

1AC

FW

I value morality because just is defined as based on or behaving according to what is morally right which indicates a moral obligation

First, reason is the source of morality: a) it is the only inescapable source because we can always question why we follow desires or the law, but we cannot ask a reason for following reasons which concedes the authority of reason b) empirical uncertainty – not everyone shares the same experiences, our perception can be manipulated; the one constant is reason bc principles remain the same for everyone c) is/ought gap – descriptive statements can't generate prescriptive obligations

Reason must be universal: a) otherwise morality would be arbitrary and subjective which is bad and would not bind people to act b) reason is universal because in order for a reason to be considered legitimate it must be shared by everyone e.g. it would be illogical to say $2+2=4$ for you but 5 for me

If an agent regards their purpose as important, they must regard the means as important, one of which is freedom.

Denying individuals' independent choice, or outer freedom, is rationally contradictory. As you expand your freedom to limit someone else's freedom which results in contradiction and is incoherent, so we can't limit anyone's freedom.

A universal system of freedoms requires consistency with the omnilateral will.
Ripstein // 04

[Arthur Ripstein, (University Professor of Law and Philosophy, [University of Toronto](#)) "Authority and Coercion" Philosophy & Public Affairs, 32: 2–35, 2004, <http://onlinelibrary.wiley.com/doi/10.1111/j.1467-6486.2004.00003.x/abstract>, DOA:12-16-2017 //] Bracketed for clarity

Kant explains the need for the three branches of government in Rousseau's vocabulary of the "general will." Kant finds this concept helpful, since it manages to capture the way in which the specificity of the law and the monopoly on [the law's] its enforcement do not thereby make it the unilateral imposition of one person's will upon another. Instead, it is what Kant calls an "omnilateral" will, since all must agree to set up procedures that will make right possible. All must agree, because without such procedures, equal freedom is impossible, and so the external freedom of each is impossible. But the sense in which they must agree is not just that they should agree: it is that they cannot object to being forced to accept those procedures, because any objection would be nothing more than an assertion of the right to use force against others unilaterally. Once the concept of the General Will is introduced, it provides further constraints on the possibility of a rightful condition, and even explains the ways in which a state can legitimately coerce its citizens for reasons other than the redress of private wrongs. Kant's treatment of these issues of "Public Right" has struck many readers as somewhat perfunctory, especially after his meticulously detailed, if not always transparent, treatment of private right. He treats these issues as he does because he takes them to follow directly from the institution of a social contract. The details of his arguments need not concern us here, because he does not claim that these exhaust the further powers of the state. Instead, he puts them forward as additional powers a state must have if it is to create a rightful condition, and it is the structure of that argument that is of concern here.

For the state to maintain its united will, the powerful need to be regulated so they cannot rightfully abuse positions over those subject to them to maintain equal freedom. Coercion is when your circumstance requires adopting another's purposes because of imbalanced bargaining position.

Ripstein 9 "Force and Freedom." Arthur Ripstein, 2009. Prof. of Philosophy and Law at University of Toronto.

https://books.google.com/books?id=W_B3oVsdOZUC&pg=PA272&lpg=PA272&dq=%22Kant+argues+that+provision+for+the+poor+follows+directly+from+the+very+idea+of+a+united+will.%22&source=bl&ots=qeZgxmZ4o0&sig=ACfU3U09Kis9KW3g9jVDf3h8LHA3lm7hdq&hl=en&sa=X&ved=2ahUKEwiW4aCQ3ePzAhX7nWoFHZIQCPiQ6AF6BAgDEAM#v=onepage&q=%22Kant%22

0 argues%20that%20provision%20for%20the%20poor%20follows%20directly%20from%20the%20very%20idea%20of%20a%20united%20will.%22Because%20each%20person%20is%20master%20&f=false SJMS Bracketed for clarity

Kant argues that **provision for the poor follows directly from the very idea of a united will.** He remarks that **the idea of a united lawgiving will requires that citizens regard the state as existing in perpetuity.** By this he does not mean to impose an absurd requirement that people live forever, or even the weaker one that it must sustain an adequate population, or make sure that all of its members survive.⁷ **The state does need to maintain its material preconditions** and as we saw in Chapter 7. **this need generates its entitlement to “administer the state’s economy and finance.”** **The state’s existence in perpetuity, however, is presented as a pure normative requirement, grounded in its ability to speak and act for everyone.** That ability **must be able to survive changes in the state’s membership. You are the same person you were a year ago** because **your normative principle of organization has stayed the same through changes** in the matter making you up. **As a being entitled to set and pursue your own purposes, you decide what your continuing body will do.** That is why **your deeds can be imputed to you even after every molecule in your body has changed** and even if you have forgotten what you did. **The unity of your agency is created by the normative principle that makes your actions imputable to you.** in the same way, **the state must sustain its basic normative principle of organization through time** even as some members die or move away and new ones are born or move in. As we saw in Chapter 7. **its unifying principle—“in terms of which alone we can think of the legitimacy of the state”—is the idea of the original contract, through which people are bound by laws they have given themselves through public institutions.** 10 **The state must have the structure that is required in order for everyone to be bound by it** so that it can legitimately claim to speak and act for all across time. **The requirement of unity across time is clear in the cases of legislation by officials** if the official’s decision were only binding while a particular human being held office, a citizen would be entitled to regard laws as void once the official’s term ended. Because each person is master of him- or herself. **one person is only bound by the authority of another through the idea of a united will. So the idea of a united will presupposes some manner in which it exists through time. Past legislation, like past agreement, can only bind those who come after if the structure through which laws are made is one that can bind everyone it governs. The solution to this family of problems is a self-sustaining system that guarantees that all citizens stand in the right relation to each other and, in particular, do not stand in any relation inconsistent with their sharing a united will.** The **most obvious way in which people could fail to share such a will is through relations of private dependence through which one person is subject to the choice of another. A serf or slave does not share a united will with his or her lord** or master, so **these forms of relationship are inconsistent with a rightful condition.** Yet the same relation of dependence can arise through a series of rightful actions. The problem of poverty, on Kant’s analysis, is exactly that: **the poor are completely subject to the choice of those in more fortunate circumstances [the rich].** Although Kant argues that there is an ethical duty to give to charity,¹¹ the crux of his argument is that dependence on private charity is inconsistent with its benefactor and beneficiary sharing the united will that is required for them to live together in a rightful condition. **The difficulty is that the poor person is subject to the choice of those who have more** they are entitled to use their powers as they see fit, and so the decision whether to give to those in need, or how much to give, or to which people, is entirely discretionary. 12 **So long as there are a variety of unmet wants, private persons are entitled to determine which ones to attach priority to.**

Thus, the standard is consistency with the omnilateral will. 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.

[3] Aspec - Ripstein has a better explanation of how states can take action because different politicians can have different views on aggregation proven by opposition in the political world but everyone is bound to universal maxims and the state is bound to the original contract as a state and not individual policy makers so only we assign the state obligations

[4] Consequences Fail:

[1] We can never predict every consequence of our action because there are unintended effects, which means it cannot guide action

[2] Aggregation is impossible – it is impossible to compare 10 headaches to one migraine

[3] It leads to atrocities – we can justify any action as long as it benefits more people than it harms which means we can justify mass death.

Advocacy

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 (so your DA's link) and a revision to the Outer Space Treaty that explicitly bans appropriation of outer space by private entities

Private entities are non-governmental.

Dunk 11 – Frans G. von der Dunk, 2011, ["The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law," University of Nebraska] Justin

4. Interpreting Article VI of the Outer Space Treaty One main novel feature of Article VI stood out with reference to the role of private enterprise in this context. Contrary to the version of the concept applicable under general international law, where "direct state responsibility" only pertained to acts somehow directly attributable to a state and states could only be addressed for acts by private actors under "indirect," "due care"/"due diligence" responsibility,¹⁸ Article VI made no difference as to whether the activities at issue were the state's own ("whether such activities are carried on by governmental agencies" . . .) or those of private actors (. . . "or by non-governmental entities"). The interests of the Soviet Union in ensuring that, whomever would actually conduct a certain space activity, some state or other could be held responsible for its compliance with applicable rules of space law to that extent had prevailed. However, the general acceptance of Article VI as cornerstone of the Outer Space Treaty unfortunately was far from the end of the story. Partly, this was the consequence of key principles being left undefined.

Outer Space is everything 60 miles above the earth's surface

Howell 17 Elizabeth Howell [Elizabeth Howell, Ph.D., is a contributing writer for Space.com since 2012. As a proud Trekkie and Canadian, she tackles topics like spaceflight, diversity, science fiction, astronomy and gaming to help others explore the universe. Elizabeth's on-site reporting includes two human spaceflight launches from Kazakhstan, and embedded reporting from a simulated Mars mission in Utah. She holds a Ph.D. and M.Sc. in Space Studies from the University of North Dakota, and a Bachelor of Journalism from Canada's Carleton University. Her latest book, NASA Leadership Moments, is co-written with astronaut Dave Williams. Elizabeth first got interested in space after watching the movie Apollo 13 in 1996, and still wants to be an astronaut someday.] "What is Space?" June 07, 2017 <https://www.space.com/24870-what-is-space.html>

From the perspective of an Earthling, outer space is a zone that occurs about 100 kilometers (60 miles) above the planet, where there is no appreciable air to breathe or to scatter light. In that area, blue gives way to black because oxygen molecules are not in enough abundance to make the sky blue.

Offense

[1] Privatization is bad

[a] The OST prevents state-based sovereignty claims in space. But it does not clearly restrict corporations and even if it does it may imminently be changed. This means that regions could be under the exclusive control of corporations, while no government has authority.

Ward 19 Peter Ward (Peter Ward studied journalism at the University of Sheffield before moving to Dubai, where he reported on the energy sector. After three years in the Middle East, he earned his master's degree in business journalism from the Columbia University Graduate School of Journalism. His work has appeared in GQ, Bloomberg Businessweek, The Economist, and Newsweek. He lives in New York City.) "The unintended consequences of privatising space," ScienceFocus (Online version of BBC Science Focus Magazine). Nov. 6th, 2019.

<https://www.sciencefocus.com/space/the-unintended-consequences-of-privatising-space/> SJMS

Imagine a colony on the Moon or Mars run by a corporation. That one company would control everything the colonists need to survive, from the water to the oxygen to the food. That's a **dangerous amount of power** for any company, but it's a very real scenario. So what stops a major corporation landing on the Moon and setting up a colony? One very old document, **The Outer Space Treaty** was signed in 1967 by all of the major space-faring nations, and **explicitly states nobody can go to another planet or the Moon and claim that territory for**

their own. It's a very important document, but **it's flawed**. For one thing, the private space sector wasn't around when the treaty was written so **it's not clear how** some of the **rules would be applied to private companies**. And secondly, **given the ambitions of many countries and corporations**, there's no way it's going to last much longer. Anyone with a plan to land on the Moon or Mars and stay there is going to run into the Outer Space Treaty, and the **smart money** is on the **wealthy and powerful winning out against an old loophole-ridden document**. Politicians such as **Ted Cruz** in the United States have **already called for changes** to be made to the treaty, and **given** the increasing amounts of **money private space companies spend on lobbying** in the United States, more such attempts will follow. **It's imperative that the space community as a whole takes this issue on to ensure the needs of all, and not just the private sector, are taken into account should any alterations be made**. The further we look into the future of humans in space, the more reality resembles science fiction. That's why it's difficult to make people take the issues which could potentially arise seriously. **But now is the time to consider the problems that could arise from a commercially-led space race, and take the necessary small steps now to avoid** potentially disastrous consequences in the future.

[b] That's an instance of a unilateral will governing individuals while universal decision making is absent. This is an unjust state.

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] "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.

[2] Extending neoliberal policies in space violate universal law through continued injustice.

Segobaetso 18 Segobaetso, Benjamin. *Ethical Implications of the Colonization, Privatization and Commercialization of Outer Space.* SJEP

It can be argued through Kantian ethics that our record here on Earth paints a picture of neoliberal and capitalist policies with tendencies to favour the highest bidder at the exclusion of the under privileged and puts profit first at the expense of the environment. For Kantians, there are two questions that we must ask ourselves whenever we decide to act: (i) Can I rationally will that everyone act as I propose to act? If the answer is no, then we must not perform the action. (ii) Does my action respect the goals of human beings? Again, if the answer is no, then we must not perform the action. Kantian ethicists would argue that extending to space neoliberal and capitalist policies is immoral because these systems create economic disparities and life threatening environmental injustices; therefore, they are set up in a way that we could not rationally will everyone to act the way they act either here on Earth or in space. Also, Kantian ethicists would ask whether the action of extending neoliberal and capitalist policies to space would respect the goals of extra-terrestrial intelligent life if any rather than merely using them for humans' own purposes? If the answer is no, then the participating agent must not perform the action. Kant wrote on the possible existence of extra-terrestrial intelligent species in the final pages of the last book that he published, *Anthropology from a Pragmatic Point of View* [Anthropologie in pragmatischer Hinsicht] (1978). In this publication, Kant hinted that the highest concept of the Alien species may be that of a terrestrial rational being [eines irdischen vernünftigen]; however, he argued that it will be difficult to describe its characteristics because there is no knowledge available of a non-terrestrial rational being [nicht irdischen Wesen] which could be used as a reference in regards to its properties and ultimately classify that terrestrial being as rational. This dilemma will continue until extraterrestrial intelligent life is discovered because comparing two species of rational beings has to be on the basis of experience, but that experience has not been possible yet (Kant, 237-238). In applying Kant's deontological moral theory, it must first be recognized that Kant visualized a kind of respect in which we all can recognize every rational being exists as an end in itself (1) as being not fully comprehensible by any human understanding, (2) as being an end in him- or herself, and (3) as being a potential source of moral law (Kant, 2012). In this regard, since Kant insinuated that the highest concept of the extraterrestrial intelligent species may be that of a terrestrial rational being [eines irdischen vernünftigen]; that implies any encounter with extra-terrestrial intelligent life will compel us under the deontological moral theory to recognize that life as being not fully comprehensible by any human understanding, as being an end in itself, and as being a potential source of moral law (Kant, 2012). It must be realized that Kant's deontology theory does not go without criticism by critical theorists who believe in dismantling all systems of oppression.

PIC's and CP's don't negate, because it doesn't deny the general principle of the resolution. e.g. If I were to say "birds fly", just because some birds don't fly doesn't prove the statement false. A PIC or CP just prove an acceptance to the principle, they don't disprove the whole principle that it's unjust.

Advantage

Low earth orbit is currently congested with space debris and on track to increase with more corporate appropriation – causes debris cascades. David 21’ (Leonard David, April 14,

2021, “Space Junk Removal is Not Going Smoothly”,
<https://www.scientificamerican.com/article/space-junk-removal-is-not-going-smoothly/>)

A Space Age “tragedy of the commons” is unfolding right under our nose—or, really, right over our head—and no consensus yet exists on how to stop it. For more than a half-century, humans have been hurling objects into low-Earth orbit in ever growing numbers. And with few meaningful limitations on further launches into that increasingly congested realm, the prevailing attitude has been persistently permissive: in orbit, it seems, there is always room for one more. After so many decades of the buildup of high-speed clutter in the form of spent rocket stages, stray bolts and paint chips, solid-rocket-motor slag, dead or dying satellites and the scattered fragments from antisatellite tests—all of which could individually damage or destroy other assets—low-Earth orbit is finally on the verge of becoming too crowded for comfort. And the problem is now poised to get much worse because of the rise of satellite “mega constellations” requiring thousands of spacecraft, such as SpaceX’s Starlink, a broadband Internet network. Starlink is but one of many similar projects: Another mega constellation from a company called OneWeb is already being deployed. And Amazon’s Project Kuiper is seeking to create a mega constellation of up to 3,200 satellites in the near future. As the congestion has grown, so too have close calls between orbiting assets. The International Space Station, for instance, regularly tweaks its orbit to avoid potentially hazardous debris. Worse yet, there has been an uptick in the threat of full-on collisions that generate menacing refuse that exacerbates the already bad situation. Consider the February 2009 run-in between a dead Russian Cosmos satellite and a commercial Iridium spacecraft, which produced an enormous amount of debris. Finding ways to remove at least some of all that space junk should be a top global priority, says Donald Kessler, a retired NASA senior scientist for orbital debris research. In the late 1970s he foretold the possibility of a scenario that has been dubbed the Kessler syndrome: as the density of space rubbish increases, a cascading, self-sustaining runaway cycle of debris-generating collisions can arise that might ultimately make low-Earth orbit too hazardous to support most space activities.

OST ambiguity fails to address space debris allowing corporations to increase congestion in LEO – SpaceX proves Stockwell ‘20:

Stockwell, Samuel. “Legal “Black Holes” in Outer Space: The Regulation of Private Space Companies.”
E-International Relations 20 (2020).

Yet the proliferation of these commercial satellite plans also pose significant environmental issues. Article IX of the OST asserts that: “States shall pursue activities of outer space in a manner that avoids any harmful contamination or adverse environmental changes on Earth” (UN, 1967). However, the use of terms like ‘harmful’ or ‘adverse change’ underscores the lack of specificity over what exactly constitutes environmental damage, or for whom it must refrain from harming. There is also a failure to address the explicit problem of space debris since the discourse is primarily concentrated on chemical effluent pollution, undermining attempts to facilitate the removal of floating wreckage (Gupta, 2016: 26). The inability of the OST to properly promote environmental considerations in space has been mirrored in the NewSpace community, where there has been a woeful lack of ecological consideration: “The hundreds of articles and books on outer space resource development seldom mention that such actions may adversely affect the environment

in ways that will potentially disadvantage their enterprises and the humans that will be required to implement them” (Kramer, 2017: 136). Such images evoke the types of difficulties that private firms have encountered on Earth reconciling capital with the environment in a way that doesn’t damage profit margins (Magdoff & Foster, 2011: 61-66). Yet in doing so, **this neglect is only likely to result in the proliferation of extra-terrestrial debris that the UN OST failed to address.** Indeed, despite its vastness there is only a narrow region of orbital space that is either useable or beneficial for prolonged human missions (Brearley, 2005: 2), meaning that the **increase in space debris from these massive commercial satellite constellations will likely be at the detriment of developing nations who have yet fostered spacefaring** capabilities. Elon Musk’s **SpaceX company has already caused complications** for Earth-bound astrologists. **The brightness of** his recent **‘Starlink’ satellite constellation system** in comparison to other satellites **has been obscuring telescopic images** (see Grush, 2020). More concerning, Starlink may be much more visible during twilight hours which could be problematic in identifying potentially hazardous asteroids in a timely manner (The Verge, 2020). In this sense, whilst **private space entrepreneurs are** able to increase their profitability from being able to establish constellations, such endeavours are **spoiling the scientific work of researchers** on Earth that may complicate the monitoring of Earthbased asteroid impacts.

Clustering makes the risk of collisions *uniquely high* and the risk is understated

Dr. Darren **McKnight 17**, Ph.D., Technical Director for Integrity Applications, Previously Senior Vice President and Director of Science and Technology Strategy at Science Applications International Corporation, “Proposed Series of Orbital Debris Remediation Activities,” 3rd International Conference and Exhibition on Satellite & Space Missions, 5/13/2017, <https://iaaweb.org/iaa/Scientific%20Activity/debrisminutes03166.pdf> [graphics omitted]

In the future, this **population will be added to primarily from collisions between large objects** in orbit **as the number** of LNT **produced is proportional to the mass** involved in a collision (or explosion).² Cataloged debris produced from a catastrophic collision will be liberated at about 1-3 fragments per kilogram of mass involved while LNT production is around 10-40 fragments per kilogram of mass involved. The Iridium/Cosmos collision involved a total mass of 2,000kg and produced over 3,000 trackable fragments and likely 10,000-15,000 LNT debris. The Feng-Yun purposeful collision yielded over 2,200 trackable fragments and likely over 30,000 LNT from only ~850kg of mass involved. While it is important to prevent these types of events from occurring in the future, the consequence of a collision (based on number of LNT produced) will be proportional to the mass involved in the collision. The term “mass involved” implies a good coupling of the impactor mass with the target mass. For a large fragment (e.g., several kilograms) striking a typical payload (that is densely built) in its main satellite body (vice striking a solar array or other appendage) at hypervelocity speeds (i.e., above 6km/s) will result in all the mass being “involved” in the debris. However, a large fragment striking a derelict rocket body, due to the way that the mass is concentrated at the ends of a rocket body, will likely not result in all of the mass being “involved” in the liberated debris. **However, it is likely that when two large derelicts, either rocket bodies or payloads, collide with each other, then all of the mass will be involved** due to the likely direct physical interaction between the mass. The table below summarizes the mass involvement scenarios which highlight why the massive-on-massive collisions are the focus of our analyses. Therefore, it is best to prevent the collision of the most massive objects with each other (higher consequence) and the ones that are the most likely (higher probability) since risk is probability multiplied by consequence. **Our ability to model and predict the rate of collisions is based empirically upon only one catastrophic accidental collision event and a model developed on the kinetic theory of gases (KTG).** However, **clusters of massive objects** that have identical inclinations plus similar and overlapping apogees/perigees may indeed **have a greater probability of collision than predicted** by the KTG-based algorithms as **they are not randomly distributed and their orbital element evolution (e.g., change in right ascension of ascending node and argument of perigee) is also similar.** It is hypothesized that these similarities could result in resonances of collision dynamics that may lead to **larger probability of collision values than predicted with current algorithms.** The not well-known fact is that many of **the most massive objects are in tightly clumped clusters that will likely produce greater probability** of collision than estimated by the KTG approach (see attached paper) and with the much larger consequence (i.e., creation of catalogued LNT fragments). The attached paper that studied this possibility shows some initial

indications that this may indeed be true but much more analysis is needed to provide this conclusively. This table of clusters represents well over 50% of the total derelict mass in LEO. However, no one is currently monitoring these potential events. It is proposed that it would be a prudent risk management approach for space flight safety to monitor and characterize this inter-cluster collision risk. The Massive Collision Monitoring Activity (MCMA) is proposed whereby the encounters between members of these clusters are constantly monitored and close encounter information collected, plotted, analyzed, and shared. This would provide a rich research base for scientists and a predictive service for spacefaring countries. I am currently executing a subset of this proposed activity in an ad hoc fashion in conjunction with JSpOC. I have been monitoring the interaction dynamics between the SL-16 population in the 820- 865km altitude region for the last nine months.

Satellites are key to environmental monitoring – debris collapses it and causes climate extinction

Ben **Biggs 18**, PhD Researcher in Computer Vision and Deep Learning at the University of Cambridge, “How Satellites Can Protect Planet Earth From Disaster”, HowItWorks Daily, 12/22/2018, <https://www.howitworksdaily.com/how-satellites-can-protect-planet-earth-from-disaster/>

It might not look it, but our planet is a fragile place. A delicate balance of pressure, temperature and gases keeps us alive, as our atmosphere lets in enough heat for us to thrive – but not too much that we get too toasty. For many years our planet has looked after itself with ease. Now, with humans on the scene, things are changing more than ever, from climate change to mass deforestation. If our planet is going to survive long into the future it’s going to need our help. Fortunately, we’ve got plenty of missions that are working for the benefit of our world already. Using observation satellites in orbit, scientists have been monitoring Earth for decades, watching how the planet pulsates and changes over time. From orbit we can watch how species migrate, identify and predict environmental changes and even fix problems. A great example of this was the global effort to repair a hole in the ozone above the Antarctic back in 1987. Two years prior, scientists had discovered that chemicals known as chlorofluorocarbons (CFCs) – produced by fridges and aerosols, among other things – were causing the hole to grow. As a result countries around the world agreed to phase out the use of CFC as part of the Montreal Protocol. In early 2018, NASA announced that its Aura satellite had watched the hole successfully close, with it expected to fully repair as early as 2060. It was proof that we could work together to change the planet for the better. Aura is part of a broader NASA project called the Earth Observing System (EOS). This programme, which began in 1997, has seen NASA launch missions and instruments into orbit. This has included the groundbreaking Landsat series of satellites, which have provided surface images of the whole globe. Then there’s the Terra mission that launched in 2009 and studies clouds, sea ice and more from orbit. Most of these satellites are in polar orbits, which means they orbit the planet from top to bottom so that it rotates underneath and gives them a global view. Planning for the EOS began back in the 1980s, with NASA keen to regularly fly instruments for at least 15 years. “Human activity has altered the condition of the Earth by reconfiguring the landscape, by changing the composition of the global atmosphere, and by stressing the biosphere in countless ways,” they noted in a handbook in 1993. “There are strong indications that natural change is being accelerated by human intervention.” More than two dozen missions have been launched as part of the EOS to date. Among the programme’s many accomplishments, scientists watched as an ice shelf collapsed on the Antarctic Peninsula in 2002 using the Terra satellite. The same satellite, along with the Aqua satellite launched in 2002, has provided a global view of how the vegetation cycle changes over the course of a year and the effect the climate has on it. Those same two satellites have also allowed us to see how summer sea ice in the Arctic is decreasing, which means that more of the Sun’s light is being absorbed rather than being reflected, raising global temperatures. The EOS has helped in other ways too, such as enabling scientists to keep a close eye on the levels of toxic gases like carbon monoxide being emitted from massive fires in the atmosphere. This allows people on the ground to be alerted to these dangers, and they can in turn be advised to limit their outdoor activity to protect their health. The EOS is even helping to track and monitor rare animals, such as chameleons in Madagascar. Here, scientists have been able to use satellite imagery, combined with known habitats of the animals, to map out where they are likely to be living. It would take survey teams on the ground thousands of years to replicate this information without satellites. It’s not just NASA that has been keeping a close eye on the planet. The European Space Agency (ESA) runs the Copernicus project, billed as the world’s largest single Earth observation campaign. Previously known as the Global Monitoring for Environment and Security (GMES) programme, it began with the launch of the Sentinel-1A satellite in April 2014. This radar imaging satellite provides images both day and night and during all weather conditions, and these are being used to map sea ice, track oil spills and more. This has been followed by half a dozen more missions, with the latest – Sentinel-3B – launching on 25 April 2018. This mission is focusing on monitoring the behaviour and health of the oceans, but it has a wide range of abilities. It

flies in formation with its predecessor, Sentinel-3A, and together the two of them can provide global data for Earth across an entire day. The satellites can measure the temperature over oceans, as well as the colour and height of the sea. They can also monitor wildfires from space, check the health of vegetation and map the way that land is being used around the world. And there are more Sentinel satellites on the way. In the coming years we'll see the Sentinel-4 and Sentinel-5 missions launch, studying the composition of our planet's atmosphere, while Sentinel-6 will measure global sea surface height for ocean and climate studies. "Copernicus will help shape the future of our planet for the benefit of all," said the ESA, also noting that it is the "most ambitious Earth observation programme to date," one that will provide accurate and timely data on the environment, climate change and more. All of this data is vital for directing climate policy and other human activities on Earth. By observing our planet around the clock from space we can see the direct effect that humans are having on it. These are not the only climate-monitoring missions run by NASA and the ESA. The former has a number of other missions, including the Deep Space Climate Observatory, which observes the sunlit side of Earth. The latter has eight missions on the books in its Earth Explorer programme, including a mission to study how Earth's gravity field varies over the surface of the planet, called the Gravity field and steady-state Ocean Circulation Explorer (GOCE), which ended in 2013. In 2016, countries of the world came together to sign the Paris Climate Agreement, a global effort to reduce carbon emissions to prevent the global average temperature rising by two degrees Celsius above pre-industrial levels. While the US later infamously reneged from this agreement, it was proof that with enough level-headed minds, minds that can see the data from missions showing how the planet is changing, we can take action. Humans continue to have a major effect on the planet, for better or worse, and monitoring that change is vital to our planet's survival.