# 1AC

## 1AC—Plan

### Article II

#### Plan: The appropriation of outer space through lunar mining by private entities should be banned.

#### We’ll defend normal means as the signatories of the OST adding an optional protocol under Article II.

Tronchetti 7[Fabio Tronchetti is a professor at the International Institute of Air and Space Law, Leiden University, The Netherlands, 2007, <https://iislweb.org/docs/Diederiks2007.pdf>, 12-15-2021 amrita]

ARTICLE II OF THE OUTER SPACE TREATY: A MATTER OF DEBATE The legal content of Article II of the Outer Space Treaty is one of the most debated and analysed topic in the field of space law. Indeed, several interpretations have been put forward to explain the meaning of its provisions. Article II states that: “Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means”. **The text of Article II represents** the final point of a process, formally initiated with Resolution 1721, aimed at conferring to outer space the status of res communis omnium, namely a thing open for the **free exploration** and use by all States **without the possibility of being appropriated**. By prohibiting the possibility of making territorial claims over outer space or any part thereof based on use or occupation, Article II **makes clear that** the customary procedures of **i**nternational **law allowing** subjects to obtain **sovereignty rights over un-owed lands**, namely discovery, occupatio and effective possession, **do not apply to** outer **space.** This prohibition was considered by the drafters of the Outer Space Treaty the best guarantee for preserving outer space for peaceful activities only and for stimulating the exploration and use of the space environment in the name of all mankind. What has been the object of controversy among legal scholars is the question of whether both States and private individuals are subjected to the provisions of Article II. Indeed, **while Article II forbids** expressis verbis the national **appropriation by** claims of **sovereignty**, by means of use and occupation or other means of outer space, **it does not** make **a**ny explicit **mention** **to** its **private** appropriation. Relying on this consideration, some authors have argued that the private appropriation of outer space and celestial bodies is allowed. For instance, in 1968 Gorove wrote: “Thus, at present an individual acting on his own behalf or on behalf of another individual or private association or an international organisation could lawfully appropriate any parts of outer space…”6 . The same argument is used today by the enterprises selling extraterrestrial acres. They base their claim to the Moon and other celestial bodies on the consideration that Article II does not explicitly forbid private individuals and enterprises to claim, exploit or appropriate the celestial bodies for profit7 . However, it must be said, that nowadays there is a general consensus on the fact that **both national appropriation and private** property rights **are denied** under the Outer Space Treaty. Several way of reasoning have been advanced to support this view. Sters and Tennen affirm that the argument that Article II does not apply to private entities since they are not expressly mentioned fails for the reason that they do not need to be explicitly listed in Article II to be fully subject to the non-appropriation principle8 . **Private entities are allowed to carry out** space **activities but**, according to Article VI of the Outer Space Treaty, they **must be authorized** to conduct such activities **by the** appropriate **State** of nationality. But if the State is prohibited from engaging in certain conduct, then it lacks the authority to license its nationals or other entities subject to its jurisdiction to engage in that prohibited activity. Jenks argues that “States bear international responsibility for national activities in space; it follows that what is forbidden to a State is not permitted to a chartered company created by a State or to one of its nationals acting as a private adventurer”9 . It has been also suggested that **the prohibition of national** appropriation **implies prohibition of private** appropriation because the latter cannot exist independently from the former10. In order to exist, indeed, private property requires a superior authority to enforce it, be in the form of a State or some other recognised entity. In outer space, however, this practice of State endorsement is forbidden. Should a State recognise or protect the territorial acquisitions of any of its subjects, this would constitute a form of national appropriation in violation of Article II. Moreover, it is possible to use some historical elements to support the argument that both the acquisition of State sovereignty and the creation of private property rights are forbidden by the words of Article II. During the negotiations of the Outer Space Treaty, the Delegate of Belgium affirmed that his delegation “had taken note of the interpretation of the non-appropriation advanced by several delegations-apparently without contradiction-as covering both the establishment of sovereignty and the creation of titles to property in private law”11. The French Delegate stated that: “…there was reason to be satisfied that three basic principles were affirmed, namely: the prohibition of any claim of sovereignty or property rights in space…”12. The fact that the accessions to the Outer Space Treaty were not accompanied by reservations or interpretations of the meaning of Article II, it is an evidence of the fact that this issue was considered to be settled during the negotiation phase. Thus, summing up, we may say that **prohibition of appropriation of outer space** and its parts is a rule which **is valid for both private and public entity**. The theory that private operators are not subject to this rule represents a myth that is not supported by any valid legal argument. Moreover, it can be also added that if any subject was allowed to appropriate parts of outer space, the basic aim of the drafters of the Treaty, namely to prevent a colonial competition in outer space and to create the conditions and premises for an exploration and use of outer space carried out for the benefit of all States, would be betrayed. Therefore, **the need to protect the non-appropriative nature o**f outer **space emerges** in all its relevance.

#### Countries and their companies are making their own rules through patchwork which creates conflict—an international body is key.

**Whittington 21** [Mark Whittington, 3-28-2021, "The new race to the moon: the Artemis Alliance vs. the Sino-Russian Axis," TheHill, <https://thehill.com/opinion/technology/545280-the-new-race-to-the-moon-the-artemis-alliance-vs-the-sino-russian-axis>] [pT]

Space News recently [reported](https://spacenews.com/china-russia-enter-mou-on-international-lunar-research-station/) that China and Russia have signed a memorandum of understanding to build what the two countries call an “International Lunar Research Station” (ILRS). The facility would conduct a number of activities either on the lunar surface or lunar orbit and would be “open to all interested countries and international partners.” Whether deliberate or not, the two countries have formed an axis against what has come to be known as the Artemis Alliance being formed by NASA with a number of countries and commercial partners. In effect, China and Russia have challenged the United States and the rest of the world to a new race to the moon. With the Biden administration having [endorsed](https://thehill.com/opinion/technology/537663-the-biden-administration-endorses-nasas-artemis-the-space-force) the Trump-era Artemis program, it looks like two credible, rival return-to-the-moon programs are now ongoing. Since one of those programs is run by two authoritarian nations and the other is led by NASA and consists of what many would consider the civilized world, the very definition of a race to the moon has developed, without fanfare, without brave speeches throwing down gauntlets. Is this a good thing or a bad thing? On the positive side, nothing like competition with a hostile power or two focuses the mind and ensures that the Artemis program remains on track and on a sensible schedule. The Apollo program succeeded because the winner of the race to the moon would have bragging rights for being the more technologically adept superpower. On the negative side, what happens to determine which side “wins” the modern space race? During the Apollo-era, the answer was easy. President John F. Kennedy [declared](https://history.nasa.gov/moondec.html) the goal of sending a man to the moon and returning him safely to the Earth before the end of the 1960s. In July 1969, the mission was accomplished. Indeed, the Apollo program had enough momentum for six more manned lunar missions before the United States stopped going to the moon and turned to other priorities. What must happen for the winner to be declared in the new moon race? Who is first to return to the moon is not as important as what happens next. The south pole of the moon is replete with water ice in shadowed craters, Water can be used to help sustain a lunar base. Water can be refined into [rocket propellent](https://thehill.com/opinion/technology/439692-returning-to-the-moon-for-rocket-fuel-and-clean-energy), making the moon a refueling stop for spacecraft headed to other destinations in the solar system, such as Mars. The moon also has a number of other resources ranging from rare earths, to platinum-group metals, to industrial metals such as titanium, iron and aluminum. [Helium-3](https://thehill.com/opinion/technology/540856-solving-the-climate-and-energy-crises-mine-the-moons-helium-3), an isotope embedded in lunar soil, could serve as fuel for future fusion power plants. In short, the side that first exploits lunar resources effectively will be the side that creates a space-based industrial revolution enabled by lunar resources. Either the Sino-Russian Axis or the Artemis Alliance will own the future. A few years ago, [according to Space.com](https://www.space.com/28189-moon-mining-economic-feasibility.html), Ian Crawford, a professor of planetary science and astrobiology at Birkbeck College in the UK, suggested that an economic case could be made for prospecting and mining lunar resources as a way to enable a near-Earth industrial infrastructure. He was skeptical about helium-3, which he regarded as a kind of “fossil fuel.” However, he concluded that in aggregate, the variety of resources on the moon could be exploited in an economical manner. The other question is, who can own space resources? The [Outer Space Treaty](https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html) prohibits any assertion of sovereignty on the moon or any other celestial body. However, Congress passed a law a few years ago called the [U.S. Space Launch Competitiveness Act](https://www.govtrack.us/congress/bills/114/hr2262/summary) that asserts that American citizens who mine space resources, including on the moon, own those resources. The fact that the United States owns the moon rocks that the Apollo astronauts gathered is seen as a precedent. On the other hand, some suggest that since the act can be seen as an assertion of sovereignty, it violates the spirit of the Outer Space Treaty. The governments of China and Russia might be expected to support the latter view. In order to avoid conflict over resources on the moon or anywhere else in space, some kind of agreement, perhaps based on the [Artemis Accords,](https://www.nasa.gov/specials/artemis-accords/index.html) needs to be struck between the Artemis Alliance and the Sino-Russian Axis. The first side to exploit a deposit of minerals should own it. Otherwise, we might expect the possibility that the Third World War might start on the moon with catastrophic consequences.

## 1AC—Advantages

### Advantage – Lunar Competition

#### Private companies are set to mine on the moon – financial incentives and state funding set a legal precedent for private activity on the moon.

**Helmore 20** [Edward Helmore, 9-11-2020, "Nasa is looking for private companies to help mine the moon," <https://www.theguardian.com/science/2020/sep/11/nasa-moon-mining-private-companies>] [pT]

Nasa has announced it is looking for private companies to go to the moon and collect dust and rocks from the surface and bring them back to Earth. The American space agency would then buy the moon samples in amounts between 50 to 500 grams for between $15,000 to $25,000. The Nasa administrator, Jim Bridenstine, announced on Thursday that the moon material collection would become part of a technology development program that would help astronauts “live off the land” for crewed missions in the future to the moon or elsewhere. Bridenstine [wrote that the agency](https://twitter.com/JimBridenstine/status/1304049845309669376?s=20) “is buying lunar soil from a commercial provider. It’s time to establish the regulatory certainty to extract and trade space resources.” The collection is part of Nasa’s [Artemis](https://www.nasa.gov/artemis) lunar exploration program established last year to land US astronauts, including the first woman and the next man, on the moon by 2024. The agency has indicated that missions further afield, to Mars for instance, will require the use of locally mined resources. “We will use what we learn on and around the moon to take [the next giant leap](http://www.nasa.gov/specials/moon2mars/) – sending astronauts to Mars,” Bridenstine wrote. [In a blogpost,](https://blogs.nasa.gov/bridenstine/2020/09/10/space-resources-are-the-key-to-safe-and-sustainable-lunar-exploration/) Bridenstine said the effort would comply with the [Outer Space Treaty of 1967](https://history.nasa.gov/1967treaty.html), which says that no country may lay sovereign claim to the moon or other celestial bodies in much the same way that the Antarctic continent is off-limits for territorial conquest. In May, Nasa [unveiled a legal framework](https://www.washingtonpost.com/technology/2020/05/15/moon-rules-nasa-artemis/) that would govern the behavior of countries and companies in space and on the moon. The legal framework, known as the Artemis Accords, include the creation of “safety zones” around sites where mining and exploration would take place on the lunar surface. Nasa’s top administrator also told a [forum](https://swfound.org/events/2020/planetary-protection-and-lunar-activities) held by the Secure World Foundation that the policies that will govern mining from celestial bodies would be much the same as those that currently exist for the world’s oceans. “We do believe we can extract and utilize the resources of the moon, just as we can extract and utilize tuna from the ocean,” he said, without referring to overfishing and pollution that is rapidly destroying fish stocks in many regions. Unlike fisheries, however, participating celestial mining companies would be required to provide imagery of the material and the location from which it was recovered. Nasa already has a separate program to contract companies to fly science experiments and cargo to the moon ahead of a human landing. Those include Astrobotic, SpaceX, Blue Origin, Sierra Nevada Corp and Lockheed Martin. Bridenstine said he anticipated some of those might also be interested in lunar mining. Casey Dreier, chief advocate & senior space policy adviser at the Planetary Society, [wrote on Twitter](https://twitter.com/CaseyDreier/status/1304080050262736896) that the importance of Nasa’s announcement is “not so much the financial incentive (which is tiny) but in establishing the legal precedent that private companies can collect and sell celestial materials (with the explicit blessing of NASA/U.S. gov)”.

#### That’s set to drive conflict- current treaties have zero authority and lack clarity—creates ineffective regulations.

**Jasmamie 21** [Cecilia Jasmamie, 2-2-2021, "Experts warn of brewing space mining war among US, China and Russia," MINING, <https://www.mining.com/experts-warn-of-brewing-space-mining-war-among-us-china-and-russia/>] DD AG recut [pT]

A brewing war to set a mining base in space is likely to see China and Russia joining forces to keep the US increasing attempts to dominate extra-terrestrial commerce at bay, experts warn.  The Trump Administration took an active interest in space, announcing that America would [return astronauts to the moon](https://www.nytimes.com/2019/03/26/science/nasa-moon-pence.html) by 2024 and creating the [Space Force](https://www.npr.org/2019/12/21/790492010/trump-created-the-space-force-heres-what-it-will-do) as the newest branch of the US military. It also proposed global legal framework for mining on the moon, called the Artemis Accords, encouraging citizens to mine the Earth’s natural satellite and other celestial bodies with commercial purposes. The directive classified outer space as a “legally and physically unique domain of human activity” instead of a “global commons,” paving the way for mining the moon without [any sort of international treaty.](https://www.mining.com/how-earth-bound-mining-lawyers-think-about-space-mining/) Spearheaded by the US National Aeronautics and Space Administration (NASA), the Artemis Accords [were signed in October](https://www.businessinsider.com/nasa-artemis-accords-deep-space-exploration-moon-mars-asteroids-comets-2020-10) by Australia, Canada, England, Japan, Luxembourg, Italy and the United Emirates. “Unfortunately, the Trump Administration exacerbated a national security threat and risked the economic opportunity it hoped to secure in outer space by failing to engage Russia or China as potential partners,” says Elya Taichman, former legislative director for then-Republican Michelle Lujan Grisham. “Instead, the Artemis Accords have driven China and Russia toward increased cooperation in space out of fear and necessity,” [he writes](https://www.politico.com/news/2021/01/29/biden-space-diplomacy-russia-china-455963). Russia’s space agency Roscosmos was the first to speak up, [likening the policy to colonialism](https://www.mining.com/russia-slams-trumps-order-to-spur-mining-the-moon-asteroids/). “There have already been examples in history when one country decided to start seizing territories in its interest — everyone remembers what came of it,” Roscosmos’ deputy general director for international cooperation, Sergey Saveliev, said at the time. China, which made history in 2019 by becoming the [first country](https://www.washingtonpost.com/science/2019/01/03/china-lands-spacecraft-far-side-moon-historic-first/) to land a probe on the far side of the Moon, chose a different approach. Since the Artemis Accords [were first announced](https://www.mining.com/russia-slams-trumps-order-to-spur-mining-the-moon-asteroids/), Beijing has approached Russia to [jointly build a lunar research base](https://tass.com/science/1181861). President Xi Jinping has also he made sure [China planted its flag on the Moon](https://www.bbc.com/news/world-asia-china-55192692), which happened in December 2020, more than 50 years after the US reached the lunar surface. The next Wild West? China has historically been excluded from the US-led international order in space. It is not a partner in the International Space Station (ISS) program, and a US legislative provision has limited NASA’s ability to cooperate with it in space since 2011.

#### The race to the lunar reservoir ensures escalation – only a prohibition on private entities checks.

#### **1 --** Flashpoints – water, eternal light peaks, iron, and cold traps.

**Dorminey 20** [Bruce Dorminey, 11-26-2020, "Moon Rush Could Spark Conflict, Claims Study," Forbes, <https://www.forbes.com/sites/brucedorminey/2020/11/26/moon-rush-could-spark-conflict-claims-study/>] [pT]

The coming near-term Moon rush may end up creating new political and economic tensions, or even conflicts, as both commercial and national space agency players compete for a limited number of easily accessible lunar resources. Or so says a new study by an international team of researchers led by the Harvard Smithsonian Center for Astrophysics. In their paper just published in The Philosophical Transactions of the Royal Society A., the authors argue that many of the useful and valuable resources on the Moon are concentrated into a modest number (tens) of quite small regions (in the order of a few kilometers). “Once a resource is sufficiently valuable and scarce, disputes are inevitable.” Martin Elvis, a senior astrophysicist at the Harvard Smithsonian Center for Astrophysics and the paper’s lead author, told me. “Whether they become conflicts in the sense of being violent is up to how we choose to govern the Moon.” The authors note that conflicts over access to five prime lunar resources are potential flashpoints: —- Water. Both for life support. And to split into its constituent components of hydrogen and oxygen which can then be liquefied and used as rocket fuel. —- Peaks of Eternal Light. These Peaks are valuable for both the collection of almost continuous solar power, say the authors. And as locations where the approximately 300-degrees-Celsius day-to-night temperature swings of the typical equatorial lunar surface location are mostly avoided, they note. —- Iron. Lunar Iron-rich regions derived from asteroid impacts are some 30–300km across and limited to 20 or so sites, write the authors. However, asteroid iron also has the advantage that it may also be rich in precious metals, including platinum and palladium, they note. And Iron becomes important when building heavy industrial equipment. —- Cold Traps. So-called Cold Traps in the permanently dark craters at the poles are thought to contain volatile materials from the early solar system, including water, write the authors. The floors of such craters have been in almost total darkness for up to 3.5 billion years, they note, illuminated only by starlight and reflections off the nearby rims. Extremely cold (below −180 Celsius), they may be uniquely well-suited sites for far-infrared telescopes, or as a spot to build ultra-cold atom facilities on a far larger scale than on Earth or in laboratories in free space, the authors write. —- And Helium-3. Such lunar sources of Helium-3 will be needed to power fusion nuclear reactors back here on Earth. But such fusion reactors remain a technology whose fruition is still decades in the future. Lunar cold traps located at the South Pole of the moon, are critical to all moon-based operations ... [+] DAVID PAIGE, REPRODUCED WITH PERMISSION. Who might be at loggerheads within the next few years about lunar resources? We are already seeing increasing Chinese and Russian state-led activity, albeit with private sector plug-ins, and a rescheduled NASA program will see a return to the Moon, and to much the same sites that China and Russia are also targeting, Tony Milligan, Senior Researcher at the Cosmological Visionaries project at King’s College London and one of the paper’s co-authors, told me. So, the initial stages of tension development over the coming decade may look like a continuation of the old cold war, albeit with China as a bigger player, he says. And also over the next five years, at least five sovereign nations have credible plans to land on the Moon (China, India-Japan, Russia, USA), write the authors. In addition, several commercial companies (including PTScientists, Moon Express, Astrobotic, Masten, ispace), and the non-profit SpaceIL, have stated intentions to do so, they note. However, Elvis thinks that an initial point of contention could come with the construction of solar power towers. Elvis says that the first lunar human base will need a 100 kW or so. A few 20-meter-high solar panels could supply that power, he says. But because the Sun circles very close to the horizon at the lunar South Pole, at some time during the lunar day one tower will inevitably cast its long shadow on any other towers in the vicinity, says Elvis. To avoid daily lunar blackouts, there will need to be some sort of coordination on where they place their solar power towers, he says. Does the current 1967 Outer Space Treaty (OST) offer guidance in avoiding such conflicts? As Elvis points out, the OST is heavily based on the Antarctic Treaty, with many equivalent points: territorial claims ”on hold”; no military use; no nukes; inspections of facilities consultative meetings of signatories; disputes resolved by negotiation, mediation, and conciliation. “The big difference is that for Antarctica disputes can be sent to the International Court of Justice,” said Elvis. “The OST has no enforcement mechanism.” Can the current outer space treaty be updated? “On the Moon, you don’t need all out war in order for people to be harmed in avoidable ways, you just need pressures to overextend supply lines, and failures to assist in a timely manner,” said Milligan. Thus, some level of tacit coordination will be necessary to avoid problems once the Moon rush begins. Yet coordination will be most effective if it is pursued before actors make difficult-to-reverse commitments to mission designs or substantial investments, Alanna Krolikowski, a political scientist at the Missouri University of Science and Technology (Missouri S&T) and one of the paper’s co-authors, told me. Even so, Elvis is not overly optimistic about any sort of new negotiated outer space treaty. It's hard to see any new treaty being negotiated in today's situation, says Elvis. Not only because of increased nationalism, he says, but also because in 1967 there were really only two players: the U.S.A. and the U.S.S.R. Now there are many, and an increasing number, including commercial companies, says Elvis. Conflict on the Moon itself may begin as a kind of arms race, where one party tries to exclude another from a valuable location, and the response is to find a way to by-pass these ploys, he says. “After a certain point some mechanism to resolve these disputes will be necessary; the alternative is not good,” says Elvis.

#### 2 -- International Dominance – great powers want to appear hegemonically superior.

Cunningham 22 [Philip J. Cunningham has been a regular visitor to China since 1983, working variously as a tour guide, TV producer, freelance writer, independent scholar and teacher. He has conducted media research in China as a Knight Fellow and Fulbright Scholar and was the recipient of a Nieman Fellowship at Harvard. He is the author of Tiananmen Moon, a first-hand account of the 1989 protests in Beijing.] “US extends rivalry with China to the moon as it resists cooperation and seeks control over mining,” January 23rd, 2022, South China Morning Post, <https://www.scmp.com/comment/opinion/article/3164195/us-extends-rivalry-china-moon-it-resists-cooperation-and-seeks>, VM

US extends rivalry with China to the moon as it resists cooperation and seeks control over mining; Nasa claims its Artemis lunar programme will promote diversity and cooperation, but fellow space powers China and Russia have been left out in the cold. With the US attempting to lay down rules for mineral extraction, the new space race looks set to divide the world – and the moon – along Cold War fault lines There’s enough strife on land, sea and in the air to keep US Cold Warriors and their Wolf Warrior counterparts in China sparring for a long time to come, but the race to create zones of influence and secure resources doesn’t begin and end with planet Earth. With the roll-out of Nasa’s Space Launch System rocket and Orion spacecraft last March in support of the US Artemis Programme, the moon has been added to the mix. “Through Artemis, Nasa aims to land the first woman and first person of colour on the moon,” the mission statement reads. The US will “collaborate with commercial and international partners and establish the first long-term presence on the moon”. At first glance, both China and Russia would be logical international partners, but the statement has a distinctly American accent. It’s not the first time the US has tried to set the terms by which other nations can explore Earth’s only natural satellite. A US-scripted “Moon Treaty” was drawn up in 1979 but eventually withered away because the tiny handful of nations capable of competing with the US in space were not interested in signing away their rights. Even the flag-waving president Donald Trump came to disdain the treaty because it suggested that the moon should be treated as part of a “global commons” rather than as a private resource base that individual nations and corporations could exploit. Eager to approve American mining on the moon, Trump issued an executive order on April 6, 2020, “Encouraging International Support for the Recovery and Use of Space Resources”. The moribund 1979 Moon Treaty was thus scrapped. In Trumpian terms, it was “a failed attempt at constraining free enterprise”. The executive order issued by Trump is still in effect and the language has been altered only slightly. The goal of sending the “first woman and next man” to the moon was amended by the Biden administration to read “first woman and first person of colour”. There are several ironies inherent in the way US leaders talk about the space programme. One is the partisan political flavour; the Democrats emphasise its links with identity politics, while Republicans emphasise the capitalist free market element. But neither party wants to be stuck with the budget shortfalls and delays that have dogged the programme from day one. And no one is talking about including China. Given the way Nasa promotes astronaut identity, there’s a further irony in the fact that China happens to have a woman in space at this very moment, and has been sending, by the arcane terms of the US mission statement, “persons of colour” into space since the inception of their programme. If human diversity was really a serious goal of the Artemis programme, there would be scant reason not to cooperate with China. Or Russia for that matter. But why should China and Russia sign on to a day-late, dollar-short programme jump-started by Trump that defines the rules of exploitation on US terms? The US has solicited a number of allies to sign on the Artemis Accords, including members of the Five Eyes intelligence sharing bloc, as well as Japan and South Korea. But it is the recent inclusion of Ukraine that speaks volumes about the political cast of the programme. What the mission statement is really saying is that the US reserves the right to exploit the mineral resources of the moon, and will do so with allies of its choosing and within guidelines of its own creation. As for China and Russia, the only two serious rivals to the US in space, they have been left out in the cold. The Artemis Accords add another brick to the regulatory firewall the US has built regarding cooperation with China in space. The 2011 Wolf Amendment prohibited such cooperation, with the unsurprising result that China has taken a go-it-alone approach ever since. Furthermore, the inclusion in the US space bloc of Ukraine, a bitter adversary of Russia, only serves to increase the likelihood that China and Russia will look to one another as partners in space. Already, plans for a Sino-Russian moon base are being touted. The implicit anti-China gist of the Artemis programme is symptomatic of US party-driven politics in general. On the one hand, there’s a seemingly unbridgeable political divide at home; on the other, one administration looks the same as the other when viewed from afar. The ostensible aim of the Artemis programme is to promote cooperation, diversity and set down rules for lunar exploration. In reality, it is dividing the world into two camps, following the familiar East-West fault lines established in the last Cold War.

#### **3 -- Miscalculation compounded by harsh space conditions and Sino-US competition**

LSE 21 [LSE IDEAS is LSE’s foreign policy think tank [London School of Economics and Political Science]. They connect academic knowledge of diplomacy and strategy with the people who use it.] April 29th, 2021, “Coordination Failure: Risks of US-China competition in space,” <https://lseideas.medium.com/coordination-failure-risks-of-us-china-competition-in-space-7112ca4f4da1>, VM Geographically Concentrated Sites of Interest Given the vast expanse of space beyond Earth orbit, it may seem odd to raise the US and China “stepping on each other’s toes” as a potential concern. However, should sites of scientific, commercial and exploration interest be geographically concentrated, the risks of a national incident **stemming from miscalculation** or obstinacy by either the US, China, or both, are **not to be dismissed**. This will likely be less due to direct competition over resources or scientific data, but because of the fact that **harsh space environments** increase the risk of harmful interference from other parties. At present, no comprehensive, agreed framework of norms exists to coordinate the activities of state and commercial actors beyond Earth orbit. Whilst international treaties exist that provide general provisions, most infamously the preclusion of the appropriation of celestial bodies by the Outer Space Treaty, a need exists for more detailed mechanisms of coordination of various interests seeking to expand their operations beyond the Earth’s well-populated orbital spheres. The US has initiated the Artemis Accords, which have been signed by 9 nations to date, and establish provisions such as the creation of safety zones to de-risk simultaneous operations. However, being bilateral and US led, these have been met by **effective silence** from China (and **outright condemnation** by Russia). This fact elevates the risk of harmful miscalculations by respective actors. Both nations’ lunar exploration programmes are exemplary of these issues and present the most urgent imminent risks. Both Artemis Basecamp and the ILRS will be situated on the Lunar South Pole. Most likely, any crewed CNSA mission hoping to establish a sustainable presence on the moon will also situate itself at the South Pole. Reflecting this, the majority of the US and China’s robotic surface missions, under the Commercial Lunar Payload Services (CLPS) and Chang’e programme respectively, are bound for the region. This trend is primarily driven by the fact that the South Pole presents an optimal environment for the establishment of semi-permanent and permanent crewed bases on the moon, and, in the longer term, for the enablement of future missions beyond the Earth-Moon system. Reasons for this include the high-duration exposure to sunlight of certain terrain within the region, alongside an apparently elevated concentration of useful and accessible resources, most immediately water.[13] A lack of coordination in such a concentrated geography could pose considerable risk, primarily because of the harsh and unforgiving environment of space.

#### 4 – Debris -- mining greatly increases the risk of debris in satellite-specific orbits

Sarah Scoles 15, “Dust from asteroid mining spells danger for satellites,” New Scientist, 5-27-2015, <https://www.newscientist.com/article/mg22630235-100-dust-from-asteroid-mining-spells-danger-for-satellites/> ,re-cut KR

NASA chose the second option for its Asteroid Redirect Mission, which aims to pluck a boulder from an asteroid’s surface and relocate it to a stable orbit around the moon. But an asteroid’s gravity is so weak that it’s not hard for surface particles to escape into space. Now a new model warns that debris shed by such transplanted rocks could intrude where many defence and communication satellites live – in geosynchronous orbit. According to Casey Handmer of the California Institute of Technology in Pasadena and Javier Roa of the Technical University of Madrid in Spain, 5 per cent of the escaped debris will end up in regions traversed by satellites. Over 10 years, it would cross geosynchronous orbit 63 times on average. A satellite in the wrong spot at the wrong time will suffer a damaging high-speed collision with that dust. The study also looks at the “catastrophic disruption” of an asteroid 5 metres across or bigger. Its total break-up into a pile of rubble would increase the risk to satellites by more than 30 per cent (arxiv.org/abs/1505.03800). That may not have immediate consequences. But as Earth orbits get more crowded with spent rocket stages and satellites, we will have to worry about cascades of collisions like the one depicted in the movie Gravity. Handmer and Roa want to point out the problem now so that we can find a solution before any satellites get dinged. “It is possible to quantify and manage the risk,” says Handmer. “A few basic precautions will prevent harm due to stray asteroid material.”

#### 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 10,000-15,0003 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.

#### Laundry list of impacts – compromised communication, loss of military capability and more

Divorsky 15 George Divorsky [George P. Dvorsky (born May 11, 1970) is a Canadian bioethicist, transhumanist and futurist. He is a contributing editor at io9[1] and producer of the Sentient Developments blog and podcast. He was Chair of the Board for the Institute for Ethics and Emerging Technologies (IEET)[2][3] and is the founder and chair of the IEET's Rights of Non-Human Persons Program], 6-4-2015, "What Would Happen If All Our Satellites Were Suddenly Destroyed?," Gizmodo <https://gizmodo.com/what-would-happen-if-all-our-satellites-were-suddenly-d-1709006681> DD AG

Given these grim prospects, it’s fair to ask what might happen to our civilization if any of these things happened. At the risk of gross understatement, the complete loss of our satellite fleet would instigate a tremendous disruption to our current mode of technological existence—disruptions that would be experienced in the short, medium, and long term, and across multiple domains.

Compromised Communications

Almost immediately we’d notice a dramatic reduction in our ability to communicate, share information, and conduct transactions.

“If our communications satellites are lost, then bandwidth is also lost,” Jonathan McDowell tells io9. He’s an astrophysicists and Chandra Observatory scientist who works out of the Harvard-Smithsonian Center for Astrophysics.

McDowell says that, with telecommunication satellites wiped out, the burden of telecommunications would fall upon undersea cables and ground-based communication systems. But while many forms of communication would disappear in an instant, others would remain.

All international calls and data traffic would have to be re-routed, placing tremendous pressure on terrestrial and undersea lines. Oversaturation would stretch the capacity of these systems to the limit, preventing many calls from going through. Hundreds of millions of Internet connections would vanish, or be severely overloaded. A similar number of cell phones would be rendered useless. In remote areas, people dependent on satellite for television, Internet, and radio would practically lose all service.

“Indeed, a lot of television would suddenly disappear,” says McDowell. “A sizable portion of TV comes from cable whose companies relay programming from satellites to their hubs.”

It’s important to note that we actually have a precedent for a dramatic—albeit brief —disruption in com-sat capability. Back in 1998, there was a day in which a single satellite failed and all the world’s pagers stopped working.

The sudden loss of satellite capability would have a profound effect on the military.

The Marshall Institute puts it this way: “Space is a critical enabler to all U.S. warfare domains,” including intelligence, navigation, communications, weather prediction, and warfare. McDowell describes satellite capability as as the “backbone” of the U.S. military.

And as 21st century warfare expert Peter W. Singer from New America Foundation tells io9, “He who controls the heavens will control what happens in the battles of Earth.” Singer summarized the military consequences of losing satellites in an email to us:

Moreover, and as McDowell explains to io9, the loss of satellite capability would have a profound effect on arms control capabilities. Space systems can monitor compliance; without them, we’d be running blind.

“The overarching consideration is that you wouldn’t really know what’s going on,” says McDowell. “Satellites provide for both global and local views of what’s happening. We would be less connected, less informed—and with considerably degraded situational awareness.”

One great thing satellites have done for us is improve our ability to forecast weather. Predicting a slight chance of cloudiness is all well and good, but some areas, like India, Pakistan, and Bangladesh, are dependent on such systems to predict potentially hazardous monsoons. And in the U.S., the NOAA has estimated that, during a typical hurricane season, weather satellites save as much as $3 billion in lives and property damage.

There’s also the effect on science to consider. Much of what we know about climate change comes from satellites.

As McDowell explains, the first couple of weeks without satellites wouldn’t make much of a difference. But over a ten-year span, the lack of satellites would preclude our ability to understand and monitor such things as the ozone layer, carbon dioxide levels, and the distribution of polar ice. Ground-based and balloon-driven systems would help, but much of the data we’re currently tracking would suddenly become much spottier.

#### 5 -- Governmental tensions - Private exploration of the moon causes conflict with the government over resources – escalates

Smith 20 Adam Smith [Science and Technology reporter for The Independent.], 11-24-2020, "Scientists fear conflicts over the Moon’s resources between governments and companies," Independent, <https://www.independent.co.uk/life-style/gadgets-and-tech/moon-government-companies-resources-conflicts-b1761170.html> DD AG

Scientists fear that the Moon might be plundered too quickly by private companies hoping to extract its valuable resources, new research has hypothesized.

A lack of international policies and agreements could result in tensions, overcrowding, and a rapid expansion of moon mining projects, the Center for Astrophysics | Harvard & Smithsonian says in a new paper.

Water and iron are particularly valuable resources that could be collected from the Moon, which would help companies construct infrastructure and develop agriculture as well as letting them avoid the vast expense of transporting such materials from the Earth.

"A lot of people think of space as a place of peace and harmony between nations. The problem is there's no law to regulate who gets to use the resources, and there are a significant number of space agencies and others in the private sector that aim to land on the moon within the next five years," said Martin Elvis, astronomer at the Center for Astrophysics | Harvard & Smithsonian and the lead author on the paper, which has been published in Philosophical Transactions of the Royal Society A.

"We looked at all the maps of the Moon we could find and found that not very many places had resources of interest, and those that did were very small. That creates a lot of room for conflict over certain resources."

The treaties that do exist, such as the 1967 Outer Space Treaty, do not offer staunch protection of celestial bodies from companies. The Outer Space Treaty declares that “the moon and other celestial bodies shall be used by all states parties to the treaty exclusively for peaceful purposes”, but is not exclusive to governments.

The United States insisted on a clause that allowed commercial companies to explore space as long as they “require authorisation and continuing supervision” of the government, as opposed to the Russian view that space exploration should be limited to governments.

A following treaty, the 1979 Moon Treaty, has not been ratified by any state that engages in self-launched spaceflight such as the US, Russia, China, Japan, or members of the European Space Agency.

"It tries to address the ownership of resources obtained from outer space, and really it was pretty much rejected by the international community”, Dr Jill Stuart, head of space policy at the London School of Economics, previously told The Independent.

In 2020 the Artemis Accords were announced, which are a set of agreements that requires countries working with the US to return to the moon to commit to transparency about their work, to only explore space for “peaceful purposes”, and to guarantee they would work together to save any astronauts that came into danger during a mission. However, this still does not protect celestial bodies from being overly exploited for resources.

"The biggest problem is that everyone is targeting the same sites and resources: states, private companies, everyone. But they are limited sites and resources. We don't have a second moon to move on to. This is all we have to work with." Alanna Krolikowski, assistant professor of science and technology policy at Missouri University of Science and Technology, and a co-author on the paper, said in a statement.

"While a comprehensive international legal regime to manage space resources remains a distant prospect, important conceptual foundations already exist and we can start implementing, or at least deliberating, concrete, local measures to address anticipated problems at specific sites today."

Governments should also identify worse-case outcomes, such as overcrowding and interference at each site, and use those as a basis for legislation, Krolikowski added.

Existing laws which protect common-pool resources, such as the oceans or local lakes on Earth, could be used as a baseline for these regulations, but policymakers need to decide how these resources will be classified.

"Are these resources, say, areas of real estate at the high-value Peaks of Eternal Light, where the sun shines almost continuously, or are they units of energy to be generated from solar panels installed there? At what level can they can realistically be exploited? How should the benefits from those activities be distributed? Developing agreement on those questions is a likely precondition to the successful coordination of activities at these uniquely attractive lunar sites", Krolikowski said.

Russian president Vladimir Putin warned last year that a new space race may develop between his country and the US, pushing the expansion of anti-satellite technologies and "space-based weapons" capable of targeting Earth and other objects in orbit.

#### **6 -- Proximity – sites are too close to each other and resources are limited.**

**Smith 20** [Adam Smith, 11-24-2020, "Scientists fear conflicts over the Moon’s resources between governments and companies," Independent, <https://www.independent.co.uk/life-style/gadgets-and-tech/moon-government-companies-resources-conflicts-b1761170.html>] [pT]

Scientists fear that the Moon might be plundered too quickly by private companies hoping to extract its valuable resources, new research has hypothesized. A lack of international policies and agreements could result in tensions, overcrowding, and a rapid expansion of moon mining projects, the Center for Astrophysics | Harvard & Smithsonian says in a new paper. Water and iron are particularly valuable resources that could be collected from the Moon, which would help companies construct infrastructure and develop agriculture as well as letting them avoid the vast expense of transporting such materials from the Earth. "A lot of people think of space as a place of peace and harmony between nations. The problem is there's no law to regulate who gets to use the resources, and there are a significant number of space agencies and others in the private sector that aim to land on the moon within the next five years," said Martin Elvis, astronomer at the Center for Astrophysics | Harvard & Smithsonian and the lead author on the paper, which has been published in [Philosophical Transactions of the Royal Society A.](http://dx.doi.org/10.1098/rsta.2019.0563) "We looked at all the maps of the Moon we could find and found that not very many places had resources of interest, and those that did were very small. That creates a lot of room for conflict over certain resources." The treaties that do exist, such as the 1967 Outer Space Treaty, do not offer staunch protection of celestial bodies from companies. The Outer Space Treaty declares that “the moon and other celestial bodies shall be used by all states parties to the treaty exclusively for peaceful purposes”, but is not exclusive to governments. The United States insisted on a clause that [allowed commercial companies to explore space](https://www.independent.co.uk/news/long_reads/if-no-one-owns-moon-can-anyone-make-money-there-space-astronomy-a8087126.html) as long as they “require authorisation and continuing supervision” of the government, as opposed to the Russian view that space exploration should be limited to governments. A following treaty, the 1979 Moon Treaty, has not been ratified by any state that engages in self-launched spaceflight such as the US, Russia, China, Japan, or members of the European Space Agency. "It tries to address the ownership of resources obtained from outer space, and really it was pretty much rejected by the international community”, Dr Jill Stuart, head of space policy at the London School of Economics, [previously told The Independent.](https://www.independent.co.uk/news/world/who-owns-outer-space-and-what-happens-when-corporations-want-extract-resources-asteroids-or-planets-10492126.html) In 2020 the [Artemis Accords were announced](https://www.independent.co.uk/life-style/gadgets-and-tech/news/nasa-moon-mission-artemis-accords-us-china-a9517091.html), which are a set of agreements that requires countries working with the US to return to the moon to commit to transparency about their work, to only explore space for “peaceful purposes”, and to guarantee they would work together to save any astronauts that came into danger during a mission. However, this still does not protect celestial bodies from being overly exploited for resources. "The biggest problem is that everyone is targeting the same sites and resources: states, private companies, everyone. But they are limited sites and resources. We don't have a second moon to move on to. This is all we have to work with." Alanna Krolikowski, assistant professor of science and technology policy at Missouri University of Science and Technology, and a co-author on the paper, said in a statement. "While a comprehensive international legal regime to manage space resources remains a distant prospect, important conceptual foundations already exist and we can start implementing, or at least deliberating, concrete, local measures to address anticipated problems at specific sites today."

#### Aff is try or die – a lunar gold rush is coming in this decade and triggers conflict

Milligan 20 Tony Milligan [Tony Milligan is a Scottish philosopher who is currently a teaching fellow in ethics and the philosophy of religion in the Department of Theology and Religious Studies at King's College London. Much of his research concerns Iris Murdoch, the philosophy of love, animal ethics, space policy and civil disobedience.], 12-9-2020, "Lunar gold rush could create conflict on the ground if we don't act now – new research," Conversation, <https://theconversation.com/lunar-gold-rush-could-create-conflict-on-the-ground-if-we-dont-act-now-new-research-151645> DD AG

When it comes to the Moon, everyone wants the same things. Not in the sense of having shared goals, but in the sense that all players target the same strategic sites – state agencies and the private sector alike. That’s because, whether you want to do science or make money, you will need things such as water and light.

Many countries and private companies have ambitious plans to explore or mine the Moon. This won’t be at some remote point in time but soon – even in this decade. As Martin Elvis, Alanna Krolikowski and I set out in a recent paper, published in the Transactions of the Royal Society, this will spark tension on the ground unless we find ways to manage the situation imminently.

So far, much of the debate around exploring and mining the Moon has focused on tensions in space between state agencies and the private sector. But as we see it, the pressing challenge arises from limited strategic resources.

Important sites for science are also important for infrastructure construction by state agencies or commercial users. Such sites include “peaks of eternal light” (where there is almost constant sunlight, and hence access to power), and continually shaded craters at the polar regions, where there’s water ice. Each is rare, and the combination of the two – ice on the crater floor and a narrow peak of eternal light on the crater rim – is a prized target for different players. But they occur only in polar regions, rather than at the equatorial sites targeted by the Apollo programme in the 1960s and 1970s.

The recent successful landing of Chang’e 5 by China targeted a relatively smooth landing site on the lunar nearside, but it is part of a larger, phased programme due to take China’s space agency down to the lunar south pole by 2024.

India tried a more direct polar route, with its failed Chandrayaan-2 lander crashing in the same region in 2019. The Russian Roscosmos, collaborating with the European Space Agency, is also targeting the south polar region for landings late in 2021 and, in 2023, at Boguslavsky crater, as a test mission. Next, Roscosmos will aim for the Aitken Basin in the same region in 2022 on the to prospect for water in permanently shadowed areas. A number of private companies also have ambitious plans for mining the Moon for resources.

Strategic resources that aren’t in the polar regions tend to be concentrated rather than evenly distributed. Thorium and uranium, which could be used for radioactive fuel, are found together in 34 regions that are areas of less than 80km wide. Iron resulting from asteroid impacts can be found within broader territories, ranging from 30-300km across, but there are only around 20 such areas.

And then there is the poster boy of lunar resources, mined in dozens of science fiction films: Helium-3, for nuclear fusion. Seeded by the Sun in the powdery crushed rock of the lunar surface, it is present in wide areas across the Moon, but the highest concentrations are found in only about eight regions, all relatively small (less than 50km across).

These materials will be of interest both to those trying to establish infrastructure on the Moon and are later targeting Mars as well as commercial exploitation (mining), or science – for example creating telescopic arrays on the lunar far side, away from the growing noise of human communications.

How then do we deal with the problem? The Outer Space Treaty (1967) holds that “the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind.” States do not get to claim parts of the Moon as property, but they can still use them. Where this leaves disputes and extraction by private companies is unclear.

Proposed successors to the treatment, such as the Moon Agreement (1979), are seen as too restrictive, requiring a formal framework of laws and an ambitious international regulatory regime. The agreement has failed to gain support among key players, including the US, Russia and China. More recent steps, such as the Artemis Accords – a set of guidelines surrounding the Artemis Program for crewed exploration of the Moon – are perceived as heavily tied to the US programme.

In the worst case, this lack of framework could lead to heightened tensions on Earth. But it could also create unnecessary duplication of infrastructure, with everyone building their own stuff. That would drive up costs for individual organisations, which they would then have reasons to try to recoup in ways that could compromise opportunities for science and the legacy we leave for future generations.

#### No generic thumpers -- commercial mining on the moon comes lexically prior to other forms of mining in space **Gilbert 21** [Alex Gilbert is a complex systems researcher and a PhD student in space resources at the Colorado School of Mines. He is a fellow at the Payne Institute at the Colorado School of Mines and is the cofounder of SparkLibrary.] April 26th, 2021, “Mining in Space is Coming,” https://www.milkenreview.org/articles/mining-in-space-is-coming, VM

“The Moon is **a prime space mining target**. Boosted by NASA’s mining solicitation, it is likely the first location for commercial mining. The Moon has **several advantages**. It is relatively close, requiring a journey of **only several days** by rocket and creating communication lags of only a couple seconds — a delay small enough to allow remote operation of robots from Earth. Its low gravity implies that relatively **little energy expenditure** will be needed to deliver mined resources to Earth orbit.”

#### Conflict thumps any da – science and exploration have lower priority

Yan 18 [Laura Yan is a writer in Brooklyn. Her writing has appeared in Wired, GQ, The Cut, Pacific Standard, Longreads, The Outline, and elsewhere. Should We Really Be Mining in Space? May 5, 2018. https://www.popularmechanics.com/space/a20195040/should-we-be-really-be-mining-in-space/]

Commerical space mining could lead to conflicts between profitability and public interest. "Once you’re on board with the commercial space industry, then you as a researcher must accept, if not support, everything that comes with it," Skibba writes. "To succeed, these businesses will seek profitable missions, while science, exploration, and discovery—goals that stimulate public interest—will inevitably have lower priority,"

#### Space wars go nuclear and tensions uniquely spill down to Earth

Grego 18 [Laura, Senior Scientist in the Global Security Program at the Union of Concerned Scientists, Postdoctoral Researcher at the Harvard-Smithsonian Center for Astrophysics, PhD in Experimental Physics at the California Institute of Technology, Space and Crisis Stability, Union of Concerned Scientists, 3-19-18, <https://www.law.upenn.edu/live/files/7804-grego-space-and-crisis-stabilitypdf>]

Why space is a particular problem for crisis stability For a number of reasons, space poses particular challenges in preventing a crisis from starting or from being managed well. Some of these are to do with the physical nature of space, such as the short timelines and difficulty of attribution inherent in space operations. Some are due to the way space is used, such as the entanglement of strategic and tactical missions and the prevalence of dual-use technologies. Some are due to the history of space, such the absence of a shared understanding of appropriate behaviors and consequences, and a dearth of stabilizing personal and institutional relationships. While some of these have terrestrial equivalents, taken together, they present a special challenge. The vulnerability of satellites and first strike incentives Satellites are inherently fragile and difficult to protect; in the language of strategic planners, space is an “offense-dominant” regime. This can lead to a number of pressures to strike first that don‘t exist for other, better-protected domains. Satellites travel on predictable orbits, and many pass repeatedly over all of the earth‘s nations. Low-earth orbiting satellites are reachable by missiles much less capable than those needed to launch satellites into orbit, as well as by directed energy which can interfere with sensors or with communications channels. Because launch mass is at a premium, satellite armor is impractical. Maneuvers on orbit need costly amounts of fuel, which has to be brought along on launch, limiting satellites‘ ability to move away from threats. And so, these very valuable satellites are also inherently vulnerable and may present as attractive targets. Thus, an actor with substantial dependence on space has an incentive to strike first if hostilities look probable, to ensure these valuable assets are not lost. Even if both (or all) sides in a conflict prefer not to engage in war, this weakness may provide an incentive to approach it closely anyway. A RAND Corporation monograph commissioned by the Air Force15 described the issue this way: First-strike stability is a concept that Glenn Kent and David Thaler developed in 1989 to examine the structural dynamics of mutual deterrence between two or more nuclear states.16 It is similar to crisis stability, which Charles Glaser described as ―a measure of the countries‘ incentives not to preempt in a crisis, that is, not to attack first in order to beat the attack of the enemy,‖17 except that it does not delve into the psychological factors present in specific crises. Rather, first strike stability focuses on each side‘s force posture and the balance of capabilities and vulnerabilities that could make a crisis unstable should a confrontation occur. For example, in the case of the United States, the fact that conventional weapons are so heavily dependent on vulnerable satellites may create incentives for the US to strike first terrestrially in the lead up to a confrontation, before its space-derived advantages are eroded by anti-satellite attacks.18 Indeed, any actor for which satellites or space-based weapons are an important part of its military posture, whether for support missions or on-orbit weapons, will feel “use it or lose it” pressure because of the inherent vulnerability of satellites. Short timelines and difficulty of attribution The compressed timelines characteristic of crises combine with these “use it or lose it” pressures to shrink timelines. This dynamic couples dangerously with the inherent difficulty of determining the causes of satellite degradation, whether malicious or from natural causes, in a timely way. Space is a difficult environment in which to operate. Satellites orbit amidst increasing amounts of debris. A collision with a debris object the size of a marble could be catastrophic for a satellite, but objects of that size cannot be reliably tracked. So a failure due to a collision with a small piece of untracked debris may be left open to other interpretations. Satellite electronics are also subject to high levels of damaging radiation. Because of their remoteness, satellites as a rule cannot be repaired or maintained. While on-board diagnostics and space surveillance can help the user understand what went wrong, it is difficult to have a complete picture on short timescales. Satellite failure on-orbit is a regular occurrence19 (indeed, many satellites are kept in service long past their intended lifetimes). In the past, when fewer actors had access to satellite-disrupting technologies, satellite failures were usually ascribed to “natural” causes. But increasingly, even during times of peace operators may assume malicious intent. More to the point, in a crisis when the costs of inaction may be perceived to be costly, there is an incentive to choose the worst-case interpretation of events even if the information is incomplete or inconclusive. Entanglement of strategic and tactical missions During the Cold War, nuclear and conventional arms were well separated, and escalation pathways were relatively clear. While space-based assets performed critical strategic missions, including early warning of ballistic missile launch and secure communications in a crisis, there was a relatively clear sense that these targets were off limits, as attacks could undermine nuclear deterrence. In the Strategic Arms Limitation Treaty, the US and Soviet Union pledged not to interfere with each other‘s ―national technical means‖ of verifying compliance with the agreement, yet another recognition that attacking strategically important satellites could be destabilizing.20 There was also restraint in building the hardware that could hold these assets at risk. However, where the lines between strategic satellite missions and other missions are blurred, these norms can be weakened. For example, the satellites that provide early warning of ballistic missile launch are associated with nuclear deterrent posture, but also are critical sensors for missile defenses. Strategic surveillance and missile warning satellites also support efforts to locate and destroy mobile conventional missile launchers. Interfering with an early warning sensor satellite might be intended to dissuade an adversary from using nuclear weapons first by degrading their missile defenses and thus hindering their first-strike posture. However, for a state that uses early warning satellites to enable a “hair trigger” or launch-on-attack posture, the interference with such a satellite might instead be interpreted as a precursor to a nuclear attack. It may accelerate the use of nuclear weapons rather than inhibit it. Misperception and dual-use technologies Some space technologies and activities can be used both for relatively benign purposes but also for hostile ones. It may be difficult for an actor to understand the intent behind the development, testing, use, and stockpiling of these technologies, and see threats where there are none. (Or miss a threat until it is too late.) This may start a cycle of action and reaction based on misperception. For example, relatively low-mass satellites can now maneuver autonomously and closely approach other satellites without their cooperation; this may be for peaceful purposes such as satellite maintenance or the building of complex space structures, or for more controversial reasons such as intelligence-gathering or anti-satellite attacks. Ground-based lasers can be used to dazzle the sensors of an adversary‘s remote sensing satellites, and with sufficient power, they may damage those sensors. The power needed to dazzle a satellite is low, achievable with commercially available lasers coupled to a mirror which can track the satellite. Laser ranging networks use low-powered lasers to track satellites and to monitor precisely the Earth‘s shape and gravitational field, and use similar technologies. 21 Higher-powered lasers coupled with satellite-tracking optics have fewer legitimate uses. Because midcourse missile defense systems are intended to destroy long-range ballistic missile warheads, which travel at speeds and altitudes comparable to those of satellites, such defense systems also have inherent ASAT capabilities. In fact, while the technologies being developed for long-range missile defenses might not prove very effective against ballistic missiles—for example, because of the countermeasure problems associated with midcourse missile defense— they could be far more effective against satellites. This capacity is not just theoretical. In 2007, China demonstrated a direct-ascent anti-satellite capability which could be used both in an ASAT and missile defense role, and in 2009, the United States used a ship-based missile defense interceptor to destroy a satellite, as well. US plans indicated a projected inventory of missile defense interceptors with capability to reach all low earth orbiting satellites in the dozens in the 2020s, and in the hundreds by 2030.22 Discrimination The consequences of interfering with a satellite may be vastly different depending on who is affected and how, and whether the satellite represents a legitimate military objective. However, it will not always be clear who the owners and operators of a satellite are, and users of a satellite‘s services may be numerous and not public. Registration of satellites is incomplete23 and current ownership is not necessarily updated in a readily available repository. The identification of a satellite as military or civilian may be deliberately obscured. Or its value as a military asset may change over time; for example, the share of capacity of a commercial satellite used by military customers may wax and wane. A potential adversary‘s satellite may have different or additional missions that are more vital to that adversary than an outsider may perceive. An ASAT attack that creates persistent debris could result in significant collateral damage to a wide range of other actors; unlike terrestrial attacks, these consequences are not limited geographically, and could harm other users unpredictably. In 2015, the Pentagon‘s annual wargame**,** or simulated conflict, involving space assets focused on a future regional conflict. The official report out24warnedthatit was hard to keep the conflict contained geographically when using anti-satellite weapons: As the wargame unfolded, a regional crisis quickly escalated, partly because of the interconnectedness of a multi-domain fight involving a capable adversary. The wargame participants emphasized the challenges in containing horizontal escalation once space control capabilities are employedto achieve limited national objectives. Lack of shared understanding of consequences/proportionalityStates havefairly similar understandings of the implications of military actions on the ground, in the air, and at sea,built over decades of experience. The United States and the Soviet Union/Russia have built some shared understanding of each other‘s strategic thinking on nuclear weapons, though this is less true for other states with nuclear weapons. But in the context of nuclear weapons, there is an arguable understanding about the crisis escalation based on the type of weapon (strategic or tactical) and the target (counterforce—against other nuclear targets, or countervalue—against civilian targets). Because of a lack of experience in hostilities that target space-based capabilities, it is not entirely clear what the proper response to a space activity is and where the escalation thresholds or “red lines” lie. Exacerbating this is the asymmetry in space investments; not all actors will assign the same value to a given target or same escalatory nature to different weapons.

#### Nuclear war causes extinction.

Starr 17 (Steven; director of the University of Missouri’s Clinical Laboratory Science Program, senior scientist at the Physicians for Social Responsibility, Associate member of the Nuclear Age Peace Foundation, expert in the environmental consequences of nuclear war; 1/9/17; “Turning a Blind Eye Towards Armageddon — U.S. Leaders Reject Nuclear Winter Studies”; <https://fas.org/2017/01/turning-a-blind-eye-towards-armageddon-u-s-leaders-reject-nuclear-winter-studies/>; Federation of American Scientists; accessed 11/24/18; TV) [AV]

The detonation of an atomic bomb with this explosive power will **instantly ignite fires** over a surface area of three to five square miles. In the recent studies, the scientists calculated that the **blast**, **fire**, and **radiation** from a war fought with 100 atomic bombs could produce **direct fatalities** comparable to all of those worldwide in World War II, or to those once estimated for a “**counterforce**” **nuclear war** between the superpowers. However, the **long-term environmental effects** of the war **could** significantly disrupt the global weather for at least a decade, which would likely **result in** a vast **global famine**. The scientists predicted that **nuclear firestorms** in the burning cities would cause at least five million tons of **black carbon smoke** to quickly rise above cloud level into the stratosphere, where it could not be rained out. The smoke would circle the Earth in **less than two weeks** and would form **a** global **stratospheric smoke layer** that **would remain for** more than **a decade**. The smoke would absorb warming sunlight, which would **heat the smoke** to temperatures near the boiling point of water, producing **ozone losses of** 20 to **50 percent** over populated areas. This would almost double the amount of UV-B reaching the most populated regions of the mid-latitudes, and it would create UV-B indices unprecedented in human history. In North America and Central Europe, the time required to get a painful sunburn at mid-day in June could decrease to as little as six minutes for fair-skinned individuals. As the smoke layer blocked warming sunlight from reaching the Earth’s surface, it would produce the **coldest** average **surface temperatures** in the last 1,000 years. The scientists calculated that global **food production would decrease** by 20 to **40 percent** during a five-year period following such a war. Medical experts have predicted that the shortening of growing seasons and corresponding decreases in agricultural production could cause up to **two billion** people to perish from **famine**. The climatologists also investigated the effects of a nuclear war fought with the vastly more powerful modern **thermonuclear** weapons possessed by the United States, Russia, China, France, and England. Some of the thermonuclear weapons constructed during the 1950s and 1960s were 1,000 times more powerful than an atomic bomb. During the last 30 years, the average size of thermonuclear or “strategic” nuclear weapons has decreased. Yet today, each of the approximately 3,540 strategic weapons deployed by the United States and Russia is seven to **80 times** more powerful than the atomic bombs modeled in the India-Pakistan study. The smallest strategic nuclear weapon has an explosive power of **100,000 tons of TNT**, compared to an atomic bomb with an average explosive power of 15,000 tons of TNT. Strategic nuclear weapons produce much larger nuclear firestorms than do atomic bombs. For example, a standard Russian 800-kiloton warhead, on an average day, will ignite fires covering a surface area of 90 to 152 square miles. A **war** fought with hundreds or thousands of U.S. and Russian strategic nuclear weapons would **ignite immense** **nuclear firestorms** covering land surface areas of many thousands or **tens of thousands** of square miles. The scientists calculated that these fires would produce up to **180 million tons** of black carbon soot and **smoke**, which would form a dense, **global stratospheric smoke layer**. The smoke would remain in the stratosphere for 10 to **20 years**, and it **would block** as much as **70 percent of sunlight** from reaching the surface of the Northern Hemisphere and 35 percent from the Southern Hemisphere. So much sunlight would be blocked by the smoke that the noonday sun would resemble a full moon at midnight. Under such conditions, it would only require a matter of days or weeks for daily minimum **temperatures** to **fall below freezing** in the largest agricultural areas of the Northern Hemisphere, where freezing temperatures would occur every day for a period of between one to more than two years. Average surface temperatures would become colder than those experienced 18,000 years ago at the height of the last Ice Age, and the prolonged cold would cause average rainfall to decrease by up to 90%. Growing seasons would be completely eliminated for more than a decade; it would be **too cold and dark** to grow food crops, **which would doom the** majority of the **human population.** NUCLEAR WINTER IN BRIEF The profound cold and darkness following nuclear war became known as nuclear winter and was first predicted in 1983 by a group of NASA scientists led by Carl Sagan. During the mid-1980s, a large body of research was done by such groups as the Scientific Committee on Problems of the Environment (SCOPE), the World Meteorological Organization, and the U.S. National Research Council of the U.S. National Academy of Sciences; their work essentially supported the initial findings of the 1983 studies. The idea of nuclear winter, published and supported by prominent scientists, generated extensive public alarm and put political pressure on the United States and Soviet Union to reverse a runaway nuclear arms race, which, by 1986, had created a global nuclear arsenal of more than 65,000 nuclear weapons. Unfortunately, this created a backlash among many powerful military and industrial interests, who undertook an extensive media campaign to brand nuclear winter as “bad science” and the scientists who discovered it as “irresponsible.” Critics used various uncertainties in the studies and the first climate models (which are primitive by today’s standards) as a basis to criticize and reject the concept of nuclear winter. In 1986, the Council on Foreign Relations published an article by scientists from the National Center for Atmospheric Research, who predicted drops in global cooling about half as large as those first predicted by the 1983 studies and described this as a “nuclear autumn.”

#### Even limited nuclear war immediately kills hundreds of millions in one week

Toon et al 19 [Owen B. Toon, PhD, Physics at Cornell; Charles G. Bardeen, Atmospheric Chemistry Observations and Modeling Laboratory, National Center for Atmospheric Research; Alan Robock, Department of Environmental Sciences, Rutgers University, New Brunswick; Lili Xia, Federation of American Scientists; Hans Kristensen, Natural Resources Defense Council; Matthew McKinzie, Department of Physics, University of Colorado, Boulder; R. J. Peterson, School of Earth, Environmental, and Marine Sciences, University of Texas Rio Grande Valley; Cheryl S. Harrison, Institute of Arctic and Alpine Research, University of Colorado, Boulder; Nicole S. Lovenduski , Department of Atmospheric and Oceanic Sciences, Institute of Arctic and Alpine Research; and Richard P. Turco, Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles] "Rapidly expanding nuclear arsenals in Pakistan and India portend regional and global catastrophe," Science Advances, https://advances.sciencemag.org/content/5/10/eaay5478 Science Advances 02 Oct 2019: Vol. 5, no. 10 RE

Regional nuclear war casualty estimates. Even one nuclear weapon explosion in a city can do a great deal of damage. For example, in the most densely populated urban area in Pakistan, a 15-kt airburst at the optimum height to maximize blast damage could kill about 700,000 people (fig. S2B) and injure another 300,000. With a 100-kt airburst over the same region, roughly 2 million fatalities and an additional 1.5 million nonfatal casualties could occur. Similar numbers would result for nuclear explosions over large Indian cities (fig. S2A). Toon et al. (16) estimated that a war between India and Pakistan involving 50 nuclear weapons with 15-kt yield detonated as airbursts over the most densely populated cities of each nation would lead to about 22 million immediate fatalities and 44 million total casualties. Casualties include fatalities, severe injuries, and lesser injuries that can develop into more serious conditions, especially in the aftermath of a nuclear attack. At that time, it was assumed (16) that India had 85 (65 to 110) nuclear weapons and Pakistan had 52 (44 to 62), all with 15-kt yields. These casualty and fatality estimates were made using the LandScan2003 (18) population database together with the Gaussian probability distribution for fatalities and total casualties versus distance from ground zero shown in fig. S3 (16). However, the urban populations of India and Pakistan are growing rapidly. The total urban populations of India and Pakistan are projected to increase by about 90% between 2000 and 2025, as shown in fig. S4 (19). The number of weapons possessed by the two countries is also thought to be increasing rapidly. By 2025, India and Pakistan could have three and five times, respectively, the number of weapons estimated by Toon et al. (16), and these would likely have higher yields than previously estimated (16). We have recomputed the fatalities and casualties for the most recent Indian and Pakistani urban population counts using the approach discussed in Methods (see below) and in Toon et al. (16). Figure 2 illustrates the cumulative fatalities and cumulative total casualties as a function of the number of explosions and their yield derived using the LandScan2016 (20) population database. The corresponding fatalities calculated for individual targets are given in the Supplementary Materials (fig. S2). Cumulative fatalities (as well as overall casualties) are higher in India because it has a greater urban population. Fatalities are not linear with respect to the number, or yield, of the weapons used, because smaller cities (of which there are greater numbers) have lower populations, whereas higher-yield weapons on these targets would encounter low-density suburban or rural areas away from the city centers where lower-yield weapons concentrate most of their damage. Compared with India, Pakistani fatalities (fig. S2B) vary less with weapon yield above 15 kt, especially after the most densely populated 100 targets have been attacked, due to the relatively low populations of the remaining targets. India has many more moderate-sized cities than Pakistan, and fatalities continue to grow rapidly with yield above 15 kt, even for the 250th target (fig. S2A). For 50 weapons of 15-kt yield exploding on both India and Pakistan, we find that the casualty estimates have risen relative to Toon et al. (16) from 22 to 27 million fatalities and from 44 to 45 million total casualties (Fig. 2) due to the expanded urban populations in LandScan2016 (20) compared to LandScan2003 (18). These increases in fatalities and casualties are much less than the ~50% increase in urban population between 2000 and 2015 (fig. S4), suggesting that the size of the area that is urban increases more than the population density within the urban region. An even more marked increase in fatalities and casualties shown in Fig. 2 is due to increasing numbers of weapons and increasing yields. In Fig. 2, the targets are graphed in decreasing order of the population density within the target area [refer to Methods and (16)]. In the scenario outlined in table S1, Pakistan is assumed to use 150 strategic weapons on Indian urban targets and India is assumed to use 100 weapons on Pakistani urban targets. The calculations use the current population of India and Pakistan, not those for 2025, because it is not possible to forecast changing populations in individual target areas. Targets that are not in urban areas are not considered, but they would lead to additional fatalities and casualties. Table S2 lists the fatalities and casualties from the scenario given in table S1. About 50 million people would die if 15-kt weapons are used, almost 100 million if 50-kt weapons are used, and about 125 million if 100-kt weapons are used. The population density in the target area affects the casualties, as well as the estimated fuel load. Table S3 lists the population and population densities for the densest urban areas attacked and the least dense. The population density in the target area usually declines as the yield increases because more suburban areas are included in the larger areas that are damaged by higher-yield weapons. In some cases, especially for low-population regions in Pakistan, the population may decrease with yield because different urban areas are chosen as the last target for differing yields. The highest population densities in table S3 are in the range of 37,000 to 80,000 people/km2. The population density in the area of the mass fire in Hamburg during WWII is estimated to have been about 20,000 people/km2 (21). Similarly, the population density for the 150th weapon used on India is between 17,000 and 4900 people/km2 and that for the 100th weapon used on Pakistan is between 8500 and 1600 people/km2. For reference, the population density of 1980s San Jose, California, a suburban city, was estimated to be about 1300 people/km2 (16). During WWII, it is estimated that about 50 million people were killed, not considering those who died from disease and starvation over 6 years [e.g., (22)]. Because of the dense populations of cities in Pakistan and India, table S2 shows that even a war with 15-kt weapons could lead to fatalities approximately equal to those worldwide in WWII and a war with 100-kt weapons could directly kill about 2.5 times as many as died worldwide in WWII, and in this nuclear war, the fatalities could occur in a single week. The world’s annual death rate from all causes is about 56 million people per year (23). Therefore, a war between India and Pakistan in our scenario with 15-kt weapons could kill the same number of people in a week as would die naturally worldwide in a year, effectively increasing the immediate global death rate by a factor of 50. A regional catastrophe would occur if India and Pakistan were to engage in a full-scale nuclear war with their expanding arsenals. India would suffer two to three times more fatalities and casualties than Pakistan (table S2) because, in our scenario, Pakistan uses more weapons than India and because India has a much larger population and more densely populated cities. However, as a percentage of the urban population, Pakistan’s losses would be about twice those of India. In general, as shown in Fig. 2, the fatalities and casualties increase rapidly even up to the 250th explosion due to the high population in India, whereas the rate of increase for Pakistan is much lower even for the 50th explosion. The fatalities and casualties outlined in table S2, Fig. 2, and fig. S2 are computed, assuming airbursts used against urban targets, and that mass fires were started in each city, as occurred in Hiroshima. It is likely that some of the 45 strategic weapons assumed to be used against isolated military targets, and some of the 40 tactical weapons, will be exploded as ground bursts. The direct casualties and fatalities from ground bursts may be relatively small. However, ground bursts carry soil into the fireball, where very small radioactive particles can attach themselves to the dust particles. The relatively large dust particles are likely to fall out of the atmosphere within a few days, when the radioactive particles are still very dangerous. Large numbers of fatalities and casualties, potentially larger than the values given in table S2 and Fig. 2, can be caused by exposure to this radioactive material within a few days of the explosions.

## 1AC — FW

#### The standard is maximizing expected wellbeing, or hedonistic util.

#### Prefer:

#### 1] Actor spec – we chose to specify an actor which is the most logical since they are the only ones who could – that oweighs their fw warrants and proves governments need to aggregate using body count and wellbeing ONLY

#### 2] Intuitions – why do we know that some things are harmful and somethings are good for us – the answer is because we’ve observed it in the real world -- Robust neuroscience proves ONLY pain and pleasure matter – everything else regresses

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

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

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

Evolutionary theories of pleasure: The love connection BO:D

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

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

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

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

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

Finding happiness is different between apes and humans

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

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

Desire and reward centers

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

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

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

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

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

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

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

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

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

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

#### Extinction first:

**1] Moral uncertainty means preventing extinction should be our highest priority.  
Bostrom 12** [Nick Bostrom. Faculty of Philosophy & Oxford Martin School University of Oxford. “Existential Risk Prevention as Global Priority.” Global Policy (2012)]  
These reflections on **moral uncertainty suggest** an alternative, complementary way of looking at existential risk; they also suggest a new way of thinking about the ideal of sustainability. Let me elaborate.¶ **Our present understanding of axiology might** well **be confused. We may not** nowknow — at least not in concrete detail — what outcomes would count as a big win for humanity; we might not even yet **be able to imagine the best ends** of our journey. **If we are** indeedprofoundly **uncertain** about our ultimate aims,then we should recognize that **there is a great** option **value in preserving** — and ideally improving — **our ability to recognize value and** to **steer the future accordingly. Ensuring** that **there will be a future** version of **humanity** with great powers and a propensity to use them wisely **is** plausibly **the best way** available to us **to increase the probability that the future will contain** a lot of **value.** To do this, we must prevent any existential catastrophe.