## 1

#### Interpretation: “outer space” is a generic indefinite singular. The aff may not defend a subset of appropriation of outer space by private entities being unjust.

#### The upward entailment test and adverb test determine the genericity of a definite singular

Leslie 16 [Sarah-Jane Leslie, Ph.D., Princeton, 2007. Dean of the Graduate School and Class of 1943 Professor of Philosophy. Served as the vice dean for faculty development in the Office of the Dean of the Faculty, director of the Program in Linguistics, and founding director of the Program in Cognitive Science at Princeton University.] “Generic Generalizations.” Stanford Encyclopedia of Philosophy. April 24, 2016. <https://plato.stanford.edu/entries/generics/> TG

1. Generics and Logical Form

In English, generics can be expressed using a variety of syntactic forms: bare plurals (e.g., “tigers are striped”), indefinite singulars (e.g., “a tiger is striped”), and definite singulars (“the tiger is striped”). However, none of these syntactic forms is dedicated to expressing generic claims; each can also be used to express existential and/or specific claims. Further, some generics express what appear to be generalizations over individuals (e.g., “tigers are striped”), while others appear to predicate properties directly of the kind (e.g., “dodos are extinct”). These facts and others give rise to a number of questions concerning the logical forms of generic statements.

1.1 Isolating the Generic Interpretation

Consider the following pairs of sentences:

(1)a.Tigers are striped.

b.Tigers are on the front lawn.

(2)a.A tiger is striped.

b.A tiger is on the front lawn.

(3)a.The tiger is striped.

b.The tiger is on the front lawn.

The sentence pairs above are prima facie syntactically parallel—both are subject-predicate sentences whose subjects consist of the same common noun coupled with the same, or no, article. However, the interpretation of first sentence of each pair is intuitively quite different from the interpretation of the second sentence in the pair. In the second sentences, we are talking about some particular tigers: a group of tigers in ([1b](https://plato.stanford.edu/entries/generics/#ex1b)), some individual tiger in ([2b](https://plato.stanford.edu/entries/generics/#ex2b)), and some unique salient or familiar tiger in ([3b](https://plato.stanford.edu/entries/generics/#ex3b))—a beloved pet, perhaps. In the first sentences, however, we are saying something general. There is/are no particular tiger or tigers that we are talking about.

The second sentences of the pairs receive what is called an existential interpretation. The hallmark of the existential interpretation of a sentence containing a bare plural or an indefinite singular is that it may be paraphrased with “some” with little or no change in meaning; hence the terminology “existential reading”. The application of the term “existential interpretation” is perhaps less appropriate when applied to the definite singular, but it is intended there to cover interpretation of the definite singular as referring to a unique contextually salient/familiar particular individual, not to a kind.

There are some tests that are helpful in distinguishing these two readings. For example, the existential interpretation is upward entailing, meaning that the statement will always remain true if we replace the subject term with a more inclusive term. Consider our examples above. In ([1b](https://plato.stanford.edu/entries/generics/#ex1b)), we can replace “tiger” with “animal” salva veritate, but in ([1a](https://plato.stanford.edu/entries/generics/#ex1a)) we cannot. If “tigers are on the lawn” is true, then “animals are on the lawn” must be true. However, “tigers are striped” is true, yet “animals are striped” is false. ([1a](https://plato.stanford.edu/entries/generics/#ex1a)) does not entail that animals are striped, but ([1b](https://plato.stanford.edu/entries/generics/#ex1b)) entails that animals are on the front lawn (Lawler 1973; Laca 1990; Krifka et al. 1995).

Another test concerns whether we can insert an adverb of quantification with minimal change of meaning (Krifka et al. 1995). For example, inserting “usually” in the sentences in ([1a](https://plato.stanford.edu/entries/generics/#ex1a)) (e.g., “tigers are usually striped”) produces only a small change in meaning, while inserting “usually” in ([1b](https://plato.stanford.edu/entries/generics/#ex1b)) dramatically alters the meaning of the sentence (e.g., “tigers are usually on the front lawn”). (For generics such as “mosquitoes carry malaria”, the adverb “sometimes” is perhaps better used than “usually” to mark off the generic reading.)

#### It applies to “outer space” – 1] upward entailment test – “the appropriation of outer space is unjust” doesn’t entail that “the universe is unjust”, 2] adverb test – “the appropriation of outer space is usually unjust” doesn’t mean anything substantially different from the rez

#### **Violation – they only defend \_\_\_\_**

#### Vote neg:

#### 1] Limits – they can pick any form of appropriation from internet satellites to asteroid mining to moon basing to Mars colonization and there’s no universal disad since they’re all different and require different uses space – explodes neg prep and leads to random appropriation of the week affs which makes cutting stable neg links impossible. PICs don’t solve – it’s absurd to say neg potential abuse justifies the aff being flat out not T, which leads to a race towards abuse. Limits key to reciprocal engagement since they create a caselist for neg prep.

#### 2] TVA – read the aff as an advantage to a whole rez aff.

**Fairness is a voter—debate is a competitive activity that requires objective evaluation.**

**Drop the debater—to deter future abuse and set better norms.**

**Use competing interps— A) leads to a race to the top since we figure out the best possible norm B) avoids judge intervention since there’s a clear brightline**

**No RVIs—**

**a. Baiting—they’ll just bait theory and prep it out—justifies infinite abuse and results in a chilling effect and**

#### b. illogical – you don’t win because you’re fair. It means that we both should win which makes the round irresolvable.

#### T First – A] advocacy impacts every part of the round so it frames my abuse B] Urgency – we only have two months to debate the topic.

#### NC theory first A) abuse is self inflicted if I was abusive its because you forced me to B) It’s introduced earlier in the debate which means we have more time for norming C) scope disclosure impacts very speech starting from the 1AC

## 2

#### Appropriations pass now but floor time and bipartisanship are key, Folley 1-26

[Aris Folley, 1-26-2022, "Fiscal spending deadline nears while lawmakers face pressure to strike deal", TheHill, https://thehill.com/homenews/senate/591375-fiscal-spending-deadline-nears-while-lawmakers-face-pressure-to-strike-deal, date accessed 1-26-2022] //Lex AT

Lawmakers on both sides of the aisle are facing mounting pressure to meet a critical deadline on a fiscal year spending deal to prevent a government shutdown, with just weeks remaining before funds are scheduled to lapse. While leaders have made some strides in recent weeks, Congress has until Feb. 18 to hash out an agreement on spending levels for fiscal 2022. Sen. [Richard Shelby](https://thehill.com/people/richard-shelby) (Ala.), top Republican on the Senate Appropriations Committee, indicated to reporters last week that leaders have their work cut out for them in trying to reach a bipartisan agreement on a potential omnibus spending bill by deadline. “It’d be hard to get it by the 18th,” Shelby told reporters ahead of recess. “But if we can make huge progress, we’ll probably get it done this soon, but we’ve got to continue to work together. ... If we don’t work together, we’ll never pass any appropriation bill.” Republican and Democratic leaders have pushed back on the idea of Congress passing a full-year continuing resolution (CR), a measure that would allow the government to remain funded at the previous fiscal year’s funding levels, with Shelby and Speaker [Nancy Pelosi](https://thehill.com/people/nancy-pelosi) (D-Calif.) strongly against the option, even in the short term. “To go to a continuing resolution instead of a decisionmaking omnibus bill is to weaken our security and our stability,” Pelosi said at her weekly briefing last week. “The Republicans should know that. So, we hope that we will be able to bring that legislation to the floor before it expires.” The House has so far passed nine out of 12 appropriations bills to fund the government for fiscal 2022. The Senate, however, has yet to bring any appropriations bills to the floor, as leaders on both sides of the evenly split chamber have struggled for months to reach a bipartisan agreement on a top-line spending number. There have also been disagreements in areas like defense spending and longtime riders like the Hyde amendment, as well as concurrent, lengthy spending battles over the nation’s debt limit. There was also [President Biden](https://thehill.com/people/joe-biden)’s Build Back Better proposal that has gobbled up legislative time for leaders over the past few months. February marks the third such deadline for Congress to reach a spending deal since the fiscal year started in October. Before lawmakers headed home last week, Sen. [Jon Tester](https://thehill.com/people/jon-tester) (D-Mont.), a member of the Senate Appropriations Committee, appeared to express optimism in the progress lawmakers are making. “What I’m hoping is that we’ll have something the beginning of next week that will be a real top-line number and an agreement on the riders,” he said, before adding concerns that, if lawmakers fail to act quickly, they’ll be “looking at a CR, which is disastrous.” But some experts say it’s likely Congress is staring down another temporary continuing resolution in February, given the amount of work still outstanding. Zach Moller, a former Senate Democratic budget aide who heads the economic program at the centrist think tank Third Way, told The Hill he’s “more optimistic” lawmakers will reach a top-line agreement by the deadline but less so about the chances that “the whole bill will be done.” “Running into this deadline may force Republicans and Democrats to come together enough that they reach a deal on a top line, but that doesn’t mean that they won’t need another short term CR to go finish the rest of the details,” Moller said.

#### Large President-led national space policies incite immense partisan backlash that spills over to kill the entire political agenda

Dreier 16 [Casey Dreier, Chief Advocate & Senior Space Policy Adviser for The Planetary Society, April 13, 2016. “Does Presidential Intervention Undermine Consensus for NASA?” https://www.planetary.org/blogs/casey-dreier/2016/0413-does-a-strong-president-help-or-hurt-consensus-on-NASA.html]

To see how this happens, I recommend reading the book “[Beyond Ideology](http://smile.amazon.com/Beyond-Ideology-Politics-Principles-Partisanship/dp/0226470768/ref=smi_www_rco2_go_smi_g2243582042?_encoding=UTF8&*Version*=1&*entries*=0&ie=UTF8)” by Frances Lee. The author’s larger premise is that issues having no intrinsic relation to stated party ideology have become increasingly polarized in recent years. This is a function of the two party nature of our political system. If your party coalition wins, the other one loses. It’s zero-sum. Your party can win in one of two ways: you can make a better pitch to voters by demonstrating the superiority of your agenda; or you can undermine and stymie the agenda of the opposition party, making them unpopular with voters, and pick up the seats that they lose. Since you’re the only other political party, you gain in either scenario. I’m not sure if you’ve noticed, but the “undermine and stymie” approach has been popular for quite some time now in the U.S. Congress. Given this situation, the President and their policies naturally become the symbolic target of the opposition party. Anything promoted by the President effectively induces opposition by association. Lee demonstrates the magnitude of this induced polarization on various types of issues. For highly polarized issues like the role of government in the economy, or social issues, the impact is minimal—the opposition has already been clearly defined and generally falls into clearly defined ideologies of the Republican and Democratic parties. But for issues that do not fit readily into a predefined political ideology—like space—the induced polarization by the President can be significant. In fact, Lee showed that space, science, and technology issues incur the greatest increase in partisanship based on their inclusion in the Presidential agenda. One need only look to at the responses by political operatives of the opposing party to the strong human spaceflight proposals by [Barack Obama in 2010](http://www.shelby.senate.gov/public/index.cfm/mobile/newsreleases?ID=25F3AD2E-802A-23AD-4960-F512B9E205D2), [George W. Bush in 2004](http://www.nbcnews.com/id/3950099/ns/technology_and_science-space/t/bush-sets-new-course-moon-beyond/#.Vw3UMRMrKHo), and [George H.W. Bush in 1989](http://www.nytimes.com/1989/07/21/us/president-calls-for-mars-mission-and-a-moon-base.html) to see this reflected in recent history. This isn’t to say that Presidents can’t have a significant impact on the space program. Clearly they can. But the broad consensus needed for stability after their departure from office may be undermined by the very priority they gave it during their tenure. It what amounts to a mixed blessing for NASA, the U.S. space program does have an unusually strong bipartisan group of politicians who support the program due to NASA centers in a variety of states throughout the union. Berger notes this throughout his article, and it does, in a way, act as force that is resistant to change for good and bad. This mitigates somewhat the pure polarization seen on other science and technology issues. But for a Journey to Mars—a major effort that would, at best, require stability and significant funding over many Presidential administrations—that may not be enough. Perhaps the solution is for the next President to maintain a light touch on space. Maybe they should speak softly through the budget process, and avoid the Kennedyesque speeches and declarations to Congress that induce the types of partisanship we so dearly need to avoid.

#### CR stopgap ruins UAVs for decades—that undermines strategic competition

Wynne 1/14 [Brian Wynne, Federal Aviation Administration’s Drone Advisory Committee and Management Advisory Council, "A yearlong continuing resolution will hinder unmanned systems integration", 1/14/22, https://www.defensenews.com/opinion/commentary/2022/01/14/a-yearlong-continuing-resolution-will-hinder-unmanned-systems-integration/]

With fiscal 2022 well underway and the current continuing resolution set to expire without congressional consensus on a way forward on appropriations, the U.S. Department of Defense is preparing for the possibility of operations under a full-year CR stopgap measure. Let’s be clear: That will hinder the continued integration of unmanned systems into the U.S. military and ultimately harm our preparedness for strategic competition. During a hearing this week of the House Appropriations Committee’s Defense Subcommittee, appropriators rightly acknowledged that a full-year CR would make our military less agile and curtail our ability to prepare for current security challenges. Members of Congress must also realize that failure to pass funding bills will create a domino effect that will harm U.S. national security for years to come by damaging the growing unmanned systems industry. As the Pentagon moves resources and dollars to address this new era of strategic competition, unmanned systems — in the air, in space, in the sea and on land — will be the tip of the sword for our sailors, Marines, soldiers and airmen against rising geopolitical threats. Launched last year, the Navy’s Unmanned Campaign Plan and related task force are two examples that demonstrate the extent to which DoD leaders understand the unparalleled value uncrewed systems will provide in achieving the vision presented in the National Defense Strategy. However, the new normal of cycles of CRs results in real-dollar budget reductions and program delays that threaten the progress of this vision — and these losses harm both U.S. strategic competitiveness and the defense-industrial base. As Adm. Mike Gilday stated during the House Appropriations Committee hearing: “Every day matters in this critical decade.” Appropriators must understand that the importance of full funding for the research, development, test and evaluation as well as the procurement of uncrewed systems at this moment cannot be overstated. A full-year CR will prevent critical, new uncrewed systems programs from being initiated. This includes authorization of $57 million for the Marine Corps’ Group 5 UAS development project; projects totaling $52.5 million for the development of counter-small UAS capabilities; and $57.6 million dedicated to the maturation of technologies under the AFWERX prime project. By operating at FY21 funding levels, the program for small unmanned undersea vehicles will see only a third of its FY22 authorized budget. These cuts represent significant losses of time and capital that the unmanned systems industry has spent in preparing systems for field action. The defense-industrial base has made investments in the technology, supply base, workforce, supply chain and infrastructure based on the DoD’s vision for the future. Companies working to advance the front lines of innovation already face a “procurement trough” caused by delays and gaps in new programs. A full-year CR would set off an irreversible ripple effect that would deepen this trough for years to come. Simply put, saddling companies nationwide with long-standing Capital Beltway problems prevents the development and adoption of critical tools. Smaller and midsized companies feel the impacts of these delays most, and continued delays will force them to move their investments away from unmanned systems to other, more predictable markets. Until Congress puts American warfighters before political concerns, the U.S. will fall behind in the development, fielding and adoption of modern tools that support a full range of missions. The time is now to make the DoD’s strategic visions reality by accelerating investments in air, surface and subsurface platforms. Congressional leaders must immediately work to build consensus in support of stable funding that enables the development and integration of uncrewed systems. The country is looking for assertive congressional leadership — now is the time to step up.

#### That causes nuclear war with Russia and china

Kroenig & Gopalaswamy 18, \*Associate Professor of Government and Foreign Service at Georgetown University and Deputy Director for Strategy in the Scowcroft Center for Strategy and Security at the Atlantic Council. \*\*Director of the South Asia Center at the Atlantic Council. He holds a PhD in mechanical engineering with a specialization in numerical acoustics from Trinity College, Dublin. (Matthew & Bharath, 11-12-2018, "Will disruptive technology cause nuclear war?", *Bulletin of the Atomic Scientists*, https://thebulletin.org/2018/11/will-disruptive-technology-cause-nuclear-war/)

Rather, we should think more broadly about how new technology might affect global politics, and, for this, it is helpful to turn to scholarly international relations theory. The dominant theory of the causes of war in the academy is the “bargaining model of war.” This theory identifies rapid shifts in the balance of power as a primary cause of conflict. International politics often presents states with conflicts that they can settle through peaceful bargaining, but when bargaining breaks down, war results. Shifts in the balance of power are problematic because they undermine effective bargaining. After all, why agree to a deal today if your bargaining position will be stronger tomorrow? And, a clear understanding of the military balance of power can contribute to peace. (Why start a war you are likely to lose?) But shifts in the balance of power muddy understandings of which states have the advantage.You may see where this is going. New technologies threaten to create potentially destabilizing shifts in the balance of power. For decades, stability in Europe and Asia has been supported by US military power. In recent years, however, the balance of power in Asia has begun to shift, as China has increased its military capabilities. Already, Beijing has become more assertive in the region, claiming contested territory in the South China Sea. And the results of Russia’s military modernization have been on full display in its ongoing intervention in Ukraine. Moreover, China may have the lead over the United States in emerging technologies that could be decisive for the future of military acquisitions and warfare, including 3D printing, hypersonic missiles, quantum computing, 5G wireless connectivity, and artificial intelligence (AI). And Russian President Vladimir Putin is building new unmanned vehicles while ominously declaring, “Whoever leads in AI will rule the world.” If China or Russia are able to incorporate new technologies into their militaries before the United States, then this could lead to the kind of rapid shift in the balance of power that often causes war. If Beijing believes emerging technologies provide it with a newfound, local military advantage over the United States, for example, it may be more willing than previously to initiate conflict over Taiwan. And if Putin thinks new tech has strengthened his hand, he may be more tempted to launch a Ukraine-style invasion of a NATO member.Either scenario could bring these nuclear powers into direct conflict with the United States, and once nuclear armed states are at war, there is an inherent risk of nuclear conflict through limited nuclear war strategies, nuclear brinkmanship, or simple accident or inadvertent escalation. This framing of the problem leads to a different set of policy implications. The concern is not simply technologies that threaten to undermine nuclear second-strike capabilities directly, but, rather, any technologies that can result in a meaningful shift in the broader balance of power. And the solution is not to preserve second-strike capabilities, but to preserve prevailing power balances more broadly.

## 3

#### Starlink key to global broadband

**Menon 21** [Arun Menon Sep 8, 2021 08, "SpaceX’s Starlink kickstarts a satellite broadband market that could disrupt telecom — Menon," Fierce Telecom, [https://www.fiercetelecom.com/telecom/spacex-s-starlink-kickstarts-a-satellite-broadband-market-could-disrupt-telecom-menon accessed 12/19/21](https://www.fiercetelecom.com/telecom/spacex-s-starlink-kickstarts-a-satellite-broadband-market-could-disrupt-telecom-menon%20accessed%2012/19/21)] Adam

In recent years, more than 10 low earth orbit (LEO) satellite projects have surfaced, among which SpaceX’s Starlink has a clear first-mover advantage. With 1,500+ active satellites, Starlink is by far the largest network in the orbit. Elon Musk most recently [tweeted](https://twitter.com/elonmusk/status/1429907171639103489?lang=en) that Starlink has now shipped 100,000 terminals to users in 14 countries, with license applications pending in several other countries. That’s significant given that a full commercial service has not yet begun.

RELATED: [Industry Voices—Menon: Satellite mega-constellations are connectivity’s new frontier post-5G revolution](https://www.fiercetelecom.com/telecom/industry-voices-menon-satellite-mega-constellations-are-connectivity-s-new-frontier-post-5g)

Despite service downtimes during the initial beta-testing phase, Starlink’s satellite broadband service managed to provide a comparable experience to fixed-based internet service. A recent post by broadband network intelligence firm [Ookla](https://www.speedtest.net/insights/blog/starlink-hughesnet-viasat-performance-q2-2021/) noted Starlink as the only satellite broadband service provider in the U.S. to offer fixed-broadband-like latency figures of 45 ms and median download speeds at 97.23 Mbps (vs. fixed broadband’s 14 ms and 115 Mbps) in 2Q21. Elsewhere, Starlink managed to beat the average download speeds of fixed broadband in markets like Canada (Starlink’s 86.92 Mbps vs. fixed broadband’s 84.24 Mbps), Germany (107.98 Mbps vs. 58.17 Mbps), New Zealand (127.02 Mbps vs. 78.85 Mbps), and the UK (108.30 Mbps vs. 50.14 Mbps).

All these stats point to Starlink emerging as a strong alternative for broadband service. As more Starlink satellites join the orbit, the occasional downtimes will reduce significantly, also improving the latency and speed. And if Elon Musk is to be believed, Starlink’s speed will [double](https://www.business-standard.com/article/international/starlink-internet-speed-will-double-to-300mbps-this-year-elon-musk-121022300223_1.html) to 300 Mbps by the end of this year, from the current promised speeds of 50-150 Mbps range.

Rivals make progress but lag Starlink’s pace of growth

Several other players are prepping to launch new constellation projects. Three of the most promising LEO satellite projects (other than SpaceX’s Starlink) include OneWeb, Amazon’s Kuiper, and Telesat’s Lightspeed. Starlink’s direct competitor in terms of scale, goal, and target market is Amazon’s Kuiper which plans to operate a fleet of 3,236 LEO satellites. Though Amazon is yet to deploy any satellites, it received U.S. Federal Communications Commission (FCC) approval mid last year to deploy half of the satellites by mid-2026 and the rest by mid-2029. Despite signing a [contract](https://www.cnbc.com/2021/04/19/amazon-signs-ula-rockets-to-launch-bezos-kuiper-internet-satellites.html) for nine launches of its Project Kuiper internet satellites on United Launch Alliance’s Atlas V rockets, Amazon did not reveal any timeline for those launches. This is in stark contrast to Starlink’s satellite internet service, which will be up and running commercially by [September](https://www.zdnet.com/article/spacex-president-says-starlink-global-satellite-broadband-service-to-be-live-by-september/) this year.

#### Broadband is critical to American agriculture.

Zippy Duvall 18. president of the American Farm Bureau Federation, 11-1-2018, "For farmers, broadband is a necessity, not a luxury," TheHill, https://thehill.com/blogs/congress-blog/technology/414370-for-farmers-broadband-is-a-necessity-not-a-luxury

Just like every other U.S. business competing in an increasingly global economy, America’s farmers and ranchers need reliable, high-speed internet service. It is no longer a luxury; it is an absolute necessity in our digital age. Robust broadband networks foster more efficient, economical and environmentally responsible agriculture operations. Rural broadband deployment is now a priority for Congress, the administration and federal agencies. But there is still work to do to ensure rural and agricultural communities have fair and open access to the fixed and mobile broadband networks they need to prosper and succeed. High-speed broadband networks are vital to ensure farmers and ranchers can use the latest in precision agricultural equipment. They are central to following commodity markets and communicating with customers, vendors and suppliers. Speedy internet connections mean American farmers can gain a foothold in new markets around the world while ensuring they are complying with ever-changing regulatory standards. The nature and science and technology of farming is constantly changing. Modern farming techniques such as [precision agriculture give farmers important information](https://www.nationalgeographic.com/environment/future-of-food/food-future-precision-agriculture/) to maximize yields on every piece of the land they work right down to the square foot, in many cases. But precision ag requires a wireless broadband connection for data collection and analysis done on the farm and in remote data centers, too. Farmers and ranchers cannot take full advantage of such cutting-edge equipment if they do not have access to wireless broadband in the field or on the ranch. As time goes by, those connections will become ever more important in a world [expected to add more than 2 billion people by 2050](https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html). Rural communities – already under extreme economic pressure – need broadband now and will need it even more in the very near future. Broadband is essential to help rural communities access health care and government services, as well as educational and business opportunities that would otherwise be unavailable. Put simply, our rural and farming communities must be able to access high-speed internet just as easily and efficiently as suburban and urban communities. Bridging this digital divide is critical to the success of America’s farmers. Rural broadband is to this century what rural electrification was to the last: a critical part of economic survival. Chances for economic recovery in rural America will fade unless we have broadband service throughout the nation.

#### Great power war.

John Castellaw 17. 36-year veteran of the U.S. Marine Corps and the Founder and CEO of Farmspace Systems LLC, “Opinion: Food Security Strategy Is Essential to Our National Security,” 5/1/17, https://www.agri-pulse.com/articles/9203-opinion-food-security-strategy-is-essential-to-our-national-security

The **U**nited **S**tates faces many threats to our National Security. These threats include continuing wars with extremist elements such as **ISIS** and potential wars with rogue state **North Korea** or regional nuclear power **Iran.** The heated economic and diplomatic competition with **Russia** and a surging **China** could **spiral out of control**. Concurrently, we face threats to our future security posed by growing civil strife, famine, and refugee and migration challenges which create incubators for extremist and anti-American government factions. Our response cannot be one dimensional but instead must be a nuanced and comprehensive National Security Strategy combining all elements of National Power including a Food Security Strategy. An **American Food Security Strategy** is an imperative factor in **reducing the multiple threats impacting our National wellbeing.** Recent history has shown that **reliable food supplies and stable prices produce more stable and secure countries.** Conversely, food insecurity, particularly in poorer countries, can lead to instability, unrest, and violence. **Food insecurity** drives **mass migration** around the world from the Middle East, to Africa, to Southeast Asia, destabilizing neighboring populations, **generating conflicts**, and threatening our own security by **disrupting** our **economic, military, and diplomatic relationships**. Food system shocks from extreme food-price volatility can be correlated with protests and riots. Food price related protests toppled governments in Haiti and Madagascar in 2007 and 2008. In 2010 and in 2011, food prices and grievances related to food policy were one of the major drivers of the Arab Spring uprisings. Repeatedly, history has taught us that **a strong agricultural sector** is **an unquestionable requirement** for inclusive and sustainable growth, broad-based development progress, and **long-term stability**. The impact can be remarkable and far reaching. **Rising income**, in addition to reducing the opportunities for an upsurge in extremism, leads to changes in diet, producing **demand** for more diverse and nutritious foods provided, in many cases, from **American farmers** and ranchers. **Emerging markets** currently purchase **20 percent of U.S. agriculture** exports and that figure is **expected to grow** as populations boom. Moving early to ensure stability in strategically significant regions requires long term planning and a disciplined, thoughtful strategy. To combat current threats and work to prevent future ones, our national leadership must employ the entire spectrum of our power including diplomatic, economic, and cultural elements. The best means to prevent future chaos and the resulting instability is positive engagement addressing the causes of instability before it occurs. This is not rocket science. We know where the instability is most likely to occur. The world population will grow by 2.5 billion people by 2050. Unfortunately, this massive population boom is projected to occur primarily in the most fragile and food insecure countries. This alarming math is not just about total numbers. Projections show that the greatest increase is in the age groups most vulnerable to extremism. There are currently 200 million people in Africa between the ages of 15 and 24, with that number expected to double in the next 30 years. Already, 60% of the unemployed in Africa are young people. Too often **these situations deteriorate into shooting wars** requiring the deployment of our military forces. We should be continually mindful that the price we pay for committing military forces is measured in our most precious national resource, the blood of those who serve. For those who live in **rural America**, this has a disproportionate impact. Fully 40% of those who serve in our military come from the farms, ranches, and non-urban communities that make up only 16% of our population. Actions taken now to increase agricultural sector jobs can provide economic opportunity and stability for those unemployed youths while helping to feed people. A recent report by the Chicago Council on Global Affairs identifies agriculture development as the core essential for providing greater food security, economic growth, and population well-being. Our active support for **food security**, including agriculture development, has helped **stabilize key regions** over the past 60 years. A robust food security strategy, as a part of our overall security strategy, can mitigate the growth of terrorism, build important relationships, and support continued American economic and agricultural prosperity while materially contributing to our Nation’s and the world’s security.

## 4

#### CP: States should ban all satellites launched by private entities in the LEO by declaring all satellites violate appropriation.

#### Perm severs out of enforcement they say appropriation is about orbits, Virgiliu pop no date

[Virgiliu Pop, xx-xx-xxxx, "Appropriation in outer space: the relationship between land ownership and sovereignty on the celestial bodies", No Publication, https://www.sciencedirect.com/science/article/abs/pii/S0265964600000370, date accessed 1-15-2022] //Lex AT

The second view, shared by most of the authors, holds that private property is denied under the Outer Space Treaty [6, p. 322]. Several methods of legal reasoning sustain their view. Application of the a fortiori principle to the prohibition of national appropriation of outer space and celestial bodies, as expressed in the Outer Space Treaty, results in its implicit extension to private parties. Sterns, Stine and Tennen hold that States may not license private entities to `appropriate privately that which cannot be appropriated publiclya [7, p. 53]. Jenks believes that, as `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 adventurera [8]. Historical interpretation would sustain the same viewpoint. Prior to the negotiation of the Outer Space Treaty, many legal institutes viewed the private appropriation of extraterrestrial realms as undesirable. In 1960, the Association of the Bar of the City of New York recommended that `Celestial bodies (2) shall not be subject to exclusive appropriation by any person, organisation, or State on the Eartha [9]. Three years later, the Institute of International Law suggested that `Outer space and the celestial bodies are not subject to any kind of appropriation (2)a [10]. The same was the view of the International Institute of Space Law in 1966, whose Working Group III drafted a resolution concerning the legal status of celestial bodies; its third principle held that `[c]elestial bodies or regions of them shall not be subject to national or private appropriation (2)a [11]. The negotiating history of the Outer Space Treaty itself points towards the implicit prohibition of private appropriation. Dembling considers that the text of article II `provoked little debatea [12, pp. 35, 39]. Towards the end of the Outer Space Treaty negotiations, on August 4, 1966, Delegate Bal of Belgium stated that his delegation `had taken note of the interpretation of the term &nonappropriation' advanced by several delegations \* apparently without contradiction \* as covering both the establishment of sovereignty and the creation of titles to property in private lawa [13, pp. 344, 350, 14, p. 274]. The French Delegate also mentioned that 2there was reason to be satis"ed that three basic principles were a$rmed, namely: the prohibition of any claim of sovereignty or property rights in space2 [14]. Opposing views, such as that of Oosterlink consider however that the history of article II, as recorded during the negotiating meetings, shows that it was the intention of at least some participants to give a wider scope to this article than its actual reading [14]. Brooks also comments that [i]t would be more correct to say that several delegations had raised, rather than settled, the precise point [13] 276 V. Pop / Space Policy 16 (2000) 275}282 and that the entire record is more evidence that other contracting parties did not wish to foreclose future positions by setting forth precisely the rights of the Powers in using the resources of celestial bodies. In that sense the question may still be open [13]. However, the fact that the accessions to the Outer Space Treaty were not accompanied by declarations expressing the understandings of the respective nations regarding the meaning of article II may be seen as an indication of the fact that the matter was settled during the negotiation process. The teleological interpretation of the Outer Space Treaty examines the ultimate aim of the instrument. According to Myers, the Outer Space Treaty has conferred upon outer space the character of `res communis \* placed by nature at the equal disposal of all men and non-appropriable by individual States or private personsa [15, p. 68]. The systematic method of interpretation relates the norm in issue to the whole of the legal text. Property implies control over access; its essence is the exclusion of the others for the bene"t of the owner. As Article I of the Outer Space Treaty states that `there shall be free access to all areas of celestial bodiesa, no control over access can be lawful, hence private appropriation of extraterrestrial land cannot exist. Finally, another reason that may be invoked when a$rming that prohibition of national appropriation implies prohibition of private appropriation is the position according to which private appropriation cannot exist independently from State appropriation. When appropriating a previously unoccupied land, one does so necessarily on behalf of a State. Oppenheim and Lauterpacht believe that `occupation can only take place by and for a State; it must be a State act, that is, it must be performed in the service of a State, or it must be acknowledged by a State after its performancea [16]. Unless the State invests a private individual or corporation with the public power of acquisition and administration acquisition of territory and sovereignty thereon takes place outside the dominion of the Law of Nations, and the rules of this law, therefore, cannot be applied. If the individual or corporation which has made the acquisition requires protection, he or it must either declare a new State to be in existence and ask for its recognition by the Powers (2), or must ask an existing State to acknowledge the acquisition as having been made on its behalf [16]. The present author will comment in the next section upon the possibility of individuals to acquire landed property outside State sovereignty.’

Aff gets circumvented don’t know brightline for how much probable density

#### Satellite constellations are groups of satellites, Hainaut No Date

[Olivier R .Hainaut, xx-xx-xxxx, "Large Satellite Constellations and their Impact on Astronomy", No Publication, https://www.eso.org/~ohainaut/satellites/, date accessed 1-29-2022] //Lex AT

Wikipedia: "A satellite constellation is a group of artificial satellites working together as a system." A mega-constellation is a group of large constellation, with hundreds or thousands of individual satellites. The Starlink, OneWeb and others (see [below](https://www.eso.org/~ohainaut/satellites/#cons) for a list) aim at providing global telecommunication coverage, with a very low latency. The low latency implies a very low altitude, which in turns implies a very large number of satellites (see the [visibility section](https://www.eso.org/~ohainaut/satellites/vis) below for details.

#### One satellite is still profitable and triggers internet stuff, Paul 21

[Trey Paul, 12-28-2021, "Best Satellite Internet Providers of 2022", CNET, https://www.cnet.com/home/internet/best-satellite-internet/, date accessed 1-29-2022] //Lex AT

Second, Starlink will keep things as simple as possible by going with only one satellite internet plan offering a satellite dish and router for an internet signal. In April, SpaceX President Gwynne Shotwell said there are ["no plans" to introduce tiered pricing or packages](https://www.cnet.com/home/internet/spacex-president-no-plans-to-add-price-tiers-to-starlink-satellite-internet/).

Lastly, while the current equipment fee of $499 is steeper than those charged by either HughesNet or Viasat, Starlink does not require a two-year contract and features genuinely unlimited data. Once you consider the decent upload speed, these are pretty considerable upgrades for anyone stuck with satellite internet. Those facts could undoubtedly change as Starlink continues to grow, but they're intriguing aspects of the pitch that could help set it apart from the competition.

#### Solves the aff better because otherwise ppl can just launch individual satellites in the LEO or groups of 10 satellites which would circumvent all of their impacts.

## Case

### Framing

#### Permissibility and presumption Negate,

#### 1] Text – Ought is defined as expressing obligation[[1]](#footnote-1) which means absent a proactive obligation you vote neg since the aff can’t prove an obligation. O/W since text is the only thing we have access to prior to the round.

#### 2] Safety – It’s ethically safer to presume the squo since we know what the squo is but we can’t know whether the aff will be good or not if ethics are incoherent.

#### 3] Real world – Policymakers don’t pass policies they aren’t sure about, they shelve them for later.

#### Determinism hijacks Consequentialism. Consequentialism says knowledge can only be based off observed fact. Thus, free will is illogical since it would claim one could take an alternative course of action than whatever action they took, BUT that would not be an observed fact.

#### Determinism hijacks util. If pain and pleasure drive all action, then determinism is true since any action can be explained by different degrees of dopamine released. If they deny this justification, it proves their framework triggers permissibility since it’s escapable and can’t guide action.

#### Arbitrariness – if determinism is false then you imply that human acts are random since they aren’t based on any previous cause. Ethics can’t be arbitrary because otherwise it wouldn’t guide action since anything is permissible.

#### Nature – the universe is infinite, that justifies determinism since any individual act is too small to alter the fate of the universe, Horne 1

Herman H. Horne, 1912, “The Arguments for Determinism”, Excerpt from Free Will and Human Responsibility: A Philosophical Argument, https://web.csulb.edu/~cwallis/100/articles/arguments\_for\_determinism.html

This argument has been somewhat anticipated in the preceding paragraph. It is but a generalization of all the four preceding arguments. A philosophy of nature is a general theory explanatory of all the occurrences of nature. Now the ideal of scientific explanation in physics, chemistry, biology, physiology, and everywhere is mechanical. Events do not happen because anybody or any will wants them to happen; they happen because they have to happen; they happen because they must. And it is the business of science to find this necessary connection between the occurrences of nature. The universe, by this hypothesis, whole and part, is governed by the action of mechanical law. The reign of law is universal. Man is a very small creature upon a small earth, which is itself a comparatively small planet in one of the smaller solar systems of an indefinitely large number of solar systems which partially fill infinite space. The universe is a physical mechanism in which law rules, and man is but a least part of this universal machine. How then can he do otherwise than he does do? A single free-will act would introduce caprice, whim, chance, into a universe whose actions are so mechanically determined that an omniscient observer of the present could predict infallibly all futurity.

#### That negates: Determinism states obligatory responsibility doesn’t exist because everything is predetermined so the aff can’t prescribe action.

#### Consequentialism fails – A] Induction fails –saying that induction works relies on induction itself because it assumes that past trends will continue, which means it’s circular and unjustified B] Butterfly effect - every action has infinite stemming consequences so it is impossible to evaluate an action based off them;

Pummer

#### 1] Freezes action - anything could cause extinction since probability is irrelevant udner infinite maginitdue.

#### 2] Irresolvable – 100 people dying would also kill their infinite generations.

#### 3] No warrant why the random philosophies name dropped care about extinction

#### 4] No impact to moral uncertainty – people are uncertain about whether racism is bad but we can still come to conclusions.

#### 5] TURN – if we only focus on exisntential risks we’ll never resolve uncertainty

#### 6] No uncertainty – if I win my framework is true it proves moral uncertainty just misunderstands morality.

#### 7] No warrant why preservation is good the future could be a horrible apocalypse

### Case -- Debris

#### 1] Squo solves debris – private tracking, surveillance, in-orbit servicing and green satellite tech all happening now – includes Starlink

CSTP 20 – OECD Committee, The strategic objectives of the Committee as defined in its Mandate and by the work priorities agreed by Member countries' Ministers responsible for science and technology provide the framework for the Secretariat's proposals for activities to be developed or initiated under the aegis of the Committee itself or its subsidiary bodies (NESTI, TIP, GSF, BNCT and IPSO) [This paper was approved and declassified by written procedure by the Committee for Scientific and Technological Policy (CSTP) on 11 March 2020 and prepared for publication by the OECD Secretariat, “SPACE SUSTAINABILITYTHE ECONOMICS OF SPACE DEBRIS IN PERSPECTIVE,” OECD Science, Technology and Industry Policy Papers, April 2020, No. 87, https://www.oecd-ilibrary.org/science-and-technology/space-sustainability\_a339de43-en]

An emerging “space debris economy”?

* Will we see a more intensive use of cubesats and miniaturised technologies in lower orbits? Cubesats have been the fastest-growing category of launched satellites in the last years and, when launched at lower altitudes, are naturally compliant with debris mitigation guidelines. They are also ever more performant and affordable, and dedicated launch opportunities become more widespread. Furthermore, they increasingly receive preferential treatment in risk-based national legislations (e.g. introduction of sliding scale in the UK Outer Space Act for insurance requirements).
* Space surveillance and tracking capabilities, in both GEO and LEO: New (private) sources of situational awareness data are becoming increasingly important, with data analytics and modelling fuelled by advances in digital technologies. Private sector debris catalogues and tracking capabilities for the geostationary orbit may now be almost as good as government capabilities (IDA, 2016[76]), while solutions for the low-earth orbit are emerging. Start-ups such as LeoLabs provide data and services based on low-cost ground equipment and sophisticated data analysis. The company, which in October 2019 had three radars in the United States and New Zealand, has developed a cloud-based “Space Regulatory and Sustainability Platform” for the New Zealand Space Agency, a first of its kind, destined to track objects launched from New Zealand to ensure compliance with permit conditions (MBIE, 2019[77]). A novel project called TruSat intends to use blockchain technology to crowdsource and validate satellite orbital positions worldwide via open source software (TruSat, 2019[78]). The US Air Force Research Laboratory has signed agreements with several commercial space situational awareness data providers (e.g. Numerica, LeoLabs, ExoAnalytics) to get access to sensor networks and algorithms (Numerica, 2019[79]). The Space Situational Awareness (SSA) open-architecture data-sharing platform under development by the US Department of Commerce, including data from different government agencies, is also expected to spur innovative value-added products and services.
* In-orbit servicing solutions: Several governmental agencies and commercial companies have developed, or are in the process of acquiring, some capabilities for in-orbit servicing (e.g. NASA, DARPA, ESA, JAXA). In-orbit servicing involves a number of complex operations in space: the servicing of space platforms (e.g. satellite, space station) to replenish consumables and degradables (e.g. propellants, batteries, solar array); replacing failed functionality; and/or enhancing the mission through software and hardware upgrades. This is a major challenge as, when on orbit, space platforms can move at speeds of several kilometres a minute. The first commercial in-orbit servicing mission was launched in 2019, by a MEV-1 spacecraft developed by Orbital ATK for an Intelsat geostationary satellite. The main short-term market is seen in the life extension of geostationary satellites, with some 300 potential candidates, at least in theory (Kennedy, 2018[80]). However, the key benefits of in-orbit servicing are expected in the future. Satellite design is currently heavily restricted by extreme launch conditions, but the possibility of servicing could enable a much more flexible and modular satellite design, able to take advantage of the latest advances in materials and electronics, beyond software upgrades (Jaffart, 2018[81]). Market forecasts estimate a USD 3 billion market for in-orbit servicing over the 2017-27 period, mainly driven by life extension services (Northern Sky Research, 2018[82]).
* Active debris removal solutions: Active debris removal is at a less mature technological level, but several firms are preparing demonstration missions (e.g. Astroscale in 2020). Potential candidates for removal include more than 200 critical debris objects (3-9 tonnes); mainly rocket bodies, but also the European Envisat satellite. JAXA, has formally launched a project to remove a large piece of debris by 2025 (a Japanese rocket body) in a public-private partnership (Japanese Delegation to UNCOPUOS, 2019[83]). Both Airbus and Thales Alenia Space are developing in-orbit servicing vehicles with debris removal functions, some of which have been tested on the RemoveDEBRIS mission (Surrey Space Centre, 2019[84]; OECD, 2019[11]).

•

### Case – Hacking

#### 1] Hacking of SATs by the government nonuniques this advantage

#### a] 1AC Akoto proves – we’ve inserted in blue

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

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

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

#### 2] No one’s going to war over a downed satellite

Bowen 18 [Bleddyn Bowen, Lecturer in International Relations at the University of Leicester. The Art of Space Deterrence. February 20, 2018. https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/]

Space is often an afterthought or a miscellaneous ancillary in the grand strategic views of top-level decision-makers. A president may not care that one satellite may be lost or go dark; it may cause panic and Twitter-based hysteria for the space community, of course. But the terrestrial context and consequences, as well as the political stakes and symbolism of any exchange of hostilities in space matters more. The political and media dimension can magnify or minimise the perceived consequences of losing specific satellites out of all proportion to their actual strategic effect.

#### 3] Won’t go nuclear – seen as a normal conventional attack because of integration with ground forces

Firth 7/1/19 [News Editor at MIT Technology Review, was Chief News Editor at New Scientist. How to fight a war in space (and get away with it). July 1, 2019. MIT Technology Review]

Space is so intrinsic to how advanced militaries fight on the ground that an attack on a satellite need no longer signal the opening shot in a nuclear apocalypse. As a result, “deterrence in space is less certain than it was during the Cold War,” says Todd Harrison, who heads the Aerospace Security Project at CSIS, a think tank in Washington, DC. Non-state actors, as well as more minor powers like North Korea and Iran, are also gaining access to weapons that can bloody the noses of much larger nations in space.

### Case – SATs

#### 1] No miscalc or escalation

James Pavur 19, Professor of Computer Science Department of Computer Science at Oxford University and Ivan Martinovic, DPhil Researcher Cybersecurity Centre for Doctoral Training at Oxford University, “The Cyber-ASAT: On the Impact of Cyber Weapons in Outer Space”, 2019 11th International Conference on Cyber Conflict: Silent Battle T. Minárik, S. Alatalu, S. Biondi, M. Signoretti, I. Tolga, G. Visky (Eds.), <https://ccdcoe.org/uploads/2019/06/Art_12_The-Cyber-ASAT.pdf>

A. Limited Accessibility Space is difficult. Over 60 years have passed since the first Sputnik launch and only nine countries (ten including the EU) have orbital launch capabilities. Moreover, a launch programme alone does not guarantee the resources and precision required to operate a meaningful ASAT capability. Given this, one possible reason why space wars have not broken out is simply because only the US has ever had the ability to fight one [21, p. 402], [22, pp. 419–420]. Although launch technology may become cheaper and easier, it is unclear to what extent these advances will be distributed among presently non-spacefaring nations. Limited access to orbit necessarily reduces the scenarios which could plausibly escalate to ASAT usage. Only major conflicts between the handful of states with ‘space club’ membership could be considered possible flashpoints. Even then, the fragility of an attacker’s own space assets creates de-escalatory pressures due to the deterrent effect of retaliation. Since the earliest days of the space race, dominant powers have recognized this dynamic and demonstrated an inclination towards de-escalatory space strategies [23]. B. Attributable Norms There also exists a long-standing normative framework favouring the peaceful use of space. The effectiveness of this regime, centred around the Outer Space Treaty (OST), is highly contentious and many have pointed out its serious legal and political shortcomings [24]–[26]. Nevertheless, this status quo framework has somehow supported over six decades of relative peace in orbit. Over these six decades, norms have become deeply ingrained into the way states describe and perceive space weaponization. This de facto codification was dramatically demonstrated in 2005 when the US found itself on the short end of a 160-1 UN vote after opposing a non-binding resolution on space weaponization. Although states have occasionally pushed the boundaries of these norms, this has typically occurred through incremental legal re-interpretation rather than outright opposition [27]. Even the most notable incidents, such as the 2007-2008 US and Chinese ASAT demonstrations, were couched in rhetoric from both the norm violators and defenders, depicting space as a peaceful global commons [27, p. 56]. Altogether, this suggests that states perceive real costs to breaking this normative tradition and may even moderate their behaviours ac

### ASteorids

#### Asteroids threats are existential – increasingly likely

Spencer ’18 - senior editor for Salon. He manages Salon's science, tech, economy and health coverage Keith Spencer, “The Asteroids Most Likely to Hit Earth,” Salon, January 14, 2018, <https://www.salon.com/2018/01/14/the-asteroids-most-likely-to-hit-earth/>.

Like earthquakes and volcanoes, the most frightening thing about asteroid strikes is their inevitability. Our solar system formed from a planetary nebula of dust and gas that slowly coalesced into rocks, planets, moons, and the Sun. And there are plenty of rocks still floating around. Astronomers estimate that between 37,000 and 78,000 tons of solar system debris hit Earth every year, though luckily these usually rain down in tiny pieces that burn up in the atmosphere — rather than large chunks that explode on the ground. (Although those hit us too.)

As a result, our planet is littered with little geologic memento mori that foreshadow what is to come. The Chesapeake Bay looks the way it does because of a massive impact of a three- to five-kilometer-wide asteroid that hit about 35 million years ago; even today, the region’s freshwater aquifer is at risk of being contaminated by an adjacent salty underground reservoir that was created in the wake of the impact. Oil drillers and water management agencies in the region must mitigate for a 35-million-year-old natural disaster.

#### No asteroid extinction impact

Robert Walker 16, software developer, former PhD student at Wolfson College Oxford in foundations and philosophy of mathematics, M.Hum from York University in Philosophy, "Doomsday Debunked", Dec 2016, https://robertinventor.com/booklets/Doomsday\_Debunked.htm#zzee\_link\_77\_1481651596

Why we can’t be hit by such a large asteroid at all The known asteroids like Vesta and Ceres are all in nice stable orbits. There’s a tiny chance of Vesta hitting Ceres every billion yeas, but for sure nothing is going to happen there for millions of years into the future. The ones that can surprise us are Kuiper belt objects, but they come from random directions with random inclinations, and are very unlikely to lie in the same plane as the Earth's orbit or to hit Earth. We can see that also from the meteorite crater record of the solar system that such large asteroids never hit the inner solar system inside of the asteroid belt, not for billions of years. There are no huge craters in the inner solar system younger than 3 billion years, out to Mars. The Moon, Mercury, and Mars all have huge craters from the late heavy bombardment between 3.8 and 3.5 billion years ago. Craters on Mars Impact from 3.8 billion years ago when large asteroid impacts were still common. 3D map of Mars - Hellas Basin on Mars Craters on the Moon The Aitken basin at the lunar South pole. It's believed to be over 3.8 billion years but the exact date is hard to pin down. Impact of an asteroid perhaps 170 km in diameter. Craters on Mercury The Caloris basin on Mercury. Craters on Earth Earth surely had impacts this large back then as well, but the evidence is probably long erased by continental drift. The largest crater on the Earth may be the Vredefort Impact Structure in South Africa - this was about 300 km in diameter, when formed. The Sudbury basin is nearly as large, and there are three others in the 100 - 300 km range. See Largest craters ordered by size. These are thought to be the result of impactors of up to 10 or 15 km in diameter. For the largest I can find, see this Impact of 23-mile-wide asteroid boiled Earth's oceans 3.26 billion years ago (and another link, and scientific paper). When it says it boiled the oceans there - doesn't mean it boiled them dry, just surface layers, and it would come nowhere near making all life extinct. Humans could surely survive even that one if you are in a sub at the time, and after the impact, Earth would remain the most habitable place in the solar system. Anyway - that one is over three billion years ago, soon after the end of the so called "late heavy bombardment" - it is only late compared to the origins of the solar system, early of course from our perspective. Even though the "late heavy bombardment" was over, there was a tail-end of not quite such huge impacts that continued, perhaps for another 700 million years. Ancient Asteroids Kept Pelting Earth in a "Late-Late" Heavy Bombardment, up to 2.5 billion years ago. Craters on Venus Venus is shrouded in a thick layer of clouds, so hard to observe. However, we now know its surface in some detail from the Magdellan spacecraft, which orbited the planet and observed it using radar. It found a surface with almost no craters. It's easy to see why it has no small craters. Most asteroids up to about one kilometer in diameter or smaller would break up in its atmosphere in an airburst, just as most meteorites up to 30 meters diameter break up in our atmosphere, because its atmosphere is so much thicker than ours. But they also didn't find many large craters and none at all of the really huge ones. It's the least cratered body discovered so far in the entire inner solar system. This is probably because it's surface is relatively young. It has no signs of continental drift, and not much volcanism right now, compared to Earth (there are some signs that it has active volcanism, but not many). It doesn't seem to be releasing enough heat. And there are long channels, longest in the solar system, where molten lava must have run in the past. The leading hypothesis is that the whole planet gets resurfaced every few hundred million years. Because it has no continental drift, so there is no way for it to lose excess heat gradually, and instead it just gets hotter and hotter, until, from time to time, the entire surface "flips", volcanoes erupt everywhere and cover it in molten lava which completely erases the crater record. Most recently 300 to 500 million years ago. So, we can only say for up to half a billion years of history, but there have been no really huge impacts on Venus in that timescale. It's largest crater, Mead crater, is 280 km in diameter Mead crater - the largest crater on Venus, comparable in size to the larger craters on Earth. Though we don't have direct evidence, it probably has the same history as all the other planets - large impacts only up to around the end of the Late Heavy Bombardment. It must have been hit by something big early on to explain its retrograde motion - most probably about the same time as the formation of the Moon. And surely like the Moon, Earth, Mars and Mercury it had many really big impacts in the early solar system. But all trace of them is now gone. Explanation of the cratering record - why are there no huge impacts for three billion years? So, why do we see no really large impact craters in the inner solar system since the late heavy bombardment, and the "late late" heavy bombardment? First, the inner solar system is almost completely cleared out of "Texas sized objects". There are a few objects of a hundred kilometers diameter or more are all in stable orbits at least for hundreds of millions of years. Ceres, Pallas, Vesta and many smaller asteroids larger than 100 km in diameter, would be devastating if they hit Earth, but they are all in stable orbits in the asteroid belt, beyond Mars, with no chance of an impact, at least in the near future. Mercury is another object that could hit Earth - it is in a stable orbit at present, but it happens to have a potential future resonance with Jupiter - the rate of precession of its perihelion (point where it is closest to the sun) is just a little faster than the rate of precession of Jupiter's perihelion. There is a 1% chance, in simulations, that it's orbit gets destabilized. In most of those cases it hits the sun or Venus but there is a tiny chance, 1 in several thousand, that it could hit Earth (for details see this article in scholarpedia written by Jacques Laskar, expert in this topic who did many of the simulations). Mercury, diameter 4900 km, could hit Earth several hundred million years from now, though the chance is tiny, perhaps 99.95% or better chance that it doesn't have any affect on Earth at all. At any rate its current orbit is stable for hundreds of millions of years. This image shows Mercury in a subtle false colour, using infra red information and was taken by Messenger spacecraft in January 2008. Long term, also, the larger asteroids have chaotic orbits, and Vesta and Ceres have an estimated 0.2% chance per billion years of hitting each other (paper) So anyway - that's of interest to astronomers, but in the near future for hundreds of millions of years, the largest "Texas sized" objects in the inner solar system, inside of Jupiter, are in stable orbits and can't hit Earth. And anything from the outer solar system has to get past Jupiter, which tends to catch the really big ones or break them up. More accurately - anything close to the plane of the solar system, if it is in a Jupiter crossing orbit, is likely to do a close flyby of Jupiter first, because Jupiter's gravitational influence is so large. Jupiter's Hill radius - sphere of influence - is 53 million km and its distance from the sun is 778 million kilometers. Earth's hill radius is about 1.5 million km (1,497,000) and its distance from the sun is about 150 million km (149,600,000 km) - ratio of the two is actually larger, but of course, Earth's gravitational influence is much less on anything that passes through its Hill sphere. So any object coming into the inner solar system, unless it gets into some resonance with Jupiter, is going to encounter Jupiter's hill sphere pretty soon. So the explanation of the cratering record may be something like this: A large comet on its first flyby of the inner solar system is likely to miss Jupiter but will have almost no chance of hitting the tiny Earth. Also, if it comes from the outer solar system, it is very unlikely to be in exactly the same plane as Earth and likely to be like Halley's comet. As you see, Haley's comet, in this orbit, can never hit Earth because it's orbit only crosses the plane of the Earth's orbit when it is about as far away as Venus, far closer to the sun. So, - if you had a comet that came into the inner solar system for the first time, not likely it is in the same orbital plane as Earth. How tricky is it for a comet to hit exactly the same orbital plane as Earth? More exactly, Earth's diameter / distance from sun = 12,742/149.6 million = 0.00008517379 - which is also approximately its angle in radians as seen from the sun. So to hit the Earth on a first flyby into the inner solar system, without first doing numerous flybys of Jupiter, Earth etc, it has to have the same inclination as the Earth, 1.57 degrees, to within 0.00488 degrees. If you look at the list of currently known Trans-neptunian objects, they have widely varying inclinations. Out of a total of 1971 objects (as of writing), only 25 have their inclinations listed as 1.5 degrees (most of those are cubewanos so never come inside Neptune's orbit). Not only that though, Earth's diameter compared to the perimeter of its orbit is about 12,742/(2\*pi\*149.6 million). So, if it does happen to have exactly the same inclination, to two decimal places of precision, the chance of hitting Earth on it's first flyby of the inner solar system, before any flybys of Jupiter or the other planets, is still less than one chance in 74,000. It needs to be deflected into the same plane first, which it could do with flybys of Jupiter (say), which changes its orbit. Then many of them hit Jupiter, or hit the Sun, or grazes past it and melt away. Others are thrown out of the solar system. The ones that are left after all that are split into many smaller comets through close encounters of Jupiter or the Sun. These break it up through tidal interactions - the gravitational forces are different on the inner side, and outer side of the comet. As comets have low levels of gravity and are not tightly bound together, they break up easily. We saw just this happen with Comet Shoemaker Levy. It got split into numerous smaller comets Then it hit Jupiter, leaving these marks in its upper atmosphere, which gradually faded away. At the time it was thought that this was a rare once in a century type impact. But then another impact was discovered in 2009 The impact scar here is approximately the size of the Pacific ocean, and the impact was perhaps 200 to 500 meters in diameter, but was not seen before the impact. It was discovered by an amateur astronomer, Anthony Wesley, who then discovered a much smaller impact in 2010probably caused by an object just 8 - 13 meters across. And then two amateur astronomers in 2012 observed another impact. This time, by chance, a third amateur astronomer was taking a video of Jupiter at the time, and checking back through his video frames, found that he had recorded the event. This is another example of the role of amateur astronomers in Astronomy. They can watch targets like this continuously, which the professional astronomers, who have to justify their time on large telescopes, simply can't do. Though Hubble of course, for instance, could get better images of Jupiter, there is no way one could justify pointing it at Jupiter 24/7. And amateur astronomers now have equipment that lets them take photos and videos like this. For more on this, see Impact: Amateurs observe Jupiter taking another for the team. There must be many impacts we miss as well. For three to four months each year, Jupiter is behind the sun or too close to be observed easily, as seen from Earth. And scars of the larger impacts last two or three months. Based on this, then the best estimate at present (in a paper from 2010) is that Jupiter gets hit by an object between 0.5 and 1 kilometer in diameter every decade. This is five or ten times the previous estimates. That's about two thousand more than the number that hit Earth. It also gets hit, they estimate, by objects of size 300 - 400 meters every two years, and for objects of size 10 meters, it gets about 30 - 150 impacts a year. So, the answer seems to be that, by the time a giant comet from the outer solar system has a decent a chance of hitting Earth, it has probably impacted Jupiter already, or the sun, or escaped the solar system. If it has managed to escape those fates, then by then, with many flybys of Jupiter, or of the sun, it has already broken up into smaller comets of around 10-15 km scale or smaller. Even for a Jupiter family short period comet, or a very large NEO, you probably have several flybys before it hits, because the Earth is an absolutely tiny target. These are probabilities, can't say it is a certainty, but very likely. Then in that situation, for each flyby before it actually hits, it has to fly past Earth through a particular "keyhole" region close to Earth. If you can get it to miss any of those keyholes, then it won't hit Earth. So - when they talk about asteroid deflection strategies, normally is based on that assumption. They assume we have several decades of advance warning and many flybys first, or at least one flyby before it hits. In that case you just need to change its delta v by maybe a fraction of a meter per second, a long time before the flyby so it misses the keyhole, so then misses Earth next time around (or several flybys into the future). So then you can use quite gentle methods. Ideas include a gravity tractor, or nudging it, kinetic impact, lots of ideas.

1. <https://www.merriam-webster.com/dictionary/ought> [↑](#footnote-ref-1)