Washington may well have contributed more to great power peace than the overall global decline in warfare. If the former phenomenon contributed to the latter, by essentially providing a behavioral model for weaker states to emulate, then perhaps this lends some support to the hegemonic-stability case.65 During the Cold War, the United States played referee to a few intra-West squabbles, especially between Greece and Turkey, and provided Hobbesian reassurance to Germany’s nervous neighbors. Other, equally plausible explanations exist for stability in the first world, including the presence of a common enemy, democracy, economic interdependence, general war aversion, etc. The looming presence of the leviathan is certainly among these plausible explanations, but only inside the US sphere of influence. Bipolarity was bad for the nonaligned world, where Soviet and Western intervention routinely exacerbated local conflicts. Unipolarity has generally been much better, **but whether or not this was due to US action is again unclear.** Overall US interest in the affairs of the Global South has dropped markedly since the end of the Cold War, as has the level of violence in almost all regions. There is less US intervention in the political and military affairs of Latin America compared to any time in the twentieth century, for instance, and also less conflict. Warfare in Africa is at an all-time low, as is relative US interest outside of counterterrorism and security assistance.66 **Regional peace and stability exist where there is US active intervention, as well as where there is not**. No direct relationship seems to exist across regions. If intervention can be considered a function of direct and indirect activity, of both political and military action, a regional picture might look like what is outlined in Table 1. These assessments of conflict are by necessity relative, because there has not been a “high” level of conflict in any region outside the Middle East during the period of the New Peace. Putting aside for the moment that important caveat, some points become clear. The great powers of the world are clustered in the upper right quadrant, where US intervention has been high, but conflict levels low. **US intervention is imperfectly correlated with stability, however. Indeed, it is conceivable that the relatively high level of US interest and activity has made the security situation in the Persian Gulf and broader Middle East worse.** In recent years, substantial hard power investments (Somalia, Afghanistan, Iraq), moderate intervention (Libya), and reliance on diplomacy (Syria) have been equally ineffective in stabilizing states torn by conflict. While it is possible that the region is essentially unpacifiable and no amount of police work would bring peace to its people, it remains hard to make the case that the US presence has improved matters. **In this “strong point,” at least, US hegemony has failed to bring peace.** In much of the rest of the world, the United States has not been especially eager to enforce any particular rules. Even rather incontrovertible evidence of genocide has not been enough to inspire action. Washington’s intervention choices have at best been erratic; Libya and Kosovo brought about action, but much more blood flowed uninterrupted in Rwanda, Darfur, Congo, Sri Lanka, and Syria. The US record of peacemaking is not exactly a long uninterrupted string of successes. During the turn-of-the-century conventional war between Ethiopia and Eritrea, a highlevel US delegation containing former and future National Security Advisors (Anthony Lake and Susan Rice) made a half-dozen trips to the region, but was unable to prevent either the outbreak or recurrence of the conflict. Lake and his team shuttled back and forth between the capitals with some frequency, and President Clinton made repeated phone calls to the leaders of the respective countries, offering to hold peace talks in the United States, all to no avail.67 The war ended Table 1. Post-Cold War US intervention and violence by region. High Violence Low Violence High US Intervention Middle East Europe South and Central Asia Pacific Rim North America Low US Intervention Africa South America Former Soviet Union in late 2000 when Ethiopia essentially won, and it controls the disputed territory to this day. The Horn of Africa is hardly the only region where states are free to fight one another today without fear of serious US involvement. Since they are choosing not to do so with increasing frequency, something else is probably affecting their calculations. Stability exists even in those places where the potential for intervention by the sheriff is minimal. Hegemonic stability can only take credit for influencing those decisions that would have ended in war without the presence, whether physical or psychological, of the United States. It seems hard to make the case that the relative peace that has descended on so many regions is primarily due to the kind of heavy hand of the neoconservative leviathan, or its lighter, more liberal cousin. Something else appears to be at work.

#### A. Pursuit of hegemony leads to Sino-Russia alliance and is unsustainable.

Porter, DPhil, 19

(Patrick, ModernHistory@Oxford, ProfInternationalSecurityAndStrategy@Birmingham, Advice for a Dark Age: Managing Great Power Competition, The Washington Quarterly, 42:1, 7-25)

Even the United States cannot prudently take on every adversary on multiple fronts. The costs of military campaigns against these adversaries in their backyards, whether in the Baltic States or Taiwan, would outstrip the losses that the U.S. military has sustained in decades. Short of all-out conflict, to mobilize for dominance and risk escalation on multiple such fronts would court several dangers. It would overstretch the country. The U.S. defense budget now approaches $800 billion annually, not including deficit-financed military operations. This is a time of ballooning deficits, where the Congressional Budget Office warns that “the prospect of large and growing debt poses substantial risks for the nation.”27 If in such conditions, current expenditure is not enough to buy unchallengeable military preponderance—and it may not be—then the failure lies not in the failure to spend even more. Neither is the answer to sacrifice the quality of civic life at home to service the cause of preponderance abroad. The old “two war standard,” a planning construct whereby the United States configures its forces to conduct two regional conflicts at once, would be unsustainably demanding against more than one peer competitor, or potentially with a roster of major and minor adversaries all at once.28 After all, the purpose of American military power is ultimately to secure a way of life as a constitutional republic. To impose ever-greater debts on civil society and strip back collective provision at home, on the basis that the quality of life is expendable for the cause of hegemony, is perversely to set up power-projection abroad as the end, when it should be the means. The problem lies, rather, in the inflexible pursuit of hegemony itself, and the failure to balance commitments with scarce resources. To attempt to suppress every adversary simultaneously would drive adversaries together, creating hostile coalitions. It also may not succeed. Counterproliferation in North Korea is difficult enough, for instance, but the task becomes more difficult still if U.S. enmity with China drives Beijing to refuse cooperation over enforcing sanctions on Pyongyang. Concurrent competitions would also split American resources, attention and time. Exacerbating the strain on scarce resources between defense, consumption and investment raises the polarizing question of whether preponderance is even worth it, which then undermines the domestic consensus needed to support it. At the same time, reduced investment in infrastructure and education would damage the economic foundations for conducting competition abroad in the first place. Taken together, indiscriminate competition risks creating the thing most feared in traditional U.S. grand strategy: a hostile Eurasian alliance leading to continuous U.S. mobilization against hostile coalitions, turning the U.S. republic into an illiberal garrison state. If the prospect for the United States as a great power faces a problem, it is not the size of the defense budget, or the material weight of resources at the U.S. disposal, or popular reluctance to exercise leadership. Rather, the problem lies in the scope of the policy that those capabilities are designed to serve. To make the problem smaller, Washington should take steps to make the pool of adversaries smaller.

#### A strong Sino-Russian alliance combined with expanded US military presence ensures joint retaliation — that escalates to the use of nuclear force

Klare 18 – Professor of peace and world security studies at Hampshire College. (Michael T., “The Pentagon Is Planning a Three-Front ‘Long War’ Against China and Russia,” April 4, 2018, https://fpif.org/the-pentagon-is-planning-a-three-front-long-war-against-china-and-russia/)//sy

In relatively swift fashion, American military leaders have followed up their claim that the U.S. is in a new long war by sketching the outlines of a containment line that would stretch from the Korean Peninsula around Asia across the Middle East into parts of the former Soviet Union in Eastern Europe and finally to the Scandinavian countries. Under their plan, American military forces — reinforced by the armies of trusted allies — should garrison every segment of this line, a grandiose scheme to block hypothetical advances of Chinese and Russian influence that, in its global reach, should stagger the imagination. Much of future history could be shaped by such an outsized effort. Questions for the future include whether this is either a sound strategic policy or truly sustainable. Attempting to contain China and Russia in such a manner will undoubtedly provoke countermoves, some undoubtedly difficult to resist, including cyber attacks and various kinds of economic warfare. And if you imagined that a war on terror across huge swaths of the planet represented a significant global overreach for a single power, just wait. Maintaining large and heavily-equipped forces on three extended fronts will also prove exceedingly costly and will certainly conflict with domestic spending priorities and possibly provoke a divisive debate over the reinstatement of the draft. However, the real question — unasked in Washington at the moment — is: Why pursue such a policy in the first place? Are there not other ways to manage the rise of China and Russia’s provocative behavior? What appears particularly worrisome about this three-front strategy is its immense capacity for confrontation, miscalculation, escalation, and finally actual war rather than simply grandiose war planning. At multiple points along this globe-spanning line — the Baltic Sea, the Black Sea, Syria, the South China Sea, and the East China Sea, to name just a few — forces from the U.S. and China or Russia are already in significant contact, often jostling for position in a potentially hostile manner. At any moment, one of these encounters could provoke a firefight leading to unintended escalation and, in the end, possibly all-out combat. From there, almost anything could happen, even the use of nuclear weapons. Clearly, officials in Washington should be thinking hard before committing Americans to a strategy that will make this increasingly likely and could turn what is still long-war planning into an actual long war with deadly consequences.

#### Prolif solves war – our NC impact scenarios were premised on a lack of a 1AC terminal to prolif so they shouldn’t get new terminals in the 1ar – it wrecks neg strat and encourages sandbagging

Cohen, PhD, ‘17

(Michael D., PoliSci@BritishColumbia, SeniorLecturerSecurityStudies@Macquarie, “How nuclear proliferation causes conflict: the case for optimistic pessimism,” The Nonproliferation Review, Volume 23, Issue 3-4) BW

But there is a systematic effect of experience with nuclear weapons on the conflict propensity of states. The Soviet Union stopped challenging the status quo in Berlin and Cuba after 1963. The number of fatalities from terrorist violence in Kashmir in 2012 was almost that of 1989.83 Mao never again challenged Soviet forces after the 1969 Zhenbao conflict. Recent quantitative studies have also concluded that experience with nuclear weapons moderates the conflict propensity of new nuclear powers. Most quantitative scholarship concludes that nuclear proliferation does not lead to conventional conflict because quantitative tests showed no relationship between these variables.84 States that develop nuclear weapons are highly conflict prone, so a high propensity for conflict likely causes nuclear-weapon development and further conflict.85 But statistical research has ignored the role of experience with nuclear weapons. Temporally disaggregating the effect of nuclear proliferation on state conflict uncovers a robust correlation between nuclear-weapon proliferation, experience, and international dispute behavior.

University of Pennsylvania’s Michael Horowitz conducted a statistical analysis and found that the probability of new nuclear states reciprocating disputes quickly increases and then decreases over time.

The probability that a nuclear state will reciprocate a dispute with a non-nuclear state drops from .53 one year after developing nuclear weapons to .23 in year 56. Two new nuclear powers are 67 percent more likely to reciprocate a dispute than two average non-nuclear states. Two experienced nuclear powers are 65 percent less likely to reciprocate than two average non-nuclear states. The probability of dispute reciprocation between an experienced and new nuclear power is 26 percent greater than two non-nuclear states, and the probability of a very experienced state and a somewhat experienced state reciprocating is 42 percent less than two non-nuclear states.86

University of California-San Diego’s Erik Gartzke conducted a similar statistical test when the dependent variable was dispute initiation rather than reciprocation and found similarly robust results.87 Gartzke found that, while the overall effect of nuclear proliferation on conflict propensity is neutral, there is variation in the effect of proliferation over time. Nuclear proliferation influences the timing, rather than the occurrence, of disputes. While new nuclear states are prone to initiate militarized disputes, over time they moderate their policies and become as likely to initiate disputes as they were before nuclear proliferation.88 These effects wash out in statistical tests that do not control for experience with nuclear weapons. In short, if Iran and North Korea develop nuclear weapons and challenge their regional status quo, the historical record suggests that they will not do so for long. Thus James M. Lindsay and Ray Takeyh of the Council on Foreign Relations recently claimed that a nuclear Iran would be most dangerous “at first, when it would likely be at its most reckless.” But, “like other nuclear aspirants before them, the guardians of the theocracy might discover that nuclear bombs are simply not good for diplomatic leverage or strategic aggrandizement.” 89

Conclusion: proliferation pessimism, Iran, and North Korea

Three of the four mechanisms long alleged to make nuclear proliferation cause interstate conflict find little to no empirical support when the endogeneity, omitted-variable bias, and conceptual-confusion issues addressed above are recognized and applied to the evidence. Preventive-war motivations, nonsurvivable arsenals, and organizational logics that lead to accidents do not cause armed conflict. The only mechanism that has systematically led to conflict is conventional aggression by weak revisionists after nuclear proliferation, but a few years of experience with nuclear weapons moderates the conflict propensity of new nuclear states. By failing to specify how frequently we should observe preventive motivations, their effect on nonsurvivable arsenals, or how organizational logics lead to conflict, accidents, and nuclear war, proliferation pessimist claims are unfalsifiable. Pessimist scholars need to specify how much longer we should observe them not leading to conflict before concluding that their threat has been greatly exaggerated.

The undesirability of nuclear use has prevented scholars from coming to terms with what a more careful and systematic reading of the historical record suggests about the relationship between these mechanisms and conflict. Sagan has argued that proliferation fatalism and deterrence optimism reduce incentives to combat proliferation.90 But these same dynamics have led scholars to vastly exaggerate the number of threats posed by the spread of nuclear weapons. If the greatest danger posed by nuclear proliferation is conventional aggression in the short-term, scholars need to rediscover how deterrence can moderate the high conflict propensity of new nuclear states.91 Arguments about the frequency of nuclear escalation, however, say nothing about its cost. Isn’t the possibility of nuclear escalation on the Korean peninsula, for example, evidence against the arguments made throughout this paper? A few cases of accidental, unintentional, or deliberate nuclear escalation could show that the mechanisms offered by pessimist scholars linking nuclear proliferation and conflict survive the criticisms leveled at them here. A lower bar for the proliferation-pessimist theory to pass might be one case of nuclear escalation. But after seventy years, nuclear weapons have not once led to conflict through the mechanisms addressed here.

This is not the place for a lengthier treatment of how the United States and its allies should deal with the challenges posed by a North Korean (or possible Iranian) nuclear bomb. But the historical record suggests that Israeli, South Korean, and others’ preventive motivations to strike will not lead to military action, and that any strike would likely not escalate to conflict unless the United States or its allies decide to topple the regimes in Tehran and Pyongyang. The nonsurvivability of an Iranian or North Korean arsenal will not tempt others to strike. The arguments made here have contrasting findings for preventive-strike considerations. On the one hand, strikes are less costly than many believe because they rarely cause escalation. On the other hand, strikes are less necessary than many believe because the costs of nuclear proliferation are much lower than usually assumed. Nuclear accidents may occur, but these will likely only cause conventional or nuclear escalation if Tehran or Pyongyang have already attempted to revise their status quo. The historical record also suggests that a few years of experience with the bomb will teach Tehran and Pyongyang the limits of nuclear coercion and that any conflict will stop short of nuclear escalation. Future research should further refine proliferation pessimism and integrate it with optimist perspectives through addressing what causes new nuclear states to moderate their aggression and what policies by the United States and its allies might cause this. An optimistic pessimism toward the spread of nuclear weapons can better come to terms with how and when they lead to interstate conflict and form the basis for better policies to reduce the dangers.

#### Hegemony in the Middle East is financially unsustainable – it’s a fiscal sinkhole that decks growth and causes econ collapse.

Porter, DPhil, ‘18

(Patrick, ModernHistory@MagdalenCollegeOxford, ProfInternationalSecurity&Strategy@UniversityOfBirmingham, “Desert Shield of the Republic? Realism and the Middle East,” Harvard Belfer Center, p. 14-18) BW

To summarise the overall logic: Firstly, the United States is overstretched, and needs to cut back. Great powers can sustain themselves, or adjust better to a shifting environment, by rebalancing means and ends.40 Washington faces a deteriorating fiscal position, and an altered position of relative power. Its position as “global leader” is premised on a set of impermanent and atypical conditions from the earlier postwar era. Measured on Purchasing Power Parity, studies estimate that the U.S. produces 15-24% of global GDP, compared to the relative share of wealth in enjoyed in 1960, of 40%, an era when the ambition of world leadership arose. 41 This trendline is reversible to a degree – a Chinese contraction or Indian crash is also possible, and the U.S. could recover some ground as it did under the Reagan administration -but the overall balance has likely passed an inflection point. True, the U.S. remains the largest power on many metrics, but it also shoulders the most commitments, and must split its resources and energy among more theatres than its rivals. Can it afford them? This is not a choice between a sound and safe status quo and an “experiment” with alternatives, as detractors suggest. Rather, it is a choice about the experiment currently being run, an experiment that is profligate and unsustainable. The United States is accumulating record deficits and growing, unsustainable debts. Current debt levels exceed the size of the U.S. economy. According to the Congressional Budget Office, federal debt will reach 150 percent of GDP by 2047.42 America’s deficit has grown to $895 billion a year, as extravagant tax cuts, interest on debt, defence build-ups and rising domestic costs outstrip economic growth. The CBO warns that debts that get harder to service threaten solvency, that “the prospect of large and growing debt poses substantial risks for the nation.”43 Heavy fiscal burdens beyond a certain proportion of debt-to-GDP tend to choke economic growth, while a growing debt load directly impedes the country’s ability to sustain its way of life alongside its extensive international commitments. This leaves open the possibility of another fiscal crisis, but without the reserves this time to combat it. Historically, military-security build-ups trigger boom-busts in the business cycle.44 Of course, there is always the argument that deficits don’t matter, that the U.S. enjoys exceptional trust in international investment markets which will not take fright, and can sustain its deficit-financed model. While that could be true, the hazards of making that wager and being wrong are unacceptable, as the last Global Financial Crisis demonstrated. It would be imprudent to conduct the experiment. While the material base of its power erodes, Washington faces a more hostile external environment, one of competitive multipolarity, in an era of increasing great power competition. This is an era where access/area-denial military technology are making it easier for determined weaker sides to inflict prohibitive costs on great powers. Even in its pomp, before weaker states had their hands on long-range precision munitions and cheap sensors, the United States was not able to defeat a number of weaker challengers, from China in the Korean War to communists in Vietnam to Islamist insurgents in Afghanistan. The days of unipolarity are over, and cannot be wished back. The question is how well the United States can adjust to competitive multipolarity, in order to remain solvent. At the same time as resources become more scarce and economic dangers mount, the U.S. is expanding its commitments in the Middle East, and doubling down on its effort to remain the dominant power. Means and ends are increasingly misaligned. The United States is in mounting danger of what “rise and fall” realists in the tradition of Walter Lippmann called “insolvency”, where its commitments exceed its power, to the point of physical exhaustion and domestic political discord, through which division at home and incoherence abroad feed off one another.45 It has too many commitments, for resources that are increasingly scarce, and cannot proceed on its present course without the imbalance of means and ends getting worse. While forward garrisoning is not in itself especially expensive compared to repatriated forces, commitments in the Gulf drive up demands on the size of defence budget, to maintain capabilities to operate in the region. Estimates vary on the savings, ranging from $75billion a year to $121 billion.46 Drawing down in the Middle East would be one important step on the road to redressing the fiscal imbalance. Secondly, this is a problem not only because of the balance sheet of material power. It also threatens the republic’s way of life. The purpose of American statecraft should be, as Graham Allison argues, to "preserve the U.S. as a free nation with our fundamental institutions and values intact."47 Primacy realism pays much attention to the question of economic prosperity but too little attention to the ultimate objective of U.S. grand strategy, which is to ensure the health of America’s domestic order: its institutions, its constitution, and its liberties. This issue will be addressed below. Thirdly, given the need to cut back, the United States should revise the value of its commitments in the Middle East. The region is losing its grand strategic salience as a power center. It boasts only 6% of global GDP, and only 5% of the world’s population. Its oil output remains important but is decreasingly so, in the oil and gas revolutions taking place elsewhere. This region is also, increasingly, unrewarding. Compared to America’s other two major theatres of commitment, Asia and Europe, the Middle East is especially unworthwhile. It loads too much trouble on Washington’s shoulders. A set of interlocking historical forces and prior choices made the region a wildly complex one to manage as an external power.48 This is not due to any primordial “essence.” Rather, it lies in the interactions of other path-dependent forces: imperial settlements, indigenous divide-and-rule politics, authoritarian regimes’ strategies of deflection, using Islamist causes and movements to fragment opposition and channel demands for change, the “resource curse” of petro-politics and resulting economic stagnation, an explosion of sectarian identity linked to the rival power bids of Saudi Arabia and Iran, and the additional pressures created by the application of U.S. power, not only in the Iraq misadventure or in support for Israel, but in a longstanding collaboration with the very Islamist forces against which it does battle. As a result, the region the U.S. waded into is one of seething populations, a choice of bad allies for whom the superpower and its main ally, Israel, are a ready alibi. Involvement in the Middle East played a central part in bringing on the 9/11 attacks and making possible the subsequent War on Terror and America’s most disastrous war since Vietnam. It embroils America in a set of violent geopolitical storms – namely the civil wars within the Arab-Islamic world- that it does not have the power to control or extinguish, as well as more localised conflicts that deliver a bad bargain of complicity with little influence. Salafist-jihadist terrorism is energised by U.S. presence and patronage. America’s most pressing security interest, the need to suppress terrorism, is largely generated by being there in the first place. It also turns out that the region is not amenable to the kind of affordable hegemonic influence that “primacy realists” assume it wields. Not only does Washington repeatedly fail to get its way. Its clients and allies behave, persistently, in ways that infringe its interests. Even worse, the anxiety to maintain alliances, bases and a structure of hegemonic power creates “reverse leverage”, whereby the Gulf monarchies in particular exploit American anxiety about losing its position. The main economic and geopolitical interest that the U.S. does have in the region – the stability of the oil market and the threat of a hostile hegemon – can be secured and hedged against enough from a remove, while garrisoning the region would do little to shore up this interest and could jeopardise it. And the reaction to violent disorder in the region has induced a state of near-permanent war that corrupts the republic, creating unchecked executive and state power, makes foreign policy ever more militarised and praetorian, damages the Congress’ constitutional authority, increases risks of boom/bust cycles, and widens inequality at home. The net result? For considerable investment of treasure and blood, the status quo binds the U.S. to a region in ways that divert resources, leave it open to manipulation, corruption and at greater menace of terrorist blowback.

#### B. Economic collapse causes lash-out and global war – reject old defense that doesn’t assume escalating proxies, new tech, and nationalism.

Liu, PhD Econ, 18

(Qian, Uppsala, 11-13, https://www.weforum.org/agenda/2018/11/the-next-economic-crisis-could-cause-a-global-conflict-heres-why)

The response to the 2008 economic crisis has relied far too much on monetary stimulus, in the form of quantitative easing and near-zero (or even negative) interest rates, and included far too little structural reform. This means that the next crisis could come soon – and pave the way for a large-scale military conflict. The next economic crisis is closer than you think. But what you should really worry about is what comes after: in the current social, political, and technological landscape, a prolonged economic crisis, combined with rising income inequality, could well escalate into a major global military conflict. The 2008-09 global financial crisis almost bankrupted governments and caused systemic collapse. Policymakers managed to pull the global economy back from the brink, using massive monetary stimulus, including quantitative easing and near-zero (or even negative) interest rates. But monetary stimulus is like an adrenaline shot to jump-start an arrested heart; it can revive the patient, but it does nothing to cure the disease. Treating a sick economy requires structural reforms, which can cover everything from financial and labor markets to tax systems, fertility patterns, and education policies. Policymakers have utterly failed to pursue such reforms, despite promising to do so. Instead, they have remained preoccupied with politics. From Italy to Germany, forming and sustaining governments now seems to take more time than actual governing. And Greece, for example, has relied on money from international creditors to keep its head (barely) above water, rather than genuinely reforming its pension system or improving its business environment. The lack of structural reform has meant that the unprecedented excess liquidity that central banks injected into their economies was not allocated to its most efficient uses. Instead, it raised global asset prices to levels even higher than those prevailing before 2008. In the United States, housing prices are now 8% [higher](https://www.zillow.com/home-values/) than they were at the peak of the property bubble in 2006, according to the property website Zillow. The price-to-earnings (CAPE) ratio, which measures whether stock-market prices are within a reasonable range, is now [higher](http://www.multpl.com/shiller-pe/) than it was both in 2008 and at the start of the Great Depression in 1929. As monetary tightening reveals the vulnerabilities in the real economy, the collapse of asset-price bubbles will trigger another economic crisis – one that could be even more severe than the last, because we have built up a tolerance to our strongest macroeconomic medications. A decade of regular adrenaline shots, in the form of ultra-low interest rates and unconventional monetary policies, has severely depleted their power to stabilize and stimulate the economy. If history is any guide, the consequences of this mistake could extend far beyond the economy. According to Harvard’s Benjamin Friedman, [prolonged periods](https://scholar.harvard.edu/files/bfriedman/files/the_moral_consequences_of_economic_growth_0.pdf) of economic distress have been characterized also by public antipathy toward minority groups or foreign countries – attitudes that can help to fuel unrest, terrorism, or even war. For example, during the Great Depression, US President Herbert Hoover signed the 1930 Smoot-Hawley Tariff Act, intended to protect American workers and farmers from foreign competition. In the subsequent five years, global trade shrank by two-thirds. Within a decade, World War II had begun. To be sure, WWII, like World War I, was caused by a multitude of factors; there is no standard path to war. But there is reason to believe that high levels of inequality can play a significant role in stoking conflict. According to [research](http://www.hup.harvard.edu/catalog.php?isbn=9780674430006) by the economist Thomas Piketty, a spike in income inequality is often followed by a great crisis. Income inequality then declines for a while, before rising again, until a new peak – and a new disaster. Though causality has yet to be proven, given the limited number of data points, this correlation should not be taken lightly, especially with wealth and income inequality at historically high levels. This is all the more worrying in view of the numerous other factors stoking social unrest and diplomatic tension, including technological disruption, a record-breaking migration crisis, anxiety over globalization, political polarization, and rising nationalism. All are symptoms of failed policies that could turn out to be trigger points for a future crisis. Voters have good reason to be frustrated, but the emotionally appealing populists to whom they are increasingly giving their support are offering ill-advised solutions that will only make matters worse. For example, despite the world’s unprecedented interconnectedness, multilateralism is increasingly being eschewed, as countries – most notably, Donald Trump’s US – pursue unilateral, isolationist policies. Meanwhile, proxy wars are raging in Syria and Yemen. Against this background, we must take seriously the possibility that the next economic crisis could lead to a large-scale military confrontation. By the [logic](http://www.simonandschuster.com/books/The-Clash-of-Civilizations-and-the-Remaking-of-World-Order/Samuel-P-Huntington/9781451628975) of the political scientist Samuel Huntington , considering such a scenario could help us avoid it, because it would force us to take action. In this case, the key will be for policymakers to pursue the structural reforms that they have long promised, while replacing finger-pointing and antagonism with a sensible and respectful global dialogue. The alternative may well be global conflagration.

# 1AC

#### I affirm: The appropriation of outer space by private entities via Large Satellite Constellations in Lower Earth Orbit is unjust.

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

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

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

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

6. Conclusion

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

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

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

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

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

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

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

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

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

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

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

So what's not to love?

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

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

The scramble for space

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

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

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

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

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

Telecommunications: driving inequality or empowering citizens?

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

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

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

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

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

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

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

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

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

Pultarova 21 “SpaceX Starlink satellites responsible for over half of close encounters in orbit, scientist says” Tereza Pultarova [Master's in Science from the International Space University, France, to her Bachelor's in Journalism and Master's in Cultural Anthropology from Prague's Charles University. She worked as a reporter at the Engineering and Technology magazine, freelanced for a range of publications including Live Science, Space.com, Professional Engineering, Via Satellite and Space News and served as a maternity cover science editor at the European Space Agency.], August 18, 2021 <https://www.space.com/spacex-starlink-satellite-collision-alerts-on-the-rise> SM

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

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

Operators of satellite constellations are constantly forced to move their satellites because of encounters with other spacecraft and pieces of space junk. And, thanks to SpaceX's Starlink satellites, the number of such dangerous approaches will continue to grow, according to estimates based on available data.

SpaceX's Starlink satellites alone are involved in about 1,600 close encounters between two spacecraft every week, that's about 50 % of all such incidents, according to Hugh Lewis, the head of the Astronautics Research Group at the University of Southampton, U.K. These encounters include situations when two spacecraft pass within a distance of 0.6 miles (1 kilometer) from each other.

Lewis, Europe's leading expert on space debris, makes regular estimates of the situation in orbit based on data from the Socrates (Satellite Orbital Conjunction Reports Assessing Threatening Encounters in Space ) database. This tool, managed by Celestrack, provides information about satellite orbits and models their trajectories into the future to assess collision risk.

Lewis publishes regular updates on Twitter and has seen a worrying trend in the data that reflects the fast deployment of the Starlink constellation.

"I have looked at the data going back to May 2019 when Starlink was first launched to understand the burden of these megaconstellations," Lewis told Space.com. "Since then, the number of encounters picked up by the Socrates database has more than doubled and now we are in a situation where Starlink accounts for half of all encounters."

The current 1,600 close passes include those between two Starlink satellites. Excluding these encounters, Starlink satellites approach other operators’ spacecraft 500 times every week.

In comparison, Starlink's competitor OneWeb, currently flying over 250 satellites, is involved in 80 close passes with other operators' satellites every week, according to Lewis' data.

And the situation is bound to get worse. Only 1,700 satellites of an expected constellation of tens of thousands have been placed into orbit so far. Once SpaceX launches all 12,000 satellites of its first generation constellation, Starlink satellites of all close approaches, Lewis’ calculations suggest.will be involved in 90%

**Chart, line chart

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

The risk of collision

Siemak Hesar, CEO and co-founder of Boulder, Colorado, based Kayhan Space, confirms the trend. His company, which develops a commercial autonomous space traffic management system, estimates that on average, an operator managing about 50 satellites will receive up to 300 official conjunction alerts a week. These alerts include encounters with other satellites as well as pieces of debris. Out of these 300 alerts, up to ten might require operators to perform avoidance maneuvers, Hesar told Space.com.

Kayhan Space bases their estimates on data provided by the U.S. Space Surveillance Network. This network of radars and telescopes, managed by the U.S. Space Force, closely monitors about 30,000 live and defunct satellites and pieces of debris down to the size of 4 inches (10 centimeters) and provides the most accurate location data of the orbiting objects.

The size of this catalog is expected to increase ten times in the near future, Hesar added, partly due to the growth of megaconstellations, such as Starlink, and partly as sensors improve and enable detection of even smaller objects. The more objects in the catalog mean more dangerously close encounters.

"This problem is really getting out of control," Hesar said. "The processes that are currently in place are very manual, not scalable, and there is not enough information sharing between parties that might be affected if a collision happens."

Hesar compared the problem to driving on a highway and not knowing that there has been an accident a few miles ahead of you. If two spacecraft collide in orbit, the cloud of debris the crash generates would threaten other satellites travelling through the same area.

"You want to have that situational awareness for the other actors that are flying in the neighbourhood," Hesar said.

Bad decisions

Despite the concerns, only three confirmed orbital collisions have happened so far. Earlier this week, astrophysicist and satellite tracker Jonathan McDowell, who's based at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, found evidence in Space-Track data that the Chinese meteorological satellite Yunhai 1-02, which disintegrated in March this year, was actually hit by a piece of space debris.

The worst known space collision in history took place in February 2009 when the U.S. telecommunication satellite Iridium 33 and Russia's defunct military satellite Kosmos-2251 crashed at the altitude of 490 miles (789 kilometres). The incident spawned over 1,000 pieces of debris larger than 4 inches (10 cm). Many of these fragments were then involved in further orbital incidents.

Lewis is concerned that with the number of close passes growing, the risk of operators at some point making a wrong decision will grow as well. Avoidance maneuvers cost fuel, time and effort. Operators, therefore, always carefully evaluate such risks. A decision not to make an avoidance maneuver following an alert, such as that made by Iridium in 2009, could, however, clutter the orbital environment for years and decades.

"In a situation when you are receiving alerts on a daily basis, you can't maneuver for everything," Lewis said. "The maneuvers use propellant, the satellite cannot provide service. So there must be some threshold. But that means you are accepting a certain amount of risk. The problem is that at some point, you are likely to make a wrong decision."

Hesar said that uncertainties in the positions of satellites and pieces of debris are still considerable. In case of operational satellites, the error could be up to 330 feet (100 meters) large. When it comes to a piece of debris, the uncertainty about its exact position might be in the order of a mile or more.

"This object can be anywhere in this bubble of multiple kilometres," Hesar said. "At this point, and for the foreseeable future, avoidance is our best recourse. People that say 'I'm going to take the risk', in my humble opinion, that's an irresponsible thing to do."

Starlink monopoly

Lewis is concerned about the growing influence of a single actor — Starlink — on the safety of orbital operations. Especially, he says, as the spaceflight company has entered the satellite operations world only recently.

"We place trust in a single company, to do the right thing," Lewis said. "We are in a situation where most of the maneuvers we see will involve Starlink. They were a launch provider before, now they are the world's biggest satellite operator, but they have only been doing that for two years so there is a certain amount of inexperience."

SpaceX relies on an autonomous collision avoidance system to keep its fleet away from other spacecraft. That, however, could sometimes introduce further problems. The automatic orbital adjustments change the forecasted trajectory and therefore make collision predictions more complicated, according to Lewis.

"Starlink doesn't publicize all the maneuvers that they're making, but it is believed that they are making a lot of small corrections and adjustments all the time," Lewis said. "But that causes problems for everybody else because no one knows where the satellite is going to be and what it is going to do in the next few days."

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

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

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

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

Space Debris Threat Increases in the LEO

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

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

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

Constellation in the Making Could Impact Space-Based Military Assets

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

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

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

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

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

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

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

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

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

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

#### Otherwise, causes cyberwar and satellite hacking which escalates.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Commodity parts

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

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

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

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

History of hacks

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

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

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

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

#### And the desire to protect profitable LEO constellations leads states to militarize outer space—specifically with ASATs.

Bernat 19 “The Inevitability of Militarization of Outer Space” Pawel Bernat [Assistant Professor, Polish Air Force University] Safety & Defense 5(1) (2019) 49–54 <https://philarchive.org/archive/BERTIO-52> SM

Currently, the dominant interpretations of this article argue that the placement of conventional weapons, including systems with nuclear drives, in orbit does not violate the provisions of the Treaty (Bourbonniere & Lee, 2008). The Treaty, according to these elucidations, does not also prohibit nuclear weapons or weapons of mass destruction on trajectory passing through space, as it is the case with the Russian ballistic missile RS-28 Sarmat. However, it prohibits placing and keeping biological, bacteriological, chemical, and nuclear weapons in orbit (Boothby, 2017).

Of course, there are also other interpretations, according to which the Treaty has been infringed more than once. They are based on the quite right belief that in the case of modern weapons, one should talk about systems rather than a single ballistic missile. After all, the satellite navigation system was created as part of a ballistic missile guidance system with thermonuclear warheads (LaGrone, 2014). Therefore, we are dealing here with a very important philosophical and legal question whether the satellite being a part of such a system is a weapon and hence prohibited by the Treaty. This brings us back to the difficulty of clear and sound definition of the term “space weapon” addressed before. Does the fact that a civil communication satellite can be used (and often is) for military purposes make it a part of a weapon system? If so, what would be the consequences, especially if we took into consideration the fact that approximately 95% of satellites could be used that way? These questions, although theoretical in nature, bear significant consequences for the binding power of the Treaty, and therefore the whole outer space legal framework.

So far, however, the Treaty has been fulfilling its task quite well, and its provisions have been relatively seldom broken or violated. On the other hand, we are currently witnessing an undoubted renaissance of the space sector, which also applies to offensive and defensive military technologies and programs. The structure of the sector has changed as well – the twentieth-century traditional bipolar competition between the United States and the Soviet Union is long gone. New entities have appeared in the game, both, private companies, such as SpaceX, Blue Origin, Virgin Galactic and Virgin Orbit, Bigelow Aerospace, Rocket Lab, and national agencies – Indian ISRO (Indian Space Research Organization) or Chinese CNSA (China National Space Administration), which joined the key global actors like American NASA, Russian Roscosmos, European ESA, or Japanese JAXA. The record of orbital launches – 139, was set in 1967 (Kyle, 2019a). It may seem surprising that humanity has not been able to break this record for over 50 years. However, since the middle of the first decade of the 21st century, we have been observing a steady increase in the number of orbital launches (52 in 2005, 70 in 2010, 114 in 2018), and it seems that this record will be broken in 2019 because 173 starts are planned (Kyle, 2019b). The space sector is also growing as a market. It is estimated that it is currently worth about USD 350 billion, and according to various consulting companies, it should reach a value of between USD 1 and 2.7 trillion in 2040 (Foust, 2018).

The change in the sector means that the existing solutions, including the Space Treaty, are losing their significance (e.g., space mining cannot be reconciled with Article II of the Treaty), and the current geopolitical situation seems to exclude new, more adequate agreement that would be adapted to modern technologies. This situation, in turn, translates into more and more bolder violations of the existing laws, e.g., the already mentioned SPACE Act of 2015 or increasingly explicit orbital or suborbital weapons systems, which are clearly not developed “in the interest of maintaining international peace and security and promoting international co-operation and understanding” as it is stated in the Art. III of the Outer Space Treaty (UNOSA, 1967), as, e.g., the programs of Prompt Global Strike (CRS, 2019).

3. Outer Space as a Theatre for Potential Conflict

The progressive development of the space sector brings forth, as a natural consequence, the growth of its strategic importance. Every year we launch more and more satellites into the orbit. They are part of communication, navigation, reconnaissance, or security systems, which are used more and more and play an increasingly important role in the economy and security. Among many examples, one may point to the already mentioned Prompt Global Strike guidance system, the European Galileo navigation system, or Starlink - a constellation of satellites, which is expected to provide broadband internet for the entire globe and consist of approximately 42,000 satellites (SpaceX has already obtained a permission to launch 12,000 satellites, and in October 2019 the company asked the International Telecommunication Union to arrange spectrum for 30,000 new ones) (Henry, 2019).

On the other hand, there is a growing threat of the democratization of weapons capable of destroying satellite systems. According to the 2018 Worldwide Threat Assessment of the US Intelligence Community describes the space threat as one of the most significant ones (Coats, 2018, p. 13). ASAT The anti-satellite weapons (ASAT) are currently in possession of four countries – the United States, Russia, China, and, more recently, India. However, it is reported that other nation-states have the potential to develop direct-ascent (DA) ASAT systems on the basis of their ballistic missiles, e.g., Iran and North Korea (Weeden, Samson, 2019, pp. 4.1-2, 5.1-2), and some believe that Israel’s Arrow 3 missile has been developed to gain such a capability (Opall-Rome, 2009). There are many indications that this technology will eventually also be available to traditionally weak actors who will acquire it through purchase or by developing their own systems. As it was already mentioned, the space sector is growing by leaps and bounds. National-states and private entities that did not invest much or at all in the space industry before are now developing launching technologies (e.g., New Zealand, Norway, Poland), what, as a consequence, must lead to the democratization of the technology. What is more, in addition to traditional groundspace or air-space ASAT missiles, new types of that kind of weapon can be developed (potentially it could also become available for traditionally weak actors), such as small kamikaze satellites1 , cyber-hacking involving redirecting the object to a cloud of cosmic debris leading to its destruction or a weapon system that would be capable of “blinding” the satellite or destroy its sensors without physically destroying the object.

Considering the above facts, it should not come as a surprise that in order to ensure the operability of increasingly important, also for national security, satellite systems, there are programs being implemented to create offensive and defensive systems for objects in orbit. And that, in turn, has generated the construction of countermeasures – weapons that would be able to neutralize the new systems – by the potential adversaries. As a consequence, we are witnessing an expansion of the potential conflict arena where outer space becomes a possible theatre for military operations. This process is still in its early stages, but there should be no doubts that it is taking place already. Countries with sufficient technological potential caring for their current and future interests have been developing and will continue working on defensive systems (also aimed at eliminating the threat from traditionally weak actors) and offensive systems (ensuring military superiority and deterrence factor). Space corps are established and developed for exactly these purposes.

There is no indication that this process will stop. On the contrary, it seems that due to the progressive development of space technologies and the privatization of the sector, as well as substantial potential revenues from space mining or the global satellite broadband internet system, it will accelerate. As it was demonstrated in the section dedicated to the legal framework of operating in outer space, the current laws and treaties have lost their significance, and they are not taken into account while planning future operations. The United Nations and its Office for Outer Space Affairs (UNOOSA) are structurally and legally too weak to inflict punishment or sanction for breaking the rules. One may then risk the claim that further militarization of space is inevitable. It will undoubtedly further affect the validity of the Outer Space Treaty, which, over time, will not be respected at all. That, in turn, will open the door to the development of various kinds of space offensive weapon systems.

4. Militarization of Outer Space Is Imminent

The main argument of the paper provides the information why there will be a progressive increase of weapon systems placed in orbit, and various types of space corps will be further developed by national-states.

As was demonstrated above, we, as humankind, rely more and more on orbital communication, navigation, and security systems. Global and regional navigation satellite systems are continually developed and perfected by a progressive number of entities, mainly national states. Examples of GNSS include Europe’s Galileo, the US’s NAVSTAR Global Positioning System (GPS), Russia’s Global’naya Navigatsionnaya Sputnikovaya Sistema (GLONASS) and China’s BeiDou Navigation Satellite System. There are, however, another two regional systems under development, i.e., Indian Regional Navigation Satellite System (IRNSS) and Japanese Quasi-Zenith Satellite System (QZSS). All of those satellites, apart from securing civil safety (e.g., in transportation, logistics, communication), play a crucial role in national security.

Another example is the mentioned already Starlink system that will provide broadband internet for the Northern US and parts of Canada already in 2020, and the plan is to create the global system before 2027 (Mosher, 2019). Again, the system, although designed for civil purposes, will be used by the military – the US Air Force is testing SpaceX’s Starlink technology in military aircraft to deliver high bandwidth into the cockpit of Air Force planes under a program called Global Lightning (Malik, 2019). The facts are straightforward – there are more and more satellite systems that play an essential role in countries’ security and are part of critical infrastructure, so in order to secure their interests and protect that infrastructure, these national states keep developing both defensive and offensive means. The Worldwide Threat Assessment of the US Intelligence Community is very clear in its predictions in this regard:

We assess that, if a future conflict were to occur involving Russia or China, either country would justify attacks against US and allied satellites as necessary to offset any perceived US military advantage derived from military, civil, or commercial space systems (Coats, 2018).

However, we must not forget about the democratization of the weapon systems that may pose a serious and real threat to satellite systems. Currently, there are four countries in possession of the ASAT weapons that could destroy a satellite in orbit. However, more and more entities, both national states and private companies have been working on their launch technologies, like New Zeeland, Norway, Poland, just to name a few. Moreover, it should be remembered that not only ASAT missile systems may be used to attack and destroy satellites – one may use small kamikaze satellites to crash into the target, cyber-hacking to direct the object into the cloud of space debris, “blinding” the satellites with ground-based lasers (Mizokami, 2019). These technologies are much more reachable. Therefore, in time, we should expect that traditionally weak actors, like rogue states or terrorist organizations, will gain have access to them (Bernat, Posluszna, 2018).

#### China, Russia, and the US are developing dual use co-orbital ASATs that can stalk and attack other satellites using rendezvous and proximity operations – they make miscalculation highly likely

Chow ’17 - independent policy analyst with over 25 years as a senior physical scientist specializing in space and national security. He holds a PhD in physics from Case Western Reserve University and an MBA with distinction and PhD in finance from the University of Michigan. Brian G Chow, “Stalkers in Space:  Defeating the Threat,” Strategic Studies Quarterly 11, no. 2 (Summer 2017): 82-116, <https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-11_Issue-2/Chow.pdf>.

Abstract

Since 2008, China has been developing a new co-orbital antisatellite weapon (ASAT). These “space stalkers” could be placed on orbit in peacetime and maneuvered to tailgate US satellites during a crisis. At a moment’s notice, they could simultaneously attack multiple critical satellites from such close proximity that the United States would not have time to prevent damage. Current national security space strategy, existing and developing space defense capabilities, and current proposals for dealing with weapons in space cannot counter this new threat. Since space stalkers cannot be reliably distinguished from ordinary satellites, these ASATs cannot be banned outright. Instead, this article proposes to ban threatening positioning of space objects, whether satellites or space stalkers. As these positions can be observed by multiple countries, the United States should declare and work with the international community to agree that any country configuring and readying space stalkers for attack demonstrates hostile intent, which justifies preemptive self-defense as the last resort. In the case of space stalkers, self-defense is a justified action rather than a pretext for aggression. The proposed scheme would be effective in deterring and defending against space stalkers.

The United States has 554 operational satellites, the largest number of satellites among all countries and organizations in the world (see table 1).1 While these space capabilities offer great advantages for the US military, they simultaneously create great vulnerabilities. The Department of Defense (DOD) is increasingly concerned, particularly about the space threat from China. In its annual reports to Congress, Military and Security Developments Involving the People’s Republic of China for 2013,2 2014,3 2015,4 and 2016,5 the DOD has warned repeatedly: “PLA [People’s Liberation Army] writings emphasize the necessity of ‘destroying, damaging, and interfering with the enemy’s reconnaissance . . . and communications satellites,’ suggesting that such systems, as well as navigation and early warning satellites, could be among the targets of attacks designed to ‘blind and deafen the enemy.’ ” Gen John Hyten, the former head of Air Force Space Command, said without space assets, the United States would be forced to revert to industrial age warfare: “It’s Vietnam, Korea and World War II”—no more precision missiles and smart bombs.6 Hyten was also quoted as saying that “China will soon be able to threaten US satellites in every orbital regime, from low Earth orbit a few hundred miles above the Earth, to geosynchronous orbit more than 20,000 miles up—where some of the military’s most important satellites circle the Earth. . . . Now we have to figure out how to defend those satellites.”7

As threats from ground-based ASATs (such as traditional threats from ballistic missiles, lasers, and jammers and the newer cyber attacks8 ) grow, it is easy to continue focusing on these much more well-known ASATs and ignore China’s developing co-orbital ASAT—hereafter what this article refers to as space stalkers. In November 2015, the U.S.-China Economic and Security Review Commission released its annual report to Congress stating that “since 2008, China has tested increasingly complex space proximity capabilities.”9 It confirmed what it and others have been suggesting, that “China’s recent space activities indicate it is developing co-orbital antisatellite systems to target US space assets. These systems consist of a satellite armed with a weapon such as an explosive charge, fragmentation device, kinetic energy weapon, laser, radio frequency weapon, jammer, or robotic arm.”10 Space objects capable of rendezvous proximity operations and particularly equipped with a robotic arm could pose a game-changing threat as these objects could be placed in orbit during peacetime. During a crisis, such as China seizing Taiwan or territorial disputes in the South China Sea, these space objects could be maneuvered to tailgate US satellites and become space stalkers. They could simultaneously attack multiple critical satellites from such a close proximity that the United States would not have time to react. The space stalkers could destroy enough critical satellites to force the United States back toward General Hyten’s warning of fighting primitive “industrial age warfare” with greatly increased collateral damage. On 29 November 2016, CNN broadcast the documentary “War in Space: The Next Battlefield,” based on interviews of more than 10 high-ranking military personnel of the entire chain of command for space warfare. These interviews described the concerns of senior space officials about the threat from “kamikaze and kidnapper satellites launched by Russia and China.”11

Geosynchronous satellites have long been considered safe from attacks, especially simultaneous attacks, since direct-ascent ASAT ballistic missiles would typically take about four hours to reach geosynchronous satellites.12 However, these satellites could soon be under serious threat. Setting up the space stalkers to be co-orbital with, and in close proximity to, their prey is the easiest way to coordinate simultaneous attacks. If China could place these highly maneuverable space stalkers in close proximity to multiple US critical satellites, simultaneous attacks would be possible with little advance warning, leaving the United States inadequate time to save the targeted satellites.

The space-stalking threat is unique and cannot be mitigated by focusing on and responding to traditional satellite threats. Even if the United States could perfectly deter and defend against all the traditional ASAT threats and the newer cyber attacks, adversaries could still use multiple stalkers to mount a devastating first strike against critical US satellites. Thus, the United States must specifically deal with the emerging spacestalker threat. This article provides analysis and recommendations on how to develop an overarching strategy to deter and defend against space stalkers without ignoring other threats and while gaining international support for the new strategy.

One must first understand Chinese counterspace strategy to prescribe an effective US strategy and policy. The United States must also refocus its traditional space policies to address the emerging space-stalking threat— something neglected today. Additionally, the National Security Space Strategy must be updated to include a strategy to defend against and to deter space stalkers, including justified preemption as the last resort. Diplomacy alone with potential adversaries to lessen the space-stalking threat is important but not sufficient. Therefore, the new US strategy should include developing new international agreements on weapons in space and in particular space stalkers.

The space-stalker threat does not come from China alone. Russia has also been improving its close proximity operation capability, which is dual-use for non-ASAT and ASAT purposes. Its potential space-stalking capability would be more advanced than China’s.13 However, this article uses only Chinese scenarios since concerns about the threat and suggested measures for US response are essentially the same for both China and Russia.

#### Unknown legal thresholds for escalation make inadvertent escalation highly likely

MacDonald ’18 – senior director of the Nonproliferation and Arms Control Project with the Center for Conflict Analysis and Prevention, Adjunct Lecturer at Johns Hopkins School of Advanced International Studies. Bruce MacDonald, “Chapter 2. Space and Escalation” in *Outer Space; Earthly Escalation? Chinese Perspectives on Space Operations and Escalation*, A Strategic Multilayer Assessment (SMA) Periodic Publication, August 2018, <https://nsiteam.com/social/wp-content/uploads/2018/08/SMA-White-Paper_Chinese-Persepectives-on-Space_-Aug-2018.pdf>

Another dimension of the problem is the issue of the scale of the attack, both qualitatively and quantitatively. While jamming one or two satellites in isolation appears unlikely to quickly escalate into all-out space war (given the longstanding role of electronic warfare in past conflicts), attacking multiple intelligence-gathering satellites would carry a far higher risk of escalation. Somewhere between these two extremes, however, is an uncertain and unknowable boundary that divides offensive space actions that modestly threaten stability from those that are clearly destabilizing and escalatory. In this unpredictable environment, a country with no desire to spark an all-out space war may still prompt rapid escalation with modest offensive actions that inadvertently cross an unknown threshold. In addition, for technological, commercial, and other reasons the space and cyber domains are evolving far more rapidly than the conventional and nuclear domains, potentially rendering space and cyber strategies ineffective or irrelevant within a few years. In both space and cyberspace, we may learn firsthand how much escalation is too much only after it is too late to stop. Evolving space dynamics could undermine whatever current understanding we may have of crisis and strategic stability in space, and this imperfect grasp of general principles can only add to our uncertainty about the space and cyber offensive capabilities of particular adversaries. Therefore, uncertainty, bluffs, and worst-case thinking are bound to remain prominent forces in the strategic landscape of space. For example, rendezvous and proximity operations on satellites will become more common in the years to come, but they could easily be viewed in a crisis as potentially hostile acts—or in fact be used to commit hostile acts.

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

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

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

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

#### Independently, mega-constellations destroy the ozone layer.

Pultarova 21 “Air pollution from reentering megaconstellation satellites could cause ozone hole 2.0” Tereza Pultarova [Master's in Science from the International Space University, France, to her Bachelor's in Journalism and Master's in Cultural Anthropology from Prague's Charles University. She worked as a reporter at the Engineering and Technology magazine, freelanced for a range of publications including Live Science, Space.com, Professional Engineering, Via Satellite and Space News and served as a maternity cover science editor at the European Space Agency.], June 7, 2021 <https://www.space.com/starlink-satellite-reentry-ozone-depletion-atmosphere> SM

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

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

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

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

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

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

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

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

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

Learning from past mistakes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

– that are given off by the sun.

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

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

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

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

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

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

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

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

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

#### Framing—

#### The standard is maximizing expected ell being.

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

**Pleasure** is not only one of the three primary reward functions but it also **defines reward.** As homeostasis explains the functions of only a limited number of rewards, the principal reason why particular stimuli, objects, events, situations, and activities are rewarding may be due to pleasure. This applies first of all to sex and to the primary homeostatic rewards of food and liquid and extends to money, taste, beauty, social encounters and nonmaterial, internally set, and intrinsic rewards. Pleasure, as the primary effect of rewards, drives the prime reward functions of learning, approach behavior, and decision making and provides the **basis for hedonic theories** of reward function. We are attracted by most rewards and exert intense efforts to obtain them, just because they are enjoyable [10].

Pleasure is a passive reaction that derives from the experience or prediction of reward and may lead to a long-lasting state of happiness. The word happiness is difficult to define. In fact, just obtaining physical pleasure may not be enough. One key to happiness involves a network of good friends. However, it is not obvious how the higher forms of satisfaction and pleasure are related to an ice cream cone, or to your team winning a sporting event. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure [14].

Pleasure as a hallmark of reward is sufficient for defining a reward, but it may not be necessary. A reward may generate positive learning and approach behavior simply because it contains substances that are essential for body function. When we are hungry, we may eat bad and unpleasant meals. A monkey who receives hundreds of small drops of water every morning in the laboratory is unlikely to feel a rush of pleasure every time it gets the 0.1 ml. Nevertheless, with these precautions in mind, we may define any stimulus, object, event, activity, or situation that has the potential to produce pleasure as a reward. In the context of reward deficiency or for disorders of addiction, homeostasis pursues pharmacological treatments: drugs to treat drug addiction, obesity, and other compulsive behaviors. The theory of allostasis suggests broader approaches - such as re-expanding the range of possible pleasures and providing opportunities to expend effort in their pursuit. [15]. It is noteworthy, the first animal studies eliciting approach behavior by electrical brain stimulation interpreted their findings as a discovery of the brain’s pleasure centers [16] which were later partly associated with midbrain dopamine neurons [17–19] despite the notorious difficulties of identifying emotions in animals.

Evolutionary theories of pleasure: The love connection BO:D

Charles Darwin and other biological scientists that have examined the biological evolution and its basic principles found various mechanisms that steer behavior and biological development. Besides their theory on natural selection, it was particularly the sexual selection process that gained significance in the latter context over the last century, especially when it comes to the question of what makes us “what we are,” i.e., human. However, the capacity to sexually select and evolve is not at all a human accomplishment alone or a sign of our uniqueness; yet, we humans, as it seems, are ingenious in fooling ourselves and others–when we are in love or desperately search for it.

It is well established that modern biological theory conjectures that **organisms are** the **result of evolutionary competition.** In fact, Richard Dawkins stresses gene survival and propagation as the basic mechanism of life [20]. Only genes that lead to the fittest phenotype will make it. It is noteworthy that the phenotype is selected based on behavior that maximizes gene propagation. To do so, the phenotype must survive and generate offspring, and be better at it than its competitors. Thus, the ultimate, distal function of rewards is to increase evolutionary fitness by ensuring the survival of the organism and reproduction. It is agreed that learning, approach, economic decisions, and positive emotions are the proximal functions through which phenotypes obtain other necessary nutrients for survival, mating, and care for offspring.

Behavioral reward functions have evolved to help individuals to survive and propagate their genes. Apparently, people need to live well and long enough to reproduce. Most would agree that homo-sapiens do so by ingesting the substances that make their bodies function properly. For this reason, foods and drinks are rewards. Additional rewards, including those used for economic exchanges, ensure sufficient palatable food and drink supply. Mating and gene propagation is supported by powerful sexual attraction. Additional properties, like body form, augment the chance to mate and nourish and defend offspring and are therefore also rewards. Care for offspring until they can reproduce themselves helps gene propagation and is rewarding; otherwise, many believe mating is useless. According to David E Comings, as any small edge will ultimately result in evolutionary advantage [21], additional reward mechanisms like novelty seeking and exploration widen the spectrum of available rewards and thus enhance the chance for survival, reproduction, and ultimate gene propagation. These functions may help us to obtain the benefits of distant rewards that are determined by our own interests and not immediately available in the environment. Thus the distal reward function in gene propagation and evolutionary fitness defines the proximal reward functions that we see in everyday behavior. That is why foods, drinks, mates, and offspring are rewarding.

There have been theories linking pleasure as a required component of health benefits salutogenesis, (salugenesis). In essence, under these terms, pleasure is described as a state or feeling of happiness and satisfaction resulting from an experience that one enjoys. Regarding pleasure, it is a double-edged sword, on the one hand, it promotes positive feelings (like mindfulness) and even better cognition, possibly through the release of dopamine [22]. But on the other hand, pleasure simultaneously encourages addiction and other negative behaviors, i.e., motivational toxicity. It is a complex neurobiological phenomenon, relying on reward circuitry or limbic activity. It is important to realize that through the “Brain Reward Cascade” (BRC) endorphin and endogenous morphinergic mechanisms may play a role [23]. While natural rewards are essential for survival and appetitive motivation leading to beneficial biological behaviors like eating, sex, and reproduction, crucial social interactions seem to further facilitate the positive effects exerted by pleasurable experiences. Indeed, experimentation with addictive drugs is capable of directly acting on reward pathways and causing deterioration of these systems promoting hypodopaminergia [24]. Most would agree that pleasurable activities can stimulate personal growth and may help to induce healthy behavioral changes, including stress management [25]. The work of Esch and Stefano [26] concerning the link between compassion and love implicate the brain reward system, and pleasure induction suggests that social contact in general, i.e., love, attachment, and compassion, can be highly effective in stress reduction, survival, and overall health.

Understanding the role of neurotransmission and pleasurable states both positive and negative have been adequately studied over many decades [26–37], but comparative anatomical and neurobiological function between animals and homo sapiens appear to be required and seem to be in an infancy stage.

Finding happiness is different between apes and humans

As stated earlier in this expert opinion one key to happiness involves a network of good friends [38]. However, it is not entirely clear exactly how the higher forms of satisfaction and pleasure are related to a sugar rush, winning a sports event or even sky diving, all of which augment dopamine release at the reward brain site. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure.

Remarkably, there are pathways for ordinary liking and pleasure, which are limited in scope as described above in this commentary. However, there are **many brain regions**, often termed hot and cold spots, that significantly **modulate** (increase or decrease) our **pleasure or** even produce **the opposite** of pleasure— that is disgust and fear [39]. One specific region of the nucleus accumbens is organized like a computer keyboard, with particular stimulus triggers in rows— producing an increase and decrease of pleasure and disgust. Moreover, the cortex has unique roles in the cognitive evaluation of our feelings of pleasure [40]. Importantly, the interplay of these multiple triggers and the higher brain centers in the prefrontal cortex are very intricate and are just being uncovered.

Desire and reward centers

It is surprising that many different sources of pleasure activate the same circuits between the mesocorticolimbic regions (Figure 1). Reward and desire are two aspects pleasure induction and have a very widespread, large circuit. Some part of this circuit distinguishes between desire and dread. The so-called pleasure circuitry called “REWARD” involves a well-known dopamine pathway in the mesolimbic system that can influence both pleasure and motivation.

In simplest terms, the well-established mesolimbic system is a dopamine circuit for reward. It starts in the ventral tegmental area (VTA) of the midbrain and travels to the nucleus accumbens (Figure 2). It is the cornerstone target to all addictions. The VTA is encompassed with neurons using glutamate, GABA, and dopamine. The nucleus accumbens (NAc) is located within the ventral striatum and is divided into two sub-regions—the motor and limbic regions associated with its core and shell, respectively. The NAc has spiny neurons that receive dopamine from the VTA and glutamate (a dopamine driver) from the hippocampus, amygdala and medial prefrontal cortex. Subsequently, the NAc projects GABA signals to an area termed the ventral pallidum (VP). The region is a relay station in the limbic loop of the basal ganglia, critical for motivation, behavior, emotions and the “Feel Good” response. This defined system of the brain is involved in all addictions –substance, and non –substance related. In 1995, our laboratory coined the term “Reward Deficiency Syndrome” (RDS) to describe genetic and epigenetic induced hypodopaminergia in the “Brain Reward Cascade” that contribute to addiction and compulsive behaviors [3,6,41].

Furthermore, ordinary “liking” of something, or pure pleasure, is represented by small regions mainly in the limbic system

(old reptilian part of the brain). These may be part of larger neural circuits. In Latin, hedus is the term for “sweet”; and in Greek, hodone is the term for “pleasure.” Thus, the word Hedonic is now referring to various subcomponents of pleasure: some associated with purely sensory and others with more complex emotions involving morals, aesthetics, and social interactions. The capacity to have pleasure is part of being healthy and may even extend life, especially if linked to optimism as a dopaminergic response [42].

Psychiatric illness often includes symptoms of an abnormal inability to experience pleasure, referred to as anhedonia. A negative feeling state is called dysphoria, which can consist of many emotions such as pain, depression, anxiety, fear, and disgust. Previously many scientists used animal research to uncover the complex mechanisms of pleasure, liking, motivation and even emotions like panic and fear, as discussed above [43]. However, as a significant amount of related research about the specific brain regions of pleasure/reward circuitry has been derived from invasive studies of animals, these cannot be directly compared with subjective states experienced by humans.

In an attempt to resolve the controversy regarding the causal contributions of mesolimbic dopamine systems to reward, we have previously evaluated the three-main competing explanatory categories: “liking,” “learning,” and “wanting” [3]. That is, dopamine may mediate (a) liking: the hedonic impact of reward, (b) learning: learned predictions about rewarding effects, or (c) wanting: the pursuit of rewards by attributing incentive salience to reward-related stimuli [44]. We have evaluated these hypotheses, especially as they relate to the RDS, and we find that the incentive salience or “wanting” hypothesis of dopaminergic functioning is supported by a majority of the scientific evidence. Various neuroimaging studies have shown that anticipated behaviors such as sex and gaming, delicious foods and drugs of abuse all affect brain regions associated with reward networks, and may not be unidirectional. Drugs of abuse enhance dopamine signaling which sensitizes mesolimbic brain mechanisms that apparently evolved explicitly to attribute incentive salience to various rewards [45].

Addictive substances are voluntarily self-administered, and they enhance (directly or indirectly) dopaminergic synaptic function in the NAc. This activation of the brain reward networks (producing the ecstatic “high” that users seek). Although these circuits were initially thought to encode a set point of hedonic tone, it is now being considered to be far more complicated in function, also encoding attention, reward expectancy, disconfirmation of reward expectancy, and incentive motivation [46]. The argument about addiction as a disease may be confused with a predisposition to substance and nonsubstance rewards relative to the extreme effect of drugs of abuse on brain neurochemistry. The former sets up an individual to be at high risk through both genetic polymorphisms in reward genes as well as harmful epigenetic insult. Some Psychologists, even with all the data, still infer that addiction is not a disease [47]. Elevated stress levels, together with polymorphisms (genetic variations) of various dopaminergic genes and the genes related to other neurotransmitters (and their genetic variants), and may have an additive effect on vulnerability to various addictions [48]. In this regard, Vanyukov, et al. [48] suggested based on review that whereas the gateway hypothesis does not specify mechanistic connections between “stages,” and does not extend to the risks for addictions the concept of common liability to addictions may be more parsimonious. The latter theory is grounded in genetic theory and supported by data identifying common sources of variation in the risk for specific addictions (e.g., RDS). This commonality has identifiable neurobiological substrate and plausible evolutionary explanations.

Over many years the controversy of dopamine involvement in especially “pleasure” has led to confusion concerning separating motivation from actual pleasure (wanting versus liking) [49]. We take the position that animal studies cannot provide real clinical information as described by self-reports in humans. As mentioned earlier and in the abstract, on November 23rd, 2017, evidence for our concerns was discovered [50]

In essence, although nonhuman primate brains are similar to our own, the disparity between other primates and those of human cognitive abilities tells us that surface similarity is not the whole story. Sousa et al. [50] small case found various differentially expressed genes, to associate with pleasure related systems. Furthermore, the dopaminergic interneurons located in the human neocortex were absent from the neocortex of nonhuman African apes. Such differences in neuronal transcriptional programs may underlie a variety of neurodevelopmental disorders.

In simpler terms, the system controls the production of dopamine, a chemical messenger that plays a significant role in pleasure and rewards. The senior author, Dr. Nenad Sestan from Yale, stated: “Humans have evolved a dopamine system that is different than the one in chimpanzees.” This may explain why the behavior of humans is so unique from that of non-human primates, even though our brains are so surprisingly similar, Sestan said: “It might also shed light on why people are vulnerable to mental disorders such as autism (possibly even addiction).” Remarkably, this research finding emerged from an extensive, multicenter collaboration to compare the brains across several species. These researchers examined 247 specimens of neural tissue from six humans, five chimpanzees, and five macaque monkeys. Moreover, these investigators analyzed which genes were turned on or off in 16 regions of the brain. While the differences among species were subtle, **there was** a **remarkable contrast in** the **neocortices**, specifically in an area of the brain that is much more developed in humans than in chimpanzees. In fact, these researchers found that a gene called tyrosine hydroxylase (TH) for the enzyme, responsible for the production of dopamine, was expressed in the neocortex of humans, but not chimpanzees. As discussed earlier, dopamine is best known for its essential role within the brain’s reward system; the very system that responds to everything from sex, to gambling, to food, and to addictive drugs. However, dopamine also assists in regulating emotional responses, memory, and movement. Notably, abnormal dopamine levels have been linked to disorders including Parkinson’s, schizophrenia and spectrum disorders such as autism and addiction or RDS.

Nora Volkow, the director of NIDA, pointed out that one alluring possibility is that the neurotransmitter dopamine plays a substantial role in humans’ ability to pursue various rewards that are perhaps months or even years away in the future. This same idea has been suggested by Dr. Robert Sapolsky, a professor of biology and neurology at Stanford University. Dr. Sapolsky cited evidence that dopamine levels rise dramatically in humans when we anticipate potential rewards that are uncertain and even far off in our futures, such as retirement or even the possible alterlife. This may explain what often motivates people to work for things that have no apparent short-term benefit [51]. In similar work, Volkow and Bale [52] proposed a model in which dopamine can favor NOW processes through phasic signaling in reward circuits or LATER processes through tonic signaling in control circuits. Specifically, they suggest that through its modulation of the orbitofrontal cortex, which processes salience attribution, dopamine also enables shilting from NOW to LATER, while its modulation of the insula, which processes interoceptive information, influences the probability of selecting NOW versus LATER actions based on an individual’s physiological state. This hypothesis further supports the concept that disruptions along these circuits contribute to diverse pathologies, including obesity and addiction or RDS.