## 1AC

### Framing

#### Ethics must begin a priori:

#### [A] Naturalistic fallacy – experience only tells us what is since we can only perceive what is, not what ought to be. But it’s impossible to derive an ought from descriptive premises, so there needs to be additional a priori premises to make a moral theory.

#### [B] Empirical uncertainty – evil demon could deceive us, dreaming, simulation, and inability to know others’ experience make empiricism an unreliable basis for universal ethics. Outweighs since it would be escapable since people could say they don’t experience the same.

#### [C] Constitutive Authority – practical reason is the only unescapable authority because to ask for why we should be reasoners concedes its authority since it uses reason – anything else is nonbinding and arbitrary.

#### Next, the relevant feature of reason is universality – any non-universalizable norm justifies someone’s ability to impede on your ends i.e. if I want to eat ice cream, I must recognize that others may affect my pursuit of that end and demand the value of my end be recognized by others which also means universalizability acts as a side constraint on all other frameworks. It’s impossible to will a violation of freedom since deciding to do would will incompatible ends since it logically entails willing a violation of your own freedom

#### Thus, the standard is consistency with the categorical imperative. Prefer:

#### [1] Performativity—freedom is the key to the process of justification of arguments. Willing that we should abide by their ethical theory presupposes that we own ourselves in the first place. Thus, it is logically incoherent to justify a standard without first willing that we can pursue ends free from others.

#### [2] Consequences Fail: [A] Every action has infinite stemming consequences, because every consequence can cause another consequence so we can’t predict or calculate. [B] Aggregation fails – suffering is not additive can’t compare between one migraine and 10 head aches

#### [3] Only universalizable reason can effectively explain the perspectives of agents – that’s the best method for combatting oppression.

Farr 02 Arnold Farr (prof of phil @ UKentucky, focusing on German idealism, philosophy of race, postmodernism, psychoanalysis, and liberation philosophy). “Can a Philosophy of Race Afford to Abandon the Kantian Categorical Imperative?” JOURNAL of SOCIAL PHILOSOPHY, Vol. 33 No. 1, Spring 2002, 17–32.

**One** of the most popular **criticism**s **of Kant’s moral philosophy is that it is too formalistic.**13 That is, the universal nature of the categorical imperative leaves it devoid of content. Such a principle is useless since moral decisions are made by concrete individuals in a concrete, historical, and social situation. This type of criticism lies behind Lewis Gordon’s rejection of any attempt to ground an antiracist position on Kantian principles. The rejection of universal principles for the sake of emphasizing the historical embeddedness of the human agent is widespread in recent philosophy and social theory. I will argue here on Kantian grounds that **although a distinction between the universal and the concrete is** a **valid** distinction, **the unity of the two is required for** an understanding of human **agency.** The attack on Kantian formalism began with Hegel’s criticism of the Kantian philosophy.14 The list of contemporary theorists who follow Hegel’s line of criticism is far too long to deal with in the scope of this paper. Although these theorists may approach the problem of Kantian formalism from a variety of angles, the spirit of their criticism is basically the same: The universality of the categorical imperative is an abstraction from one’s empirical conditions. **Kant is** often **accused of making the moral agent an abstract, empty**, noumenal **subject. Nothing could be further from the truth. The Kantian subject is** an embodied, empirical, concrete subject. However, this concrete subject has a dual nature. Kant claims in the Critique of Pure Reason as well as in the Grounding that human beings have an intelligible and empirical character.15 It is impossible to understand and do justice to Kant’s moral theory without taking seriously the relation between these two characters. The very concept of morality is impossible without the tension between the two. By “empirical character” Kant simply means that we have a sensual nature. We are physical creatures with physical drives or desires. **The** very **fact that I cannot simply satisfy my desires without considering the rightness** or wrongness **of my actions suggests that my empirical character must be held in check** by something, or else I behave like a Freudian id. My empiri- cal character must be held in check **by my intelligible character**, which is the legislative activity of practical reason. It is through our intelligible character that **we formulate principles that keep our** empirical **impulses in check.** The categorical imperative is the supreme principle of morality that is constructed by the moral agent in his/her moment of self-transcendence. What I have called self-transcendence may be best explained in the following passage by Onora O’Neill: In restricting our maxims to those that meet the test of the categorical imperative we refuse to base our lives on maxims that necessarily make our own case an exception. The reason why a universilizability criterion is morally signiﬁcant is that it makes our own case no special exception (G, IV, 404). In accepting the Categorical Imperative we accept the moral reality of other selves, and hence the possibility (not, note, the reality) of a moral community. **The Formula of Universal Law enjoins no more than that we act only on maxims that are open to others also.**16 O’Neill’s description of the universalizability criterion includes the notion of self-transcendence that I am working to explicate here to the extent that like self-transcendence, universalizable moral principles require that the individ- ual think beyond his or her own particular desires. The individual is not allowed to exclude others **as** rational **moral agents** who have the right to act as he acts in a given situation. For example, if I decide to use another person merely as a means for my own end I must recognize the other person’s right to do the same to me. I cannot consistently will that I use another as a means only and will that I not be used in the same manner by another. **Hence,** the **universalizability** criterion **is a principle of consistency and** a principle of **inclusion.** That is, in choosing my maxims **I** attempt to **include the perspective of other moral agents.**

#### [4] Ethical frameworks are topicality interpretations of the word unjust so they must be theoretically justified. Prefer on resource disparities—focusing on evidence and statistics privileges debaters with the most preround prep excluding lone-wolfs who lack huge evidence files. A debater under my framework can easily be won without any prep since minimal evidence is required. That controls the internal link to other voters because a pre-req to debating is access to the activity.

### Plan

#### Thus, the plan – Resolved: The appropriation of outer space by private entities is unjust. Definitions and enforcement in the doc and I’ll clarify in cross.

To clarify we’ll defend implementation and a revision to the Outer Space Treaty that explicitly bans appropriation of outer space by private entities

### Offense

#### In outer space, there is no governing authority and thus claiming property imposes your will over others.

Stilz 2 (Anna Stilz, Anna Stilz is Laurance S. Rockefeller Professor of Politics and the University Center for Human Values. Her research focuses on questions of political membership, authority and political obligation, nationalism and self-determination, rights to land and territory, and collective agency. , 2009, accessed on 12-18-2021, Muse.jhu, "Project MUSE - Liberal Loyalty", https://muse.jhu.edu/book/30179)//phs st

It might seem, then, that Kant, like Simmons, would hold that although our acquired rights are initially indefinite, our private acts of appropria- tion in a state of nature can function to more clearly delimit their contours. Once I appropriate an external object—for example, my piece of land in the state of nature—the boundaries of my right to external freedom might simply be equivalent to those of the things and spaces that I have appropriated. If this were so, then individuals could succeed in more precisely defining property without the help of the state, and simply by coordinating expectations based on their private acts. In order to respect and acknowledge my external freedom, on this view, you would just have to cede me the spot I have rightfully occupied and to refrain from infringing on my choices within that sphere. Yet Kant does not take this position: he argues that the rights made possible by the postulate of practical reason are problematic. Whatever rights our private acts of appropriation outside the state confer upon us can only be understood as provisional rights, that is, they are not conclusive and settled (peremp- torische): indeed, for him, “It is possible to have something external as one’s own only in a rightful condition, giving laws publicly, that is, a civil condition” (MM, 6:255). What is the problem with these private methods of defining our rights to property? Why are they so unsatisfactory, from Kant’s perspective? The essential problem with acquiring property rights in a state of nature, for Kant, seems to be that we cannot unilaterally—through private will— impose a new obligation on other persons to respect our property that they would not otherwise have had.30 “By my unilateral choice I cannot bind another to refrain from using a thing, an obligation he would not otherwise have; hence I can do this only through the united choice of all who possess it in common” (MM, 6:261).31 Even claiming to interpret the a priori general will on another person’s behalf, says Kant, is at- tempting to impose a law on them on my own private authority, since every act of appropriation is “the giving of a law that holds for everyone” (MM, 6:253).32 And he worries that this claim to private authority over others is a potential source of injustice: “Now when someone makes ar- rangements about another, it is always possible for him to do the other wrong; but he can never do wrong in what he decides upon with regard to himself (for volenti non fit inuria)” (MM, 6:314). My will to appro- priate, in the belief that my appropriation is justifiable to others, cannot yet serve as a (coercive) law for everyone else, because it cannot put them under an obligation. Kant suggests, in other words, that figuring out how to carve up shares of the external world consistently with everyone’s freedom does not ex- haust the entire problem of justice involved in acquiring rights to prop- erty. We might appeal to criteria of salience or convention to help coordi- nate our expectations on which of the many possible property distributions to choose. But we face an additional difficulty: how do we impose one of these distributions without at the same time arrogating to ourselves the private authority to lay down the law for an equally free being, one who has an innate right not to be constrained by our private will? In coercing someone to respect our view of our property rights, we are also necessarily claiming the right to impose our private will upon that person. If it is to really respect everyone’s freedom, Kant thinks, a property distribution cannot be unilaterally imposed in this way. This additional dimension of the problem of justly acquiring rights— the problem of unilateral imposition—is rooted in each person’s basic “right to do what seems right and good to him and not to be dependent upon another’s opinion about this” (MM, 6:312). This right to do what seems right and good to him derives from the moral equality of persons: no one has an innate right to decide in another person’s behalf. And be- cause each person is an equally authoritative judge, it is therefore impossi- ble—in a state of nature—to put [them] under an obligation of justice that [they] himself does not recognize. The will of all others except for himself, which proposes to put him under obligation to give up a certain possession, is merely unilateral, and hence has as little lawful force in denying him possession as he has in asserting it (since this can be found only in a general will). (MM, 6:257) In conditions of equal authority—such as those that exist in any state of nature—one is obligated only by what one recognizes, by one’s own lights, as an objectively valid requirement of justice. For that reason, no other person’s merely unilateral will can bind one in the face of one’s own disagreement. Kant concludes from this that “no particular will can be legislative for the commonwealth” (TP, 8:295), since no private person’s will can effec- tively claim to impose an obligation on others. Instead, Kant says that “all right,” that is to say all claims that impose binding duties on others, “depends on laws” (TP, 8:294). Law overcomes the problem of unilater- alism inherent in imposing new obligations on others on one’s own au- thority, by substituting an omnilateral will in place of a unilateral one: “Only the concurring and united will of all, insofar as each decides the same thing for all, and all for each, and so only the general united will of the people, can be legislative” (MM, 6:314). But why is law—imposed from a public perspective—consistent with everyone’s freedom in a way that particular wills—based on our private judgments—are not? Fundamentally, Kant argues that defining and enforcing both our rights over our bodies and our rights to external objects through public and nonarbitrary laws is the only way to secure ourselves against the coercive interference of other private persons in our affairs. For Kant, then, the only sort of property distribution to which we could all hypothetically consent must necessarily be one that is defined and enforced by the state, since all privately enforced distributions have the inevitable side-effect of subjecting us to the wills of others. To show this in more detail, Kant points out two different ways that unilateral private enforcement under- mines our right to independence: first, through unilateral interpretation— a particularly pervasive problem in the enforcement of property rights, since these rights are fully conventional in a way our rights over our bod- ies are not; and second, through unilateral coercion, which threatens in- terference by others in all our rights, both our rights over our bodies and our rights over external things.

#### In the state of nature, everyone is an equal arbitrator of justice – that makes rights violations impossible to resolve.

Stilz 3 (Anna Stilz, Anna Stilz is Laurance S. Rockefeller Professor of Politics and the University Center for Human Values. Her research focuses on questions of political membership, authority and political obligation, nationalism and self-determination, rights to land and territory, and collective agency. , 2009, accessed on 12-18-2021, Muse.jhu, "Project MUSE - Liberal Loyalty", https://muse.jhu.edu/book/30179)//phs st

The Problem of Unilateral Interpretation Kant centrally appeals to the idea that to conclusively possess a right, it must be an objective right, rather than a subjective right based on one individual’s private interpretation of what justice requires. A subjective right is an individual’s good-faith belief about his rights: this belief gives him title to coerce others to keep off his property or to allow him bodily inviolability. But it does not yet place other people under a correlative duty. That would be so only if all individuals shared [their] interpretation of justice. But since individuals are equally authoritative judges in the state of nature, whenever they do not share another person’s belief about jus- tice, his belief imposes no duty on them at all. Instead, they are obliged only by the duties imposed by their own good-faith interpretation of jus- tice, which may not be concordant with his. It might be said, by someone of a more Lockean persuasion, that one of these competing interpreta- tions is the one that simply is valid as a matter of moral fact. That may be so. But as long as we remain in a state of nature, even this true view of right must remain unrealized, since each person, being an equally au- thoritative judge, has a right to enforce [their] own interpretation of justice, which means the true view of right places the person under no duties when it does not correspond with the person’s own. So as long as we remain our own judges and self-enforcers, there is no means by which we might establish which interpretation of right is morally valid without claiming the authority to serve as judge in another person’s behalf and forcibly subject the person to our will. And to claim that authority over someone else, Kant thinks, is refuse to recognize a person’s independence as an equally free being. For this reason, Kant thinks a procedure for the determination of objec- tive rights is a constitutive feature of justice, since a common process of adjudication is logically necessary if anyone’s rights are to impose any objective duties on other people.33 Objective rights are rights that are de- termined through such a process of adjudication, and that impose recog- nizable duties on us even when we disagree about what justice requires. If each person is threatened with violence every time another person’s private interpretation of justice disagrees with her own, [they] cannot possi- bly enjoy a secure sphere of freedom, since this other person is able to interfere with it whenever he sees fit. Instead, it is a constitutive part of justice that there be one univocal interpretation of the rights and duties to which everyone is subject, because only then can people securely enjoy independence from each other. Part of what justice demands, then, is a mechanism by which people can have their rights guaranteed in the exter- nal world without depending on the concordance of other people’s beliefs. Justice cannot be attained in the absence of such a procedure: only once it is in place are we fully independent of interference by other people, as we have an innate claim to be. To see how the unilateralism of interpretation undermines indepen- dence, imagine for a moment that you and I are state-of-nature neighbors. Say we have managed to resolve the indeterminacy of our property rights somewhat, perhaps by appropriating only in accordance with our inter- pretation of Kant’s a priori general will, or by coordinating our expecta- tions based on the most salient just system. So we have hit on some right- ful boundary that sets off your property from mine, such that if I desire to live side by side with you in peace, simply by respecting your basic rights, I ought to be able to do so. Let’s call our initial “property-owning” equilibrium E1. Now suppose some dispute arises between us over whether your prop- erty right has in fact been infringed. Perhaps I have built a huge garage in my area, which blocks the sunlight to your property and makes your gar- den unusable. Any number of examples are possible; what unites them all is that they represent new contingencies, the disposition of which is going to be indefinite enough according to whatever original criterion of appro- priation we are working with to make it likely parties acting in good faith might disagree. In our state-of-nature system, however, the interpretation of what right actually requires in this contingency is left up to you, along with the choice of whether or not to exercise your coercive rights to re- dress any (perceived) violation. So let’s say that you decide my garage is a violation of your acquired rights, since it makes your entire garden unusable, and so you cross our boundary in order to prevent me from blocking the light and to exact compensation from me. If I do not agree with your interpretation of your rights, I am under no obligation to submit to you: I am an equally authori- tative interpreter of justice. I may object to the rightfulness of your bound- ary-crossing in this case, or, even if I concede that you had a right to exact punishment, I may (in all good faith) think that you have exceeded the bounds of the compensation you are entitled to. So I may struggle against you, and regard myself as doing so rightfully. In this situation we both regard ourselves as having a claim of justice, and since we both act in good faith, we act with full subjective right. But in our state of nature, the only thing that can decide the matter between us is a contest of strength, since both sides are equally right from their point of view. As Jeremy Waldron puts it: there is an affront to the idea of justice when force is used by opposing sides, confrontationally and contradictorily, in justice’s name. The point of using force in the name of justice is to assure people of that to which they are entitled. But if force is being used to further contradic- tory ends, then its connection with assurance is ruptured.3 Let’s say that in this case you are the stronger, and that you succeed in demolishing my garage and in exacting what you regard as rightful com- pensation for my supposed infringement—say, one-quarter of my prop- erty. Now we have a new property-owning equilibrium, E2, in which you possess 125 percent of our combined share and I possess only 75 percent. And keeping with our initial assumption that both parties were acting in good faith, with full subjective right, this new equilibrium would not have come about unrightfully. Yet there is a real sense in which I retain a claim here, since the only reason you now possess more of the total is that you were stronger, not that I was convinced by your interpretation of justice. But the bounds of our sphere of control in the external world ought not to depend on the contingencies of who is stronger, and our innate independence ought not to be subject to continual interference by others who may coerce us at any moment in accordance with their private views. For this reason, Kant thinks it is a constitutive feature of justice that it be administered by an authoritative legal system, which can impose one set of objective rules about what constitutes an infringement of property—rules we must re- spect even when we disagree about what justice requires—and adjudicate our conflicting claims in a way that is consistent with our continued inde- pendence from each other. The idea is that if we want to possess claims that, as objective rights, are actually respected by others in the external world, we will need to recognize one and only one common set of rules about rights, not a variety of competing private interpretations that coer- cively struggle for the upper hand.

#### The status quo is an instance of a unilateral will governing individuals while universal decision making is absent. This is an unjust state which violates people’s freedoms and violates the categorical imperative.

Cordelli 16 Chiara Cordelli [Chiara Cordelli is an associate professor in the Department of Political Science at the University of Chicago. Her main areas of research are social and political philosophy, with a particular focus on theories of distributive justice, political legitimacy, normative defenses of the state, and the public/private distinction in liberal theory. She is the author of The Privatized State (Princeton University Press, 2020), which was awarded the 2021 ECPR political theory prize for best first book in political theory. She is also the co-editor of, and a contributor to, Philanthropy in Democratic Societies (University of Chicago Press, 2016). -- [cordelli@uchicago.edu](mailto:cordelli@uchicago.edu)] “WHAT IS WRONG WITH PRIVATIZATION?”, University of Chicago, Political Science & the College, https://www.law.berkeley.edu/wp-content/uploads/2016/01/What-is-Wrong-With-Privatization\_UCB.pdf

The intrinsic wrong of privatization, I will suggest, rather consists in the creation of an institutional arrangement that, by its very constitution, denies those who are subject to it equal freedom. I understand freedom as an interpersonal relationship of reciprocal independence. To be free is not to be subordinated to another person’s unilateral will. By building on an analytical reconstruction of Kant’s Doctrine of Right, I will argue that current forms of privatization reproduce (to a different degree) within a civil condition the very same defects that Kant attributes to the state of nature, or to a pre-civil condition, thereby making a rightful condition of reciprocal independence impossible. Importantly, this is so even if private actors are publicly authorized through contract and subject to regulations, and even if they are committed to reason in accordance with the public good. The reason for this, as I will explain, derives from the fact that private agents are constitutionally incapable of acting omnilaterally, even if their actions are omnilaterally authorized by government through some delegation mechanism, e.g. a voluntary contract. Omnilateralness, I will suggest, must be understood as a function of 1) rightful judgment and 2) unity. By rightful judgment I mean the capacity to reason publicly and to make universal rules that are valid for everyone, according to a juridical ideal of right, as necessary to solve the problem of the unilateral imposition of private wills on others. By unity I mean the capacity to make rules and decisions that change the normative situation of others, as a part of a unified system of decision-making. The condition of unity is crucial, as I shall later explain, insofar as there might be multiple interpretations compatible with rightful judgment, which would still problematically leave the definition of people’s rightful entitlements indeterminate. Further, the practical realization of the juridical idea of an omnilateral will, I will contend, requires embeddedness within a shared collective practice of decision-making. In practice, rightful judgment can only obtain when certain shared background frameworks that structure practical reasoning and confer unity to that reasoning are in place. The rules of public administration and the authority structure of bureaucracy should be understood as playing this essential function of giving empirical and practical reality to the omnilateral will, as far as the execution of rules and the concrete definition of entitlements are concerned. Together, these two requirements are necessary, (whether they are also sufficient is a different question), to make an action the omnilateral action of a state, which has the moral power to change the normative situation of citizens, by fixing the content of their rights and duties in accordance with the equal freedom of all. The phenomenon of privatization thus raises the fundamental questions of why we need political institutions to begin with, and what makes an action an action of the state. Insofar as private agents make decisions that fundamentally alter the normative situation (the rights and duties) of citizens, and insofar as, by definition, private agents are not public officials embedded in that shared collective practice, their decisions, even if well intentioned and authorized through contract, cannot count as omnilateral acts of the state. They rather and necessarily remain unilateral acts of men. Hence, I will conclude, for the very same reasons that we have, following Kant, a duty to exit the state of nature so as to solve the twofold problems of the unilateral imposition of will on others and the indeterminacy of rights, we also have a duty to limit privatization and to support, on normative grounds, a case for the re-bureaucratization of certain functions. Therefore, my paper provides foundational reasons to agree with Richard Rorty’s nonfoundational defense of bureaucracy as stated in the opening epigraph, since only agents who are appropriately embedded within a bureaucratic structure, properly understood, are, in many cases, capable of acting omnilaterally. The “bosses” I am here concerned with are not primarily those who can unilaterally impose their will on us in their capacity as private employers, but rather any private actor who acts unilaterally while in the garb of the state. This essay is structured as follows. In Section I, I assess and reject what I take to be the most powerful non-instrumental arguments against privatization. In Section II, through an interpretation of Kant, I explain in what sense the state, defined as an omnilateral system of rules, is a constitutive condition of freedom, rather than merely an instrument to promote it. In Section III, through an analytical reconstruction, based on a theory of collective action, of the conditions that make a system of rules an omnilateral system of laws rather than an aggregation of unilateral acts of men, I show that privatization constitutes a regression to the state of nature, understood as a normative condition of unfreedom. I then present some reflections on the broader implications of my argument, as it posits an expansive conception of the juridical order as an appropriate object of analysis for political philosophy. Before moving to the next section, let me first clarify what I mean by privatization. In a general sense, privatization can be defined as the devolution of public responsibilities to private actors. This however entails a baseline against which the idea of public responsibilities must be specified. Here I defend a normative, rather than, as is commonly the case, a historical or economic baseline.11 I will assume that in a just society government ought to bear, on grounds of justice, the primary responsibility to secure not only a fair distribution of general resources, including income and wealth, through tax and transfers, but also an adequate provision of particular in-kind goods, including police protection, defense, criminal justice, education and healthcare.12 This does not per se entail, however, that government should provide these goods directly. Government may fund the production of in-kind goods, while delegating their provision to private actors. I thus define privatization as the implementation of public, justice-based responsibilities through private agents.

### UV

#### [1] Presumption and permissibility affirm –

#### [a] Statements are true before false since if I told you my name, you’d believe me.

#### [b] Epistemics – we wouldn’t be able to start a strand of reasoning since we’d have to question that reason.

#### [c] Otherwise we’d have to have a proactive justification to do things like drink water.

#### [d] If anything is permissible, then definitionally so is the aff since there is nothing that prevents us from doing it.

#### 2] 1AR theory is legit otherwise the neg can be infinitely abusive and there would be no way to check back against that.

#### Competing interps – rzn is artbitrary and invites judge intervention and race to the top

#### 1AR theory is drop the debater – a 4 minute 1AR doesn’t have time to win both theory and substance – you must be punished.

#### No RVI on 1AR theory-It would be impossible to check back against neg abuse because the 2NR could just spend 6 minutes railing on the theory debate and the aff couldn’t win

### Adv

#### The advantage is debris:

#### Massive satellite development incoming and cascades debris – lack of regulations raises the risk and turns any reason satellites are good.

Hattenbach 19. Jan Hattenbach sat down with Stijn Lemmens, Senior Space Debris Mitigation Analyst at the European Space Agency (ESA) in Darmstadt, Germany, to talk about how Starlink plays into the space junk problem. 6/3/19. [Sky Telescope, “DOES STARLINK POSE A SPACE DEBRIS THREAT? AN EXPERT ANSWERS,” <https://skyandtelescope.org/astronomy-news/starlink-space-debris/>] Justin

Jan Hattenbach: The recent launch of the first 60 “Starlink” satellites has sparked outrage on social media. Some critics claim the “mega-constellation” of satellites by the U.S. company SpaceX will increase the risk of creating more space junk, even calling it a threat to space flight itself. What is your opinion — is this criticism justified or exaggerated?

Web around the worldWhen up and running Starlink will provide internet access to locations across the planet. SpaceX

Stijn Lemmens: We're talking about a constellation that — if it ever comes to full fruition — would include up to 12,000 members. Several nations have launched almost 9,000 satellites over the past six decades. Of these, about 5,000 are still in orbit. So we are talking about doubling the amount of traffic in space over a couple of years, or over a decade at most, compared to the last 60 years.

However, the space debris issue is mostly caused by the fact that we leave objects behind in orbit, which are then a target for collisions either with fragments of a previous collision event or with big, intact objects. Currently, most space debris comes from explosive break-up events; in the future, we predict collisions will be the driver. It's like a cascade event: Once you have one collision, other satellites are at risk for further collisions.

Over the past two decades, there has been a lot of effort to establish guidelines and codes of conduct. For low-Earth orbit (LEO), there is a well-known guideline to take out your spacecraft, satellite, or launch vehicle upper stage, within 25 years after the end of mission.

To have a reasonable shot at having a stable space environment, the goal is to have at least 90% of the satellites and launch-vehicle upper stages with lifetimes longer than 25 years take themselves out of orbit, or put themselves into orbits with lifetimes less than 25 years.

However, we are not really good at doing this at the moment. We’re talking about success rates of 5% to 15% for satellites (launch vehicle orbital stages do notably better, with success rates of 40-70% in low-Earth orbit). Already with current traffic, we have reasonable concerns that we're creating a real debris issue out there.

If we're now thinking about putting another couple of thousands of satellites up there, with levels of compliance similar to what we've been doing so far, then we're talking about a possible catastrophe.

Operators of any type of large satellite constellation would have to behave far better than most current actors in spaceflight have been doing. And this is the concern: Before you launch, operators can of course say and demonstrate that they are going to comply with all international norms and guidelines. But it's only after launch that we know how responsible their behavior actually was.

JH: Do you have the impression that SpaceX is aware of their responsibility?

SL: They are certainly aware of the problem. For example, to get a license to launch in the U.S. with a mission like theirs, where they are exchanging data between the mainland, space, and other operators, you need to request a license, in this case from the Federal Communications Commission (FCC). To obtain this license, they must demonstrate what they will do with respect to space debris mitigation. So they needed to demonstrate a certain adherence to the norms.

But the real question is whether the current norms are actually sufficient for large constellations, or if we are putting the bar too low with respect to future sustainability. We are talking about thousands of new satellites — the risk is that the cumulative effect is not captured in the current level of guidelines. So SpaceX would have to voluntarily demonstrate higher levels of commitment.

JH: When asked about these issues, SpaceX responded that they believe they have the “most advanced system” for space debris mitigation, e.g. that the Starlink satellites are “designed to be capable of fully autonomous collision avoidance – meaning zero humans in the loop.” Are you confident that such a system will work, especially considering the numbers?

SL: I have no technical visibility on how they implement their system, so I cannot make a judgment if it will work with their satellites or not. What I can say is that it will require a certain improvement on the current state-of-the-art. On the other hand, if a pair of Starlink satellites does collide within the operation orbit, SpaceX will be the first one who will be badly affected by the fragmentation cloud the collision generates. It's in their own best interest to make sure their system works.

JH: You mentioned the launch license issued by the FCC, which is a federal commission of the United States. However, space is not the property of the U.S. or any other country. Is there an international body that has a say in these matters?

SL: Five outer space treaties, established in the 1960s, 70s and 80s, do not mention space debris. Instead, there is a lot of coordination, first of all on the agency level. The Inter-agency Space Debris Coordination Committee coordinates 13 of the world's space agencies, including the ESA, NASA, the China National Space Administration, and Russia’s Roscosmos,to come up with debris mitigation guidelines, share best practices, and try to address the problem in a way that makes sense to everyone. The United Nations Committee on the Peaceful Uses of Outer Space has taken on these guidelines . This committee includes politicians from many countries, including those not currently flying in space. Industries in many countries likewise discuss these issues within the International Organization for Standardization.

So there is a lot of coordination internationally to make sure that we play by the same rules and implement the same set of standards. But right now there is no way to directly interface with any nation's sovereignty over what it launches — the outer space treaties make nation states responsible for the behavior of their individuals or private companies.

#### Democratization of technology spurs rapid development – feedback loops ensures debris cascades

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

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

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

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

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

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

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

#### Privatization drive rivalries and exponentially increases debris – lack of regulations spikes it.

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

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

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

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

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

Chart, line chart

Description automatically generated

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

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

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

#### Models are rigorous—inserted below.

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

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

#### That drives a space arms race which enhances the risk of debris cascades, closes off space exploration, and causes conflict.

Shah 20. Sachin Shah is a write for Cornell Undergraduate Law and Society Review. 8/30/20 [CORNELL UNDERGRADUATE LAW & SOCIETY REVIEW “The International Legal Regulation of Space Debris,” <https://www.culsr.org/articles/the-international-legal-regulation-of-space-debris>] Justin

The body of legal regulations regarding the use of space (space being defined as the area above the jurisdiction of air law) by public and private entities is referred to as space law. Currently, there are only about five such regulations of space, the most significant of those being the United Nations’ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (hereinafter referred to as the Outer Space Treaty) of 1967. In this article, I would like to specifically describe and analyze the laws and regulations’ handling of the increasingly prevalent issue of space debris in orbit around Earth. The National Aeronautics and Space Administration (NASA) defines space debris as “any man-made object in orbit about the Earth which no longer serves a useful function.” [1] However, a major point of confusion discussed below is that the Outer Space Treaty does not explicitly define what it refers to as “space objects,” nor does it mention whether space debris are space objects. An excessive clustering of space debris is a problem for a few reasons. It may result in a phenomenon known as the Kessler Syndrome, in which there is a “cascade created when debris hits a space object, creating new debris and setting off a chain reaction of collisions that eventually closes off entire orbits.” [2] This endangerment of Earth’s future ability to explore extraterrestrial planets and life must be avoided at all costs. Furthermore, space debris in orbit around Earth limits the amount of available space for satellites to orbit, which may result in the Tragedy of the Commons: multiple actors will aggressively vie, in an arms race, for their right to space as it is a limited resource. [3] Space debris is thus a potentially pressing issue in our increasingly technological world. In this essay, I will analyze the existing regulation of space debris as outlined in the Outer Space Treaty, point out the issues with these regulations of space debris and discuss potential solutions, and, finally, discuss legal considerations for private enterprises as well.

#### There are no checks on mega-constellations – specifically decks the environment.

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

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

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

[Omitted Figures 1 and 2]

Results

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

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

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

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

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

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

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

Even if debris collisions were avoidable, meteoroids are always a threat. The cumulative meteoroid flux15 for masses m > 10–2 g is about 1.2 × 10–4 meteoroids m−2 year−1 (see “Methods”). Such masses could cause non-negligible damage to satellites16. Assuming a Starlink constellation of 12,000 satellites (i.e. the initial phase), there is about a 50% chance of 15 or more meteoroid impacts per year at m > 10–2 g. Satellites will have shielding, but events that might be rare to a single satellite could become common across the constellation.

One partial response to these congestion and collision concerns is for operators to construct mega-constellations out of a smaller number of satellites. But this does not, individually or collectively, eliminate the need for an all-of-LEO approach to evaluating the effects of the construction and maintenance of any one constellation.

Surface impacts and atmospheric efects. Although failures do occur, frst stages of SpaceX rockets are usually landed and re-used, while second stages are usually controlled through re-entry and deposited in remote areas of ocean. Tis best practice might not be followed by others. For example, the frst stages of the Soyuz rockets employed by OneWeb are not reusable, nor are the second stage re-entries controllable. Te Long March rockets that will likely be employed by GW are similar. Uncontrolled re-entries do not always meet safety standards17, a situation that may be exacerbated by mega-constellations. Moreover, the cumulative impact of thousands of rocket stages on the ocean environment could be signifcant should those stages contain hazardous materials, such as unspent hydrazine fuels17–19. In the 1990s, Pacifc island countries opposed the Sea Launch project because of environmental concerns, including from discarded rocket stages20. In 2016, Inuit in the Canadian Arctic protested the Russian practice of disposing rocket stages in the North Water Polynya, a biologically rich area of year-round open water21.

Te frst Starlink satellites contained some components that survive re-entry, with the highest human casualty risk for a single satellite calculated to be 1:17,40022, below NASA’s recommended 1:10,000 threshold. However, the initial approval process did not account for the cumulative casualty risk, and if all the then-planned 12,000 satellites had contained the same components, a continuous 5-year replacement cycle would have seen a 45% probability of one or more casualties per cycle. When the subsequent FCC petition process identifed the problem, SpaceX reportedly replaced some materials with a view to having all of the satellite components now demise in the atmosphere23. Other companies, based in other countries, might not follow this best practice or be required to do so.

Te demise of satellite components during re-entry introduces a diferent problem, since none of that material actually disappears. Starlink satellites have a dry mass of about 260 kg; 12,000 satellites will total 3100 tonnes. A 5-year cycle would see on average almost 2 tonnes re-entering Earth’s atmosphere daily. While small compared to the 54 daily tonnes of meteoroid mass24, the satellites are mostly aluminum; most meteoroids, in contrast, contain less than 1% Al by mass25. Tus, depending on the atmospheric residence time of material from reentered satellites, each mega-constellation will produce fne particulates that could greatly exceed natural forms of high-altitude atmospheric aluminum deposition, particularly if the full numbers of envisaged satellites are launched. Anthropogenic deposition of aluminum in the atmosphere has long been proposed in the context of geoengineering as a way to alter Earth’s albedo26. Tese proposals have been scientifcally controversial and controlled experiments encountered substantial opposition27. Mega-constellations will begin this process as an uncontrolled experiment28.

Rocket launches themselves afect the atmosphere. While cumulative CO2 emissions are small compared to other sources, CO2 is not the relevant metric. Black carbon produced by kerosene-fueled rockets such as SpaceX’s Falcon 9 and alumina particles produced by solid-fueled rockets lead to instantaneous radiative forcing. Modelling of the cumulative efect of emissions from 1000 annual launches of hydrocarbon-fuelled rockets found that, afer one decade, the black carbon would result in radiative forcing comparable to that resulting from sub-sonic aviation29. Although 1000 launches annually is 10 times the current rate, the construction and renewal of multiple mega-constellations will require dramatic increases in launches. Current launches likely cause non-negligible radiative forcing already30.

#### Climate change causes extinction.

Dr. Peter Kareiva 18 – Ph.D. in Ecology and Applied Mathematics from Cornell University, Director of the Institute of the Environment and Sustainability at UCLA, Pritzker Distinguished Professor in Environment & Sustainability at UCLA, et al., September 2018, “Existential Risk Due To Ecosystem Collapse: Nature Strikes Back”, Futures, Volume 102, p. 39-50

In summary, six of the nine proposed planetary boundaries (phosphorous, nitrogen, biodiversity, land use, atmospheric aerosol loading, and chemical pollution) are unlikely to be associated with existential risks. They all correspond to a degraded environment, but in our assessment do not represent existential risks. However, the three remaining boundaries (climate change, global freshwater cycle, and ocean acidification) do pose existential risks. This is because of intrinsic positive feedback loops, substantial lag times between system change and experiencing the consequences of that change, and the fact these different boundaries interact with one another in ways that yield surprises. In addition, climate, freshwater, and ocean acidification are all directly connected to the provision of food and water, and shortages of food and water can create conflict and social unrest.

Climate change has a long history of disrupting civilizations and sometimes precipitating the collapse of cultures or mass emigrations (McMichael, 2017). For example, the 12th century drought in the North American Southwest is held responsible for the collapse of the Anasazi pueblo culture. More recently, the infamous potato famine of 1846–1849 and the large migration of Irish to the U.S. can be traced to a combination of factors, one of which was climate. Specifically, 1846 was an unusually warm and moist year in Ireland, providing the climatic conditions favorable to the fungus that caused the potato blight. As is so often the case, poor government had a role as well—as the British government forbade the import of grains from outside Britain (imports that could have helped to redress the ravaged potato yields).

Climate change intersects with freshwater resources because it is expected to exacerbate drought and water scarcity, as well as flooding. Climate change can even impair water quality because it is associated with heavy rains that overwhelm sewage treatment facilities, or because it results in higher concentrations of pollutants in groundwater as a result of enhanced evaporation and reduced groundwater recharge. Ample clean water is not a luxury—it is essential for human survival. Consequently, cities, regions and nations that lack clean freshwater are vulnerable to social disruption and disease.

Finally, ocean acidification is linked to climate change because it is driven by CO2 emissions just as global warming is. With close to 20% of the world’s protein coming from oceans (FAO, 2016), the potential for severe impacts due to acidification is obvious. Less obvious, but perhaps more insidious, is the interaction between climate change and the loss of oyster and coral reefs due to acidification. Acidification is known to interfere with oyster reef building and coral reefs. Climate change also increases storm frequency and severity. Coral reefs and oyster reefs provide protection from storm surge because they reduce wave energy (Spalding et al., 2014). If these reefs are lost due to acidification at the same time as storms become more severe and sea level rises, coastal communities will be exposed to unprecedented storm surge—and may be ravaged by recurrent storms.

A key feature of the risk associated with climate change is that mean annual temperature and mean annual rainfall are not the variables of interest. Rather it is extreme episodic events that place nations and entire regions of the world at risk. These extreme events are by definition “rare” (once every hundred years), and changes in their likelihood are challenging to detect because of their rarity, but are exactly the manifestations of climate change that we must get better at anticipating (Diffenbaugh et al., 2017). Society will have a hard time responding to shorter intervals between rare extreme events because in the lifespan of an individual human, a person might experience as few as two or three extreme events. How likely is it that you would notice a change in the interval between events that are separated by decades, especially given that the interval is not regular but varies stochastically? A concrete example of this dilemma can be found in the past and expected future changes in storm-related flooding of New York City. The highly disruptive flooding of New York City associated with Hurricane Sandy represented a flood height that occurred once every 500 years in the 18th century, and that occurs now once every 25 years, but is expected to occur once every 5 years by 2050 (Garner et al., 2017). This change in frequency of extreme floods has profound implications for the measures New York City should take to protect its infrastructure and its population, yet because of the stochastic nature of such events, this shift in flood frequency is an elevated risk that will go unnoticed by most people.

4. The combination of positive feedback loops and societal inertia is fertile ground for global environmental catastrophes.

Humans are remarkably ingenious, and have adapted to crises throughout their history. Our doom has been repeatedly predicted, only to be averted by innovation (Ridley, 2011). However, the many stories of human ingenuity successfully addressing existential risks such as global famine or extreme air pollution represent environmental challenges that are largely linear, have immediate consequences, and operate without positive feedbacks. For example, the fact that food is in short supply does not increase the rate at which humans consume food—thereby increasing the shortage. Similarly, massive air pollution episodes such as the London fog of 1952 that killed 12,000 people did not make future air pollution events more likely. In fact it was just the opposite—the London fog sent such a clear message that Britain quickly enacted pollution control measures (Stradling, 2016). Food shortages, air pollution, water pollution, etc. send immediate signals to society of harm, which then trigger a negative feedback of society seeking to reduce the harm.

In contrast, today’s great environmental crisis of climate change may cause some harm but there are generally long time delays between rising CO2 concentrations and damage to humans. The consequence of these delays are an absence of urgency; thus although 70% of Americans believe global warming is happening, only 40% think it will harm them (http://climatecommunication.yale.edu/visualizations-data/ycom-us-2016/). Secondly, unlike past environmental challenges, the Earth’s climate system is rife with positive feedback loops. In particular, as CO2 increases and the climate warms, that very warming can cause more CO2 release which further increases global warming, and then more CO2, and so on. Table 2 summarizes the best documented positive feedback loops for the Earth’s climate system. These feedbacks can be neatly categorized into carbon cycle, biogeochemical, biogeophysical, cloud, ice-albedo, and water vapor feedbacks. As important as it is to understand these feedbacks individually, it is even more essential to study the interactive nature of these feedbacks. Modeling studies show that when interactions among feedback loops are included, uncertainty increases dramatically and there is a heightened potential for perturbations to be magnified (e.g., Cox, Betts, Jones, Spall, & Totterdell, 2000; Hajima, Tachiiri, Ito, & Kawamiya, 2014; Knutti & Rugenstein, 2015; Rosenfeld, Sherwood, Wood, & Donner, 2014). This produces a wide range of future scenarios.

Positive feedbacks in the carbon cycle involves the enhancement of future carbon contributions to the atmosphere due to some initial increase in atmospheric CO2. This happens because as CO2 accumulates, it reduces the efficiency in which oceans and terrestrial ecosystems sequester carbon, which in return feeds back to exacerbate climate change (Friedlingstein et al., 2001). Warming can also increase the rate at which organic matter decays and carbon is released into the atmosphere, thereby causing more warming (Melillo et al., 2017). Increases in food shortages and lack of water is also of major concern when biogeophysical feedback mechanisms perpetuate drought conditions. The underlying mechanism here is that losses in vegetation increases the surface albedo, which suppresses rainfall, and thus enhances future vegetation loss and more suppression of rainfall—thereby initiating or prolonging a drought (Chamey, Stone, & Quirk, 1975). To top it off, overgrazing depletes the soil, leading to augmented vegetation loss (Anderies, Janssen, & Walker, 2002).

Climate change often also increases the risk of forest fires, as a result of higher temperatures and persistent drought conditions. The expectation is that forest fires will become more frequent and severe with climate warming and drought (Scholze, Knorr, Arnell, & Prentice, 2006), a trend for which we have already seen evidence (Allen et al., 2010). Tragically, the increased severity and risk of Southern California wildfires recently predicted by climate scientists (Jin et al., 2015), was realized in December 2017, with the largest fire in the history of California (the “Thomas fire” that burned 282,000 acres, https://www.vox.com/2017/12/27/16822180/thomas-fire-california-largest-wildfire). This catastrophic fire embodies the sorts of positive feedbacks and interacting factors that could catch humanity off-guard and produce a true apocalyptic event. Record-breaking rains produced an extraordinary flush of new vegetation, that then dried out as record heat waves and dry conditions took hold, coupled with stronger than normal winds, and ignition. Of course the record-fire released CO2 into the atmosphere, thereby contributing to future warming.

Out of all types of feedbacks, water vapor and the ice-albedo feedbacks are the most clearly understood mechanisms. Losses in reflective snow and ice cover drive up surface temperatures, leading to even more melting of snow and ice cover—this is known as the ice-albedo feedback (Curry, Schramm, & Ebert, 1995). As snow and ice continue to melt at a more rapid pace, millions of people may be displaced by flooding risks as a consequence of sea level rise near coastal communities (Biermann & Boas, 2010; Myers, 2002; Nicholls et al., 2011). The water vapor feedback operates when warmer atmospheric conditions strengthen the saturation vapor pressure, which creates a warming effect given water vapor’s strong greenhouse gas properties (Manabe & Wetherald, 1967).

Global warming tends to increase cloud formation because warmer temperatures lead to more evaporation of water into the atmosphere, and warmer temperature also allows the atmosphere to hold more water. The key question is whether this increase in clouds associated with global warming will result in a positive feedback loop (more warming) or a negative feedback loop (less warming). For decades, scientists have sought to answer this question and understand the net role clouds play in future climate projections (Schneider et al., 2017). Clouds are complex because they both have a cooling (reflecting incoming solar radiation) and warming (absorbing incoming solar radiation) effect (Lashof, DeAngelo, Saleska, & Harte, 1997). The type of cloud, altitude, and optical properties combine to determine how these countervailing effects balance out. Although still under debate, it appears that in most circumstances the cloud feedback is likely positive (Boucher et al., 2013). For example, models and observations show that increasing greenhouse gas concentrations reduces the low-level cloud fraction in the Northeast Pacific at decadal time scales. This then has a positive feedback effect and enhances climate warming since less solar radiation is reflected by the atmosphere (Clement, Burgman, & Norris, 2009).

The key lesson from the long list of potentially positive feedbacks and their interactions is that runaway climate change, and runaway perturbations have to be taken as a serious possibility. Table 2 is just a snapshot of the type of feedbacks that have been identified (see Supplementary material for a more thorough explanation of positive feedback loops). However, this list is not exhaustive and the possibility of undiscovered positive feedbacks portends even greater existential risks. The many environmental crises humankind has previously averted (famine, ozone depletion, London fog, water pollution, etc.) were averted because of political will based on solid scientific understanding. We cannot count on complete scientific understanding when it comes to positive feedback loops and climate change.

#### Debris triggers miscalculated war.

Acton and McDonald 21. James M. Acton is co-director of the Nuclear Policy Program and holds the Jessica T. Mathews Chair at the Carnegie Endowment for International Peace. Thomas D. MacDonald is a fellow in the Nuclear Policy Program. 12/10/21. [Defense One, “Nuclear Command-and-Control Satellites Should Be Off Limits,” <https://www.defenseone.com/ideas/2021/12/nuclear-command-and-control-satellites-should-be-limits/187472/>] Justin

When Russia blew up an old satellite with a new missile on November 15, it created an expanding cloud of debris that will menace the outer space environment for years to come.

Hypersonic fragments from the collision with Moscow’s ground-launched, anti-satellite weapon risk destroying other satellites used for communications, meteorology, and agriculture. They even pose a danger to China’s Tiangong Space Station and the International Space Station, where personnel—including Russia’s own cosmonauts—were forced to don spacesuits and flee into their escape capsules ahead of approaching debris.

But the greatest danger that this careless stunt highlighted is to a different potential target: high-altitude satellites used for nuclear command and control. Those critical satellites face the threat of being attacked by co-orbital anti-satellite weapons, that is, other spacecraft with offensive capabilities. Destroying a nuclear command-and-control satellite, even unintentionally, could lead a conventional conflict to escalate into a nuclear war. As such, the United States, China, and Russia have a shared interest in ensuring the security of each other’s high-altitude satellites.

Satellites are integral to the United States’ nuclear command-and-control system. They would be the preferred means to transmit a presidential order to use nuclear weapons and would provide the first warning of an incoming nuclear attack. Russia uses satellites for similar purposes, even if it appears not to rely on them quite as much as the United States. While little is publicly known about China’s nuclear command-and-control system, the U.S. Department of Defense has assessed that China is in the process of developing a space-based early-warning system.

The most important nuclear command-and-control satellites—those for communications and early warning—are located in high-altitude orbits. Fortunately, most are strung out about 22,500 miles above the equator—far above the debris from Russia’s ground-launched anti-satellite weapon test. These satellites, however, are growing more vulnerable, particularly to co-orbital anti-satellite weapons.

Nuclear command-and-control satellites might be attacked deliberately, as the prelude to a nuclear war. In a conventional conflict, if China, Russia, or the United States decided to use nuclear weapons first—or believed that its opponent was about to do so—it might try to degrade the adversary’s nuclear command-and-control system preemptively. China, for example, might attack U.S. early-warning satellites to weaken the United States’ homeland missile defenses. Conversely, the United States might target Chinese communication satellites to interfere with Beijing’s ability to wield its nuclear forces.

In a conventional war, however, nuclear command-and-control satellites might be attacked and threatened for altogether different reasons—creating the risk that nuclear war might be triggered inadvertently.

The United States, in particular, is deeply reliant on satellites to enable conventional operations. Moreover, most, if not all, nuclear command-and-control satellites also support nonnuclear missions—making them tempting targets even in a purely conventional conflict. For example, some U.S. satellites transmit orders to both U.S. conventional and nuclear forces. Russia might attack these satellites to try to undermine the United States’ ability to prosecute a conventional war, but with the added and unintended effect of degrading the U.S. nuclear command-and-control system.

Washington would be hard pressed to determine the intent behind such attacks. It could easily misinterpret them as preparations for a nuclear war and respond accordingly. It might threaten to use nuclear weapons unless its adversary backed off. In fact, the Trump administration’s nuclear policy explicitly threatened the use of nuclear weapons in precisely this circumstance. The Biden administration can and should remove this threat as part of its ongoing Nuclear Posture Review.

To make matters worse, it might not take actual attacks against nuclear command-and-control satellites to spark this kind of escalation. Satellites in high-altitude orbits are periodically moved to different positions to optimize their performance. Especially in a conventional conflict, a repositioning operation that led one spacecraft to approach a nuclear command-and-control satellite might appear to the latter’s owner as the beginning of an attack against its nuclear command-and-control system. Once again, the potential consequences could be catastrophic.

#### Any nuclear war causes extinction – ice age and famine.

Steven Starr 15 [Director of the University of Missouri’s Clinical Laboratory Science Program, as well as a senior scientist at the [Physicians for Social Responsibility](http://www.psr.org/). He has worked with the Swiss, Chilean, and Swedish governments in support of their efforts at the United Nations to eliminate thousands of high-alert, launch-ready U.S. and Russian nuclear weapons. “Nuclear War: An Unrecognized Mass Extinction Event Waiting To Happen.” Ratical. March 2015. <https://ratical.org/radiation/NuclearExtinction/StevenStarr022815.html>] TG

A war fought with 21st century strategic nuclear weapons would be more than just a great catastrophe in human history. If we allow it to happen, such a war would be a mass extinction event that [ends human history](https://ratical.org/radiation/NuclearExtinction/StarrNuclearWinterOct09.pdf). There is a profound difference between extinction and “an unprecedented disaster,” or even “the end of civilization,” because even after such an immense catastrophe, human life would go on.

But extinction, by definition, is an event of utter finality, and a nuclear war that could cause human extinction should really be considered as the ultimate criminal act. It certainly would be the crime to end all crimes.

The world’s leading climatologists now tell us that nuclear war threatens our continued existence as a species. Their studies predict that a large nuclear war, especially one fought with strategic nuclear weapons, would create [a post-war environment in which for many years it would be too cold and dark to even grow food](http://climate.envsci.rutgers.edu/pdf/RobockToonSAD.pdf). Their findings make it clear that not only humans, but most large animals and many other forms of complex life would likely vanish forever in a nuclear darkness of our own making.

The environmental consequences of nuclear war would attack the ecological support systems of life at every level. Radioactive fallout, produced not only by nuclear bombs, but also by the destruction of nuclear power plants and their spent fuel pools, would poison the biosphere. Millions of tons of smoke would act to [destroy Earth’s protective ozone layer](https://www2.ucar.edu/atmosnews/just-published/3995/nuclear-war-and-ultraviolet-radiation) and block most sunlight from reaching Earth’s surface, creating Ice Age weather conditions that would last for decades.

Yet the political and military leaders who control nuclear weapons strictly avoid any direct public discussion of the consequences of nuclear war. They do so by arguing that nuclear weapons are not intended to be used, but only to deter.

Remarkably, the leaders of the Nuclear Weapon States have chosen to ignore the authoritative, long-standing scientific research done by the climatologists, research that predicts virtually any nuclear war, fought with even a fraction of the operational and deployed nuclear arsenals, will leave the Earth essentially uninhabitable.