## 1AC

#### Plan - The appropriation of outer space by private entities through asteroid mining is unjust.

#### Mining is inevitable down the line regardless of capital limits because of oligopolistic consolidation

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The proliferation of a lunar economy rests upon patient access to capital and fostering innovative ideas for large-scale development. At the moment, capital requirements for lunar miners are too high for companies to succeed in a perfectly competitive market. For the lunar economy, the emergence of large, vertically integrated companies will lead to the economies of scale necessary for proliferation. Terrestrially, when an industry becomes mature and beholden to traditional economics, like scarcity, a focus on profit margins takes over, and limitations emerge in the form of price manipulation and a lack of competition. As mentioned, the lunar economy will operate privately, and independent of scarcity, using profit margins to increase cash flow for innovation. An oligopoly of dedicated space holding companies, each comprised of diverse companies along the value chain, funded by the parent company and incentivized by prizes, will maintain a culture of innovation and competition. Rather than a few concentrated entities, each sacrificing their identity to their acquirer, the lunar economy will be an oligopoly of teams.

#### Commercialized proximity mining operations create dual-use deflection risks – inherent interoperability makes dangerous repurposing easy and likely

Howe 15 [Jim Howe is a writer and policy analyst who focuses on space and national security issues. He works in the nuclear power industry. COMMON GROUND: Asteroid Mining and Planetary Defense. Summer 2015. https://space.nss.org/media/Asteroid-Mining-And-Planetary-Defense.pdf]

Extensive and prolonged proximity operations will be an essential element of most types of planetary defense mitigation missions. The most technologically mature method for fragmentation or deflection of a hazardous object is through a surface, subsurface, or stand-off nuclear explosion: The tremendous impulsive force of the blast and resulting surface ablation could, in one moment, deliver the necessary velocity change to the body to miss its future collision with Earth. Time permitting, to assure exact positioning and maximum deflective or fragmentation effect, the nuclear device would be buried, anchored to the surface, or orbiting just above the asteroid, an effort that would involve precise proximity operations.

On the opposite end of the spectrum for deflecting an inbound body are the “slow push" methods, which would deliver a minute but steady deflective force to the asteroid or comet, over time providing a cumulative change in velocity. With few exceptions, every proposed slow push technique would be dependent on extended operations in close proximity to the body. Gravity tractors would hover a spacecraft near the asteroid for years or decades, slowly imparting a deflective gravitational force; an enhanced gravity tractor would first collect boulders or regolith from the threatening body, to increase the mass and gravitational pull of the spacecraft. Laser or solar ablation methods would require the stationing of a spacecraft near the asteroid to direct the ablative beam. Using thrusters or a space tug would require direct physical contact with the body for years on end, nudging it to alter its velocity. Mass driver systems would land and anchor a robotic mining apparatus on the asteroid’s surface, to cast a steady stream of regolith into space and produce a minute but steady deflective counterforce.

Similarly, asteroid or comet mining would rely entirely on the ability to conduct reliable, long-term, repetitive proximity operations. Several mining concepts have been analyzed. The most common concept would land and anchor robotic mining and support systems on the asteroid or comet; these systems would methodically drill, scrape, crush, lift, or scoop the desired minerals or ice from the body. Support systems would discard unwanted tailings and transport the ore to a processing station or collection facility. The mining operation could occur on the surface, in pits, or in caverns cut into the interior of the asteroid or comet.

Alternative mining methods include leaching minerals through the injection of high pressure steam, fully encapsulating a small asteroid or comet and capturing the escaping water as the container is heated by the Sun, and collecting water vapor from a passing comet using a spacecraft stationed in a trailing position behind it. Each of these activities would require the ability to operate on and near the surface of the body for long periods.

The commonalities between planetary defense and asteroid mining are extensive for the wide range of proximity operations. For both endeavors, hovering, orbiting, landing, and anchoring on the space body are essential competencies. The same base technologies that can be used to mine metals could be employed in burying a nuclear device to fragment an asteroid, or as a mass driver apparatus used in deflection. The technologies that could be employed to secure thrusters or a solar sail to a tumbling asteroid to change its orbit could be adapted to anchor a full suite of mining equipment to the surface of a resource-rich body.

#### That increases the risk of accidental collisions, astro-terror, and space weaponization

Mares 15 [Miroslav Mares, Professor, at the Division of Security and Strategic Studies, Masaryk University, Czech Republic. Jakub Drmola PhD student, at the Divison of Security and Strategic Studies, Masaryk University, Czech Republic. Revisiting the deflection dilemma. October 1, 2015. https://academic.oup.com/astrogeo/article/56/5/5.15/235650]

Sooner or later, in order to avoid the fate of the dinosaurs, humanity needs to develop scientific and technological capabilities to prevent extinction-level impact events. But most solutions bring about new challenges, because new technologies rarely have only one application. Here lies the dilemma: any technology allowing us to deflect asteroids from a collision trajectory with the Earth could also be used to direct them towards the Earth. This means we could potentially turn any future near-miss into an impact, with all its devastating consequences.

Sagan & Ostro (1994b) concluded that this is a risk not worth taking. Considering the very low probabilities of impacts with objects larger than 1 km (generally less than 1 in 5000 for a given century), they were more worried about the misuse of such trajectory-altering technology than the undiverted asteroids themselves. Humans visited a great deal of violence upon each other during the 20th century; war has been prevalent and increasingly technological. The beginning of the 21st century does not seem overly promising either. The risk that one of humanity's irrational totalitarian powers decides to have some nearby asteroid steered towards Earth might simply be too high. Many people still see the default cosmic odds as preferable to the lessons of recent history.

Later on, a modification of sorts to the deflection dilemma appeared, positing that the “real” dilemma (Schweickart 2004, Morrison 2010) lies in putting various parts of the Earth and its population in harm's way during a deflection attempt. Inevitably, any mission to deflect an object that is on a collision course with the Earth will involve moving its supposed point of impact across the surface until it misses the planet entirely. Should such a deflection attempt fail to modify the trajectory sufficiently, the impact would still occur, albeit in a different area. This could expose to risk countries that were not originally threatened by the asteroid (depending on its size and path), while diminishing the risk to those living near the original point of impact. The damage and casualties around this new and modified point of impact would then, to some extent, be caused by those who tried but failed to deflect the asteroid. The repercussions of such an event would certainly be grave.

Privatization and industry

Both of these versions of the deflection dilemma are essentially state-centric and neither presumes that this technology might be wielded by private companies and non-state actors. But the current trend of greater involvement of private companies in space suggests that states might be unable (or unwilling) to maintain their exclusive hold on the advanced space technologies. The private sector is currently hot on the heels of national and international space agencies in exploring feasible and economically viable options. At the moment, private companies are already in the business (or at least in the process of making it a profitable business) of resupplying the International Space Station, taking tourists to the edge of space and operating communication satellites. And, recently, a new area of potential commercialization of space, asteroid mining, has received increased attention and investment. It has already spawned private companies (such as Deep Space Industries and Planetary Resources, Inc.); this industry is highly relevant to the deflection dilemma (Ostro 1999).

While the idea of mining asteroids carries with it an air of science fiction (as all space-based endeavours do, at some stage), it is based on science fact. One of the most significant facts on which to base a space mining industry is the apparent abundance of highly valued raw materials in asteroids. Platinum, rhodium and other precious metals are extremely useful because of their catalytic and electrical properties, but are also exceedingly rare in the Earth's crust. While such metals sank deep into the planet during core formation, asteroids retained their original composition and even delivered much of the accessible reserves to our planet in the form of meteorite bombardment (Willbold et al. 2011). Some of the largest known deposits of these metals on Earth are found within ancient impact craters. Platinum-group metals are deemed critical to our modern technology-based civilization, without substitutes in many applications, and their supply is at risk of “geopolitical machinations” (Graedel 2013). The combination of natural scarcity and industrial demand leads to their high price, which easily rivals that of gold. Because space missions are inherently expensive, these precious metals are prime high-value candidates for economically viable asteroid mining. Since the projected market value of these metals within an asteroid is in the order of billions or even hundreds of billions of US dollars (depending on the size of the asteroid), the success of the industry comes down to developing technically feasible and cost-effective methods of mining them and retrieving them (Blair 2000, Gerlach 2005). The other interesting and potentially worthwhile resource we could harvest from asteroids is water. Not only is liquid water required by astronauts to survive, but it can also be broken down into oxygen and hydrogen to be used as fuel. And, while water is abundant and cheap here on Earth, it is very expensive to transport it to orbit. It costs $3000–$10 000 per kilogramme to launch water (or anything else) to low Earth orbit and about two or three times more for geostationary transfer orbit (Jain & Trost 2013). It is not the prospect of procuring something we covet here on the surface of the Earth that makes this venture attractive, but rather the idea of not having to wage an expensive battle with Earth's gravity each time we want to make use of something as mundane as water in space. If the costs associated with mining water from asteroids can be brought below the cost of launching water from Earth, this seemingly counter-intuitive industry might take off and become profitable. Additionally, through the use of some form of refuelling depots, it would probably in turn make space endeavours more affordable and sustainable. The same would apply if some of the more common metals found in asteroids (such as iron or nickel) were used to build structures directly in orbit instead of launching them from the Earth. The risks of mining asteroids There are two basic ways to go about moving the resources contained within a given asteroid to the Earth. They can be extracted from the asteroid during its natural orbit and then transported to the Earth, or the entire asteroid might be moved closer to a more convenient location before starting mining. Thus repositioned, it might even be used as a shielded habitat, once hollowed out (Ostro 1999). There are different speculative costs and benefits associated with either option, which would vary with the size, orbit and composition of the asteroid. But, crucially, the second option would entail putting asteroids into orbit around the Earth, the Moon or possibly at one of the Earth's Lagrangian points. Indeed, NASA has already planned a mission to capture a small asteroid and place it in a high cislunar orbit, where it would serve as a destination for future manned missions and experiments. This “Asteroid Redirect Mission” is to take place in the next decade and is being pitched mainly as a stepping stone towards a future mission to Mars (see box “NASA's Asteroid Redirect Mission”; Brophy et al. 2012, Burchell 2014, Gates et al. 2015).

Programmes to redirect asteroids and, especially, plans to mine asteroids on an industrial scale essentially resurrect the deflection dilemma. But it is no longer a matter of superpowers intentionally misusing technology designed to prevent dangerous impacts. It becomes an issue of proliferation among private entities. Once private mining companies acquire the technical ability to redirect suitable NEOs (Baoyin et al. 2011) in order to extract platinum or water from them, perilous inflections become more likely.

The probability of accidents will rise with the number of asteroids whose trajectories we decide to manipulate. Such accidents might be very unlikely, but even a tiny technical or human error in the execution of an inflection meant to place an asteroid into the lunar or geocentric orbit might send it crashing into the Earth with potentially devastating consequences. And while we might find solace in the low probabilities associated with such an accident, even contemporary industries which are considered very safe suffer from unlikely tragedies. Despite being dependable and reliable, airliners do crash; there are a lot of them flying and very improbable accidents do happen if the dice are rolled often enough. Undoubtedly, we will not be steering as many asteroids as we steer planes any time soon, but industries tend to be more accident-prone during their infancy. Furthermore, a single asteroid can do a lot more damage than a single plane. And who is to say how much metal or water we are going to need in space over the course of the 21st century, or the next?

The second source of risk is the intentional misuse, similar to the original deflection dilemma. But the entry barrier for asteroid weaponization gets much lower if mining them and moving them around becomes a common industrial activity. This is in stark contrast to the original scenario which envisioned this technology to be used solely for planetary defence and under control of a very small number of the most powerful countries (Morrison 2010). If such a powerful technology becomes widely and commercially available, even rogue states and well-funded terrorist groups might be tempted to use it for an unexpected and devastating attack. In addition, an active asteroid mining industry would make it more difficult to detect any hostile inflection attempts among the number of legitimate and benign ones.

#### The dilemma causes the most power WMD ever – it’s more likely than natural hits and structurally outweighs

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While asteroids loom large in the horizons of habitat and some military expansionists, they receive little attention from arms controllers and most global security thinkers. As a planetary defense project, diverting asteroids seems a logical part of a Whole Earth Security program and international space infrastructure security cooperation, but opponents of military space expansion are sharply divided about asteroidal diversion. In part these disputes carry over from Cold War nuclear debates, with Edward Teller, Darth Vader for arms controllers, pushing nuclear solutions to the asteroid threat, and arms controllers raising alarms.

An important analysis of the dangers inherent in the deflection of asteroidal bodies is provided by Carl Sagan and Stephen Ostro.67 Few figures of the Space Age have been as productive and prominent as Sagan, a planetary astronomer, science educator, and SF author.68 Over the later decades of the twentieth century Sagan’s work on planetary science, particularly Mars, his television series Cosmos, and his science fiction, most notably Contact (coauthored with Ann Druyan), made him an international celebrity and influential voice for science and space exploration. Unlike virtually all other space scientists and engineers of his era, Sagan also was active in advancing nuclear arms control, studying— and publicizing—the “nuclear winter” hypothesis and promoting cooperation in space to improve Soviet-American relations.69 Although a strong supporter of the larger habitat expansionist vision, Sagan insists large-scale space activities should occur only after nuclear disarmament and planetary habitat stability have been achieved because of an ominous asteroid “deflection dilemma.”70

The essence of the deflection dilemma is simple: species and civilizational survival inevitably will eventually require the development of the ability to deflect asteroids and comets away from Earth, but this technology also inherently creates the possibility that such objects could be directed toward the Earth. The existential stakes are clear: “the destructive energy latent in a large near-Earth asteroid dwarfs anything else the human species can get its hands on,” making them potentially “the most powerful weapon of mass destruction ever devised”71 (see Table 7.4. A and B).72 Once the population of these bodies is fully mapped, and technologies to deflect them are developed, Sagan argues, the prospects for collision increase over the natural rate due to the possibility of intentional bombardment. Given these possibilities, perhaps the reason the dinosaurs lasted for nearly two hundred million years is because they did not have a space program.

In his major book on the human space future, Pale Blue Dot, Sagan lays out several scenarios for intentional collisions. His arguments are essentially the arguments of nuclear arms controllers. Madmen exist, and some “achieve the highest levels of political power in modern industrial nations.”'3 Recalling the extreme destruction caused by Hitler and Stalin, Sagan posits the possibility that a “misanthropic psychopath” or a “megalomaniac lusting after ‘greatness’ or glory, a victim of ethnic violence bent on revenge, someone in the grip of severe testosterone poisoning, some religious fanatic hastening the Day of Judgment, or just some technicians incompetent or insufficiently vigilant” will bring about a catastrophic collision.74 Earth-approaching asteroids amount to “30,000 swords of Damocles hanging over our heads,” for which “there is no acceptable national solution.”75 And, like Cole and Salkeld (not mentioned), Sagan points to the possibilities of clandestine use of this technology.

#### Accidental and intentional deflection attacks outweigh the threat of conventional hits –rogue strikes bypass conventional deterrence because attribution and detection are impossible

Dello-Iacovo 18 [Michael, PhD candidate (Mining Engineering), emphasis on space science, looking at asteroid exploration, mining and impact risk @ University of New South Wales. “Asteroids and comets as space weapons,” <http://www.michaeldello.com/asteroids-comets-space-weapons/>]

Ignoring accidental deflection, which might occur when an asteroid is moved to an Earth or Lunar orbit for research or mining purposes (see this now scrapped proposal to bring a small asteroid in to Lunar orbit), there are two categories of actors that might maliciously deflect such a body; state actors and terrorist groups.

A state actor might be incentivised to authorise an asteroid strike on an enemy or potential enemy in situations where they wouldn’t necessarily authorise a nuclear strike or conventional invasion. For example, let us consider an asteroid of around 20 m in diameter. Near Earth orbit asteroids of around this size are often only detected several hours or days before passing between Earth and the Moon. If a state actor is able to identify an asteroid that will pass near Earth in secret before the global community has, they can feasibly send a mission to alter its orbit to intersect with Earth in a way such that it would not be detected until it is much too late. Assuming the state actor did its job well enough, it would be impossible for anyone to lay blame on them, let alone even guess that it might have been caused by malicious intent.

An asteroid of this size would be expected to have enough energy to cause an explosion 30 times the strength of the nuclear bomb dropped over Hiroshima in WWII.

Footnote

\* An ‘existential threat’ typically refers to an event that could kill either all human life, or all life in general. A ‘catastrophic threat’ refers to an event that would cause substantial damage and suffering, but wouldn’t be expected to kill all human life, which would eventually rebuild.

#### Even limited deflection failures cause nuke war because they look like preemptive strikes and the risk is inversely proportion to size

Lovett 19, [Richard Lovett is a Cosmos contributor, The biggest danger about an asteroid strike? Lawyers, Blasting away at incoming space rock raises real risks of nuclear war, experts say. Richard A Lovett reports, May 7, https://cosmosmagazine.com/space/the-biggest-danger-about-an-asteroid-strike-lawyers]

Governments and space agencies seeking to protect the Earth by changing the courses of potentially hazardous asteroids might face major legal hurdles, even if our planet is in the crosshairs of a bolide big enough to kill millions, experts say. One problem is what would happen if one country, worried about protecting its own citizens, attempted to deflect the asteroid, screwed up, and accidentally dumped it on a neighbour. Space law, says David Koplow of Georgetown University Law Centre, Washington DC, is based on the principle of strict liability. “The concept is that space activities are hazardous and therefore the harm should not fall on an innocent bystander,” Koplow says. Another problem stems from the fact that only a few countries have the technological ability to deflect an incoming asteroid, and there is, at present, no international authority tasked with making sure everyone else is represented in the decision-making process. In fact, says Cordula Steinkogler, a space law expert at the University of Vienna, Austria, current treaties don’t even require nations to share information about such hazards, let alone act to protect each other. She notes, however, that the United Nations charter does establish a “very general” duty for them to act toward solving international problems that affect economic, social, cultural, educational, and health wellbeing. Failure to share information can be more than just an inconvenience. To start with, says Petr Boháček, of Charles University in Prague in the Czech Republic, it could make countries wonder if, instead of international cooperation, the rule is actually everyone for themselves. It’s a particularly important problem, he says, because the nations at risk of being hit by an asteroid may not be the ones with the greatest geopolitical power. “Asteroids do not discriminate,” he notes. The nation-state concept of sovereignty, he adds, dates back several hundred years. “I’m not sure how many concepts from the seventeenth century you use in your decision-making,” he says, “but making decisions for planetary defence based on this dinosaur method of decision-making may not be the best choice.” Another problem is that the nation hit by an asteroid might see it as an attack by a foe, and retaliate. “[It] could look like the damage of a nuclear attack,” says Seth Baum, executive director of the Global Catastrophic Risk Institute, a US-based think tank, “so the prospect [of] a counterattack seems like something worth taking very seriously.” Ironically, the risk of this is probably inversely proportional to the size of asteroid. A big asteroid, capable of wiping out an enormous swath of territory, would be seen coming well in advance, and have generated a media frenzy (assuming people didn’t brand it as “fake news”).

were damaged, but amazingly nobody was killed. We’re still trying to work out how often events like this happen. Our information on the frequency of the larger impacts is pretty limited, so estimates can vary dramatically. Typically, people argue that Tunguska-sized impacts happen [every few hundred years](https://academic.oup.com/astrogeo/article/50/1/1.18/201316), but that’s just based on a sample of one event. The truth is, we don’t really know. **What can we do about it?** Over the past couple of decades, a concerted effort has been made to search for potentially hazardous objects that pose a threat before they hit Earth. The result is the [identification of thousands of near-Earth asteroids](https://cneos.jpl.nasa.gov/stats/totals.html) upwards of a few metres across. Once found, the orbits of those objects can be determined, and their paths [predicted into the future](https://cneos.jpl.nasa.gov/ca/), to see whether an impact is possible or even likely. The longer we can observe a given object, the better that prediction becomes. But as we saw with Chelyabinsk in 2013, and again in December, we’re not there yet. While the catalogue of potentially hazardous objects continues to grow, many still remain undetected, waiting to catch us by surprise. If we discover a collision is pending in the coming days, we can work out where and when the collision will happen. That happened for the first time in 2008 when astronomers discovered the tiny [asteroid 2008 TC3](https://cneos.jpl.nasa.gov/news/2008tc3.html), 19 hours before it hit Earth’s atmosphere over northern Sudan. For impacts predicted with a longer lead time, it will be possible to work out whether the object is truly dangerous or would merely produce a spectacular but harmless fireball (like 2008 TC3). For any objects that truly pose a threat, the race will be on to deflect them – to turn a hit into a miss. **Searching the skies** Before we can quantify the threat an object poses, we first need to know that the object is there. But finding asteroids is hard. Surveys scour the skies, [looking for faint star-like points moving against the background stars](https://spaceguardcentre.com/what-are-neos/finding-and-observing-asteroids/). A bigger asteroid will reflect more sunlight, and therefore appear brighter in the sky - at a given distance from Earth. As a result, the smaller the object, the closer it must be to Earth before we can spot it. Objects the size of the Chelyabinsk and Bering Sea events (about 20 and 10 metres diameter, respectively) are tiny. They can only be spotted when passing very close to our planet. The vast majority of the time they are simply undetectable. As a result, having impacts like these come out of the blue is really the norm, rather than the exception! The Chelyabinsk impact is a great example. Moving on its orbit around the Sun, it approached us in the daylight sky - totally hidden in the Sun’s glare. For larger objects, which impact much less frequently but would do far more damage, it is fair to expect we would receive some warning. **Why not move the asteroid?** While we need to keep searching for threatening objects, there is another way we could protect ourselves. Missions such as [Hayabusa](https://solarsystem.nasa.gov/missions/hayabusa/in-depth/), [Hayabusa 2](http://www.hayabusa2.jaxa.jp/en/) and [OSIRIS-REx](https://www.asteroidmission.org/) have demonstrated the ability to travel to near-Earth asteroids, land on their surfaces, and move things around. From there, it is just a short hop to being able to deflect them – to change a potential collision into a near-miss. Interestingly, ideas of asteroid deflection dovetail nicely with the [possibility of asteroid mining](https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675). The technology needed to extract material from an asteroid and send it back to Earth could equally be used to alter the orbit of that asteroid, moving it away from a potential collision with our planet. We’re not quite there yet, but for the first time in our history, we have the potential to truly control our own destiny.

#### Yes asteroid miscalc – best studies

Baum 18 (Seth Baum is Executive Director of the Global Catastrophic Risk Institute, Uncertain Human Consequences in Asteroid Risk Analysis and the Global Catastrophe Threshold, July 28, https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3218342&download=yes)

There is one important type of indirect effect that has received some attention in the broader asteroid literature, though not in any risk analysis. That is the prospect of an asteroid explosion being misinterpreted as a hostile attack with human-made explosives, thereby triggering violent conflict (Morrison 1992, p.9; NRC 2010, p.26). Were such an event to occur, the secondary effects could be much more severe than the direct effects.

Remarkably, there is precedent for the concern of asteroid collision triggering conflict via the 2013 Chelyabinsk event. Harris et al. (2015, p.838) explain:

If it had been cloudy in Chelyabinsk that morning, it may not have been immediately apparent to locals or outsiders that this was a cosmic airburst. The bright flash and huge blast, followed by the sound of heavy artillery, and parts of the city shrouded in dark smoke, could have been misperceived as an act of aggression. Snezhinsk, to the north, is the Russian equivalent of Lawrence Livermore National Laboratory in the U.S., and the region is of nuclear strategic importance. Russia, unlike its neighbor Kazakhstan in the direction from which the asteroid came, is still a nuclear-armed state. It is hard to know what would happen in the heat of the moment when there is great uncertainty about the cause of a half-megaton explosion over a Russian city.

Could such an event lead to conflict, even nuclear war? A careful study of the history of nuclear war suggests that yes, this is a possibility. In the decades since nuclear weapons were first developed, there have been several incidents in which non-military events were misinterpreted as a possible nuclear attack, initiating nuclear weapon launch decision procedures. These events include a moonrise, an ill-timed passage of a satellite, an unusual reflection of sunlight off clouds, and the launch of a scientific weather rocket (Baum et al. 2018). How close these incidents came to actual nuclear war is a matter of historical debate (Lewis et al. 2014; Tertrais 2017). Regardless, if these seemingly innocuous events can get at least partway to nuclear war, then it is not unreasonable to believe that an asteroid explosion could get all the way.

#### The mining itself increases the risk of asteroid collisions

Byers and Boley 19 [Michael Byers, Professor of Political Science at the University of British Columbia, BA in Political Studies and Phd in International Law from Cambridge, Byers has written a number of op-ed articles on space issues. Relax: An asteroid will just miss hitting Earth. But our actions could still have a deep impact. March 19, 2019. https://www.theglobeandmail.com/opinion/article-relax-an-asteroid-will-just-miss-hitting-earth-but-our-actions-could/]

Beyond the battle over resource extraction lies a more existential threat: the act of removing large quantities of mass from an asteroid could change its trajectory, potentially leading to a human-caused Earth impact. For this reason, any asteroid mining will have to be fully informed by astrodynamics, and closely regulated under international rules. And while the U.S., Luxembourg and Russia might regulate asteroid-mining companies closely with the involvement of planetary scientists, what would happen if a mining company were to incorporate a “flag of convenience state” such as Panama or Liberia? Would the same respect be paid to science and safety?

#### Mining has significant effects on trajectory

Monzon 19 [Inigo Monson, International Business Times. Mining Asteroids Could Cause Catastrophic Earth Impact, Scientist Warns. August 6, 2019. https://www.ibtimes.com/mining-asteroids-could-cause-catastrophic-earth-impact-scientist-warns-2811005]

During an episode of astrophysicist Neil deGrasse Tyson’s “StarTalk” podcast, a cosmochemist talked about the risks involved in mining asteroids. According to the scientist, mining an asteroid could alter its trajectory and send it crashing to Earth.

The idea of sending spacecraft to space to mine nearby or passing asteroids has gained the attention of the public after space agencies and private aerospace firms expressed their interest in taking on the venture. With the amount of precious metals and other resources that can be obtained from space rocks, mining asteroids could be the next booming industry.

Unfortunately, like other major projects, mining asteroids also has its own set of risks. Probably risk it poses is altering the asteroid’s path into a collision course with Earth.

During an episode of the Tyson’s “StarTalk” podcast titled “Cosmic Queries – Asteroids and Comets,” a follower of the show asked if it’s possible to affect the trajectory of an asteroid while mining it.

Tyson’s guest Dr. Natalie Starkey, a cosmochemist, noted that mining asteroids could have significant effects on their orbit. If companies and agencies are not careful about their mining procedures, they could unintentionally cause an asteroid impact on Earth.

#### Repurposing doesn’t solve

Rapp 18 [Joshua Rapp, 08-29-2018, " Asteroid miners could use Earth's atmosphere to catch space rocks," No Publication, <https://www.science.org/content/article/asteroid-miners-could-use-earth-s-atmosphere-catch-space-rocks>]

According to Feiber-Beyer and physicist Ingo Mueller-Wodarg, who studies planetary atmospheres at Imperial College London, another potential problem is that asteroids are not perfect spheres. An object with an odd shape could wobble unpredictably in orbit. "The risk would lie in the asteroid having an irregular shape and hence experiencing torque, beginning to spin and hence go out of control," Mueller-Wodarg says. "When we do aerobraking with satellites, we carefully fire small rockets to keep [them] on course and compensate for any such wobble." But the biggest risk, Mueller-Wodarg and Fieber-Beyer say, would be causing an asteroid to crash into Earth, possibly causing widespread death and destruction. Tan disputes that charge, noting the paper looked only at asteroids smaller than 30 meters in diameter, which would vaporize as soon as they hit the lower atmosphere. He acknowledges that extra care would be needed if an asteroid were made of a denser material like iron, which might not burn up completely. Tan's team doesn't have any particular clients in mind, but he says that companies such as Deep Space Industries and Planetary Resources have plans to eventually capture and mine asteroids. They'll have plenty to choose from, Tan says—more than 1000 near-Earth asteroids fit his team's size requirements. Of course, the idea of purposely steering anything larger into Earth's orbit might have some detractors—just ask the dinosaurs.

#### Keyholes Exacerbate the risk

Sutter 21 [Paul Sutter, 07-29-2021, "Move asteroids now before they become a threat, researchers argue," Space, https://www.space.com/asteroid-impact-prevent-risk-threat]

It turns out that innocent missions to asteroids can have grave consequences. The problem has to do with gravitational "keyholes," or relatively tiny regions in space where a planet can gravitationally influence an asteroid in such a way that it sets the asteroid on an eventual planet-crossing trajectory. Keyholes are especially dangerous because it's incredibly difficult to predict if and when a particular asteroid might enter a keyhole; all it takes is a tiny nudge to make the transition from "just another rock" to "danger to humanity." As an example, the researchers examined asteroid 99942 Apophis, which will have a close approach to Earth in 2029. It turns out that this asteroid has a surprisingly large number of keyholes near its current orbit. Currently, Apophis is not predicted to enter into any of the keyholes, and it should stay safely away from us. But if a future mission to the asteroid were to go awry — like crashing instead of landing — it might shift Apophis into a keyhole, and we would have to do something about it. Apophis is just one example, but as space agencies plan future asteroid-studying missions and interest in space mining continues to ramp up, we have to be careful. So here's the advice for asteroid missions: Select the asteroids carefully — not just for ease of access but also for reducing potential harm should the mission not go according to plan.

#### They cause nuke war, miscalc, and extinction

Baum 19 (Executive director of the Global Catastrophic Risk Institute,“Risk-Risk Tradeoff Analysis of Nuclear Explosives for Asteroid Deflection,” May 31, 2019, https://onlinelibrary.wiley.com/doi/epdf/10.1111/risa.13339.)

The most severe asteroid collisions and nuclear wars can cause global environmental effects. The core mechanism is the transport of particulate matter into the stratosphere, where it can spread worldwide and remain aloft for years or decades. Large asteroid collisions create large quantities of dust and large fireballs; the fire heats the dust so that some portion of it rises into the stratosphere. The largest collisions, such as the 10km Chicxulub impactor, can also eject debris from the collision site into space; upon reentry into the atmosphere, the debris heats up enough to spark global fires (Toon, Zahnle, Morrison, Turco, & Covey, 1997). The fires are a major impact in their own right and can send additional smoke into the stratosphere. For nuclear explosions, there is also a fireball and smoke, in this case from the burning of cities or other military targets.

While in the stratosphere, the particulate matter blocks sunlight and destroys ozone (Toon et al., 2007). The ozone loss increases the amount of ultraviolet radiation reaching the surface, causing skin cancer and other harms (Mills, Toon, Turco, Kinnison, & Garcia, 2008). The blocked sunlight causes abrupt cooling of Earth’s surface and in turn reduced precipitation due to a weakened hydrological cycle. The cool, dry, and dark conditions reduce plant growth. Recent studies use modern climate and crop models to examine the effects for a hypothetical IndiaPakistan nuclear war scenario with 100 weapons (50 per side) each of 15KT yield. The studies find agriculture declines in the range of approximately 2% to 50% depending on the crop and location.11 Another study compares the crop data to existing poverty and malnourishment and estimates that the crop declines could threaten starvation for two billion people (Helfand, 2013). However, the aforementioned studies do not account for new nuclear explosion fire simulations that find approximately five times less particulate matter reaching the stratosphere, and correspondingly weaker global environmental effects (Reisner et al., 2018). Note also that the 100 weapon scenario used in these studies is not the largest potential scenario. Larger nuclear wars and large asteroid collisions could cause greater harm. The largest asteroid collisions could even reduce sunlight below the minimum needed for vision (Toon et al., 1997). Asteroid risk analyses have proposed that the global environmental disruption from large collisions could cause one billion deaths (NRC, 2010) or the death of 25% of all humans (Chapman, 2004; Chapman & Morrison, 1994; Morrison, 1992), though these figures have not been rigorously justified (Baum, 2018a).

The harms from asteroid collisions and nuclear wars can also include important secondary effects. The food shortages from severe global environmental disruption could lead to infectious disease outbreaks as public health conditions deteriorate (Helfand, 2013). Law and order could be lost in at least some locations as people struggle for survival (Maher & Baum, 2013). Today’s complex global political-economic system already shows fragility to shocks such as the 2007- 2008 financial crisis (Centeno, Nag, Patterson, Shaver, & Windawi, 2015); an asteroid collision or nuclear war could be an extremely large shock. The systemic consequences of a nuclear war would be further worsened by the likely loss of major world cities that serve as important hubs in the global economy. Even a single detonation in nuclear terrorism would have ripple effects across the global political-economic system (similar to, but likely larger than, the response prompted by the terrorist attacks of 11 September 2001).

It is possible for asteroid collisions to cause nuclear war. An asteroid explosion could be misinterpreted as a nuclear attack, prompting nuclear attack that is believed to be retaliation. For example, the 2013 Chelyabinsk event occurred near an important Russian military installation, prompting concerns about the event’s interpretation (Harris et al., 2015).

The ultimate severity of an asteroid collision or violent nuclear conflict use would depend on how human society reacts. Would the reaction be disciplined and constructive: bury the dead, heal the sick, feed the hungry, and rebuild all that has fallen? Or would the reaction be disorderly and destructive: leave the rubble in place, fight for scarce resources, and descend into minimalist tribalism or worse? Prior studies have identified some key issues, including the viability of trade (Cantor, Henry, & Rayner, 1989) and the self-sufficiency of local communities (Maher & Baum, 2013). However, the issue has received little research attention and remains poorly understood. This leaves considerable uncertainty in the total human harm from an asteroid collision or nuclear weapons use. Previously published point estimates of the human consequences of asteroid collisions12 and nuclear wars (Helfand, 2013) do not account for this uncertainty and are likely to be inaccurate.

Of particular importance are the consequences for future generations, which could vastly outnumber the present generation. If an asteroid collision or nuclear war would cause human extinction, then there would be no future generations. Alternatively, if survivors fail to recover a large population and advanced technological civilization, then future generations would be permanently diminished. The largest long-term factor is whether future generations would colonize space and benefit from its astronomically large amount of resources (Tonn, 1999). However, it is not presently known which asteroid collisions or nuclear wars (if any) would cause the permanent collapse of human civilization and thus the loss of the large future benefits (Baum et al., 2019). Given the enormous stakes, prudent risk management would aim for very low probabilities of permanent collapse (Tonn, 2009).

#### Triggers Russian dead hand

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Other events that could trigger Dead Hand sensors include meteorite strikes in Russia, whose explosion effects, such as light and pressure waves, could resemble a nuclear event and cyberattacks or network failures that result in a of loss of communications capabilities (see Figure 3).

Meteorite impacts with some resemblance to a nuclear explosion have occurred in the past. An October 1990 asteroid explosion above the central Pacific Ocean, with energy greater than one kiloton, was originally detected as a potential nuclear event by U.S. satellites; not until several months later did the Department of Defense determine the true nature of the event (Tagliaferri et al., 1994, pp. 200–201). On average, approximately eight asteroid detonations with at least one kiloton of equivalent energy occur each year, and approximately one asteroid detonation with at least 20 kilotons of equivalent energy occurs each year (Tagliaferri et al., 1994, p. 201). Although one kiloton is a very low yield as nuclear weapons go, super-EMP weapons are actually designed to have low yields, comparable to those observed in recent North Korean nuclear tests, which might have been tests of super-EMP weapons (Pry, 2012).

**It outweighs nuclear war---surveys are incomplete and geology proves frequency and magnitude**

Deel 19, [Dr. Gary Deel is a Faculty Director with the School of Business at American Military University, Can We Prevent a Killer Asteroid Striking Earth?, November, https://inspacenews.com/can-we-prevent-a-killer-asteroid-striking-earth/]

Then there are human-created threats like that of nuclear war. It is well within our power for us to destroy ourselves. Weapons of mass destruction will never be uninvented, and if we don’t take proper care with these responsibilities then it is entirely possible that we could bring an end to our own civilization through tribalism or stupidity.

**However**, one of the **most** significant and best understood – but **least predictable** – risks is that associated with the possibility of an asteroid striking the Earth

In the early development of our solar system, collisions between asteroids and celestial bodies were fairly routine. We see clear evidence of this in the preserved craters that pockmark the moon’s surface. In fact, a prevailing theory of the Moon’s origin is that it is the result of some kind of asteroid impact. The Moon Was Formed by a Violent, Head-On Collision between the Early Earth and a ‘Planetary Embryo’ According to UCLA geochemists, “the moon was formed by a violent, head-on collision between the early Earth and a ‘planetary embryo’ called Theia approximately 100 million years after the Earth formed.” The collision would have blown all of the crustal material from both Earth and Theia into space. It is postulated that the moon might have accreted from this material over the eons that followed. “Theia, which did not survive the collision (except that it now makes up large parts of the Earth and the Moon), was growing and probably would have become a planet if the crash had not occurred,” the UCLA scientists postulated.

We have more historical evidence of significant impacts on Earth. The largest known impact site is the Vredefort Crater southwest of Johannesburg, South Africa. It is more than 186 miles (300 kilometers) across and is believed to have been created by an asteroid that was roughly 6.2 miles to 9.3 miles (10 to 15 kilometers) in diameter. Although this event occurred over two billion years ago, it would have had tremendous effects on the Earth and any living thing thereupon at the time.

Another major and more recent historical event was the impact that formed the Chicxulub Crater, which lies buried under the Yucatan peninsula in Mexico. This crater was formed about 65 million years ago, coinciding with the extinction of the dinosaurs. These Impacts Would Have Wiped Humanity off the Face of the Earth

These impacts would have **wiped humanity off the face of** the **Earth** had we **been around** to experience them. It might be **tempting** to **think** that such events are rare; on the timescale of a human life span, they certainly are. But in the context of the 4.5 billion-year evolution of the Earth, we know **from geological evidence** that these impacts happen at an **imprecise** but **fairly regular frequency**. That said, there is no reason to believe that another such cataclysmic event will not occur in the future, or in the **near future** for that matter.

It Is Important that We Plan Properly for the Inevitable Asteroid Strike

It is therefore important that we **plan** properly for the **inevitable**. The first step is to create a robust monitoring program to watch the skies in order to detect potential threats as early as possible and coordinate an adequate response effort.

I have written of the dangers associated with the possibility of an asteroid impact, the current state of NASA’s Near-Earth Object (NEO) search program, and the need to better fund our search efforts so that we can address any major threats before it’s too late. In order to address the most severe risks, Congress has tasked NASA with finding all NEOs that are 460 feet (140 meters) in diameter or larger. To date, NASA has identified more than 22,000 such objects. Fortunately, none appear to pose a threat of striking the Earth anytime soon.

However, cosmologists and other experts estimate that the current catalog of known asteroids accounts for **only** about **25 percent** of all such objects in the solar system. This means that almost 70,000 more NEOs of this size remain to be found. It seems we still have quite a long way to go before we can safely say that we have a firm handle on this threat.

## Framing

#### Scenario planning is good for debate---breaks down cognitive biases and incorporates complementary theories.

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Furthermore, despite the fact that the danger of a world war seems less probable than in the previous century, there are several indicators suggesting that economic and policy-related uncertainty in the United States and in Europe has increased in recent decades (Azqueta-Gavaldón et al., 2019; Baker, Bloom, & Davis, 2016). The geopolitical risk index shows that perceived risks are on the rise globally despite the absence of large-scale wars (Caldara & Iacoviello, 2019). According to its authors, “the index captures an important dimension of uncertainty: the risk of events that disrupt the normal, democratic, and peaceful course of relations across states, populations, and territories” (Caldara & Iacoviello, 2019, p. 33). It reached its peak during the 2003 invasion of Iraq and spiked in correspondence with the major terrorist events in Europe in 2004, 2005, and 2015, the annexation of Crimea by Russia in 2014, and the escalation of ISIS military operations in Iraq and Syria in 2014-2015. Data pointing to increased uncertainty is also provided by the Risk Maps (Aon, 2019). In 2018, the likelihood of an armed interstate conflict was at the highest point since the end of the Cold War.

Against the background of these developments, it is not surprising that the apprehension of uncertainty constitutes a core part of the strategic doctrines of most Western countries (Porter, 2016, p. 240). It becomes evident that we need to acknowledge the world to be nonlinear and explore nonlinear thinking in order to better grasp its complexity and be better prepared for unexpected events. Not only policy-makers but also IR scholars have been caught off guard by the above-mentioned strategic surprises. Conventional IR theories failed to foresee the unleashing of these sudden events and their multiple effects (Tomé & Açıkalın, 2019, p. 4; Urry, 2003).

In this article, we argue that stepping out of the spectrum of conventional methods and research techniques and applying scenario approaches allows confronting uncertainty and preparing for the unexpected. As Bernstein et al. (2000) argue “[s]cenario-based forward thinking is a promising method for tracing the policies of actors and the evolution of the international system” (p. 70). IR scholars can at the same time remain rigorous and provide policy-relevant input that grasps the dynamics of unpredictability of real-world issues. Evidence of that can be found in the rare academic papers that have applied scenario methods to IR studies and have been published in first-class journals (Friedberg, 2005; Stein et al., 1998).

The overarching aim of this article is to show how and why scenario analysis can be applied by IR scholars as a complementary methodological approach, by making academic rigor and future analysis compatible. As we will present, scenario analysis in particular is an effective research technique to link academic theories with empirical data in order to better embrace the complexity and ambiguity of future world events, as it combines systematic future-oriented analysis with policy-relevant implications. Given the lack of adequate methods in the field of IR that allow for analyzing future events in a nonlinear perspective, systematic scenario analysis can contribute to filling the gap. Moreover, scenario approaches in IR correspond well with the thinking of scholars with an eclectic approach (Han, 2011; Katzenstein & Okawara, 2001-2002) and with those who apply more pragmatism in IR reasoning (Kratochwil & Friedrichs, 2009). They also fit into the complexity theory (e.g., Bousquet & Curtis, 2011)—a nonlinear paradigm according to which outcomes of interactions within complex and dynamically changing systems are unpredictable and emerge in various forms. From this perspective, nothing in the international environment is immutable. By applying nonlinearity and by developing a variety of plausible futures with multiple outcomes, scenario analysis corresponds well with this reasoning (Wilkinson, Kupers, & Mangalagiu, 2013).

This article proceeds as follows: We start with taking stock of the growing interest in the scenario analysis approach by different actors across the globe. Then, we define the core concepts of scenario analysis and present an example of the Multiple Scenario Generation (MSG) method applied at foresight exercises of the Dahrendorf Foresight Project. 1 Next, we discuss the extent to which scenario analysis fulfills the criteria of a social sciences research method. Finally, we show the contribution that scenarios can bring to IR studies and illustrate it with some examples. In conclusion, we sum up our claims and highlight the article’s key message.

Foresight is the new black: The proliferation of scenario analysis

Scenario exercises have proliferated since the end of the Second World War, where it was originally used for military planning (Mietzner & Reger, 2005). Over time, it has been adapted to the policy and business world. Royal Dutch Shell integrated the scenario approach into its decision-making process as early as the 1970s and became a benchmark for corporate scenario planning (Bentham, 2014). As actors increasingly saw the value of foresight for dealing with complexities, other companies, non-governmental organizations, and eventually governments, followed. Scenario approaches and other techniques of foresight studies such as wargaming, trend analysis, visioning, design futures, or horizon scanning have been gaining interest across the world over the last few decades (Babst, 2018; Barma et al., 2016; Bell, 2002; Wilkinson & Kupers, 2013).

One of the most prominent foresight exercises continues to be the Global Trends analysis conducted by the National Intelligence Council since 1997 (Office of the Director of National Security, 2019). The German Foreign Office recently presented a new data tool to enhance the evidence base for internal scenario planning exercises (Auswärtiges Amt, 2019). In France, the government-linked Centre d’analyse stratégique carries out regular analyses of geostrategic issues (Dreyer & Stang, 2013). Foresight is also conducted under the auspices of international organizations. Most notable in security policy are NATO’s Strategic Foresight Analysis and Framework for Future Alliance Operations foresight exercises that are crucial in advising its defense planning (NATO, 2013, 2015, 2017, 2018). The EU has also bolstered its foresight activities over the last two decades (Dreyer & Stang, 2013). Since 2010, the European Strategy and Policy Analysis System (ESPAS)—an inter-institutional cooperation between the European Parliament, the Secretariat of the Council, the European Commission and the European External Action Service—constitutes the broadest engagement with foresight. The increasing importance EU policy-makers attribute to strategic foresight is also reflected in the structure of the new European Commission since 2019. Commissioner for Inter-institutional relations and Foresight, Maroš Šefčovič, is tasked to “put foresight at the heart of better policymaking” (Von der Leyen, 2019).

These examples show that policy-makers increasingly look for future-oriented and actionable advice. Their demand is not only covered by intra-institutional bodies but also extends to academia. The EU’s Horizon 2020 research program recognizes the role of foresight for its programmatic orientation (European Parliament & Council, 2013) and it is geared toward the inclusion of findings generated through foresight exercises. Most explicitly, the need to apply foresight is acknowledged in relation to new security threats, including cybersecurity and is to be included in the academic projects (European Parliament & Council, 2013). Moreover, foresight activities are often required in calls for project proposals. 2 However, it is often think tankers, not university-based academics, that are in charge of foresight in Horizon 2020 projects, as is the case with the EU-LISTCO, MENARA or MEDRESET projects. 3

The strong involvement of think tanks in these foresight projects comes as no surprise, as they are the primary institutions engaged in foresight exercises also outside of Horizon 2020. Among the 10 highest-ranking European foreign policy think tanks (Mcgann, 2019), 9 were recently engaged in foresight exercises, either in the form of publications or workshops (e.g., Barrie et al., 2019; Brozus, 2018; Sweijs & Pronk, 2019). The methodology employed in these foresight exercises is often only briefly defined (e.g., Hett, Kellner, & Martin, 2014; Lehmann, 2016; Tira, 2016) or not communicated at all (e.g., Estella, 2008; Ham, 2016). This complicates assessing the rigor and robustness of resulting findings.

At the same time as this proliferation of foresight exercises is taking place in the periphery of academia—as academics do participate in foresight exercises organized by other actors—IR scholarship itself is struggling to grapple with the realities of today’s world. Its conventional methodological approaches such as empirical case studies and quantitative methods, and formal methods such as game theory or modeling (Sprinz & Wolinsky-Nahmias, 2002), predominately follow the traditional objective of social sciences to explain the past. Thus, they are not geared towards analyzing the dynamism introduced by complex and uncertain conditions, leading to the strategic blunders discussed in the introduction. Suitable methodological tools to confront these conditions are in fact scenario approaches. However, they are often discarded by academics for not fulfilling all the criteria of a (positivist) scientific methodology. As Brozus (2016) notes, foresight thus encounters similar contestation as the retrospective analysis of counterfactuals. We argue to the contrary: There are good reasons why scenario analysis can serve as a useful complementary approach for scholars committed to academic rigor but willing to approximate the IR practice. In the following section, we show how rigorous scenario analysis can be done.

Scenario analysis as a research method

Foresight studies as a research field encompasses a wide range of methods and techniques (see, e.g., Bishop, Hines, & Collins, 2007). On the most basic level, there is consensus to distinguish three foresight schools of thought (e.g., Wilkinson et al., 2013). The Probabilistic Modified Trends/Cross-Trends (PMT/CT) school focuses on enhancing predictions by using forecasting—a data-driven extrapolation of past trends into the future with help of computer models and simulations (Wilkinson, 2017). The tradition of La Prospective also uses quantitative modeling, but can have normative ambitions, guiding policy debates toward constructed utopias. Building on PMT/CT is the Intuitive Logics Model, which adds a new dynamic by modeling possible future events as interactions with the extrapolation of historic data (Bradfield et al., 2005), thus making use of both quantitative and qualitative data. Scenario analysis, which is at the heart of this paper, is situated within this particular school of thought (Bradfield et al., 2005). The next section defines the main concepts and suggests a process of application suitable for IR scholarship.

According to Kahn and Wiener (1967), a scenario is “a set of hypothetical events set in the future constructed to clarify a possible chain of causal events as well as their decision points” (p. 6). In turn, Schwartz (1996), another leading futurist, defines scenarios as “stories about the way the world might turn out tomorrow, stories that can help us recognize and adapt to changing aspects of our present environment” (p. 3). They are thus designed to detect weak signals and wild cards. Weak signals are the first important indications of an emerging future change and trends, paradigm shifts, drivers or discontinuities yet to materialize (Miles, Saritas, & Sokolov, 2016, p. 72). Wild cards, also known as Black Swans (Taleb, 2007), represent events of low probability, but with substantial impact on the human condition once they occur (Miles et al., 2016, p. 73).

There is a wide variety of scenario methodologies and there have been multiple attempts to create typologies (e.g., Bishop et al., 2007; Bradfield et al., 2005; Wilkinson et al., 2013). Wilkinson (2017) distinguishes between three main types of scenarios that are each arrived at via different methods. Horizon scanning produces possible scenarios, visioning and backcasting produce preferable scenarios, and scenario analysis—the method we discuss—produces plausible scenarios. Plausible scenarios are particularly suited as an analytical tool to contribute to IR policy debates. Contrary to preferable scenarios, they make no normative claims that would necessitate consensus about desired outcomes. And contrary to possible scenarios, they do not systematically cover all possible development, thus reducing the complexity and quantity of output and improving accessibility for the policy community. Their aim is explorative in nature. Rather than determining a certain future state of affairs, explorative scenarios seek to uncover and make apparent hitherto neglected trends, while proposing their plausible developments.

Scenarios are the final products of the scenario analysis process. Bouhalleb and Smida (2018) describe scenario analysis as “a structured and analytical process to create characterization of multiple futures to enable stakeholders to rethink strategic decisions and policies” (p. 2). Scenario analysis can be done with different techniques but usually starts with the identification of sources of future change. Key driving forces with uncertain trajectories are identified and plausible scenarios are constructed depending on how they play out. Scenario analysis involves multiple steps taking place in three distinct phases. Table 1 gives an example of this process using the MSG method which has proven useful in cases of uncertainty and complexity (Pherson, 2008, pp. 34–40; Popper, 2008). This procedure was applied to and refined by two consecutive foresight exercises by the Dahrendorf Foresight Project, between 2016 and 2018 (Sus & Hadeed, 2019). 4 It serves as an example of an analytical and participatory scenario process (for other examples, see Han, 2011, pp. 44–45) (Figure 1).

[Chart omitted]

The following paragraphs describe this nine-step process in detail and can be understood as a suggestion for an application of scenario analysis in IR scholarship. The preparatory phase (steps one to five) starts with the elaboration of a research question and the collection of all relevant elements of the scenario exercise. In our example, we asked the broad question of “how will Europe’s security environment look like in 2030?” A preparatory online survey can set the basis for the group exercises. Asking participants to judge the likelihood and impact of internal and external factors of change and to identify potential Black Swans establishes a common knowledge base. In our example, participants were encouraged to use the STEMPLE-Plus-framework, 5 and consider social, technological, economic, military/security, political, legal/normative, ecological, and other factors—such as psychological or cultural. Answer to surveys also reveal participants’ underlying assumptions—deeply held, implicit or explicit beliefs about the nature of things—and their perspectives on future developments of European security (Amer, Daim, & Jetter, 2013; Bouhalleb & Smida, 2018; Wilkinson, 2017).

In the second step, these key assumptions are categorized and checked. Participants judge them as “solid,” “caveat,” or “not solid,” depending on the certainty of their continued existence and impact. Only those deemed “solid,” where no challenge can be expected, are carried over into the next step. One assumption in our example was that the United States—withdrawal from multinational cooperation would continue. Revealing this assumption allows for the objection that this could change after the next election. After all, the institution of the “America First”-doctrine was quite unforeseen itself, and is all but uncontested in American political and policy circles. This assumption thus has a “caveat” and cannot be taken as a given when thinking about European security in 2030. The increasing impact of climate change on human lives, on the other hand, can be deemed as “solid” based on the overwhelming scientific consensus around the issue.

Confronting existing assumptions is a vital step in eradicating erroneous preconceptions and cognitive biases, in this case the status quo bias—the idea things will not change dramatically from the way they are today (Wilkinson et al., 2013). The key assumptions check thus provides a common understanding upon which the scenarios can be developed. Participants filter out those that are solid enough to become a basis for the development of key drivers.

Steps three to five consist of the identification, selection, and definition of those key drivers. Key drivers provide the backbone around which scenarios are constructed. They are the most crucial trends that shape the future. To identify them, the remaining “solid” key assumptions are discussed. From among them, the participants select the ones they deem most relevant to the question at hand. These are then defined as bidirectional levers of change that can manifest in a variety of ways. For example, United States involvement in global affairs could develop in any which way between complete withdrawal and maximum engagement. A chosen combination of drivers and their different manifestations produces the differences between scenarios. In the Dahrendorf Foresight Project, seven key drivers of security in 2030 were identified (Sus & Hadeed, 2019, pp. 14–20), such as technological progress in the EU, the United States role in European security, and China’s global power projection. Sticking with the first example, its impact on European security was connected to possible vulnerability to security threats, such as in the realm of cybersecurity. Moreover, lagging behind in the technological race could hamper competitiveness, thusly socio-economic well-being and therefore possibly political stability. Rapid technological progress, on the other hand, could produce significant economic benefits and improve the standard of living. It could also lead to an Orwellian dystopia. Variations in the manifestations of key drivers are thus both the expression of uncertainty and the determinants of the resulting scenario. These are the core elements that are being put together into coherent sets in the next phase.

The developmental phase (steps six to eight) involves the construction of individual scenarios. This takes place through conversation between participants, in what Wilkinson (2017) calls “a social learning process of storytelling and systems thinking, and an iteration between strategic conversation and analysis” (p. 20). In step six, participants determine which trends can plausibly co-exist in the future. This is done via a cross-consistency check. Participants combine key drivers into groups—in our case sets of two to four—and check them for internal consistency. It would, for example, appear implausible to foresee European technological leadership in the context of disintegrative tendencies. An EU paralyzed by political gridlock could not reasonably be expected to take the decisive action—and investments—needed to surpass its technological rivals. In this way, incoherent or implausible combinations of drivers are discarded. The remaining plausible combinations of drivers constitute the nuclei around which, in step seven, narratives are constructed. Narratives detail the development and interaction of drivers of change in the future (Wilkinson, 2017). They are important, not only to bring scenarios to life, but also to describe the transition from now to the timeframe under consideration, enhancing the scenario’s plausibility (Phadnis et al., 2014). Constructing a narrative and tracing the interactions of drivers also creates opportunities to contemplate possible Black Swan events, thereby integrating abrupt shifts in trajectory and shocks into the analysis. Narratives also help “to simplify the contextual complexities of environment and actors” (Bouhalleb & Smida, 2018, p. 3), thus contributing to the goal of scenario analysis to grapple with complexity and uncertainty. European technological leadership would, for example, be more plausible in the context of a strong and resilient Euro and flourishing trade, than in one of internal strife and struggling economies. One would imagine the establishment of well-funded cooperative research facilities and research programs in key future industries, such as Artificial Intelligence, energy production and storage, or robotics. Agreement to the necessary investment presupposes the political will and consensus between member states.

In addition to envisioning the future development of current trends, scenarios also model sudden future events, such as shocks, that can shape the events within it. In our example, European breakthroughs in quantum computing could leapfrog technological progress and thus change the European trajectory unexpectedly. Any such development is imaginable, and scenarios illuminate the path towards their possible realization.

In step eight, the thusly completed scenario is fed into a peer-reviewing process. In our case, six reviewers, expert practitioners and scholars, were asked to review individual scenarios according to three criteria to determine their merit: plausibility, consistency, and innovation. Plausibility concerns whether or not the described scenario is imaginable, and its development retraceable with rational thought. Consistency relates to the internal coherence of a scenario. If drivers, trends and developments within one scenario contradict each other, the resulting scenario is internally inconsistent. Innovation is achieved when a scenario contributes new insights into the policy debate.

The use phase (step nine) starts when the scenario development has concluded. Here, scenarios show their practical usefulness as bases to develop strategies for plausible future events (Bouhalleb & Smida, 2018) and enhance decision-making (Amer et al., 2013). They can produce early indicators by charting a path toward a plausible future, and making the developments that lead to it, observable (Bernstein et al., 2000). Such a process allows researchers and policy-makers alike to identify and detect early indications of a scenario coming to pass and thereby assess current and evolving situations (Bernstein et al., 2000). Having modeled a path towards technological backwardness, for example, could promote debates on new European research cooperation mechanisms and instruments. A collection of scenarios from the described exercise was presented to academics and policy-makers and debated among experts in detail. This suggests that scenarios can spark debate and exchange, as well as provide insight on the future between the policy world and academia.

The presented example of an application of MSG shows how it enables scholars to look into the future and contemplate the effects of trends that have not yet manifested empirically, as well as unforeseen and sudden changes in trajectories. This distinct advantage over traditional IR methods makes scenario analysis a useful addition to scholars’ methodological toolkit and enriches policy-recommendations by including considerations of plausible—even if unlikely—futures. How scholars can profit from the use of scenario analysis will be discussed in more detail in the section on added value.

Despite the fact that scenario analysis is thus well-situated to become a useful tool for academics to engage with relevant and timely phenomena, its application in the academic world is still relatively rare (for a few exceptions, see: Barma et al., 2016; Bernstein et al., 2000; Cruz, 2015; Kunstein & Wessels, 2012; Pourezzat et al., 2018; Stein et al., 1998; Sus, 2017; Sus, 2018; Vicente Oliva & Martinez-Sanchez, 2018). This can be attributed to the allegation that scenario approaches (and strategic foresight in general) are inherently non-academic, captured in the credo that social scientists should not engage in forward-reasoning. The following paragraphs discuss this methodological skepticism and attempt to diffuse it.

Criticism and merit of scenario analysis as a method

A vibrant interdisciplinary debate surrounds scenario analysis as a method (see, e.g., Amer et al., 2013; Bishop et al., 2007; Bouhalleb & Smida, 2018; Bradfield et al., 2005; Ramírez & Wilkinson, 2016). We aim to contribute to this debate with the following revision.

One objection against the application of scenario analysis in IR is that it does not satisfy all the criteria established by positivist epistemology (Ramírez & Wilkinson, 2016). Specifically, it evades falsifiability, nonsubjectivity, and replicability: As it concerns the future, it cannot establish facts, which cannot be falsified. As a creative, iterative process relying on individual expertise and group interaction, it is highly contingent on participants and context, and thus neither nonsubjective, nor replicable (Ramírez & Wilkinson, 2016). This violates the universally accepted positivist criteria established by Karl Popper (1963). 6 We argue that there are, nonetheless, good reasons to reconsider the admissibility of scenario analysis to IR scholarship. In the following paragraphs, we test the approach and the MSG in particular against the criteria for academic research defined by Gerring (2011). We find that it satisfies most of them. Moreover, we argue that scenario analysis excels at generating new knowledge—one of two overarching goals of research (Gerring, 2011)—and allows for unique interdisciplinary and multicausal reasoning.

Gerring (2011) specifies the criteria of scientific inquiry “to be cumulative, evidence-based (empirical), falsifiable, generalizing, nonsubjective, replicable, rigorous, skeptical, systematic, transparent and grounded in rational argument” (p. 11). Table 1 describes the ways in which scenario analysis responds to Gerring.

The table shows that scenario analysis satisfies eight out of eleven criteria that Gerring suggests, showcasing more methodological credentials than is often acknowledged. Those criteria it cannot satisfy—falsifiability, nonsubjectivity, and replicability—serve the overarching goal of appraising the truthfulness of claims, which scenario analysis cannot achieve. 7

In our example of the MSG process presented in the previous section, the cumulative knowledge of 21 experts was employed. Key assumptions brought into the process were based on their expertise. In the key assumptions check, the group together determined which assumptions to continue the exercise with, having to justify their selection with the use of evidence, including quantitative data. While data in itself is nonsubjective, the MSG relies on individual interpretation of evidence, as well as the interactive exploration of a group of participants, which makes it necessarily subjective. Accordingly, scenario exercises are also not replicable, as its results are arrived at through the interaction of a distinct group of experts at a distinct point in time. As time passes, new evidence appears and beliefs change, even the same group might arrive at different conclusions at a later point in time. As the results speak to the future, they are necessarily not falsifiable, although making key assumptions, drivers, and uncertainties transparent allows for discussions on their merit. As the previous section has shown, the scenario development process as applied in the presented example fulfilled Gerring’s next three criteria and was systematic, skeptical, and rigorous. The use of the STEMPLE-framework laid the groundwork for the integration of all imaginable dimensions of change. The assumptions- and coherence checks ensured that only plausible trends and combinations of trends are developed into scenarios. At last, the peer-review process validated the quality of the resulting scenarios, ensuring at the same time that they are grounded in rational arguments.

We thus observed that a rigorous application of the MSG contributes to its methodological quality, although some positivist criteria are impossible for it to satisfy. As already mentioned above, these—falsifiability, nonsubjectivity, and replicability—all serve the goal of appraisal, of which scenario analysis is incapable. 8 However, acknowledging the difficulty in appraisal should not disqualify scenario analysis as a methodology for IR since non-falsifiability is not uncommon in this field. Some of the most prominent theories employed in IR are hard to falsify and have nonetheless established themselves as reference points for large sections of social scientists, such as Weberianism, Marxism, or rational-choice theory (Gerring, 2011).

Moreover, scenario analysis excels at academia’s other goal: the discovery of new knowledge. Gerring (2011) already pointed out that both goals “are often in tension with each other” (p. 31). The more rigorous the methodological design, the more constraint must be put on the admissible evidence, limiting what researchers can hope to discover. Imagined on a spectrum between appraisal and discovery, scenario analysis would be far on the discovery end. As presented in the previous section, the iterative scenario development reveals hidden assumptions, challenges the status quo and makes explicit tacit knowledge of its participants (Ramírez & Wilkinson, 2016). It also counteracts biases, such as short-termism or linear thinking and enables constructive engagement with preconceptions. It thus helps reveal blind spots in our thinking and detect weak signals of change that might not yet express themselves empirically.

Furthermore, scenario analysis allows for a uniquely comprehensive causal reasoning. Applying the positivist framework of most traditional IR methods to our example, one could consider European security in 2030 as the dependent variable. It is determined by the key drivers, which constitute independent variables. The different combinations and values of the causal variables account for the variance of the dependent variable, consequently producing different scenarios. Thus, “a good scenario is an internally consistent hypothesis about how the future might unfold; it is a chain of logic that connects drivers to outcomes” (Bernstein et al., 2000, p. 54).

Also, the way a scenario plot is developed can be seen as a form of process tracing (Bernstein et al., 2000, p. 55). That is, projecting how a combination of certain key drivers can develop over time, what changes are expected to occur and identifying key events that might take place. Yet, in contrast to its traditional application in IR, process tracing during the scenario analysis pertains to the future, and not the past. For these reasons, we suggest the methodological admissibility of the MSG as an additional method in the toolkit of IR scholars.

Added-value of scenario analysis for IR scholarship

As Tomé and Açıkalın (2019) point out, in order to fill the gap between IR theory and real-world problems, “an increasing number of scholars have come to embrace a spirit of intellectual openness, recognizing both the need for greater flexibility in the theoretical formulations and the possibility of complementarity by other theories and approaches” (p. 12). This section discusses the added value of scenario analysis as a complementary approach to traditional IR methods. The most obvious advantage of scenario analysis as a methodology, grounded in the reservoir of foresight studies, lies by definition in its ability to tackle future events. As mentioned before, there are no specified instruments within traditional IR methods which would allow scholars to go beyond past and present. The only exception is forecasting, one of the formal methods in IR, which is, however, distinctly different from foresight. 9

The underlying logic of forecasting is to provide predictions about the future by drawing on mathematical models and big data-sets based on known patterns. Thus, it is not particularly suitable to accommodate discontinuities. Foresight, as described above, aims at going beyond existing patterns by developing alternative futures based on an innovative combination of multiple driving forces. Its goal is to capture a set of possible futures and learn from them by examining the causal relations between driving forces and their different evolutions. By applying scenario approaches, scholars can thus account for evolving dynamics and discuss such timely issues as the consequences of Brexit for both British and EU-security, economics and politics (Brakman, Garretsen, & Kohl, 2018; Martill & Sus, 2018; Musolff, 2017; Verschueren, 2017; Ziv et al., 2018). Yet, scenario analysis offers more than the possibility to talk about the future. We see a fourfold merit of adding scenario analysis to the range of methods applied by IR scholars.

Confronting enduring assumptions

As we presented in the previous section, the main feature of explorative scenarios, which are the subject of this paper, is to stimulate creative thinking by challenging the deeply held assumptions of their authors. In other words, this method is helpful for overcoming enduring cognitive biases—mental errors such as linearity, presentism, and group think caused by the subconscious and simplified information processing of humans (Heuer, 1999, pp. 111–112). Humans have the tendencies to focus on the present at the expense of the future and to think about the future in linear terms by extrapolating past trends into the future. As Gaddis (1992) points out, “we tend to bias our historical and our theoretical analyses too much toward continuity (…) we rarely find a way to introduce discontinuities into theory, or to attempt to determine what causes them to happen” (p. 52). Even if Gaddis does not explicitly mention scenarios, he refers to the concepts underlying scenario approaches (Han, 2011, p. 51). Scenario analysis attends to “deeper, otherwise left implicit, assumptions about continuous and linear patterns of development” (Wilkinson et al., 2013, p. 707). The process of scenario development invites the participants to reveal and question convictions which have so far remained unchallenged, and to question the linearity of world developments.

The ability of reexamining one’s own assumptions and going beyond linear patterns of development is essential for IR scholarship. To illustrate it with two examples: IR scholars and historians did not think that the Soviet Union could collapse and were startled by its fall, the peaceful resolution of the Cold War and the transformation of the bipolar system (Davis, 2005; Gaddis, 1992). In a similar vein, United States scholars were for decades so convinced of China’s economic, political, and cultural limitations that they neglected the possibility of its sudden ascent and were taken by surprise when it happened (Hundley, Kenzer, & Peterson, 2015). Interestingly, since the rise of China became evident, the United States debate on its future has been marked by a similar linearity of thought, leading to single-outcome predictions of China’s long-term future (Kerbel, 2004). In both cases, the discipline proved incapable of anticipating events of such importance, because scholars took for granted the status quo instead of confronting their bias towards linearity and detect manifestations of upcoming change. As a result, two major geopolitical surprises—the end of the Cold War and the rise of China have at first been neglected, forcing academia to catch up.

Against this backdrop, foresight helps IR scholars to exit the tunnel vision on world affairs and discover potentially valuable nonlinear lines of development. These can be both innovative in terms of scholarship, and policy-relevant by offering a reflection on unexpected discontinuities. Thus, it can facilitate the intellectual capability to think the unthinkable (Porter, 2016, p. 259).

Bringing forward new research questions

Scenario analysis starts with confronting one’s enduring assumptions and developing multiple causal possibilities, through which scholars can potentially discover topics that have not been examined before. One of the greatest challenges for any scholar is to identify innovative venues for research that might bring the discipline forward and advance publicity for one’s work. In Lakatosian terms, such an ability is often considered an evidence of a progressive research program. 10 Since the prime feature of scenario analysis is to detect rapid and significant shifts in trajectories, or the forces behind them, this method succors when defining new pressing topics for academia. In particular, as mentioned in the previous section, scenario analysis enables the detection of both weak signals and wild cards. By drawing attention to these hitherto overlooked but potentially pressing issues, scenario analysis can identify research agendas for further investigation (Barma et al., 2016). Therefore, scenario analysis seems to be the right tool to advance innovative research since it helps scholars drive their research into new areas, away from moribund topics that have been followed for many decades. By “identifying questions of likely future significance” (Barma et al., 2016, p. 6), scenario analysis can contribute to combatting the proliferation of researchers in fields occupying the political status quo, such as Soviet or Japan studies in the United States in the 1980s. At the same time, innovative research topics confront the uncertainties that are crucial for policy-makers to be monitored closely.

Dealing with the complexity and interdisciplinarity of real-world issues

Another added value of the scenario analysis for IR scholarship lies in its ability to provide comprehensive causal reasoning and thus to tackle complex issues. As mentioned in the introduction, the world’s complexity combined with abrupt shifts poses a challenge for IR scholarship. The possibility to accommodate multiple driving forces, to take into account different values they might take and finally to combine them with each other and see how they affect the dependent variable, makes the scenario approach quite unique. Traditional IR methods work with a limited number of independent variables, formulate and test hypotheses usually based on the relation between a single causal variable and the dependent variable. Investigating complex causal trajectories is therefore not possible. Against this background, we agree with Barma et al. (2016) and his colleagues who argue that scenarios are highly apt for dealing with complexity and uncertainty and providing academia with a tool for “actionable clarity in understanding contemporary global issues” (p. 1).

Moreover, the scenario approach helps to tackle the challenges of interdisciplinarity that is tied to complexity. By drawing on the active participation of people from different disciplines, backgrounds, and with different expertise in the scenario development process, it brings interdisciplinarity to the table by default. The key advantage of the approach is that this interdisciplinary conversation takes place prior to and during the research phase, rather than after it. This distinguishes the scenario approach from other methods that bring interdisciplinary perspectives together but do not facilitate a discussion between them, rather letting them passively co-exist. By exploring the dynamics between seemingly unrelated vectors of change (key drivers), scenario analysis can be useful for shedding light on developments that would have been overlooked by narrower research designs. In security studies, for example, scenario analysis can connect the dots between hard, soft, traditional and non-traditional understandings of security and capture the interplay of economic-societal-environmental and technological changes. Imposing interdisciplinarity also helps to counter the “hyper-fragmentation of knowledge” that “makes it difficult for even scholars in different disciplines to understand each other, much less policy-makers and general public” (Desch, 2015, p. 381).

Complex real-world issues that were tackled using scenario analysis include the Israel-Palestine conflict (Stein et al., 1998), Turkey’s geopolitical environment (Çelik & Blum, 2007), the prospects of the United States–China conflict (Friedberg, 2005) and the consequences of Brexit for EU foreign and security policy (Martill & Sus, 2018). An examination of these topics without the application of interdisciplinary approaches would not be possible precisely due to their multifaceted character.

Stepping out of the ivory tower

Finally, scenario analysis also enables IR scholars to establish a channel of communication with policy-makers other than conducting interviews for their own research or providing ad-hoc consultations. A participatory scenario process forges “deep and shared understanding between its participants” (Ramírez & Wilkinson, 2016, p. 21). In scenario workshops, academics and policy-makers work together, confront their world visions and assumptions and arrive at an agreement upon which they develop narratives for alternative futures. Hence, scenario analysis can be perceived as a tool towards more exchange between academia and policy-making that can contribute to a better understanding between the two worlds. For policy-makers, it provides the opportunity to consider long-term trends (an occasion not often found in the day-to-day nature of politics). For academics, it provides insight into which trends are most concerning for policy-makers, allowing them to check and ultimately enhance the relevance of their research agendas.

We acknowledge the difficulty to engage policy-makers in foresight exercises caused by their time-constrains and possible lack of interest. Yet, in our experience, this problem mostly refers to high-level policy-makers. Mid-level and former officials and policy-makers have more time and willingness to participate in foresight exercises and contribute equally valuable perspectives. The participatory character of foresight exercises facilitates the exchange of views from different stakeholders on an equal level. In our case, as the evaluation has shown, it has proven to be stimulating for each of the engaged groups.

Moreover, the policy dialogue benefits from scenarios’ accessibility to a broader audience. Scenario publications tend to be shorter and easier to read than the average academic publication and as Nye (2008) rightly notes “a premium on time is a major difference between the two cultures” of academia and policy-making. Since scenario publications are more suitable to the time- and attention-constraints of many policy-makers, they improve the accessibility of research findings for the policy world (Cairney & Kwiatkowski, 2017). An illustrative example is offered by a foresight exercise conducted by the Aspen Institute Berlin in 2017. A group of academics, think tank experts and policy-makers developed scenarios on the future of the liberal world order that served as raw material for a newspaper from the future titled “The Aspen Insight” and dated October 21, 2025. Not only did the presentation of the newspaper catch the attention of many Berlin-based policy-makers but the “The Aspen Insight” was also attached as a supplement to the Berlin daily Tagesspiegel, and reached more than 300,000 readers. 11

We acknowledge that the four aspects of the added value of scenario analysis for IR scholarship are interrelated and that their boundaries are not clear-cut. Yet, we believe, they highlight distinct benefits of this approach for academics that want to tackle the challenges of today’s world via their research.

Conclusions

The rationale of this article was to make the case that scenario analysis can be perceived as a social science method that enables IR scholars to systematically think about the future and to tackle challenges such as complexity and interdisciplinarity of world affairs. We began the article by discussing the existing complexity and uncertainty of the international order and by presenting growing demand for foresight studies. We observed that this demand is increasingly also directed at academia. Then, we introduced an example of how scenario analysis can be systematically executed and demonstrated why we think this approach can be recognized as a method according to the criteria for social science methodologies formulated by Gerring (2011). Finally, in line with scholars who argue that scenario analysis is a complementary resource for exploring surprising intersections of multiple variables and socio-political dynamics in international affairs (Barma et al., 2016; Han, 2011), we presented the added value of this approach to IR scholarship.

With this article, we want to inspire a debate on how foresight approaches, and scenario analysis in particular, can be used by IR scholars as complementary tools to the traditional methods. Yet, we would like to highlight one prerequisite condition for this reasoning: the rigorous execution of foresight approaches. For this, we suggested the MSG method. The accurate application of any foresight method—as with any traditional IR method—is essential for achieving an outcome that complies with academic standards. In doing so, academics can leverage the potential of this approach: confront their enduring assumptions; bring forward new research agendas; and reach out to the policy world. In other words, we believe scenario analysis can advance the adaptation of the IR discipline to today’s complex challenges.

In 2016, Flockhart argued in this journal that “[s]cholars and policy-makers should note that the coming multi-order world will be radically different, requiring new thinking and new institutions and the acceptance of diversity in both power and principle” (p. 4). Adding to this, we are convinced that an acceptance of unconventionality in methodological approaches is also needed in order to adapt to the dynamically changing international environment.

#### Independently - The Standard is Maximizing Expected Well-Being

#### 1] Only it can explain degrees of wrongness- it is worse to kill thousands than to lie to a friend- either ethical theories cannot explain comparative badness, or it collapses

#### 2] Extinction outweighs---it’s the upmost moral evil and disavowal of the risk makes it more likely.

Burns 2017 (Elizabeth Finneron-Burns is a Teaching Fellow at the University of Warwick and an Affiliated Researcher at the Institute for Futures Studies in Stockholm, What’s wrong with human extinction?, <http://www.tandfonline.com/doi/pdf/10.1080/00455091.2016.1278150?needAccess=true>, Canadian Journal of Philosophy, 2017)

Many, though certainly not all, people might believe that it would be wrong to bring about the end of the human species, and the reasons given for this belief are various. I begin by considering four reasons that could be given against the moral permissibility of human extinction. I will argue that only those reasons that impact the people who exist at the time that the extinction or the knowledge of the upcoming extinction occurs, can explain its wrongness. I use this conclusion to then consider in which cases human extinction would be morally permissible or impermissible, arguing that there is only a small class of cases in which it would not be wrong to cause the extinction of the human race or allow it to happen. 2.1. It would prevent the existence of very many happy people One reason of human extinction might be considered to be wrong lies in the value of human life itself. The thought here might be that it is a good thing for people to exist and enjoy happy lives and extinction would deprive more people of enjoying this good. The ‘good’ in this case could be understood in at least two ways. According to the first, one might believe that you benefit a person by bringing them into existence, or at least, that it is good for that person that they come to exist. The second view might hold that if humans were to go extinct, the utility foregone by the billions (or more) of people who could have lived but will now never get that opportunity, renders allowing human extinction to take place an incidence of wrongdoing. An example of this view can be found in two quotes from an Effective Altruism blog post by Peter Singer, Nick Beckstead and Matt Wage: One very bad thing about human extinction would be that billions of people would likely die painful deaths. But in our view, this is by far not the worst thing about human extinction. The worst thing about human extinction is that there would be no future generations. Since there could be so many generations in our future, the value of all those generations together greatly exceeds the value of the current generation. (Beckstead, Singer, and Wage 2013) The authors are making two claims. The first is that there is value in human life and also something valuable about creating future people which gives us a reason to do so; furthermore, it would be a very bad thing if we did not do so. The second is that, not only would it be a bad thing for there to be no future people, but it would actually be the worst thing about extinction. Since happy human lives have value, and the number of potential people who could ever exist is far greater than the number of people who exist at any one time, even if the extinction were brought about through the painful deaths of currently existing people, the former’s loss would be greater than the latter’s. Both claims are assuming that there is an intrinsic value in the existence of potential human life. The second claim makes the further assumption that the forgone value of the potential lives that could be lived is greater than the disvalue that would be accrued by people existing at the time of the extinction through suffering from painful and/or premature deaths. The best-known author of the post, Peter Singer is a prominent utilitarian, so it is not surprising that he would lament the potential lack of future human lives per se. However, it is not just utilitarians who share this view, even if implicitly. Indeed, other philosophers also seem to imply that they share the intuition that there is just something wrong with causing or failing to prevent the extinction of the human species such that we prevent more ‘people’ from having the ‘opportunity to exist’. Stephen Gardiner (2009) and Martin O’Neill (personal correspondence), both sympathetic to contract theory, for example, also find it intuitive that we should want more generations to have the opportunity to exist, assuming that they have worth-living lives, and I find it plausible to think that many other people (philosophers and non-philosophers alike) probably share this intuition. When we talk about future lives being ‘prevented’, we are saying that a possible person or a set of possible people who could potentially have existed will now never actually come to exist. To say that it is wrong to prevent people from existing could either mean that a possible person could reasonably reject a principle that permitted us not to create them, or that the foregone value of their lives provides a reason for rejecting any principle that permits extinction. To make the first claim we would have to argue that a possible person could reasonably reject any principle that prevented their existence on the grounds that it prevented them in particular from existing. However, this is implausible for two reasons. First, we can only wrong someone who did, does or will actually exist because wronging involves failing to take a person’s interests into account. When considering the permissibility of a principle allowing us not to create Person X, we cannot take X’s interest in being created into account because X will not exist if we follow the principle. By considering the standpoint of a person in our deliberations we consider the burdens they will have to bear as a result of the principle. In this case, there is no one who will bear any burdens since if the principle is followed (that is, if we do not create X), X will not exist to bear any burdens. So, only people who do/will actually exist can bear the brunt of a principle, and therefore occupy a standpoint that is owed justification. Second, existence is not an interest at all and a possible person is not disadvantaged by not being caused to exist. Rather than being an interest, it is a necessary requirement in order to have interests. Rivka Weinberg describes it as ‘neutral’ because causing a person to exist is to create a subject who can have interests; existence is not an interest itself.3 In order to be disadvantaged, there must be some detrimental effect on your interests. However, without existence, a person does not have any interests so they cannot be disadvantaged by being kept out of existence. But, as Weinberg points out, ‘never having interests itself could not be contrary to people’s interests since without interest bearers, there can be no ‘they’ for it to be bad for’ (Weinberg 2008, 13). So, a principle that results in some possible people never becoming actual does not impose any costs on those ‘people’ because nobody is disadvantaged by not coming into existence.4 It therefore seems that it cannot be wrong to fail to bring particular people into existence. This would mean that no one acts wrongly when they fail to create another person. Writ large, it would also not be wrong if everybody decided to exercise their prerogative not to create new people and potentially, by consequence, allow human extinction. One might respond here by saying that although it may be permissible for one person to fail to create a new person, it is not permissible if everyone chooses to do so because human lives have value and allowing human extinction would be to forgo a huge amount of value in the world. This takes us to the second way of understanding the potential wrongness of preventing people from existing — the foregone value of a life provides a reason for rejecting any principle that prevents it. One possible reply to this claim turns on the fact that many philosophers acknowledge that the only, or at least the best, way to think about the value of (individual or groups of) possible people’s lives is in impersonal terms (Parfit 1984; Reiman 2007; McMahan 2009). Jeff McMahan, for example, writes ‘at the time of one’s choice there is no one who exists or will exist independently of that choice for whose sake one could be acting in causing him or her to exist … it seems therefore that any reason to cause or not to cause an individual to exist … is best considered an impersonal rather than individual-affecting reason’ (McMahan 2009, 52). Another reply along similar lines would be to appeal to the value that is lost or at least foregone when we fail to bring into existence a next (or several next) generations of people with worth-living lives. Since ex hypothesi worth-living lives have positive value, it is better to create more such lives and worse to create fewer. Human extinction by definition is the creation of no future lives and would ‘deprive’ billions of ‘people’ of the opportunity to live worth-living lives. This might reduce the amount of value in the world at the time of the extinction (by killing already existing people), but it would also prevent a much vaster amount of value in the future (by failing to create more people). Both replies depend on the impersonal value of human life. However, recall that in contractualism impersonal values are not on their own grounds for reasonably rejecting principles. Scanlon himself says that although we have a strong reason not to destroy existing human lives, this reason ‘does not flow from the thought that it is a good thing for there to be more human life rather than less’ (104). In contractualism, something cannot be wrong unless there is an impact on a person. Thus, neither the impersonal value of creating a particular person nor the impersonal value of human life writ large could on its own provide a reason for rejecting a principle permitting human extinction. It seems therefore that the fact that extinction would deprive future people of the opportunity to live worth-living lives (either by failing to create either particular future people or future people in general) cannot provide us with a reason to consider human extinction to be wrong. Although the lost value of these ‘lives’ itself cannot be the reason explaining the wrongness of extinction, it is possible the knowledge of this loss might create a personal reason for some existing people. I will consider this possibility later on in section (d). But first I move to the second reason human extinction might be wrong per se. 2.2. It would mean the loss of the only known form of intelligent life and all civilization and intellectual progress would be lost A second reason we might think it would be wrong to cause human extinction is the loss that would occur of the only (known) form of rational life and the knowledge and civilization that that form of life has created. One thought here could be that just as some might consider it wrong to destroy an individual human heritage monument like the Sphinx, it would also be wrong if the advances made by humans over the past few millennia were lost or prevented from progressing. A related argument is made by those who feel that there is something special about humans’ capacity for rationality which is valuable in itself. Since humans are the only intelligent life that we know of, it would be a loss, in itself, to the world for that to end. I admit that I struggle to fully appreciate this thought. It seems to me that Henry Sidgwick was correct in thinking that these things are only important insofar as they are important to humans (Sidgwick 1874, I.IX.4).5 If there is no form of intelligent life in the future, who would there be to lament its loss since intelligent life is the only form of life capable of appreciating intelligence? Similarly, if there is no one with the rational capacity to appreciate historic monuments and civil progress, who would there be to be negatively affected or even notice the loss?6 However, even if there is nothing special about human rationality, just as some people try to prevent the extinction of nonhuman animal species, we might think that we ought also to prevent human extinction for the sake of biodiversity. The thought in this, as well as the earlier examples, must be that it would somehow be bad for the world if there were no more humans even though there would be no one for whom it is bad. This may be so but the only way to understand this reason is impersonally. Since we are concerned with wrongness rather than badness, we must ask whether something that impacts no one’s well-being, status or claims can be wrong. As we saw earlier, in the contractualist framework reasons must be personal rather than impersonal in order to provide grounds for reasonable rejection (Scanlon 1998, 218–223). Since the loss of civilization, intelligent life or biodiversity are per se impersonal reasons, there is no standpoint from which these reasons could be used to reasonably reject a principle that permitted extinction. Therefore, causing human extinction on the grounds of the loss of civilization, rational life or biodiversity would not be wrong. 2.3. Existing people would endure physical pain and/or painful and/or premature deaths Thinking about the ways in which human extinction might come about brings to the fore two more reasons it might be wrong. It could, for example, occur if all humans (or at least the critical number needed to be unable to replenish the population, leading to eventual extinction) underwent a sterilization procedure. Or perhaps it could come about due to anthropogenic climate change or a massive asteroid hitting the Earth and wiping out the species in the same way it did the dinosaurs millions of years ago. Each of these scenarios would involve significant physical and/or non-physical harms to existing people and their interests. Physically, people might suffer premature and possibly also painful deaths, for example. It is not hard to imagine examples in which the process of extinction could cause premature death. A nuclear winter that killed everyone or even just every woman under the age of 50 is a clear example of such a case. Obviously, some types of premature death themselves cannot be reasons to reject a principle. Every person dies eventually, sometimes earlier than the standard expected lifespan due to accidents or causes like spontaneously occurring incurable cancers. A cause such as disease is not a moral agent and therefore it cannot be wrong if it unavoidably kills a person prematurely. Scanlon says that the fact that a principle would reduce a person’s well-being gives that person a reason to reject the principle: ‘components of well-being figure prominently as grounds for reasonable rejection’ (Scanlon 1998, 214). However, it is not settled yet whether premature death is a setback to well-being. Some philosophers hold that death is a harm to the person who dies, whilst others argue that it is not.7 I will argue, however, that regardless of who is correct in that debate, being caused to die prematurely can be reason to reject a principle when it fails to show respect to the person as a rational agent. Scanlon says that recognizing others as rational beings with interests involves seeing reason to preserve life and prevent death: ‘appreciating the value of human life is primarily a matter of seeing human lives as something to be respected, where this involves seeing reasons not to destroy them, reasons to protect them, and reasons to want them to go well’ (Scanlon 1998, 104). The ‘respect for life’ in this case is a respect for the person living, not respect for human life in the abstract. This means that we can sometimes fail to protect human life without acting wrongfully if we still respect the person living. Scanlon gives the example of a person who faces a life of unending and extreme pain such that she wishes to end it by committing suicide. Scanlon does not think that the suicidal person shows a lack of respect for her own life by seeking to end it because the person whose life it is has no reason to want it to go on. This is important to note because it emphasizes the fact that the respect for human life is person-affecting. It is not wrong to murder because of the impersonal disvalue of death in general, but because taking someone’s life without their permission shows disrespect to that person. This supports its inclusion as a reason in the contractualist formula, regardless of what side ends up winning the ‘is death a harm?’ debate because even if death turns out not to harm the person who died, ending their life without their consent shows disrespect to that person. A person who could reject a principle permitting another to cause his or her premature death presumably does not wish to die at that time, or in that manner. Thus, if they are killed without their consent, their interests have not been taken into account, and they have a reason to reject the principle that allowed their premature death.8 This is as true in the case of death due to extinction as it is for death due to murder. However, physical pain may also be caused to existing people without killing them, but still resulting in human extinction. Imagine, for example, surgically removing everyone’s reproductive organs in order to prevent the creation of any future people. Another example could be a nuclear bomb that did not kill anyone, but did painfully render them infertile through illness or injury. These would be cases in which physical pain (through surgery or bombs) was inflicted on existing people and the extinction came about as a result of the painful incident rather than through death. Furthermore, one could imagine a situation in which a bomb (for example) killed enough people to cause extinction, but some people remained alive, but in terrible pain from injuries. It seems uncontroversial that the infliction of physical pain could be a reason to reject a principle. Although Scanlon says that an impact on well-being is not the only reason to reject principles, it plays a significant role, and indeed, most principles are likely to be rejected due to a negative impact on a person’s well-being, physical or otherwise. It may be queried here whether it is actually the involuntariness of the pain that is grounds for reasonable rejection rather than the physical pain itself because not all pain that a person suffers is involuntary. One can imagine acts that can cause physical pain that are not rejectable — base jumping or life-saving or improving surgery, for example. On the other hand, pushing someone off a cliff or cutting him with a scalpel against his will are clearly rejectable acts. The difference between the two cases is that in the former, the person having the pain inflicted has consented to that pain or risk of pain. My view is that they cannot be separated in these cases and it is involuntary physical pain that is the grounds for reasonable rejection. Thus, the fact that a principle would allow unwanted physical harm gives a person who would be subjected to that harm a reason to reject the principle. Of course the mere fact that a principle causes involuntary physical harm or premature death is not sufficient to declare that the principle is rejectable — there might be countervailing reasons. In the case of extinction, what countervailing reasons might be offered in favour of the involuntary physical pain/ death-inducing harm? One such reason that might be offered is that humans are a harm to the natural environment and that the world might be a better place if there were no humans in it. It could be that humans might rightfully be considered an all-things-considered hindrance to the world rather than a benefit to it given the fact that we have been largely responsible for the extinction of many species, pollution and, most recently, climate change which have all negatively affected the natural environment in ways we are only just beginning to understand. Thus, the fact that human extinction would improve the natural environment (or at least prevent it from degrading further), is a countervailing reason in favour of extinction to be weighed against the reasons held by humans who would experience physical pain or premature death. However, the good of the environment as described above is by definition not a personal reason. Just like the loss of rational life and civilization, therefore, it cannot be a reason on its own when determining what is wrong and countervail the strong personal reasons to avoid pain/death that is held by the people who would suffer from it.9 Every person existing at the time of the extinction would have a reason to reject that principle on the grounds of the physical pain they are being forced to endure against their will that could not be countervailed by impersonal considerations such as the negative impact humans may have on the earth. Therefore, a principle that permitted extinction to be accomplished in a way that caused involuntary physical pain or premature death could quite clearly be rejectable by existing people with no relevant countervailing reasons. This means that human extinction that came about in this way would be wrong. There are of course also additional reasons they could reject a similar principle which I now turn to address in the next section. 2.4. Existing people could endure non-physical harms I said earlier than the fact in itself that there would not be any future people is an impersonal reason and can therefore not be a reason to reject a principle permitting extinction. However, this impersonal reason could give rise to a personal reason that is admissible. So, the final important reason people might think that human extinction would be wrong is that there could be various deleterious psychological effects that would be endured by existing people having the knowledge that there would be no future generations. There are two main sources of this trauma, both arising from the knowledge that there will be no more people. The first relates to individual people and the undesired negative effect on well-being that would be experienced by those who would have wanted to have children. Whilst this is by no means universal, it is fair to say that a good proportion of people feel a strong pull towards reproduction and having their lineage continue in some way. Samuel Scheffler describes the pull towards reproduction as a ‘desire for a personalized relationship with the future’ (Scheffler 2012, 31). Reproducing is a widely held desire and the joys of parenthood are ones that many people wish to experience. For these people knowing that they would not have descendants (or that their descendants will endure painful and/or premature deaths) could create a sense of despair and pointlessness of life. Furthermore, the inability to reproduce and have your own children because of a principle/policy that prevents you (either through bans or physical interventions) would be a significant infringement of what we consider to be a basic right to control what happens to your body. For these reasons, knowing that you will have no descendants could cause significant psychological traumas or harms even if there were no associated physical harm. The second is a more general, higher level sense of hopelessness or despair that there will be no more humans and that your projects will end with you. Even those who did not feel a strong desire to procreate themselves might feel a sense of hopelessness that any projects or goals they have for the future would not be fulfilled. Many of the projects and goals we work towards during our lifetime are also at least partly future-oriented. Why bother continuing the search for a cure for cancer if either it will not be found within humans’ lifetime, and/or there will be no future people to benefit from it once it is found? Similar projects and goals that might lose their meaning when confronted with extinction include politics, artistic pursuits and even the type of philosophical work with which this paper is concerned. Even more extreme, through the words of the character Theo Faron, P.D. James says in his novel The Children of Men that ‘without the hope of posterity for our race if not for ourselves, without the assurance that we being dead yet live, all pleasures of the mind and senses sometimes seem to me no more than pathetic and crumbling defences shored up against our ruins’ (James 2006, 9). Even if James’ claim is a bit hyperbolic and all pleasures would not actually be lost, I agree with Scheffler in finding it not implausible that the knowledge that extinction was coming and that there would be no more people would have at least a general depressive effect on people’s motivation and confidence in the value of and joy in their activities (Scheffler 2012, 43). Both sources of psychological harm are personal reasons to reject a principle that permitted human extinction. Existing people could therefore reasonably reject the principle for either of these reasons. Psychological pain and the inability to pursue your personal projects, goals, and aims, are all acceptable reasons for rejecting principles in the contractualist framework. So too are infringements of rights and entitlements that we accept as important for people’s lives. These psychological reasons, then, are also valid reasons to reject principles that permitted or required human extinction.

#### 3] That is the only egalitarian metric---anything else collapses cooperation on collective action crises and makes extinction inevitable

Khan 18 (Risalat, activist and entrepreneur from Bangladesh passionate about addressing climate change, biodiversity loss, and other existential challenges. He was featured by The Guardian as one of the “young climate campaigners to watch” (2015). As a campaigner with the global civic movement Avaaz (2014-17), Risalat was part of a small core team that spearheaded the largest climate marches in history with a turnout of over 800,000 across 2,000 cities. After fighting for the Paris Agreement, Risalat led a campaign joined by over a million people to stop the Rampal coal plant in Bangladesh to protect the Sundarbans World Heritage forest, and elicited criticism of the plant from Crédit Agricolé through targeted advocacy. Currently, Risalat is pursuing an MPA in Environmental Science and Policy at Columbia University as a SIPA Environmental Fellow, “5 reasons why we need to start talking about existential risks,” https://www.weforum.org/agenda/2018/01/5-reasons-start-talking-existential-risks-extinction-moriori/)

Infinite future possibilities I find the story of the Moriori profound. It teaches me two lessons. Firstly, that human culture is far from immutable. That we can struggle against our baser instincts. That we can master them and rise to unprecedented challenges. Secondly, that even this does not make us masters of our own destiny. We can make visionary choices, but the future can still surprise us. This is a humbling realization. Because faced with an uncertain future, the only wise thing we can do is prepare for possibilities. Standing at the launch pad of the Fourth Industrial Revolution, the possibilities seem endless. They range from an era of abundance to the end of humanity, and everything in between. How do we navigate such a wide and divergent spectrum? I am an optimist. From my bubble of privilege, life feels like a rollercoaster ride full of ever more impressive wonders, even as I try to fight the many social injustices that still blight us. However, the accelerating pace of change amid uncertainty elicits one fundamental observation. Among the infinite future possibilities, only one outcome is truly irreversible: extinction. Concerns about extinction are often dismissed as apocalyptic alarmism. Sometimes, they are. But repeating that mankind is still here after 70 years of existential warning about nuclear warfare is a straw man argument. The fact that a 1000-year flood has not happened does not negate its possibility. And there have been far too many nuclear near-misses to rest easy. As the World Economic Forum’s Annual Meeting in Davos discusses how to create a shared future in a fractured world, here are five reasons why the possibility of existential risks should raise the stakes of conversation: 1. Extinction is the rule, not the exception More than 99.9% of all the species that ever existed are gone. Deep time is unfathomable to the human brain. But if one cares to take a tour of the billions of years of life’s history, we find a litany of forgotten species. And we have only discovered a mere fraction of the extinct species that once roamed the planet. In the speck of time since the first humans evolved, more than 99.9% of all the distinct human cultures that have ever existed are extinct. Each hunter-gatherer tribe had its own mythologies, traditions and norms. They wiped each other out, or coalesced into larger formations following the agricultural revolution. However, as major civilizations emerged, even those that reached incredible heights, such as the Egyptians and the Romans, eventually collapsed. It is only in the very recent past that we became a truly global civilization. Our interconnectedness continues to grow rapidly. “Stand or fall, we are the last civilization”, as Ricken Patel, the founder of the global civic movement Avaaz, put it. 2. Environmental pressures can drive extinction More than 15,000 scientists just issued a ‘warning to humanity’. They called on us to reduce our impact on the biosphere, 25 years after their first such appeal. The warning notes that we are far outstripping the capacity of our planet in all but one measure of ozone depletion, including emissions, biodiversity, freshwater availability and more. The scientists, not a crowd known to overstate facts, conclude: “soon it will be too late to shift course away from our failing trajectory, and time is running out”. In his 2005 book Collapse, Jared Diamond charts the history of past societies. He makes the case that overpopulation and resource use beyond the carrying capacity have often been important, if not the only, drivers of collapse. Even though we are making important incremental progress in battles such as climate change, we must still achieve tremendous step changes in our response to several major environmental crises. We must do this even while the world’s population continues to grow. These pressures are bound to exert great stress on our global civilization. 3. Superintelligence: unplanned obsolescence? Imagine a monkey society that foresaw the ascendance of humans. Fearing a loss of status and power, it decided to kill the proverbial Adam and Eve. It crafted the most ingenious plan it could: starve the humans by taking away all their bananas. Foolproof plan, right? This story describes the fundamental difficulty with superintelligence. A superintelligent being may always do something entirely different from what we, with our mere mortal intelligence, can foresee. In his 2014 book Superintelligence, Swedish philosopher Nick Bostrom presents the challenge in thought-provoking detail, and advises caution. Bostrom cites a survey of industry experts that projected a 50% chance of the development of artificial superintelligence by 2050, and a 90% chance by 2075. The latter date is within the life expectancy of many alive today. Visionaries like Stephen Hawking and Elon Musk have warned of the existential risks from artificial superintelligence. Their opposite camp includes Larry Page and Mark Zuckerberg. But on an issue that concerns the future of humanity, is it really wise to ignore the guy who explained the nature of space to us and another guy who just put a reusable rocket in it? 4. Technology: known knowns and unknown unknowns Many fundamentally disruptive technologies are coming of age, from bioengineering to quantum computing, 3-D printing, robotics, nanotechnology and more. Lord Martin Rees describes potential existential challenges from some of these technologies, such as a bioengineered pandemic, in his book Our Final Century. Imagine if North Korea, feeling secure in its isolation, could release a virulent strain of Ebola, engineered to be airborne. Would it do it? Would ISIS? Projecting decades forward, we will likely develop capabilities that are unthinkable even now. The unknown unknowns of our technological path are profoundly humbling. 5. 'The Trump Factor' Despite our scientific ingenuity, we are still a confused and confusing species. Think back to two years ago, and how you thought the world worked then. Has that not been upended by the election of Donald Trump as US President, and everything that has happened since? The mix of billions of messy humans will forever be unpredictable. When the combustible forces described above are added to this melee, we find ourselves on a tightrope. What choices must we now make now to create a shared future, in which we are not at perpetual risk of destroying ourselves? Common enemy to common cause Throughout history, we have rallied against the ‘other’. Tribes have overpowered tribes, empires have conquered rivals. Even today, our fiercest displays of unity typically happen at wartime. We give our lives for our motherland and defend nationalistic pride like a wounded lion. But like the early Morioris, we 21st-century citizens find ourselves on an increasingly unstable island. We may have a violent past, but we have no more dangerous enemy than ourselves. Our task is to find our own Nunuku’s Law. Our own shared contract, based on equity, would help us navigate safely. It would ensure a future that unleashes the full potential of our still-budding human civilization, in all its diversity. We cannot do this unless we are humbly grounded in the possibility of our own destruction. Survival is life’s primal instinct. In the absence of a common enemy, we must find common cause in survival. Our future may depend on whether we realize this.