## 1AC TOC Round 2

### 1AC---Plan

#### Plan - Private entities ought not appropriate lunar heritage sites in outer space.

Harrington 19, Andrea J. "Preserving Humanity's Heritage in Space: Fifty Years after Apollo 11 and beyond." J. Air L. & Com. 84 (2019): 299. (Associate Professor and Director of the Schriever Space Scholars at USAF Air Command and Staff College)//Elmer

The issue of humanity’s cultural heritage in space has arisen as one of many unanswered questions in space law, with no international agreements specifically addressing it. With the beginning of the space age fifty-six years ago and a series of remarkable achievements in space exploration behind us, it is necessary to determine what should be done regarding the “artifacts” of this exploration. NASA has promulgated their recommendations for spacefaring entities with the goal of protecting the lunar artifacts left behind by the Apollo missions.8 These recommendations establish “keep-out zones” of up to a four kilometer diameter with the aim of protecting the artifacts, particularly from dangerous, fastmoving particles that arise as a result of craft landings.9 Experience has shown that even artifacts that are sheltered by craters can be significantly sandblasted and pitted as a result of the moving particles.10 These recommendations, supposedly drafted in conformity with the Outer Space Treaty, however, are completely nonbinding.11 Legislation that has passed the U.S. Senate and is under consideration by the House of Representatives as of July 2019 would make these recommendations binding on U.S. entities seeking to land on the Moon.12 Accidental damage from unrelated missions, however, is only one of many threats to space artifacts. With the impending return to the Moon, it is likely that individuals and corporations will be looking to turn a profit from space heritage, without concern for the protection of such heritage. Tourists may disrupt sites with careless expeditions and landing sites may be desecrated so that the items can be sold. A Russian Lunakhod lunar rover has already been sold at auction to a private party, though it has not yet been moved from its original position on the Moon.13 While national heritage legislation can protect space artifacts from citizens of their own countries, there is currently no effective means in the present space law regime by which a country can protect its heritage from other countries.14 Both California and New Mexico have added Tranquility Base to their list of protected heritage sites.15 However, this solution, and those proposed in the bill put forth to the U.S. House of Representatives, only serve to restrict the activities of a small subset of the potential visitors to the Moon. Though the Senate bill calls for the President to initiate negotiations for a binding international agreement, there is still a long road from this bill to a potential agreement.16 A solution is needed to prevent the damage, destruction, loss, or private appropriation of our cultural heritage in space.

#### We’ll defend NASA’s list of Lunar Heritage Sites – insert Map below.

JPL 13 12-13-2013 "Lunar Heritage Sites" <https://moon.nasa.gov/resources/53/lunar-heritage-sites/> (Jet Propulsion Laboratory at CalTech)//Elmer

A picture containing dome

Description automatically generated

### 1AC---Advantage

#### Global Moon Rush by private actors is coming now.

Sample 19 Ian Sample 7-19-2019 “Apollo 11 site should be granted heritage status, says space agency boss” <https://www.theguardian.com/science/2019/jul/19/apollo-11-site-heritage-status-space-agency-moon> (PhD at Queens Mary College)//Elmer

But protecting lunar heritage may not be straightforward. On Earth, the United Nations Educational, Scientific and Cultural Organisation (Unesco) decides what deserves world heritage status from nominations sent by countries that claim ownership of the sites. Different rules apply in space. The UN’s outer space treaty, a keystone of space law, states that all countries are free to explore and use space, but warns it “is not subject to national appropriation by claim of sovereignty”. In other words, space is for all and owned by none. Wörner is not put off and sees no need for troublesome regulations. “My hope is that humanity is smart enough not to go back to this type of earthly protection. Just protect it. That’s enough. Just protect it and have everybody agree,” he said. A no-go zone of 50 metres around Tranquility base should do the job, he added. Martin Rees, the Cambridge cosmologist and astronomer royal, said there was a case for designating the sites so future generations and explorers were aware of their importance. “If there are any artefacts there, they shouldn’t be purloined,” he said. “Probably orbiting spacecraft will provide routine CCTV-style coverage which would prevent this from being done clandestinely.” Beyond the dust-covered hardware that stands motionless on the moon, Lord Rees suspects future activity could drive calls for broader lunar protection. The Apollo 17 astronaut and geologist Harrison Schmidt has advocated strip mining the moon for helium-3, a potential source of energy. The proposal, which Rees suggests has raised eyebrows in the community, could potentially provoke a backlash. “There might be pressure to preserve the more attractive moonscapes against such despoilation, and to try to enforce regulations as in the Antarctic,” he said. Fifty years on from Apollo 11, the moon is still a place to make statements. In January, the Chinese space agency became the first to land a probe on the far side. On Monday, India hopes to launch a robotic probe, the delayed Chandrayaan-2 lander that is bound for the unchartered lunar south pole. Far more is on the cards. Major space agencies, including ESA and Nasa, plan a “lunar gateway”, described by Wörner as a “bus stop to the moon and beyond”. His vision is for a “moon village”, but rather than a sprawl of domes, shops and a cosy pub, it is more an agreement between nations and industry to cooperate on lunar projects. The private sector is eager to be involved. Between now and 2024, at least five companies aim to launch lunar landers. In May, Nasa selected three companies to design, build and operate spacecraft that will ferry scientific experiments and technology packages to the moon. The coming flurry of activity may make protection more urgent. Michelle Hanlon, a space lawyer at the University of Mississippi, co-founded the non-profit organisation For all Moonkind to protect, preserve and memorialise human heritage on the moon. While she conceded that not all of the sites that bear evidence of human activity needed protection, she said many held invaluable scientific and archaeological data that we could not afford to lose. “These sites need to be protected from disruption if only for that reason,” she added. The protection should be far wider, and more formal, than Wörner calls for, Hanlon argues. “It is astounding to me that we wouldn’t protect the site of Luna 2, the very first object humans crashed on to another celestial body, and Luna 9, the very first object humans soft-landed on another celestial body,” she said. The Soviet Luna programme sent robotic craft to the moon between 1959 and 1976. “The director general has a much more optimistic view of human nature than I do,” Hanlon said. “I completely agree that the entities and nations headed back to the moon in the near future will take a commonsense approach and give due regard to the sites and artefacts. However, that is the near future. We have to be prepared for the company or nation that doesn’t care. Or worse, that seeks to return to the moon primarily to pillage for artefacts that will undoubtedly sell for tremendous amounts of money here on Earth.”

#### Corporate development, tourism, and looting will destroy scientifically rich Tranquility base artifacts.

Fessl 19 Sophie Fessl 7-10-2019 “Should the Moon Landing Site Be a National Historic Landmark?” <https://daily.jstor.org/should-the-moon-landing-site-be-a-national-historic-landmark/> (PhD King’s College London, BA Oxford)//Elmer

When Neil Armstrong set foot on the moon on July 20, 1969, the pictures sent to Earth captured a historical moment: It was the first time that any human set foot on another body in our solar system. Fifty years later, experts are debating how to preserve humankind’s first steps beyond Earth. Could a National Park on the moon be the solution to saving Armstrong’s bootprints for future archaeologists? Flags, rovers, laser-reflecting mirrors, footprint—these are just a few of the dozens of artifacts and features that bear witness to our exploration of the moon. Archaeologists argue that these objects are a record to trace the development of humans in space. “Surely, those footprints are as important as those left by hominids at Laetoli, Tanzania, in the story of human development,” the anthropologist P.J. Capelotti wrote in Archaeology. While the oldest then known examples of hominins walking on two feet were cemented in ash 3.6 million years ago, “those at Tranquility Base could be swept away with a casual brush of a space tourist’s hand.” Fragile Traces Just how fragile humankind’s lunar traces are was seen already during Apollo 12. On November 19, 1969, Charles “Pete” Conrad and Alan Bean manually landed their lunar module in the moon’s Ocean of Storms, 200 meters from the unmanned probe Surveyor 3, which was left sitting on the moon’s surface two years earlier, in 1967. The next day, Conrad and Bean hopped to Surveyor 3. As they approached the spacecraft, they were surprised: The spacecraft, originally bright white, had turned light brown. It was covered in a fine layer of moon dust, likely kicked up by their landing. Harsh ultraviolet light has likely bleached the U.S. flag bright white. Without Apollo 12 upsetting the moon dust, Surveyor 3 would likely have remained stark white. Unlike Earth, the moon has no wind that carries away the dust, no rain to corrode materials, and no plate tectonic activity to pull sites on the surface back into the moon. But the moon’s thin atmosphere also means that solar wind particles bombard the lunar surface, and harsh ultraviolet light has likely bleached the U.S. flag bright white. The astronauts’ first bootprints will likely be on the moon for a long time, and will almost certainly still be there when humans next visit—unless, by tragic coincidence, a meteorite hits them first. Had LunaCorp not abandoned the idea in the early 2000s, the company’s plan to send a robot to visit the most famous sites of moon exploration could have done a lot of damage. And with Jeff Bezos’ recent unveiling of a mock-up of the lunar lander Blue Moon, it is only a matter of time before corporate adventurers and space tourists reach the moon. Historians and archaeologists are keen to avoid lunar looting. Roger Launius, senior curator of space history at the National Air and Space Museum in Washington, D.C., warned: “What we don’t want to happen is what happened in Antarctica at Scott’s hut. People took souvenirs, and nothing was done to try to preserve those until fairly late in the game.” On the other hand, there is a legitimate scientific interest in investigating how the equipment that’s on the moon was affected by a decades-long stay there.

#### Private entities are a unique threat---universal rules key.

1. Private Key Card – AT: Alt Causes
2. AT: Unilat CP
3. AT: Adv CP
4. AT: Generic DA
5. AT: OST DA
6. Solvency Advocate

Hertzfeld and Pace 13 (, H. and Pace, S., 2013. International Cooperation on Human Lunar Heritage. [online] Cpb-us-e1.wpmucdn.com. Available at: <https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/7/314/files/2018/10/Hertzfeld-and-Pace-International-Cooperation-on-Human-Lunar-Heritage-t984sx.pdf> [Accessed 18 January 2022] Dr. Hertzfeld is an expert in the economic, legal, and policy issues of space and advanced technological development. Dr. Hertzfeld holds a B.A. from the University of Pennsylvania, an M.A. from Washington University, and a Ph.D. degree in economics from Temple University. He also holds a J.D. degree from the George Washington University and is a member of the Bar in Pennsylvania and the District of Columbia. Dr. Hertzfeld joined the Space Policy Institute in 1992. His research projects have included studies on the privatization of the Space Shuttle, the economic benefits of NASA R&D expenditures, and the socioeconomic impacts of earth observation technologies. He teaches a course in Space Law and a course in microeconomics through the Economics Department at G.W. Dr. Hertzfeld has served as a Senior Economist and Policy Analyst at both NASA and the National Science Foundation, and has been a consultant to many U.S. and international organizations, including a recent project on space applications with the OECD. He is the co-editor of Space Economics (AIAA 1992). Selected other publications include a study of the issues for privatizing the Space Shuttle (2000), an analysis of the value of information from better weather forecasts, an analysis of sovereignty and property rights published in the Journal of International Law (University of Chicago, 2005), and an economic analysis of the space launch vehicle industry (2005). Dr. Hertzfeld has also edited and prepared a new edition of the Study Guide and Case Book for Managerial Economics (Sixth Edition, W.W. Norton & Co.). Dr. Scott N. Pace is the Deputy Assistant to the President and Executive Secretary of the National Space Council (NSpC). He joined the NSpC in August 2017. From 2008-2017, he was the Director of the Space Policy Institute and a Professor of the Practice of International Affairs at George Washington University’s Elliott School of International Affairs. From 2005-2008, he served as the Associate Administrator for Program Analysis and Evaluation at NASA. Prior to NASA, he was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy. From 1993-2000, he worked for the RAND Corporation’s Science and Technology Policy Institute, and from 1990-1993, he served as the Deputy Director and Acting Director of the Office of Space Commerce, in the Office of the Deputy Secretary of the Department of Commerce. In 1980, he received a Bachelor of Science degree in Physics from Harvey Mudd College; in 1982, Masters degrees in Aeronautics & Astronautics and Technology & Policy from the Massachusetts Institute of Technology; and in 1989, a Doctorate in Policy Analysis from the RAND Graduate School.)-rahulpenu

International Cooperation on Human Lunar Heritage The U.S. Apollo Space Program was a premier technological accomplishment of the 20th century. Preserving the six historic landing sites of the manned Apollo missions, as well as the mementos and equipment still on the Moon from those and other U.S. (e.g., Ranger and Surveyor) and Soviet Union (e.g., Luna) missions is important. Some of the instruments on the lunar surface are still active, monitored, and provide valuable scientifi c information. But recent government and **private**-**sector** **plans** to explore and potentially use lunar resources for commercial activity raise questions about the use of the Moon and potential accidental or purposeful threats to the historic sites and scientific equipment there. Although some steps to protect these sites have been proposed, we suggest a better way, drawing on international, not U.S. unilateral, recognition for the sites. Less than 2 years before the fi rst footsteps on the lunar surface on 20 July 1969 (see the image) , the United Nations Outer Space Treaty (OST) was drafted, ratifi ed, and came into force ( 1). Article II of the OST reinforced and formalized the international standard that outer space, the Moon, and other celestial bodies would not be subject to claims of sovereignty from any nation by any means, including appropriation. The OST prohibits ownership of territory or its appropriation by any state party to the treaty, which includes the United States, Russia, and 126 other nations. It does not prohibit the use of the Moon and its resources. In fact, the treaty emphasizes the importance of freedom of access to space for any nation and the importance of international cooperation in space exploration. These principles of the space treaties have enabled gains in science and technology and have contributed to international stability in space. New attention is being focused on the lunar surface. China has an active Moon exploration program and is considering sending astronauts (taikonauts) to the Moon. **Private** **firms** are contemplating robotic **missions** that could land in the vicinity of the historical sites of Apollo and other missions. Although we might assume the best of intentions for such missions, they could **irreparably** **disturb** the **traces** **of** the first **human** **visits** to another world. NASA has taken **steps** **to** **protect** the lunar landing **sites** and equipment and to initiate a process to create recognized norms of behavior. In July 2011, guidelines were issued for private companies competing in the Google Lunar X Prize that established detailed requirements for avoiding damage to U.S. government property on the Moon ( 2). H.R. 2617, The Apollo Lunar Landing Legacy Act, was introduced into the U.S. Congress on 8 July 2013 ( 3). In essence, it proposes to designate the Apollo landing sites and U.S. equipment on the Moon as a U.S. National Park with jurisdiction under the auspices of the U.S. Department of the Interior. Although the bill acknowledges treaty obligations of the United States, it would create, in effect, a unilateral U.S. action to control parts of the Moon. This would **create** a **direct** **conflict** **with** **i**nternational **law** and could be viewed as a **violation** **of** U.S. commitments under the **OST**. It would be an ineffective way of protecting historical U.S. sites, and it fails to address interests of other states that have visited and will likely visit the Moon. It is **legally** **flawed**, **unenforceable**, and **contradictory** **to** our national **space** **policy** and our international relations in space ( 4). There is a better way for the United States to protect its historic artifacts and equipment on the Moon. The fi rst step is to clearly distinguish between U.S. artifacts left on the Moon, such as fl ags and scientifi c equipment, and the territory they occupy. The second is to gain international, not unilateral, recognition for the sites upon which they rest. Aside from debris from crash landings (by Japan, India, China, and the European Space Agency), there are only two nations with “soft-landed” equipment on the lunar surface: the United States and Russia. China has plans to soft-land Chang’e 3 on the Moon in December 2013. All three nations (and any others wishing to participate) have much to gain and little or **nothing** **to** **lose** **from** a **multinational** **agreement** based on mutual respect and mutual protection of each other’s historical sites and equipment. Legal Issues Although ownership of planets, the Moon, and celestial bodies is prohibited, ownership of equipment launched into space remains with the nation or entity that launched the equipment, wherever that equipment is in the solar system. Under the OST, that nation is both responsible and liable for any harmful acts that equipment may create in space. There are no prescribed limits on time or the amount of damage a nation may have to pay. The U.S. government therefore still owns equipment it placed on the Moon. Ownership has the associated right of protecting the equipment, subject to using necessary and proportional means for protection. But, because no nation can claim ownership of the territory on which equipment rests, there is an open issue of how to control the spots on the Moon underneath that equipment, because the site is **integral** **to** the **historical** **signifi** **-** **cance**. In H.R. 2617, establishment of Apollo sites as a unit of the U.S. National Park System could be interpreted as a declaration of territorial sovereignty on the Moon, even though ensuing paragraphs specify the Park’s components as the “artifacts on the surface of the Moon” at those sites. This problem needs international legal clarifi cation, achievable via a formal agreement among those nations that have the technological ability to directly access the Moon ( 5). Section 6(a) raises another legal issue. The bill proposes that the Secretary of the Interior shall administer the park in accordance with laws generally applicable to U.S. National Parks. It also requires the Secretary to act in accordance with applicable international law and treaties. The U.S. National Park System Act states that the Parks are “managed for the benefi t and inspiration of all the people of the United States” ( 6). The OST clearly emphasizes that the exploration and use of space by nations is to benefi t all peoples. The laws and space policies of the United States have always emphasized peaceful uses of space and the benefi ts of space for humankind. It may not be possible to implement and execute provisions of this Bill without raising important and fundamental questions about these contradictions between the language of the treaty and the mandates of our National Park Service. A third legal issue is raised in section (6) (c)(2) that allows private donations and cooperative agreements to “provide visitors centers and administrative facilities within reasonable proximity to the Historical Park.” This **implies** **future** **private** **use** of the Moon **under** **rights** **granted** **by** the **U.S.** government. **Unilateral** **granting** **of** lunar territorial **rights** to private individuals and implicit sovereign protection of that territory **violates** the **OST**. Finally, section 8 of the bill requires the Secretary of the Interior to submit the Apollo 11 lunar landing site to the United Nations Educational, Scientifi c, and Cultural Organization (UNESCO) for designation as a World Heritage Site. This violates Article II of the OST. All current World Heritage Sites are located on sovereign territory of nations. The only exception is a separate treaty that allows UNESCO to designate underwater sites (such as sunken ships) as protected cultural sites ( 7). These designations are very limited, and although the convention has been ratifi ed by 43 nations, the United States, Russia, and China are not among them. Thus, any new treaty of this type specifi cally for outer space would have little chance of being ratifi ed by the major space-faring nations. A Proposal to Protect Lunar Sites Although a new U.N. treaty for space artifacts of signifi cant cultural and historic importance may be reasonable someday, this would start a very long process with unknown outcomes. Such a treaty could be delayed to a point beyond the time when nations and/or companies may be active on the Moon ( 8). Our suggested alternative is to create a bilateral agreement between the United States and Russia, offered as a multilateral agreement to other nations with artifacts on the Moon. This would be more legally expedient, politically sustainable, and would more likely meet and exceed the stated goals of the bill. It would also emphasize the important role of national laws to implement and enforce these international space agreements. **Any** **nation** **with** **assets** on the lunar surface will **endeavor** **to** **protect** those assets. This creates a situation where those nations have a **timely**, **current**, and **common** **interest** incorporating important implications for peaceful uses of outer space; **scientific** **research** and the advancement of **knowledge**; and **cultural** **and** **heritage** **value**, either presently or in the foreseeable future. The United States, Russia, and China all engage in multilateral cooperative space programs. They share many economic and trade dependencies adding to the international importance of promoting cooperation in space and commerce. In spite of today’s charged political environment, an **agreement** of the type we propose may still be possible to negotiate because it **focuses** **on** the **culture** **of** **space**, the use of space to benefit humankind, and the **archaeological** **record** of our civilization. It specifi cally would not touch sensitive issues of real property rights, export controls, human rights, or the weaponization of outer space. **Cooperation** on recognizing and protecting each other’s interests in historical sites and on equipment and artifacts also has no signifi cant security, prestige, or technological impediments. It reinforces the basic principles of the existing space treaties, avoids declarations of sovereignity on the Moon, and encourages multilateral cooperation resulting in a more stable and predictable environment for private activities on the Moon. The best mechanism for implementing a new agreement would be direct negotiations at highest levels of government in the United States, Russia, and China, with priority to include Russian sites in a proposal that protects U.S. sites. It could be included in meetings of heads of state of those nations, either jointly or sequentially among the three nations. Such an agreement could be executed in a relatively short period of time, setting precedents for peaceful and coordinated research, exploration, and exploitation of the Moon ( 9). An international agreement on lunar artifacts among the United States, Russia, and China would be a far superior and long-lasting solution than the unilateral U.S. proclamation in H.R. 2617. Enforcement of the agreement would be through each nation’s national laws, applying to those entities subject to the jurisdiction or control of the agreement members. Each nation’s property would be protected and preserved. Other nations should be free to join the agreement, and particularly encouraged to do so if they have the ability to access the Moon. An important result would be to develop a new level of trust among nations that could then lead to more **comprehensive** **future** cooperative agreements on **space**, **science**, **exploration**, **commerce**, **and** the use of the Moon and **other** **celestial** **bodies**.

#### Heritage Sites are critical for science research around Dust.

OSTP 18 Office of Science and Technology Policy March 2018 “PROTECTING & PRESERVING APOLLO PROGRAM LUNAR LANDING SITES & ARTIFACTS” (The Office of Science and Technology Policy is a department of the United States government, part of the Executive Office of the President, established by United States Congress on May 11, 1976, with a broad mandate to advise the President on the effects of science and technology on domestic and international affairs.)//Elmer

The Moon continues to hold great significance around the world. The successes of the Apollo missions still represent a profound human technological achievement almost 50 years later and continue to symbolize the pride of the only nation to send humans to an extraterrestrial body. The Apollo missions reflect the depth and scope of human imagination and the desire to push the boundaries of humankind’s existence. The Apollo landing sites and the accomplishments of our early space explorers energized our Nation's technological prowess, inspired generations of students, and greatly contributed to the worldwide scientific understanding of the Moon and our Solar System. Additionally, other countries have placed hardware on the Moon which undoubtedly has similar historic, cultural, and scientific value to their country and to humanity. Three Apollo sites remain scientifically active and all the landing sites provide the opportunity to learn about the changes associated with long-term exposure of human-created systems in the harsh lunar environment. These sites offer rich opportunities for biological, physical, and material sciences. Future visits to the Moon’s surface offer opportunities to study the effects of long-term exposure to the lunar environment on materials and articles, including food left behind, paint, nylon, rubber, and metals. Currently, very little data exist that describe what effect temperature extremes, lunar dust, micrometeoroids, solar radiation, etc. have on such man-made material, and no data exist for time frames approaching the five decades that have elapsed since the Apollo missions. While some of the hardware on the Moon was designed to remain operational for extended periods and successfully telemetered scientific data back to the Earth, much of what is there was designed only for use during the Apollo mission and then abandoned with no expectation of further survivability. How these artifacts and their constituent materials have survived and been altered while on the lunar surface is of great interest to engineers and scientists. The Apollo artifacts and the impact sites have the potential to provide unprecedented data if lunar missions to gather and not corrupt the data are developed. These data will be invaluable for helping to design future long-duration systems for operation on the lunar surface. NASA has formally evaluated the possible effects of the lunar environment and identified potential science opportunities. For example, using Apollo 15 as a representative landing site, the crew left 189 individually cataloged items on the lunar surface, including the descent stage of the Lunar Module, the Lunar Roving Vehicle, the Apollo Lunar Surface Experiments Package, and a wide variety of miscellaneous items that were offloaded by the astronauts to save weight prior to departure. The locations of many of these items are well documented, and numerous photographs are available to establish their appearance and condition at the time they were left behind.

#### Moon Dust Research key to Moon Basing.

Smith 19 Belinda Smith 7-18-2019 “Who protects Apollo sites when no-one owns the Moon?” <https://www.abc.net.au/news/science/2019-07-19/apollo-11-moon-landing-heritage-preservation-outer-space-treaty/11055458> (Strategic Communications Advisor at Department of Education and Training at University of Victoria)//Elmer

It's not just about history Alongside heritage value, the bits and pieces left on the Moon have enormous scientific significance. Take moon dust. It's a real problem for moon-bound equipment because it's made of fine, super sticky and highly abrasive grains, which have a habit of clogging instruments and spacesuits. But as Armstrong and Aldrin trotted across the surface, the footprints they left behind gave us valuable information into the properties of moon dust, Flinders University space archaeologist Alice Gorman said. "The ridges on the boots were meant to measure how far they sank into the dust. "Then they used the light contrast between the ridges to measure the reflectance properties of the dust." A boot print in grey dust. This iconic photo of Buzz Aldrin's footprint is also a science experiment. (Supplied: NASA) It's data like this that will help if we want a long-term base on the Moon — we need to know how our gear will stand up to lunar conditions. Apart from the sticky, gritty dust, the lunar surface is also peppered with meteorites and cosmic rays. So, Dr Gorman said, one of the very few reasons to revisit a moon site is to collect some of the equipment left behind and see how it fared. "What has happened to this material in 50 years of sitting on the lunar surface? "This is going to be really interesting scientific information because it will help planning for future missions and get an understanding of long-term conditions." And NASA has already done this. The Apollo 12 mission, which landed on the Moon four months after Apollo 11, collected parts from the 1967 Surveyor probe and brought them back to Earth. An astronaut standing next to a piece of equipment on the lunar surface Along with rocks and soil samples, Apollo 12 astronauts collected pieces of the Surveyor 3 probe for analysis back on Earth. (Supplied: NASA) Another reason to preserve the equipment left on the Moon is to prove we really went there, Professor Capelotti said. "There's a lot of people out there who still don't believe it happened. "The stuff on the Moon is a testament to what we did and when we did it."

#### Scenario 1 is Warming

#### Lunar observatory solves warming adaptation.

Ding et al. 17 (, Y., Liu, G. and Guo, H., 2017. Moon-based Earth observation: scientific concept and potential applications. [online] Volume 11, 2018. Available at: <https://www.tandfonline.com/doi/full/10.1080/17538947.2017.1356879> [Accessed 22 January 2022] Yixing Ding - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Guang Liu - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Huadong Guo - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China.)-rahulpenu

4. Scientific goal of moon-based earth observation A basic question for moon-based Earth observation is, ‘What to see?’ According to the characteristics of moon-based Earth observation, the phenomena suitable for Moon-based Earth observation may have at least one of the following features: long-lasting, related to Sun–Earth–Moon motion, requires stable baseline observation, large-scale and describes multiple parameters. In the following sections, we will present several observation objectives to discuss in detail. 4.1. Solid earth dynamics Solid Earth tides, continental plate movement and glacier isostatic adjustment (GIA) are three typical large-scale solid Earth movements (Jiang et al. 2016), the measurement of which is a basic task of geodesy. For a uniform layered Earth, accurately predicting tidal movement can be done theoretically, but complex ocean tides and the inelasticity and heterogeneity of Earth’s interior material make the solid tide of the real Earth difficult to research theoretically. For GIA studies, prior knowledge about ancient ice cover evolution and a large amount of observational data are needed. Plate tectonics theory is a quantitative description of Earth plate movement (Ni et al. 2016). It may well explain the movement of most oceanic plates, but still have some problems to explain the mechanism of strong continental earthquakes, large-scale continental deformation, as well as the movements of other oceanic plates (Bird 2003). Accurately **measuring** solid **Earth** **dynamics** is **beneficial** **to** **understanding** solid Earth **tides**, **continental** **plate** **movement** and **GIA**, and provides further support for geodynamics and seismology. Devices such as a superconducting gravimeter and global navigation satellite system are currently used to measure small deformations of solid Earth, but these point-by-point methods are spatially limited to certain regions. Spaceborne InSAR measures deformation continuously, but the swath is not wide enough for mapping large-scale solid Earth movement. The Moon is a vast and stable platform that can provide sufficiently long and stable baseline interferometry. Its movement is easier to predict and the time interval of repeat-pass interferometry could be reduced to one day (Fornaro et al. 2010). In addition, the Moon is one of the main sources of tides on the Earth; so if we compare two measurements at different times, the lunar tide portion can be subtracted, leaving only the solar tide portion. After proper processing, it may help us learn more about the interior structure of Earth’s crust. To measure the large-scale deformation, a Moon-based repeat-pass InSAR system needs to be carefully designed. Except for the general SAR parameters, the critical baseline is a key factor that impacts its performance. The critical baseline Bc leading to a complete spatial decorrelation is given by Bc = BlDem tan ui c . (7) In this equation, the incidence angle ui is related to the observational geometry, while l and B are optional. When the bandwidth is 100 MHz and the incidence angle is 25°, the critical baselines are 14,000, 3300 and 1770 km at the L-band, C-band and X-band, respectively. In order to keep the correlation between two repeat passes, a practical baseline must be smaller than Bc. Therefore, from a practical point of view, the L-band is better than the C-band or X-band. Figure 4 shows the simulation results of one-day interval interferometry, but the side-looking constraints are not involved. In this case, the temporal decorrelation is highly reduced. It is obvious that the interferometric area is larger in the L-band than in X-band. Meanwhile, when the declination of the Moon is near the extremes, the interferometric area becomes larger. When the declination of the Moon is near the equatorial plane, one-day interval repeat-pass interferometry is not feasible, but a half month or one month interval repeat-pass interferometry is available. The magnitude of the solid Earth motion is not large. For example, the typical solid Earth tide amplitude is dozens of centimetres in one day. A resolution of hundreds of metres or even coarser will be enough if the wave is stably scattered. 4.2. Energy budget of earth Fundamentally, **climate** **change** **depends** **on** Earth’s **radiation** **balance**. **Observation** **of** both the solar **radiation** **and** Earth’s **reflection** and emission will **depend** **on** **accurate** **measurement** with space technology. Since the late 1970s, the United States and Europe have launched a number of missions to measure solar and terrestrial radiation, such as NASA’s Active Cavity Radiometer Irradiance Monitor Series programme (ACRIM1, 1980–1989; ACRIM2, 1991–2001; ACRIM3, 2000–present), Earth Radiation Budget Experiment (ERBE, 1984–1994), Clouds and Earth’s Radiant Energy System (CERES, 1997–present), Solar Radiation and Climate Experiment (SORCE, 2003–present) and the French Megha-Tropiques satellite on the Scanner for Radiation Budget (ScaRaB, 2011–present). These missions have greatly improved our understanding of Earth’s energy system. The Deep Space Climate Observatory (DSCOVR), placed at the earth–Sun first Lagrangian point, has been designed to measure the outgoing radiation of the sunlit Earth disk with a constant look angle. But in the outgoing radiation, the reflected shortwave **radiation** is **highly** **affected** **by** **albedo** **and** **atmospheric** **conditions**, showing obvious anisotropy. **Lack** **of** **sampling** in space and time is **vulnerable** **to** **uncertainties**. The **lunar** **observatory** **provides** **large**-**scale** **observation** **with** continuously **changing** **angles**, enabling it to calibrate the **data** of satellites in different orbits at different times. Its most important property is that it can provide a **very** **long**-**term** time series from a single orbit platform. In a year, the time series covers all local times, all seasons (different weather pattern) and all Earth phases for all underlying surfaces (Pallé and Goode 2009; Karalidi et al. 2012). The diversity of the **surface**-**weatherphase** combination is beneficial to improving the quality of global energy budget data and to the study of regional energy redistribution and its multi-layer coupling effects. The Moon-based data will also provide a direct connection between the data from space technology and the data from ground-based earthshine measurement series, which span almost one hundred years. The system design can consult the DSCOVR satellite, a radiometer measuring irradiance of the Earth phase and an imaging camera taking images of the Earth phase for various Earth sciences purposes. In order to take into account the needs of observing the Earth’s environmental elements, 1 km spatial resolution and 20–30 channels of the camera are suggested. 4.3. Earth’s environmental elements Vegetation is an important part of the global carbon pool and a key element of global carbon cycle. Most vegetation is distributed in middle- and low-latitude regions. A Moon-based optical camera can image global **vegetation** almost every day. SAR maps not only the horizontal distribution of vegetation, but also extracts forest morphological structure through tomography. The Moon provides multi-baseline **accessibility** within a single pass to eliminate the tomographic temporal decorrelation, but the imaging temporal decorrelation within a long synthetic aperture time hampers the focusing of forest. Therefore, to validate the feasibility of Moon-based **3D** **mapping** of forest, more imaging methods for unstable scatterer, for example, the time reversal imaging method (Jin and Moura 2007), need to be tested and new methods are also expected. Glaciers are sensitive variables of climate change. The monitoring of glacier area, surface velocity and mass balance plays an important role in understanding the status of glaciers and their response to global change. Remote sensing techniques, such as optical sensors, SAR and altimeter data, provide regular observations of key glacial parameters. A lunar platform would provide continuous three- or four-day temporal coverage per month at the polar regions, but the observation incidence angle would typically be larger than 40° (see Figure 5) due to the relatively small inclination angle of the lunar orbit. For the High Asia area, the average coverage is about 4 h per day with proper incidence angle. The challenges may be the cost of high-resolution mapping for the optical sensor, and the layover problem (Tilley and Bonwit 1989) in heavy gradient area for SAR. Moon-based altimetry faces the same problems as LiDAR mentioned before, and is not recommended. An **atmospheric** **observatory** on the Moon can be used to evaluate the cloud fraction in an unambiguous manner, **determine** the **composition** in terms **of** the major **trace** **gas** and aerosols (Hamill 2016), and shed light on the relationship between lunar phases and **cloudiness** or **precipitation**. Particularly, the Moon offers a good place for **occultation** observation, which means observing the light or microwave changes emitted by stars or satellites when they are obstructed by atmosphere around the Earth. The Global Ozone Monitoring by Occultation of Stars (GOMOS) instrument on board the Envisat satellite is a typical system using the stellar occultation measurement principle in monitoring ozone and other trace gases in Earth’s stratosphere (Kyrola et al. 2004). Moon-based occultation was proposed in Link (1969), and was considered promising in Moon-based Earth atmosphere monitoring (Hamill 2007, 2016; Guo et al. 2014). The advantage of Moon-based occultation is that a star descends several times slower through the atmosphere than when viewed from a LEO satellite. This helps by increasing the SNR and resolution to some extent, but the practical performance also relies on the system design and the probability of finding an appropriate occultation geometry. 4.4. Earth-space environment Observing the environment of outer space surrounding Earth requires much larger FOV than only observing the solid Earth. The Moon is an ideal place to monitor the interaction between the solar wind and the magnetosphere. Moon-based observation combined with high near-polar Earth orbit or Molniya orbit observations can help us construct the three-dimensional structure of the magnetosphere by X-ray and EUV remote imaging. Images in all meridian planes of the whole plasma layer have already been captured by the EUV camera on the Chang’e 3 lander. Some initial results reflect the basic features of the plasmasphere, and also verified the accessibility of high-quality data of magnetosphere from the Moon (Feng et al. 2014). 5. Conclusion In this paper, we propose the Moon as a platform for Earth observation with long-term, dynamic capabilities, mainly focusing on large-scale geoscience phenomena. The characteristics of a lunar platform, the sensors and the scientific objectives of Moon-based Earth observation are discussed in detail. A lunar platform could observe Earth in quite a different way, and give a long-lasting disk view, a stable baseline and a unique perspective. The proposed sensors include some optical sensors and SAR. LiDAR, altimeters and scatterometers may not be functional on the lunar surface mainly because of the long viewing distance, and Moon-based radiometers may not be necessary if spaceborne radiometers are effective enough. Though the cost is not discussed in this paper, a Moon-based SAR would be extremely expensive and face too many specific technical difficulties to be implemented at the present time. On the contrary, passive optical sensors, such as spectrographs and panchromatic cameras, are much easier to realize. The scientific objectives of Moon-based Earth observation include measuring solid Earth dynamics and the global energy budget, and monitoring Earth’s environment and the surrounding environment of outer space. Moon-based Earth observation will be effective in measuring solid Earth tides, detecting outgoing radiation, and monitoring the magnetosphere and some of Earth’s environmental elements. Finally, we suggest that numerical simulations are indispensable to validate the proposals and to address specific problems.

#### Moon Base is the only option and outweighs Satellites.

Ding et al. 17 (, Y., Liu, G. and Guo, H., 2017. Moon-based Earth observation: scientific concept and potential applications. [online] Volume 11, 2018. Available at: <https://www.tandfonline.com/doi/full/10.1080/17538947.2017.1356879> [Accessed 22 January 2022] Yixing Ding - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Guang Liu - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Huadong Guo - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China.)

There are several characteristics of Moon-based Earth observation as listed below. (1) Longevity The life cycle of artificial satellites is generally several years, while the Moon has already existed for billions of years, and will not go extinct in the foreseeable future. It is a longstanding, essentially permanent platform. The revisit cycle is quite different from LEO satellite. Except for the polar regions, the revisit period is one day, the same as Earth’s rotation period. The revisit period in the same geometric condition is one month, the same as the moon’s revolution period. The temporal sampling of the lunar platform is not systematically biased. It covers all local times in a month and all seasons in a year. This will be very useful for long-term time series analysis in climate change research. Furthermore, the lunar platform can also provide time series data to calibrate the remote sensing data from other platforms. (2) Integrity The whole Earth disk facing the Moon, both the sunlit portion and dark portion, is always observable from the near side of the Moon, with a field angle of only about 2°. This allows an observer on the Moon to view the whole Earth disk at any given time and Earth’s entire surface in a day, both in dark and sunlit conditions. (3) Stability Studies show that the lunar crust lacks plate tectonics; so the quantity and degree of moonquake activities are much less than earthquakes (Jaumann et al. 2012). Compared to satellite platforms, the Moon has vast spaces on which to install a set of sensors to form a long, stable baseline of large observational networks for precise measurement. Moon also moves stably, which enables repeat-pass interferometry. (4) Uniqueness Moon exerts influences on precipitation, ice nuclei concentrations, diurnal pressure changes, hurricanes, cloudiness, thunderstorm and surface temperature (Balling and Cerveny 1995). The tidal force of the Moon is also considered as a trigger of earthquakes (Cochran et al. 2004) and a resource generating internal waves (Simmons et al. 2004). For those Moon-related terrestrial phenomena, the lunar platform provides such a unique perspective that any place on the Earth can be continuously monitored at different Moon–Earth phase angles each day. A Moon-based sensor can dynamically trace the whole process covering their occurrence, development and dissipation. It will help the understanding of the relationship between the tidal phases and the evolution of the phenomena. 3. Sensors for moon-based earth observation For most of the history of lunar exploration, the United States, China and Japan have been taking a few pictures of Earth with cameras both on the lunar surface and in lunar orbit. This proved that it is possible to observe Earth utilizing Moon-based optical sensors. However, except for observing Earth’s magnetosphere, these photos had no specific scientific objective. Few works about the sensors for Moon-based Earth observation have been published by previous missions. So, in this section we discuss the feasibility and the key parameters of various traditional remote sensors, including both the optical sensors and the microwave sensors. 3.1. Optical sensors for moon-based earth observation One important parameter of most remote sensing systems is the spatial resolution. The detection range of Moon-based optical sensors is much further than spaceborne sensors. The diffraction limited resolution of optical sensors r is given by = 1.22lR/d, (1) where l is the wavelength, d the telescopic aperture and R the distance from the sensor to the target. In the visible band, the limiting resolution is 0.17–0.36 km, when d is 1 m. In short, if the telescopic aperture is 0.5 m, the spatial resolution can be less than 1 km in the visible band and several kilometres in the near-infrared and thermal infrared bands, which satisfies the needs of climatologic models and global mapping for oceans, clouds and land use (Ding, Guo and Liu 2014). LiDAR is an example of an active sensor. To place a LiDAR on the Moon, many technological challenges must be taken into consideration, such as the echo power, the size of the laser beam on earth’s surface and the coverage performance. If the scattering solid angle of a homogeneous scatterer is p, the received power of this system falls within the square of the distance from LiDAR to scatterer R (Wagner et al. 2006): Pr = PtrD2 r 4R2 , (2) where the received power and transmitted power is Pr and Pt, Dr the receiving aperture and r the reflectivity. The power needed for Moon-based LiDAR would be a hundred thousand times greater than that of satellite-based LiDAR, which is at the megawatt level. The footprint of the laser beam on Earth’s surface is proportional to the laser divergence angle. Under a divergence of 0.1 m/rad, the beam of Moon-based LiDAR would be 36–40 km, two orders of magnitude larger than the beam width of spaceborne LiDAR. Such a large beam would stretch the length of the echo signal and complicate its waveform, and will lead to a difficulty to determine the exact echo position of the target in measuring the altitude of sea surface and the thickness of vegetation.

#### Adaptation solves Climate Change’s worst effects – it’s the Silver Bullet.

Rood and Gibbons 21 Richard B. Rood and Elizabeth Gibbons 9-11-2021 "After a summer of weather horrors, adapting to climate change is an imperative" <https://archive.is/VKac8#selection-391.0-413.1> (Richard B. (Ricky) Rood is a professor of climate and space sciences and engineering at the University of Michigan. Elizabeth (Beth) Gibbons is executive director of the American Society of Adaptation Professionals.)//Elmer

This summer, the extraordinary heat in the Pacific Northwest, floods across the Northern Hemisphere and Hurricane Ida’s swath across the country have awakened more people to the dangers of climate change. As professionals working on climate change, we receive many requests for comments and interviews. More telling, perhaps, have been panic-tinged personal letters from family and friends as well as colleagues working in the field awakening to the real-world consequences of our warming climate. Public messaging on climate change is dominated by the discussion of reducing carbon dioxide emissions to limit the warming and to stop the “worst effects” of climate change. This is the mitigation of global warming. Headlines range from declarations of climate despair to the measured voices of those who insist that there is still the time and wherewithal to limit warming to the goals aspired to by the United Nations. Amid this cacophony of mitigation panic and sought-after patience is another discussion that has been going on for more than a decade. Namely, that we are not likely to meet emission-reduction goals such as those of the Paris agreement. This is complemented by the fact that we live in a rapidly changing climate, rapid change will continue, and we are not going back to the climate of our childhoods. When we consider how we will address our climate future, it is worth considering our past behavior and choices. We have had the ability and the roadmap to make major strides in reducing carbon dioxide emissions and mitigating climate change for many years. In many cases, these mitigation tactics are “no regrets,” with very quick monetary payback for expenditures — the insulation of houses and choosing fuel-efficient vehicles, for example. Yet we have not taken these steps at the scales that are required for effective intervention. Mitigation is one response, but adaptation can be framed as the other response. Adaptation is responding to the effects of warming or perhaps coping with the consequences of the warming Earth. With the public conversation focusing overwhelmingly on mitigation, adaptation has been a neglected topic. Compared with mitigation, adaptation is relatively easy. Effective mitigation requires changing human behavior, ingrained geopolitical and economic power structures, and built infrastructure on a global scale. It requires convincing people to invest for the common good of other people, often decades into the future. At its simplest, adaptation can be carried out by an individual. You can sell the house next to the ocean and move to northern Michigan. You can reinforce your roof and put your oceanside house on stilts. There is a concrete value proposition. Although adaptation can be carried out by individuals, it is better and certainly more equitable to plan on the larger scales of a community, a city or a region. As the geographical scale increases and more individuals, organizations and local governments are involved, it does get more difficult. However, the threats to life, property and the local environment often serve as motivation to challenge the barriers of cooperation and shared beneficial outcomes. For example, a region threatened by rising seas is motivated to come together to find solution strategies. Indeed such efforts are underway, for example, in the Southeast Florida climate compact, the Puget Sound climate collaborative, and efforts across Southeast Virginia’s Hampton Roads region. When a region successfully implements adaptation plans, communities are likely to have wins when the next storm is not as destructive and costly. These wins help people cope with global warming and realize some ability to take control of what has been often stated as an existential threat. There have been those calling for adaptation policy for many years. However, it has been difficult to get adaptation on the policy agenda. This is ascribed to many reasons, including the persistent, spurious argument that if we talk of adaptation, then we will decide that we do not need to mitigate our emissions. However, we are at the point that, even if we were to meet all of the emission reduction goals of the United Nations’ Paris agreement, adaptation will still be required. In the end, the most important aspect of adaptation is fundamentally human. If individuals and communities can see adaptation as a way of sustaining their well-being in the face of rapidly changing weather, then it is a step of moving past the narrative that we must, between now and 2030, solve an existential threat to our survival. We can see successful adaptation strategies spreading, scaling, and bringing planetary warming into the mind-set and the behavior of more and more people. We must entrain dealing with the weather of a warming Earth into all that we do. And that, we assert, will make the need for mitigation more real and urgent.

#### Prevents extinction.

Sears 21 (, N., 2021. Great Powers, Polarity, and Existential Threats to Humanity: An Analysis of the Distribution of the Forces of Total Destruction in International Security. [online] ResearchGate. Available at: <https://www.researchgate.net/publication/350500094> [Accessed 22 November 2021] Nathan Alexander Sears is a PhD Candidate in Political Science at The University of Toronto. Before beginning his PhD, he was a Professor of International Relations at the Universidad de Las Américas, Quito. His research focuses on international security and the existential threats to humanity posed by nuclear weapons, climate change, biotechnology, and artificial intelligence. His PhD dissertation is entitled, “International Politics in the Age of Existential Threats”)-re-cut rahulpenu

Climate Change Humanity faces existential risks from the large-scale destruction of Earth’s natural environment making the planet less hospitable for humankind (Wallace-Wells 2019). The decline of some of Earth’s natural systems may already exceed the “planetary boundaries” that represent a “safe operating space for humanity” (Rockstrom et al. 2009). Humanity has become one of the driving forces behind Earth’s climate system (Crutzen 2002). The major anthropogenic drivers of climate change are the burning of fossil fuels (e.g., coal, oil, and gas), combined with the degradation of Earth’s natural systems for absorbing carbon dioxide, such as deforestation for agriculture (e.g., livestock and monocultures) and resource extraction (e.g., mining and oil), and the warming of the oceans (Kump et al. 2003). While humanity has influenced Earth’s climate since at least the Industrial Revolution, the dramatic increase in greenhouse gas emissions since the mid-twentieth century—the “Great Acceleration” (Steffen et al. 2007; 2015; McNeill & Engelke 2016)— is responsible for contemporary climate change, which has reached approximately 1°C above preindustrial levels (IPCC 2018). Climate change could become an existential threat to humanity if the planet’s climate reaches a “Hothouse Earth” state (Ripple et al. 2020). What are the dangers? There are two mechanisms of climate change that threaten humankind. The direct threat is extreme heat. While human societies possesses some capacity for adaptation and resilience to climate change, the physiological response of humans to heat stress imposes physical limits—with a hard limit at roughly 35°C wet-bulb temperature (Sherwood et al. 2010). A rise in global average temperatures by 3–4°C would increase the risk of heat stress, while 7°C could render some regions uninhabitable, and 11–12°C would leave much of the planet too hot for human habitation (Sherwood et al. 2010). The indirect effects of climate change could include, inter alia, rising sea levels affecting coastal regions (e.g., Miami and Shanghai), or even swallowing entire countries (e.g., Bangladesh and the Maldives); extreme and unpredictable weather and natural disasters (e.g., hurricanes and forest fires); environmental pressures on water and food scarcity (e.g., droughts from less-dispersed rainfall, and lower wheat-yields at higher temperatures); the possible inception of new bacteria and viruses; and, of course, large-scale human migration (World Bank 2012; Wallace-Well 2019; Richards, Lupton & Allywood 2001). While it is difficult to determine the existential implications of extreme environmental conditions, there are historic precedents for the collapse of human societies under environmental pressures (Diamond 2005). Earth’s “big five” mass extinction events have been linked to dramatic shifts in Earth’s climate (Ward 2008; Payne & Clapham 2012; Kolbert 2014; Brannen 2017), and a Hothouse Earth climate would represent terra incognita for humanity. Thus, the assumption here is that a Hothouse Earth climate could pose an existential threat to the habitability of the planet for humanity (Steffen et al. 2018., 5). At what point could climate change cross the threshold of an existential threat to humankind? The complexity of Earth’s natural systems makes it extremely difficult to give a precise figure (Rockstrom et al. 2009; ). However, much of the concern about climate change is over the danger of crossing “tipping points,” whereby positive feedback loops in Earth’s climate system could lead to potentially irreversible and self-reinforcing “runaway” climate change. For example, the melting of Arctic “permafrost” could produce additional warming, as glacial retreat reduces the refractory effect of the ice and releases huge quantities of methane currently trapped beneath it. A recent study suggests that a “planetary threshold” could exist at global average temperature of 2°C above preindustrial levels (Steffen et al. 2018; also IPCC 2018). Therefore, the analysis here takes the 2°C rise in global average temperatures as representing the lower-boundary of an existential threat to humanity, with higher temperatures increasing the risk of runaway climate change leading to a Hothouse Earth. The Paris Agreement on Climate Change set the goal of limiting the increase in global average temperatures to “well below” 2°C and to pursue efforts to limit the increase to 1.5°C. If the Paris Agreement goals are met, then nations would likely keep climate change below the threshold of an existential threat to humanity. According to Climate Action Tracker (2020), however, current policies of states are expected to produce global average temperatures of 2.9°C above preindustrial levels by 2100 (range between +2.1 and +3.9°C), while if states succeed in meeting their pledges and targets, global average temperatures are still projected to increase by 2.6°C (range between +2.1 and +3.3°C). Thus, while the Paris Agreements sets a goal 6 that would reduce the existential risk of climate change, the actual policies of states could easily cross the threshold that would constitute an existential threat to humanity (CAT 2020).

#### Scenario 2 is Aquaculture

#### Lunar Basing would require aquaculture that provides mutual benefits that spill-down terrestrially – results in sustainable aquaculture.

Przybyla 21, Cyrille. "Space aquaculture: prospects for raising aquatic vertebrates in a bioregenerative life-support system on a lunar base." Frontiers in Astronomy and Space Sciences 8 (2021): 107. (Studies Aquaculture Research at University of Montpellier)

Space Aquaculture: A Relevant Source of Complementary Nutrition Resupplying a base in space from Earth on a weekly basis is neither economically nor technologically feasible (a trip to the Moon takes 4–7 days, and to Mars 5–8 months). A short-term solution is to provide processed and prepackaged space food. However, lyophilized conservation is unstable, especially concerning essential nutrients such as potassium, calcium, vitamin D, and vitamin K, which is involved in muscle and bone maintenance. The micronutrients most sensitive to storage degradation are vitamins A, C, B1, and B6 after one year at ambient temperature (Cooper et al., 2017). A possible nutrition strategy for space bases could be to couple local fresh production with supplies brought by cargo spaceships. Providing fresh, nutritious and safe food is imperative for the success of a manned base on Moon or Mars. Recent studies have shown that food energy needs during a spaceflight are similar to those required on Earth. If energy intake is reduced, the human body is subjected to physiological stress causing cardiovascular deconditioning, bone demineralization, muscle atrophy and immune system deficiency. Moreover, microgravity exposure reduces the nitrogen balance in an astronaut’s body. This results in a 30% reduction in protein synthesis (Stein, 2001). A study of previous manned missions in low orbit monitored the crew’s physical performance consuming food commonly used in space missions and showed that an increase in carbohydrates (from plants) and a decrease in animal protein and fat can disturb the diet balance (Gretebeck et al., 1994). Ideally, a fresh animal-based food source should be included in the diet of space residents. Seafood is one of the healthier animal products for human nutrition. Its nutritional merits and protective benefits have been abundantly described over the last century. Like wild fish, aquaculture fish sequester digestible proteins and essential amino acids, lipids, including essential polyunsaturated fatty acids (PUFAs), essential vitamins and minerals in their muscles. Vitamins are precursors of molecules that are essential coenzymes for enzyme catalysis. When the synthesis of coenzymes is not included in an organism’s genetic heritage (this is the case for Homo sapiens), their natural synthesis must be achieved by the ingestion of living cells. These cells are provided by a diet of plants or animals. In addition to micronutrients, farmed marine, brackish and freshwater fish can sequester ALA (PUFA precursor), EPA or DHA from their diet (Tocher, 2015). Several aquaculture fish have the physiological capability to produce EPA and DHA (ALA chain elongation) and store these essential compounds (Morais et al., 2015; Gregory et al., 2016). The micronutrients commonly found in fish and their health benefits are presented in Table 1 (Tacon et al., 2020). At the beginning of the 1980s, the first study on the possibility of space aquaculture emphasized the shared points between recirculating aquaculture systems (RAS) and BLSS (Hanson, 1983). Yet although aquaculture seems to offer a relevant solution for manned long-term missions (Bluem and Paris, 2003), almost four decades later, no significant innovative solutions have been proposed for space exploration. This may be due to the international strategy of developing low orbit science over the last 30 years with the ISS program, to the detriment of more complex and ambitious projects such as trips to the Moon or Mars involving long-term stays. Why Raise Aquatic Organisms in Space? Hydrogen and oxygen are abundant in the Universe, and water molecules are everywhere in the solar system. Sub-glacial liquid water has been detected on many rocky planets such as Mars, Mercury, and Venus (Liu, 2019; McCubbin and Barnes, 2019). There is evidence of the presence of an internal ocean on icy moons such as Enceladus (Cadek et al., 2016) and Europa (Kalousova et al., 2016). Recent research has indicated the presence of water molecules on rocky exoplanets from other solar systems in our galaxy (Olson et al., 2020). Water is the main in situ resource required for a planetary mission, both for long-term human settlement or astrobiology considerations; however, most observations have revealed that this water has high mineral content or is close to brine due to geological mineralization (Orosei et al., 2018). It would need to be purified to use as a source for water of drinking quality, yet it could be primarily used for rearing marine organisms such as algae, invertebrates, or fish. Today, producing protein from farmed animals (poultry, cattle, or sheep) in low gravity does not seem feasible. A large surface area is needed for livestock rearing, which would directly compete with human space, and costly synthetized air reconditioned from precious in situ resources such as lunar or planetary water or gas produced by BLSS biotechnology would be reserved for the human residents’ artificial atmosphere. Due to their poikilothermic physiology, fish require five to twenty times less energy than mammals, and around three times less oxygen, as well as generate less carbon dioxide emissions, which is an important consideration for BLSS gas exchange management. Another issue is waste management. With terrestrial animals such as pigs, chickens, goats, or cows, feces collection is not easy to solve. However, in aquatic vertebrate production, all dissolved compounds and particulate matter are sequestered in the water and can be easily treated and removed from the system or converted by another organism. Lastly, compared to terrestrial farmed animals, aquaculture is commonly viewed as playing a major role in improving global food security on Earth because the feed conversion ratio (FCR: the feed biomass necessary to provide to a farmed organism to obtain a weight increase of 1 kg) for fish is drastically lower than for land vertebrates. The FCR for different aquaculture organisms compared to that of the main farmed land animals is shown in Figure 1. Protein and calorie retention from aquaculture production is comparable to livestock production (Fry et al., 2018). All aquatic vertebrates exhibit better feed efficiency, which implies less feed to produce in a BLSS and to manage on the Moon or Mars. Gas management in lunar or Martian bases will probably be the main challenge for engineers in the next decade. On Earth, the atmosphere sequesters a stock of oxygen, and its continuous production is provided by oceanic and terrestrial photosynthetic organisms. Before the Industrial Revolution, carbon dioxide production was balanced with oxygen consumption. Today, even with the rise in CO2 emissions, oxygen is not a limited source. In contrast, in a closed system in an extreme environment such as the Moon or Mars, oxygen is not available in its basic form and must be produced. Hence, it is a precious molecule and it is of particular interest to include low oxygen consumers–and consequently, low carbon dioxide producers–in a BLSS. Compared to animals that breathe air, fish, and more generally aquatic organisms, have the lowest oxygen requirement and are the lowest producers of carbon dioxide (Figure 2). In fish, carbon dioxide production from respiration is dissolved, concentrated and stored in the water column. Fish have been shown to maintain their oxygen consumption under conditions of elevated CO2 partial pressure (Ishimatsu et al., 2008). The dissolved CO2 from RAS effluent could be used directly by an aquatic photosynthetic organism such as algae. Collecting CO2 emitted from fish and dissolved in the water column and directing it to a secondary biological system without an additive process would be a huge advantage for BLSS gas management. In contrast to farmed poultry and mammals, aquatic organisms would also be protected from cosmic rays by the water environment, which is an intrinsic radiation shield. The first life forms on Earth developed in a brackish ocean with a salinity of around 10 mg/L (Quinton, 1912). Complex life emerged from the Earth’s oceans when the atmospheric layer had not yet been totally formed by the respiration of microorganisms (stromatolites, bacteria and microalgae) and volcanic activity. The thin atmosphere exposed the Earth’s surface to intense cosmic radiation. The hypothesis that water played a role as a radiation shield in the appearance of aquatic life is strong and plausible. In connection with the development of space aquaculture, further experiments would be needed to determine the integrity or splitting of a heavy charged particle from cosmic radiation entering the water of an aquaculture tank. Transporting any type of animal in a space mission would subject them for several minutes to hypergravity between 4 and 8 g (unit of acceleration due to gravity) depending on the space engine. But hypergravity conditions are not unknown for oceanic fish such as the bluefin tuna (Thunnus thynnus). In one stress experiment, the force required for maximal acceleration was measured in this species. The associated hypergravity applied to the tuna was around 3 g for a few seconds (Dubois et al., 1976). No experiments have been conducted on aquaculture fish, but the natural acceleration caused by an escape behavior has been recorded as between 1 and 3 g. Another argument in favor of finfish as candidates for space aquaculture is that as opposed to other reared vertebrates and humans, in the water column they can move vertically as well as horizontally. Fish use a ballast system, the swim bladder, and otolith sensitivity to move in a volume of water, experiencing gravity but also buoyancy. In the ocean, fish are already in microgravity conditions due to water density and Archimedes’ principle. Thus, altered gravity should not interfere with swimming behavior during the lifecycle of a fish. Experiments have revealed that a fish in microgravity during a space mission orients its swimming direction and body position according to the position of the light in the module without losing the ability to feed or affecting social behavior. Fish movement can also be correlated with spaceship rotation (Ibsch et al., 2000; Anken et al., 2002). Indeed, astronauts train underwater as this is the best way to imitate the weightless conditions found in space. The suits they wear in the training pool are designed to provide neutral buoyancy (like a fish’s swim bladder) to simulate the microgravity experienced during spaceflight (Otto F.Trout, 1969). Spaceflight analog missions are conducted underwater in NASA’s Extreme Environment Mission Operations (NEEMO), involving multi-hour activities at a depth of 19 m (Koutnik et al., 2021). While the hypothesis that the variation in space gravity will not drastically disturb the fish from a physical, behavioral or welfare point of view is plausible, this remains to be tested in experiments on aquaculture fish species. Ornamental Fish as a Model for Understanding Human Physiology in Space The zebrafish Danio, the medaka Oryzias, and the swordtail fish Xiphophorus have been frequently boarded on space missions as models for understanding human gravitational sensations, due to the homology with human morphological and physiological systems. These species have proved the most suited vertebrate animals for basic gravity research. The gravity-sensing system in vertebrates from fish to humans has the same basic structure. Although aquarium fish are not aquaculture fish, space missions over the last five decades have provided useful results on fish physiology, behavior and well-being in microgravity (Lychakov, 2016). The earliest spaceflight with fish occurred on July 28, 1973. Two fingerlings and fifty embryonated eggs of the mummichog (Fundulus heteroclitus) were launched by a Saturn 1B rocket. The Apollo service module joined Skylab 3 and the fish were positioned in a plastic bag filled with seawater. This American space mission preferred the mummichog, a small saltmarsh killifish, to goldfish for this experiment. This species was not well known or described at that time, but it became the first “fishonaut”. For three days, swimming in loops and circles was observed for the two fingerlings, but they gradually returned to normal swimming. The fish acclimation period was comparable to that for a human crew during a first spaceflight. This observation suggested that the vestibular function (the otolith for fish–the inner ear for humans) probably plays the same sensory role in microgravity. The Fundulus heteroclitus eggs carried aboard the Skylab station in low orbit hatched successfully during the mission with a very good hatching rate (96%). The hatched fry displayed normal swimming behavior in contrast to the first hours in microgravity for the fingerlings (Baumgarten, 1975). Fish embryos in microgravity develop a physiological strategy to compensate for the unusual environment, and the larvae formed were already adapted to microgravity, as evidenced by the lack of looping behavior. In 1975, during nine days of the manned Apollo-Soyuz MA-161 mission, a group of 21-day-old juvenile mummichogs were exposed to real microgravity, and similar irregular swimming was observed. Fish eggs were also boarded (n = 100/samples at 32 hpf [hours post-fertilization], 66 hpf, and 128 hpf stages; pre-liftoff fertilization times) and were subjected to post-flight hatching rate evaluation back on Earth. The juveniles were evaluated using light orientation tests, and no significant differences were observed in behavior, suggesting an adaption capability to the space environment. The embryo hatching rate was 75%, and hatching date monitoring showed that the three earliest stages of egg batches carried on Apollo-Soyuz hatched at 15 days (normal hatching rate is 21 days), much sooner than the latest stage batch and earlier than the control batches at 1 g. Apparently, the development of young eggs was faster under microgravity, but the embryos exhibited no abnormalities resulting from development in a zero-gravity environment. The eyes, heart, nerves, and bones were found to be the same in the flight group as in the control group. There was no evidence of calcium deficiency, except in the shorter hatching-time group (Hoffman et al., 1977). In July 1994, the 17th Columbia space shuttle mission STS-65 boarded Japanese medaka (Oryzia latipes) for 15 days of spaceflight in the second International Microgravity Laboratory (IML-2). These ornamental fish laid eggs, and normal hatching was observed in space, with the results showing that medaka fertilization and embryonic development was not significantly impaired by altered gravity (Ijiri, 1998). Probably the most impressive aquatic closed-loop experiment in low orbit and a successful demonstration of an aquatic trophic chain in space, in the 1990s, a German team from Ruhr University Bochum and the German Aerospace Centre (DLR) developed the Closed Equilibrated Biological Aquatic System (CEBAS) with fresh water, containing small aquarium fish (Xiphophorus hellerii), water snails (Biomphalaria glabata), aquatic plants (Ceratophyllum dermersum), and aquatic microorganisms. The ground-based demonstration showed that a filter system was able to keep a closed artificial aquatic ecosystem stable for several months and to eliminate waste products deriving from degraded dead fish without a decrease in oxygen concentration to less than 3.5 mg/I at 25°C (Blum et al., 1994; Blum et al., 1995). Then in January 1998, during the Endeavour space shuttle mission STS-89 to the MIR station, aquarium swordtail fish (Xiphophorus helleri) were exposed to 9 days of microgravity, with 200 juveniles and four pregnant adult fish carried in a mini CEBAS module (10 L) (Blum et al., 1994). The aim of this aquatic mini-module (Figure 3) was to record the behavior of an artificial ecological closed loop in low orbit and verify the hypothesis that aquatic life is not affected by exposure to space conditions using a complementary organism. The female fish were retrieved in good physiological condition, adult and juvenile fish had a survival rate of about 33%, and almost 97% of the snails had survived and produced more than 250 neonates in microgravity (Bluem et al., 2000). During the spaceflight, the vertebrates were video-recorded for behavioral analysis and no aberrant looping or spinning behavior was observed. Immediately after landing back on Earth, the adult fish swam vertically, head upward, to the top of their habitat, strongly beating the caudal and pectoral fins. This was due to empty swim bladders not used during the spaceflight and reuse acclimation on Earth (Anken et al., 2000; Bluem et al., 2000; Rahmann and Anken, 2002). In April 1998, another population of swordtail fish and four adult wild marine fish oyster toadfish (Opsanus tau) flew with the space shuttle STS-90 mission, hosted in the Neurolab facility. After 16 days in real microgravity, fish brain synaptic contacts were compared to a control population at 1 g on Earth. Spaceflight yielded an increase in synaptic contacts within the vestibular nucleus indicating a compensation processes for neonates swordtail fish (Ibsch et al., 2000). Results revealed a gravity compensation process and the role of the fish lateral line associated to the fish brain for appropriate swimming behavior (Anken et al., 2002). The Vestibular Function Experiment Unit (VFEU) aboard STS-95’s SpaceHab again hosted two oyster toadfish as experimental subjects. The fish were electronically monitored to determine the effect of gravitational changes on the otolith system. The freely moving fish provided physiological signals of the otolith nerves. Measurements of afferent and efferent responses were made before, during, and post-flight (Boyle et al., 2001). In January 2003, four medaka eggs laid on Earth in an artificially controlled environment were launched by the Columbia space shuttle during the STS-107 mission. For the control, four eggs in the same condition remained on the ground. No difference was observed in the time of development. In the ground experiment, the embryos were observed to rotate in the egg membrane, whereas in flight they did not rotate. One egg hatched 8 days after the mission launch in the flight unit, while four eggs hatched in the ground unit. In the flight unit, the fry was observed with its back usually to the camera and little swimming movement suggest. The results shown no appreciable difference in the time course of development between space- and ground-based embryos. (Niihori et al., 2004). The hatched medaka larva, embryos and the crew from the space mission tragically never returned to Earth alive due to the accident during the space shuttle’s reentry in the atmosphere. In 2007, dry eggs of the ornamental killifish the redtail notho (Nothobranchius guentheri) were placed into cotton-cloth bags, then into plastic Petri dishes, and fastened on the outer side of the ISS. The aim of the Biorisk-MSN mission was to expose dry incubated eggs to low orbit radiation. Unfortunately, no data is available concerning the resistance of the fish eggs as the equipment had no temperature sensor and the plastic dishes reached 95°C, deforming the plates, and the eggs died due to the high temperature and vacuum contact (Baranov et al., 2009). To study the fish response at early stage to microgravity, two missions using medaka fish were performed on ISS, in 2012 and 2014. Each time a Soyuz rocket sent 24 juveniles medaka (6 weeks after hatching, 16 mm) with the objective of rearing this population in the Aquatic Habitat (AQH) on the Kibo section of the ISS. Medaka fish in space and control fish from the same family on Earth were filmed. The movies showed that the fish became adapted to life under microgravity although despite an unusual swimming behavior. In addition, a mating behavior was observed under microgravity at day 33 and was not different from that on the Earth, indicating microgravity environment doesn’t disturb fish reproduction. The aquarium fish used for this experiment have fluorescent osteoclast cells, which makes them easier to observe. An osteoclast is a type of bone cell that breaks down bone tissue and responsible for bone loss. After 47 days in space, the fish tended to stay still in the tank. After 56 days, the mission fish group had normal growth compared to a terrestrial control. For fish in microgravity impairment of some physiological functions was accompanied by the activity of osteoclasts and a slight decrease in mineral density and vertebral bones. (Chatani et al., 2015; Murata et al., 2015; Chatani et al., 2016). Historical space missions involving ornamental fish are listed in Table 2. Missions With Aquaculture Fish in Low Orbits Very few missions involving aquaculture fish have been carried out to date (Table 3). In one of these, the common carp (Cyprinus carpio)—considered a very important aquaculture species in many countries–was chosen as a model for a sensor motor experiment by Japanese university teams and the Japan Aerospace Exploration Agency (JAXA). Two colored carp (16 months old, 26 cm and 263–270 g) were carried to the American SpaceLab in 1992. One of the two carp was given a labyrinthectomy (the otolith was removed). For both fish, swimming behavior and dorsal light response was studied and compared. As observed during the first space missions with small fish, the normal carp was unstable (associated with a kind of space motion-sickness) for the first three days, then finally recovered its Earth-based swimming behavior. The fish whose otolith was removed two months before showed a normal dorsal light response 22 h after launch, and disruption for the next two days as with the normal carp. Unfortunately, the recovery process for the fish with the removed otolith could not be evaluated due to a technical issue, but these observations provided evidence of a sensory-motor disorder during the early phase of adaption to microgravity in aquaculture fish (Mori et al., 1996). The change in body weight was monitored from two days before launch to four days after landing. Both fish recorded a weight loss around 12% in low orbit after 14 days of fasting. No conclusion can be made as a fasting replicate on the ground was not available (Mori et al., 1994). During space shuttle missions STS-55 (1993) and STS-84 (1997), tilapia Oreochromis mossambicus larvae that had not yet developed the roll-induced static vestibuloocular reflex were exposed to microgravity for 9–10 days. Young larvae (11–14 days after hatching) already exhibited the vestibuloocular reflex on the 1993 mission. Back on Earth, a vestibuloocular reflex test (fish were turned around their longitudinal axis at an angle of 15, 30, and 45°) showed that eye movement and reflex were not affected by exposure to microgravity during the two space missions (Sebastian et al., 2001). The OMEGAHAB (Aquatic Habitat) is a closed artificial ecosystem that was sent into orbit for 13 days on board the Russian satellite FOTON-M3 in 2007. The goal of the mission led by the German Space Agency was to investigate the possibility of designing a trophic chain in real microgravity using the photosynthetic flagellate Euglena gracilis as an oxygen producer and larvae of tilapia Oreochromis mossambicus as a consumer. This freshwater and brackish species is a popular aquaculture fish, with worldwide production of around 15,000 tons per year. In the 2007 experiment, 26 small larvae (approx. 12 mm in length) in the flagellate aquarium were studied in low orbit to increase knowledge about the development of the vestibular organs and enzymatic activity. The best fish survival rate (42%) ever achieved in a German experiment was recorded. Conditions of real microgravity during spaceflight induced a larger than normal otolith compared to a control maintained at 1 g. This could result in a difference in the ability to sense gravity (Anken et al., 2016). In a same ground unit, the photosynthetic producers supplied sufficient amounts of oxygen to a fish compartment with 35 larval cichlids (Hader et al., 2006). Historical space missions involving aquaculture fish are listed in Table 3. Feeding Fish in Space: Integrated Multi-Trophic Aquaculture If fish were farmed on a space base, sending aquaculture feed from Earth to Moon or Mars would make no sense from an economic or lifecycle analysis point of view. Aquatic systems contain a large diversity of species with different roles in nutrient cycles and biomass conversion that contribute to ecosystem balance. Photosynthetic organisms (algae, phytoplankton), invertebrates (crustaceans, mollusks, zooplankton), vertebrates (fish, amphibians), and microorganisms interact in a complex trophic web. By associating different complementary species such as fish, filter feeders, detritivores and primary producers, integrated multi-trophic aquaculture (IMTA) provides an innovative possibility for BLSS on the Moon or Mars. The nutritional profile of fish is closely linked to their diet quality. In aquaculture, this can be easily adjusted by ensuring a fish feed formulation that includes organisms that synthesize or sequester proteins, lipids of interest (e.g., EPA or DHA), vitamins and minerals. These aquatic organisms can be cultivated separately in a chain (from algae to invertebrates to fish) exclusively with fish waste as a fertilizer or using other available waste from human activities, such as exhaled carbon dioxide, space agriculture byproducts, or residents food waste. In the framework of sustainable aquaculture on Earth, researchers are studying trophic webs using closed or semi-closed aquatic systems that reuse fish nutrients dissolved in the water column or fish fecal matter as a fertilizer or food source for another aquatic organism. In an IMTA system, microalgae or macroalgae cultivation is easy using fish tank effluents, as the N/P ratio fits the requirements of algae: the increasing algae biomass assimilates nitrogen and phosphorus forms (Pagand et al., 2000). To return treated water back to the fish tank, it can be cleaned so it is safe for fish growth and welfare (Mladineo et al., 2010). Moreover, fish farm effluent is a suitable media for cultivating Nannochloropsis gaditana, a marine algae with a high PUFA content (Dourou et al., 2018). Several studies have reported the possibility of feeding aquaculture fish with microalgae (mostly marine) included in the fish feed formulation. Several microalgae strains have been tested successfully (they do not alter growth kinetics or organoleptic quality) with fish feed made up of 20–40% of microalgae: Crypthecodinium sp., Phaeodactylum sp. (Atalah et al., 2007) and Schizochytrium sp. (Ganuza et al., 2008; Stuart et al., 2021) have been tested for the seabream and amberjack diet; Tetraselmis sp. (Tulli et al., 2012), and Isochrysis sp. (Tibaldi et al., 2015) for European seabass; Nanofrustulum sp. for salmon, common carp and schrimps (Kiron et al., 2012); and Tetraselmis sp. and Isochrysis sp. for cod (Walker and Berlinsky, 2011). The modern feed form for aquaculture fish is dried pellets with less than 10% moisture. However, a study has shown that feeding fish using a moist formulation, such as algae or aquatic worms, with a water content around that of the natural prey profile in oceans, did not affect fish growth parameters and in fact increased resistance and immune protection (Przybyla et al., 2014). Thus, photosynthetic or invertebrate aquatic organisms produced in a Moon or Mars greenhouse could be fed directly to aquaculture fish with no transformation process. Researchers are exploring these alternatives to preserve wild fish stocks currently used for aquaculture fish feed (e.g., processed into fish meal and fish oil). Other algae sources with higher integration rates in feed formulations are the focus of future studies, while research is also investigating new types of aquatic prey compatible with fish feed, such as jellyfish (Marques et al., 2016). The algae cultivated in an IMTA system, as well as fish effluent, can also be a feed source for invertebrates, mollusks (Li et al., 2019), and sea cucumbers (Chary et al., 2020). A team from NASA is studying the possibility of using invertebrate production systems to purify water while growing protein-rich species as food/feed sources. Aquatic species such as copepods or mussels should grow rapidly, offer good protein content and have low mass for launch requirements (Brown et al., 2021). In the ocean, copepods and mussels are the favored natural prey of fish (especially seabream) and can be used as live feed for aquaculture fish. This production could also serve as food for the human crew. Thus, aquatic invertebrates and microalgae could play a key role in a trophic chain on a space base. In a recirculating aquaculture system, particulate matter is composed mainly of feces, mucus and bacterial clusters. This waste is easy to separate and remove from the RAS. Some copepods can use this media as feed, but another invertebrate is being studied for its ability to reduce this particulate matter and convert it into valuable biomass: the aquatic worm (Galasso et al., 2020). Polychaeta are detritivores and can be a feed source of interest for fish. Aquatic worms cultivated in an RAS can convert fecal matter into useful fatty acids for fish feed (Kicklighter et al., 2003; Bischoff et al., 2009; Palmer et al., 2014). Other synergies might also be possible: for example, Caenorhabditis elegans is a small terrestrial nematode already studied in space as a model for ageing in microgravity, as 35% of C. elegans genes have human homologs (Honda et al., 2014). This nematode could thus be both cultivated and observed in space in a BLSS. In wild environments on Earth, a fish’s diet is composed of its own congener, algae or invertebrates. Ground-based experiments have evaluated Nile tilapia as a bioregenerative sub-process for reducing solid waste potentially encountered in a space aquaculture system (Gonzales, 2009). The Tilapia feed formulation consisted of vegetable, bacterial, or food waste. Sulfur, nitrogen, protein, carbon and lysine content of waste residues were assimilated, sequestered and recycled in Tilapia muscle. Although Tilapia’s specific growth rate from population fed with different fibrous waste were widely inferior (1.4—89.8 mg/day−1) compared to the control population (281.6 mg/day−1), the Tilapia’s survival rate was not different. These results suggest additional research to improve feed formulation composed with fibrous residues (Gonzales and Brown, 2007). When considering formulating aquaculture fish feed on a space base using exclusively aquatic organisms cultivated in an IMTA system, it is essential to determine the digestive efficiency of the fish feed. A recent study highlighted the extreme flexibility of European seabass to feed formulations without fish meal and fish oil. In the experiment, fish were given several formulations containing 85% plant sources and 15% alternative sources (yeast, insects, and processed animal protein or Arthrospira platensis). Zootechnical results showed that three formulations resulted in a growth equal to fish fed with a traditional commercial formulation including a wild fish source. The bacterial community in the fish digestive tract adapted to the new formulation composed of alternative protein and lipid sources, and bacterial diversity was not altered (Perez-Pascual et al., 2020). This plasticity is probably common to other fish species, allowing a promising avenue to test new innovative formulations for aquaculture fish using exclusively BLSS raw matter sources such as cyanobacteria, plants, algae, and invertebrates. Applicability and Limitations of a Space Aquaculture System Like the systems for other types of food sources being studied for a future BLSS, such as those to produce microalgae and higher plants (Tikhomirov et al., 2007), the design of a space aquaculture system (SAS) is subject to various parameters, including the location in the Solar System. The size of the SAS would depend on the number of residents to feed, the other food sources necessary based on nutritionist’s recommendations, the space available on the lunar base, water availability and quality, the energy available for this activity, and the duration the BLSS will need to operate. One scenario might be to provide around 250 g of fish per person per week. The volume of the tank for rearing the fish should also be correlated to the fish growth rate and the frequency at which the fish are harvested. The diversity of fish species allows possibilities to be imagined such as using the area under the floor of the lunar base for flat fish, for example, or a tank that is not connected to the crew’s living area. On the Moon as on Earth, an aquaculture system requires water circulation. While the energy needed to pump water in an SAS with lunar gravity (one-sixth of Earth’s gravity) is yet to be defined, maintaining a set water temperature will have an energy cost. Within a window of tolerance depending on the species, fish growth directly depends on the water temperature (Handeland et al., 2008). In a context of 14 days of Sun exposure and 14 days of darkness, the latter period will require warming the water to maintain the growth rate. Thus the thermal profile of the selected species will be one of the parameters to consider. This aspect will have a direct impact on the total energy required for an acceptable growth yield in the SAS. Although fish have a low oxygen uptake compared to other vertebrates (Figure 2), a regular supply is required. Oxygen dissolution in the water from hydroxyl extraction and oxygen from the regolith and/or from photosynthesis in plants cultivated in the BLSS must be synchronized with the biological demands of the fish. This requires the capacity to regularly collect, store and dissolve oxygen in the water column. The oxygen data from the CEBAS experiment on the STS-89 and STS-90 missions was analyzed to model this concept. Results based on the experimental MINI-MODULE (8.6 L) showed different periods of oxygen accumulation and depletion in the aquatic habitat in plants (oxygen producer) and snails (oxygen consumer). Simulations from ground-based models predict the oxygen concentration and can be adapted for other species (Drayer and Howard, 2014). A trend has to be defined between the volume of oxygen instantly available or stored and the demand of aquatic consumers. This highlights the importance of an oxygen buffer tank linked to a feedback control mechanism (possibly remotely controlled from Earth) in case of a lack of oxygen. Another aspect to monitor is bacterial development inside the system. An axenic environment cannot be considered as bacteria play an essential role in all stages of a balanced ecosystem. Yet bacteria activity affects the nutrient budget and oxygen measurement and availability (Konig et al., 2001). All these parameters will drive the size of the SAS and the fish biomass allowed in an extreme environment such as the Moon. Another issue to consider is aquatic biomass extraction in the space environment. Harvesting cells such as microalgae is a current challenge, today handled using vacuum and flocculation (Barrut et al., 2012). The development of harvesting tools is required for different aquatic organisms in a limited and constrained space. Regardless of the organism, extraction is necessary when the biomass has reached its optimum growth to avoid uncontrolled water degradation and increased oxygen consumption by microorganisms that would endanger fish production. The time needed for fish management on a lunar base also depends on the size of the SAS. Current technology developed for RAS drastically reduces the time necessary to maintain the system. Most of the tasks can be automated, such as starting and cleaning the biofilter, monitoring water parameters (Konig et al., 2001), and regulating the water. Fish feeding is a time-consuming task, but this can also be automated. Fish are able to adapt to self-feeding devices (Coves et al., 1998; Di-Poi et al., 2008), which contribute to the social interaction of the population (Chen et al., 2002). As in plant production systems (Bamsey et al., 2009), several automated SAS actions could be carried out remotely from a control room on Earth. A daily routine (visual checking of the system and fish behavior and non-automated actions) could be considered to involve around 1 h every 12 h for a closed loop system composed of 16 tanks (1 m3) and 8 kg/m3 of fish biomass (based on personal experience). The energy available to power the SAS will also determine its design. A ground-based greenhouse simulation for food production with lunar constraints is necessary to study and understand gas flow management, organism interactions, and all related parameters necessary to maintain a stable and balanced ecosystem. Studying the Feasibility of Sending Aquaculture Fish Embryos to the Moon: The Lunar Hatch Program In research underway since 2019, the Lunar Hatch program is investigating the feasibility of shipping embryonated aquaculture fish eggs to space for programmed hatching in a lunar BLSS. The hatched larvae would then be fed with local resources and reared until they reached an appropriate size for human consumption. The aim of the study is proof of concept based on experimental data collected first in ground-based trials, followed by test missions in low orbit, and concluding with a real flight to space, perhaps leading to the hatching of the first vertebrate on the Moon. The program focuses on the viability of European seabass (Dicentrarchus labrax) for such a project, by analyzing the potential effects on embryos of a Moon journey and the associated environmental changes. Water found on celestial bodies in the Solar System have a saline or hypersaline profile. The choice of the European seabass in the Lunar Hatch program was based on the fact it is a marine organism with an appreciated taste, and its physiology and behavior have been abundantly described. A secondary water source for fish aquaculture could also be considered such as recycled water from a greenhouse or non-potable water from technical process or human activities. The diversity of aquaculture fish species allows the appliacation of many potential “fishonauts”, depending on the primary or secondary water resource available in situ (fresh or salt water). Other aquaculture species could equally be considered for rearing in space, such as trout, flat fish or shrimp. As mentioned, in the 1970s, spaceflight tests were carried out at the egg stage with ornamental fish (Table 2). The choice of eggs as the biological stage for space travel is relevant for several reasons. A low volume of water is required for egg incubation, so the initial launch biological payload could be less than 1 kg for around 900 future larvae. In aquaculture nurseries, European seabass egg density in the water column is around one egg per milliliter. Unlike the larval or adult stages, the embryogenesis phase is suitable for a spaceflight because embryo development does not require human intervention for several days (the duration of embryogenesis depends on the species). Although embryogenesis involves intense metabolic activity for the development of the future larva, the low biomass and the chorion limit catabolite emission as well as the self-pollution of water during the journey. This would allow either long manned spaceflights with no need for maintenance from the crew, or simply the transport of fish eggs using an automated cargo ship. Compared to normal conditions in land-based aquaculture production, during a spaceflight fish embryos would be initially subjected to atypical acoustic and mechanical vibrations caused by launcher motors and acceleration in the atmosphere. The effects of this are under study in the framework of the Lunar Hatch program (supported by the French National Institute for Ocean Science, Ifremer) using a standard qualification test commonly employed in the space industry. In a recent experiment, a vibration exciter mimicked the conditions of a SOYUZ-2/FREGAT launch on a population of fish embryos (Figure 4). In this test, two triplicates (n = 300) of embryos of aquaculture species (European seabass and meagre in two separate experiments) were submitted to the acoustic and mechanical environment of a launch for 10 min at one-third and two-thirds of their development. The hatching rate was then compared to a control triplicate (n = 300). No significant differences were observed on the hatching rate for either species whatever the stage of development when the embryos were exposed to the conditions (Figure 5). These encouraging results indicate the egg robustness of two major aquaculture species. A credible hypothesis to explain these results is that the success of the global aquaculture industry is based on the selection of aquatic species for robustness criteria to actions such as unusual and stressful handling–especially at an early lifecycle stage–such as sorting, sampling, transfer from aquarium to tank, or long transport by road or air. The aquaculture sector has selected the most biologically flexible strains with the most interesting nutritional profile for economic reasons. The resulting robustness could benefit space programs–it would not be surprising if other aquaculture species also successfully pass this qualifying test. Beyond intense vibrations, understanding the influence of hypergravity and microgravity on embryonic development is essential to evaluate the feasibility of space aquaculture. Previous studies on ornamental aquarium fish can provide some information on fish behavior and physiology in space that may be useful. Hypergravity is experienced during rocket take-off, an acceleration phase that lasts about 10 min at 4–8 g, depending on the launcher motors. This situation was tested on swordtail fish and medaka otoliths (Anken et al., 1998; Ijiri et al., 2003; Brungs et al., 2011; Anken et al., 2016) and larvae bone development (Aceto et al., 2015; Chatani et al., 2015), but its effects on early ontogeny (hatching capability) are as yet poorly described. A recent research showed that six month exposition at 5 g can induce vertebral curvatures and asysmetric otoliths (Chatani et al., 2019). However, the duration of exposure to hypergravity during a launch to the Moon or Mars will be about 10 min, the time to extract the embryos from the Earth’s attraction. Ongoing experiments are exploring the ability of aquaculture finfish embryos to develop in these conditions. It is credible to posit that hypergravity applied to a water reservoir may be less felt by a submerged embryo. In contrast to poultry eggs stored in air, the water density surrounding fish eggs may reduce the acceleration force on the chorion. Following the initial conditions of rocket vibrations and acceleration, a situation of microgravity appears beyond an altitude of 110 km. During the entire evolution of life on Earth, the development of all organisms took place under constant gravity conditions in different media (air/water). It should be noted that in the ocean, fish embryos are already in a kind of microgravity compared to terrestrial organisms due to Archimedes’ principle and other physical phenomena. This is why, to simulate partial microgravity, astronaut training exercises are carried out in a swimming pool. A study has found that embryos of Xenopus (an aquatic frog) are able to adjust to microgravity environments until hatching through an adaptation mechanism and strategy (Black et al., 1995). Might this capability be common to other aquatic organisms, including fish embryos? Supported by the French space agency (CNES), the Lunar Hatch program plans to study the embryo behavior of European seabass in hypergravity and microgravity in the Gravitational Experimental Platform for Animal Models (GEPAM), a European Space Agency platform to test different gravity environments on animals (Bonnefoy et al., 2021). Exposure to radiation during the space journey will be the last environmental change investigated in future Lunar Hatch program studies: this is probably the parameter with the most impact on fish embryo biology. Knowledge about the effects of space radiation on a variety of organisms has increased over the last decades: for bacteria (Leys et al., 2009), plant and mammalian cells (Arena et al., 2014), and amphibians (Fuma et al., 2014). A ground-based study on the influence of radiation on fish immediately post-hatching was carried out on the ornamental zebrafish (Danio rerio), in which eggs were irradiated with doses ranging from 1 to 1,000 mSv.d−1 for 20 days (Simon et al., 2011). At the stage of 3 days post-hatching, no significant difference in mortality was observed between irradiated eggs and the control. The maximum daily dose was 100 times greater than the total dose astronauts were subjected to during the Apollo 11 mission. These results are consistent with a study in which no significant difference in mortality was observed between 0.8 mGy (the threshold recommended to protect ecosystems) and 570 mGy delivered per day, but the radiation exposure induced accelerated hatching for both doses and a decrease in yolk bag diameter for the highest dose (Gagnaire et al., 2015). In contrast, another study exposing zebrafish embryos to 1, 2.5, 5, 7.5, and 10 mGy of gamma radiation at 3 hpf showed that increasing gamma radiation increased DNA damage, decreased hatching rate, increased median hatching time, decreased body length, increased mortality rate, and increased morphological deformities (Kumar et al., 2017). A higher total dose but spread over time therefore seems to be less harmful than a single high dose concentrated in the early stages of development. Gagnaire et al. also found abnormal development of the spine for individuals subjected to 570 mGy.d−1. These research results on a small fish provide useful information for countermeasures that would need to be implemented on a lunar base. Fish and crew should be protected to reduce cosmic ray damage. Fish embryos could benefit from progress in countermeasure technology developed for humans, but it would be valuable to conduct experiments on the impact of different particles and charges (separate and cumulative) from cosmic radiation on the candidate fish. Conclusion The Lunar Hatch program is investigating the prospects of lunar aquaculture based on a circular food system using a selected species at a specific stage of the lifecycle. It may be of interest to investigate other aquaculture species for other targeted planets or other lifecycle development stages. In the case of the Moon, it is so close to Earth that rearing adults for reproduction would not be worthwhile: a regular shipment of fertilized eggs for monthly generation would avoid costly fish-spawning management on the lunar base. For a more distant destination such as Mars, the embryo stage would be realistic for the first part of the mission, but the total flight would be longer than the duration of embryogenesis. In this case, larval development would need to be considered during the multi-month journey. For farther destinations, studies would need to determine the possibility of rearing broodstock to control the entire biological lifecycle in space. Space aquaculture would provide a valuable food source in addition to those already studied for long-term missions. The diversity of nutrients provided by fish and the benefits for human metabolism may help in the challenges of space medicine, in particular the prevention of cancer caused by long-term exposure to radiation. The activity of fish farming itself could have positive psychological and cognitive effects. Reports about plant-growth chambers on manned missions have described the psychological benefits of working with living organisms in space. An investigation involving social scientists could be conducted to better understand the possible positive benefits of human–animal interaction in space. Vertebrates may recall basic human activities and provide a psychological umbilical cord with the Earth. Modern recirculating aquaculture systems share many characteristics with the closed bioregenerative life-support systems planned for space. Progress in aquaculture technology on land and in space can feed into each other. For example, developments that allow space aquaculture systems to recover and convert waste molecules into edible food could be deployed on Earth to increase food availability while avoiding waste discharge in the environment and preserving biodiversity. Joint efforts to design such waste conversion systems will be applicable above all to human activities on Earth. Like other aspects of BLSS, while space aquaculture is close to being a reality, it is highly dependent on the water and energy available in situ. At the turn of the 20th century, the Russian father of astronautic science Konstantin Tsiolkovsky wrote: “Earth is the cradle of humanity, but one cannot remain in a cradle forever.” Plants and animals are part of the human biosphere and food chain. Space exploration will likely be more successful if humans leave the cradle with a part of their own biosphere and their knowledge of agricultural science, including aquaculture.

#### Aquaculture solves Over-Fishing.

Dennett 19 Carrie Dennett 2-13-2019 “Seafood lovers’ paradox: Eating fish is healthy, but overfishing is a problem. A fix? Eat more farmed fish” <https://www.seattletimes.com/life/wellness/its-time-to-think-differently-about-farmed-fish/> (PhD, nutritionist and reporter for Seattle Times)//Veronica

Why the disconnect? For many, the environmental impact of overfishing is a major concern. News reports of incidents like the large-scale escape of farmed Atlantic salmon near the San Juans in 2017 raise concerns about the impact of aquaculture on wild fish populations. But could it be possible to make the healthful choice — eating more fish and seafood — sustainably? Before dismissing farmed fish, keep in mind that both wild fisheries and fish farms can be well-managed and sustainable — or not. For centuries, the seas and oceans were considered to be a limitless source of food, but unsustainable fishing practices have led to overfishing, which means more fish are caught than can be replaced through natural reproduction. Even worse, specific fishing methods also destroy aquatic habitats and ecosystems, erode coastal economies and kill animals not being fished. Known as “bycatch,” denoting their status as innocent bystanders, these animals include sea turtles, marine mammals, sharks and albatross. According to the National Oceanic and Atmospheric Administration (NOAA), production from wild fisheries around the world plateaued in the mid-1980s, and even with improved management, is not likely to increase significantly. Meanwhile, consumer demand for seafood has risen. A report recently released by the global EAT-Lancet Commission on Food, Planet, Health, which I wrote about last week, pointed out that about 60 percent of world fish stocks are fished to capacity, and over 30 are overfished. The authors called for both improved management of the world’s oceans and sustainable expansion of aquaculture, aka fish farming. According to the Monterey Bay Aquarium Seafood Watch program, aquaculture may be the solution to the increasing pressures on our ocean resources. Fish farming is nothing new — it’s been in practice for hundreds of years in some parts of the world, even if the term “farmed fish” makes some seafood lovers grimace. To help meet the growing global demand for seafood, aquaculture is on the rise. According to NOAA, worldwide aquaculture production has increased annually by 8.3 percent since 1970. Current estimates indicate that half of seafood consumed worldwide and in the U.S. is farm-raised, with that percentage expected to reach 62 percent by 2030. Unfortunately, the U.S. lags behind in aquaculture production, ranking 13th in the world, one of the reasons we import 90 percent of our seafood. Although federally managed U.S. fisheries are improving, and overfishing rates are decreasing, domestic wild fish can’t meet demand, especially if more people start eating the recommended amount of fish and seafood. Sustainable aquaculture operations have very little environmental impact because they use practices that limit disease, fish escapes, damage to natural habitats and use of wild fish as feed. One example of sustainable U.S. aquaculture is Colorado Hybrid Striped Bass, produced by the family-owned fish farm Colorado Catch. According to NOAA, many countries are investing in sustainable aquaculture research and development and developing systems for regulation. To take the guesswork out of buying sustainably, look for the Best Aquaculture Practices certification labels. The Global Aquaculture Alliance administers this third-party certification to seafood products that come from facilities managed in an environmentally, socially and economically responsible manner.

#### Overfishing is the crucial internal link to marine biodiversity

Pauly 9 Daniel Pauly 9-28-2009 “Aquacalypse Now” <http://www.newrepublic.com/article/environment-energy/aquacalypse-now> (professor at the Fisheries Centre of the University of British Columbia)//Elmer

The jig, however, is nearly up. In 1950, the newly constituted Food and Agriculture Organization (FAO) of the United Nations estimated that, globally, we were catching about 20 million metric tons of fish (cod, mackerel, tuna, etc.) and invertebrates (lobster, squid, clams, etc.). That catch peaked at 90 million tons per year in the late 1980s, and it has been declining ever since. Much like Madoff’s infamous operation, which required a constant influx of new investments to generate “revenue” for past investors, the global fishing-industrial complex has required a constant influx of new stocks to continue operation. Instead of restricting its catches so that fish can reproduce and maintain their populations, the industry has simply fished until a stock is depleted and then moved on to new or deeper waters, and to smaller and stranger fish. And, just as a Ponzi scheme will collapse once the pool of potential investors has been drained, so too will the fishing industry collapse as the oceans are drained of life. Unfortunately, it is not just the future of the fishing industry that is at stake, but also the continued health of the world’s largest ecosystem. While the climate crisis gathers front-page attention on a regular basis, people--even those who profess great environmental consciousness--continue to eat fish as if it were a sustainable practice. But eating a tuna roll at a sushi restaurant should be considered no more environmentally benign than driving a Hummer or harpooning a manatee. In the past 50 years, we have reduced the populations of large commercial fish, such as bluefin tuna, cod, and other favorites, by a staggering 90 percent. One study, published in the prestigious journal Science, forecast that, by 2048, all commercial fish stocks will have “collapsed,” meaning that they will be generating 10 percent or less of their peak catches. Whether or not that particular year, or even decade, is correct, one thing is clear: Fish are in dire peril, and, if they are, then so are we.The extent of the fisheries’ Ponzi scheme eluded government scientists for many years. They had long studied the health of fish populations, of course, but typically, laboratories would focus only on the species in their nation’s waters. And those studying a particular species in one country would communicate only with those studying that same species in another. Thus, they failed to notice an important pattern: Popular species were sequentially replacing each other in the catches that fisheries were reporting, and, when a species faded, scientific attention shifted to the replacement species. At any given moment, scientists might acknowledge that one-half or two-thirds of fisheries were being overfished, but, when the stock of a particular fish was used up, it was simply removed from the denominator of the fraction. For example, the Hudson River sturgeon wasn’t counted as an overfished stock once it disappeared from New York waters; it simply became an anecdote in the historical record. The baselines just kept shifting, allowing us to continue blithely damaging marine ecosystems. It was not until the 1990s that a series of high-profile scientific papers demonstrated that we needed to study, and mitigate, fish depletions at the global level. They showed that phenomena previously observed at local levels--for example, the disappearance of large species from fisheries’ catches and their replacement by smaller species--were also occurring globally. It was a realization akin to understanding that the financial meltdown was due not to the failure of a single bank, but, rather, to the failure of the entire banking system--and it drew a lot of controversy. The notion that fish are globally imperiled has been challenged in many ways--perhaps most notably by fisheries biologists, who have questioned the facts, the tone, and even the integrity of those making such allegations. Fisheries biologists are different than marine ecologists like myself. Marine ecologists are concerned mainly with threats to the diversity of the ecosystems that they study, and so, they frequently work in concert with environmental NGOs and are often funded by philanthropic foundations. By contrast, fisheries biologists traditionally work for government agencies, like the National Marine Fisheries Service at the Commerce Department, or as consultants to the fishing industry, and their chief goal is to protect fisheries and the fishermen they employ. I myself was trained as a fisheries biologist in Germany, and, while they would dispute this, the agencies for which many of my former classmates work clearly have been captured by the industry they are supposed to regulate. Thus, there are fisheries scientists who, for example, write that cod have “recovered” or even “doubled” their numbers when, in fact, they have increased merely from 1 percent to 2 percent of their original abundance in the 1950s. Yet, despite their different interests and priorities--and despite their disagreements on the “end of fish”--marine ecologists and fisheries scientists both want there to be more fish in the oceans. Partly, this is because both are scientists, who are expected to concede when confronted with strong evidence. And, in the case of fisheries, as with global warming, the evidence is overwhelming: Stocks are declining in most parts of the world. And, ultimately, the important rift is not between these two groups of scientists, but between the public, which owns the sea’s resources, and the fishing-industrial complex, which needs fresh capital for its Ponzi scheme. The difficulty lies in forcing the fishing-industrial complex to catch fewer fish so that populations can rebuild. It is essential that we do so as quickly as possible because the consequences of an end to fish are frightful. To some Western nations, an end to fish might simply seem like a culinary catastrophe, but for 400 million people in developing nations, particularly in poor African and South Asian countries, fish are the main source of animal protein. What’s more, fisheries are a major source of livelihood for hundreds of million of people. A recent World Bank report found that the income of the world’s 30 million small-scale fisheries is shrinking. The decrease in catch has also dealt a blow to a prime source of foreign-exchange earnings, on which impoverished countries, ranging from Senegal in West Africa to the Solomon Islands in the South Pacific, rely to support their imports of staples such as rice. And, of course, the end of fish would disrupt marine ecosystems to an extent that we are only now beginning to appreciate. Thus, the removal of small fish in the Mediterranean to fatten bluefin tuna in pens is causing the “common” dolphin to become exceedingly rare in some areas, with local extinction probable. Other marine mammals and seabirds are similarly affected in various parts of the world. Moreover, the removal of top predators from marine ecosystems has effects that cascade down, leading to the increase of jellyfish and other gelatinous zooplankton and to the gradual erosion of the food web within which fish populations are embedded. This is what happened off the coast of southwestern Africa, where an upwelling ecosystem similar to that off California, previously dominated by fish such as hake and sardines, has become overrun by millions of tons of jellyfish. Jellyfish population outbursts are also becoming more frequent in the northern Gulf of Mexico, where the fertilizer-laden runoff from the Mississippi River fuels uncontrolled algae blooms. The dead algae then fall to a sea bottom from which shrimp trawling has raked all animals capable of feeding on them, and so they rot, causing Massachusetts-sized “dead zones.” Similar phenomena--which only jellyfish seem to enjoy--are occurring throughout the world, from the Baltic Sea to the Chesapeake Bay, and from the Black Sea in southeastern Europe to the Bohai Sea in northeastern China. Our oceans, having nourished us since the beginning of the human species some 150,000 years ago, are now turning against us, becoming angry opponents. That dynamic will only grow more antagonistic as the oceans become warmer and more acidic because of climate change. Fish are expected to suffer mightily from global warming, making it essential that we preserve as great a number of fish and of fish species as possible, so that those which are able to adapt are around to evolve and propagate the next incarnations of marine life. In fact, new evidence tentatively suggests that large quantities of fish biomass could actually help attenuate ocean acidification. In other words, fish could help save us from the worst consequences of our own folly--yet we are killing them off. The jellyfish-ridden waters we’re seeing now may be only the first scene in a watery horror show.

#### Oceans are key to overall biodiversity

Schofield 14 3-10-2014 “Why our precious oceans are under threat” <http://uowblogs.com/globalchallenges/2014/03/10/the-threats-facing-our-precious-oceans/> (Director of Research at the Australian Centre for Ocean Resource and Security University of Wollongong)//Elmer

Science fiction author Arthur C Clarke once observed, “How inappropriate to call this planet Earth when it is quite clearly Ocean.” Good point, well made. The oceans clearly dominate the world spatially, encompassing around 72 per cent of the surface of the planet. The vast extent of the oceans only tells part of the story, however. The oceans are critical to the global environment and human survival in numerous ways – they are vital to the global nutrient cycling, represent a key repository and supporter of biological diversity on a world scale and play a fundamental role in driving the global atmospheric system.Coastal and marine environments support and sustain key habitats and living resources, notably fisheries and aquaculture. These resources continue to provide a critical source of food for hundreds of millions of people.The fishing industry supports the livelihoods of an estimated 540 million people worldwide and fisheries supply more than 15 per cent of the animal protein consumed by 4.2 billion people globally. Moreover, the oceans are an increasing source of energy resources and underpin the global economy through sea borne trade. Overall, it has been estimated that 61 per cent of global GNP is sourced from the oceans and coastal areas within 100km of the sea. Coasts and marine zones also provide essential, but often not fully acknowledged, ecosystem services. Coasts and marine zones are therefore of critical importance across scales, from the global to the regional, national and sub-national coastal community levels. At the same time the oceans also remain largely (95 per cent) unexplored.

#### Biodiversity Loss causes Extinction.

Torres 16 Phil Torres 4-11-2016 “Biodiversity loss: An existential risk comparable to climate change” thebulletin.org/biodiversity-loss-existential-risk-comparable-climate-change9329 (founder of the X-Risks Institute, an affiliate scholar at the Institute for Ethics and Emerging Technologies)//Elmer

The sixth extinction. The repercussions of biodiversity loss are potentially as severe as those anticipated from climate change, or even a nuclear conflict. For example, according to a 2015 study published in Science Advances, the best available evidence reveals “an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way.” This conclusion holds, even on the most optimistic assumptions about the background rate of species losses and the current rate of vertebrate extinctions. The group classified as “vertebrates” includes mammals, birds, reptiles, fish, and all other creatures with a backbone. The article argues that, using its conservative figures, the average loss of vertebrate species was 100 times higher in the past century relative to the background rate of extinction. (Other scientists have suggested that the current extinction rate could be as much as 10,000 times higher than normal.) As the authors write, “The evidence is incontrovertible that recent extinction rates are unprecedented in human history and highly unusual in Earth’s history.” Perhaps the term “Big Six” should enter the popular lexicon—to add the current extinction to the previous “Big Five,” the last of which wiped out the dinosaurs 66 million years ago. But the concept of biodiversity encompasses more than just the total number of species on the planet. It also refers to the size of different populations of species. With respect to this phenomenon, multiple studies have confirmed that wild populations around the world are dwindling and disappearing at an alarming rate. For example, the 2010 Global Biodiversity Outlook report found that the population of wild vertebrates living in the tropics dropped by 59 percent between 1970 and 2006. The report also found that the population of farmland birds in Europe has dropped by 50 percent since 1980; bird populations in the grasslands of North America declined by almost 40 percent between 1968 and 2003; and the population of birds in North American arid lands has fallen by almost 30 percent since the 1960s. Similarly, 42 percent of all amphibian species (a type of vertebrate that is sometimes called an “ecological indicator”) are undergoing population declines, and 23 percent of all plant species “are estimated to be threatened with extinction.” Other studies have found that some 20 percent of all reptile species, 48 percent of the world’s primates, and 50 percent of freshwater turtles are threatened. Underwater, about 10 percent of all coral reefs are now dead, and another 60 percent are in danger of dying. Consistent with these data, the 2014 Living Planet Report shows that the global population of wild vertebrates dropped by 52 percent in only four decades—from 1970 to 2010. While biologists often avoid projecting historical trends into the future because of the complexity of ecological systems, it’s tempting to extrapolate this figure to, say, the year 2050, which is four decades from 2010. As it happens, a 2006 study published in Science does precisely this: It projects past trends of marine biodiversity loss into the 21st century, concluding that, unless significant changes are made to patterns of human activity, there will be virtually no more wild-caught seafood by 2048. Catastrophic consequences for civilization. The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. There could be surprising effects of biodiversity loss that scientists are unable to fully anticipate in advance. For example, prior research has shown that localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point. According to a 2012 paper published in Nature, there are reasons for thinking that we may be approaching a tipping point of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization. As the authors write, a planetary-scale transition could precipitate “substantial losses of ecosystem services required to sustain the human population.” An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be “widespread social unrest, economic instability, and loss of human life.” According to Missouri Botanical Garden ecologist Adam Smith, one of the paper’s co-authors, this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive. Biodiversity loss is a “threat multiplier” that, by pushing societies to the brink of collapse, will exacerbate existing conflicts and introduce entirely new struggles between state and non-state actors. Indeed, it could even fuel the rise of terrorism. (After all, climate change has been linked to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary Chuck Hagel and CIA director John Brennan, have affirmed that climate change and terrorism are connected.) The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization “in as little as three human lifetimes,” as the aforementioned 2012 Nature paper notes. Furthermore, the widespread decline of biological populations could plausibly initiate a dramatic transformation of the global ecosystem on an even faster timescale: perhaps a single human lifetime. The unavoidable conclusion is that biodiversity loss constitutes an existential threat in its own right. As such, it ought to be considered alongside climate change and nuclear weapons as one of the most significant contemporary risks to human prosperity and survival.

### 1AC---Framework

#### The standard is maximizing expected well being or act hedonistic util.

#### Pleasure and pain *are* intrinsic value and disvalue – everything else *regresses* – robust neuroscience.

Blum et al. 18

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

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

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

Evolutionary theories of pleasure: The love connection BO:D

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

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

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

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

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

Finding happiness is different between apes and humans

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

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

Desire and reward centers

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

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

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

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

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

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

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

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

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

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

#### Extinction 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.

**ASPEC: every policy benefits some and harms others which also means side constraints freeze action, other frameworks might be good for individual decision makers but the resolution pertains to institutions with obligations to more than just themselves**

### 1AC---Method

#### Empirical approaches to international relations are epistemologically valid — prefer quantitative analyses.

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The questions we ask in our articles require a more comprehensive approach to data collection. By collecting information about dozens (or hundreds) of cases rather than just one or two, we can gain insights into whether the patterns we observe in any individual case are representative of broader trends. The implicit question in our research is always ‘what would have happened if conditions had been different?’ Of course, it is impossible to answer this counterfactual with certainty since history happens only once, and we cannot repeat the ‘experiment’ in a laboratory. But that does not mean we should shrug our shoulders and abandon the enterprise.

Instead, we can gain insight by looking at cases in which conditions were, in fact, different. To illustrate, let’s return to the smoking example above. Studying a single smoker in depth might give us an accurate and textured understanding of the role of smoking in this person’s life, but it would be a poor way to learn about the broader health effects of smoking, because we could not make an informed guess about what would have happened had he not smoked. Our approach described earlier, in contrast, allows us to generalize about the effects of smoking on health. For precisely this reason, large-scale quantitative analysis is the primary method by which medical researchers have tackled the health effects of tobacco smoke. To be sure, some of the data in our hypothetical study would surely be inaccurate, and we would know comparatively little about the lives of each individual subject. But the loss in individual case knowledge would be more than compensated by the increase in information about the variables we hope to study.

So it is with nuclear weapons. To understand how nuclear weapons impact international crises, we must examine crises in which nuclear ‘conditions’ were different. For Kroenig, this means comparing the fortunes of crisis participants that enjoyed nuclear superiority to those that did not. For Sechser and Fuhrmann, it means comparing the effectiveness of coercive threats made by nuclear states to those made by nonnuclear states. By making these comparisons, we can begin to engage in informed and evidence-based speculation about how nuclear weapons change (or do not change) crisis dynamics. Indeed, the statistical models we employ require this comparison – they will return no results if all of our cases look the same.

Gavin argues that the Berlin/Cuba episode is sufficient for understanding the dynamics of nuclear weapons because it is the “most important and representative” case of nuclear deterrence and coercion.12 There are two distinct (and contradictory) claims here: that the case is the most important crisis episode for studying nuclear weapons, and that it is representative of the broader universe of such episodes. With respect to the first claim, Gavin offers no criteria for evaluating what an “important” case might be. What makes a case important – its profile among the general public? Its consequences? The availability of information about it? The countries involved? Moreover, for whom must the case be important? Gavin may view the 1958–1962 case as critical for understanding nuclear dynamics, but it is by no means clear that policymakers today look to this example for guidance about dealing with Iran or North Korea. This is not to say that we disagree with Gavin’s assessment – undoubtedly the 1958–1962 episode is important in many respects. But importance, like beauty, is in the eye of the beholder. The second claim is equally dubious: that the 1958–1962 episode is somehow representative of the ways in which nuclear weapons typically shape international politics. Without first examining other cases, Gavin simply has no grounds on which to base this claim. Moreover, there is tension between this claim and his previous assertion that the case is important: one key reason the Cuba/Berlin episode is often seen as important is because it was not like other Cold War crises: nuclear weapons were brandished more explicitly, and stoked more public anxiety about nuclear war, than any other crisis before or since. In the broader universe of crises, this episode actually may be quite anomalous. If so, then studying it to the exclusion of other cases would yield misleading conclusions about the role of nuclear weapons in world politics.

A key advantage of quantitative methods is that the researcher need not make questionable judgments about which cases are more or less important: unless explicitly instructed otherwise, statistical models assign equal weight to each case. Likewise, statistical models provide ways to identify – and exclude – anomalous cases that deviate markedly from dominant trends. Indeed, a quantitative analysis can be a useful precursor to the selection of individual cases for in-depth analysis, precisely because it allows us to locate cases that either represent or deviate from the overall pattern. These selections, however, are based on careful comparisons with other cases, not opaque judgments.

A second advantage is that quantitative analyses provide greater transparence about methods, judgments, and conclusions. One of Gavin’s central critiques is that various cases in our quantitative analyses have been miscoded. In other words, he argues, we have mismeasured important factors.13 This criticism – irrespective of its validity14 – is possible only because our coding decisions are unambiguous and easily ascertained from our datasets. Moreover, each of our studies sets forth clear rules for how each variable in our datasets was coded. This does not mean that our coding decisions are all correct and beyond dispute, but it does mean that they are clearly stated for outside scholars to evaluate. This degree of transparency is a key strength of quantitative research. Because each case in a quantitative analysis necessarily must be clearly coded,15 there is no ambiguity about how the researcher has classified each case. If other researchers believe a case should be coded differently, they can make that change and rerun the analysis.

By extension, quantitative research designs permit scholars to easily evaluate how much a study’s findings depend on individual coding decisions. Simply noting a few coding errors or differences of interpretation in a large quantitative dataset is of little consequence unless one can demonstrate that those differences are responsible for generating incorrect inferences. In a quantitative study, this typically amounts to recoding disputed cases and repeating the core statistical models to determine whether the results change substantially. 16 Not only are the original coding decisions laid bare, but it is also straightforward to determine whether the study’s inferences depend on them. This high level of transparency — and the external quality-control it enables – is one of the most attractive features of quantitative research designs. Transparency is useful not because it produces scholarly consensus, but because it allows opposing sides to identify the precise nature and implications of their disagreements.

Consider, for example, the 1990 exchange in World Politics between Paul Huth and Bruce Russett on one hand, and Richard Ned Lebow and Janice Gross Stein on the other. highlights the similarities between this debate and the present exchange, separated by almost twenty-five years, as evidence that quantitative analysis has made little progress in understanding nuclear issues. We see the issue differently. Both debates, in fact, illustrate a key strength of quantitative analysis: the ability to assess the importance of individual coding decisions. In the World Politics debate, Lebow and Stein objected that Huth and Russett had improperly coded many cases in their deterrence dataset, much as Gavin has disputed some of our classifications But Huth and Russett responded by noting that “even if Lebow and Stein’s recodings of our cases are accepted, the statistical and substantive findings of our past research remain fundamentally unchanged.”18 Similarly, as we report in our articles, our central findings do not change even if we accept Gavin’s arguments. In a quantitative study, simply showing that certain coding decisions can be contested is insufficient: one must also demonstrate that the core results depend on those decisions. While Gavin is correct to argue that coding cases is a tricky exercise, quantitative approaches allow us to evaluate the substantive importance of questionable coding decisions. Qualitative research, by contrast, is not always so amenable to external oversight. Whereas quantitative models demand clear coding decisions, qualitative research designs can be much more forgiving of ambiguous classifications. Gavin’s critique of our coding decisions illustrates this problem: while he criticizes the way we have coded particular cases in our datasets, he offers no clear alternative coding scheme. He raises questions about our coding decisions, but then declines to answer them. This ambiguity allows him to have his cake and eat it too: he can criticize our classifications without being liable for his own. Uncertainty, of course, is inherent to any scientific enterprise, and quantification is sometimes criticized for presenting a false illusion of certainty. To be clear, quantitative research cannot create certainty where the evidence is ambiguous. Just because a case is coded a certain way does not mean that the broader scholarly community (or even the researcher) has reached a consensus about that case. Likewise, the problem of ambiguity is not inherent to qualitative research: nothing intrinsic to historical research precludes scholars from laying their assumptions bare. But by compelling scholars to take a clear initial position on coding cases, the process of quantification allows scholars to debate each decision and evaluate whether potentially questionable choices are decisive in generating a study’s core results. This transparency is central to peer evaluation and, ultimately, scientific advancement.

A third advantage of statistical analysis is that it is designed to cope with probabilistic events. In the physical world, causal relationships are often deterministic: a certain amount of force imparted to an object will cause that object to move a certain distance. So long as conditions are kept constant, this result will obtain again and again, no matter how many times the experiment is repeated. In the social world, however, we are not blessed with such ironclad reliability. No two individual people are exactly identical, and even in carefully controlled environments it is rare to find a “force” that begets exactly the same effect on all people with perfect regularity. The causal relationships we observe are not deterministic – they are probabilistic, occurring with imperfect regularity.19

The ‘force’ of interest to us in our articles is, broadly, the possession of nuclear weapons. When this force is applied to crisis bargaining situations, what happens? Implicit in this question, however, is a question about probability: when nuclear weapons are inserted into a crisis bargaining situation, what is the likelihood of a particular outcome? Kroenig’s study, for example, asks: in a nuclear crisis, what is the likelihood that the nuclear-superior side will achieve its basic goals? Likewise, Sechser and Fuhrmann seek to discover the likelihood that a coercive demand made by a nuclear-armed state will be met. The central difficulty with posing our research questions in this way is that we cannot actually see the thing we care about: probability is inherently unobservable. We cannot examine a crisis and directly observe the probability of one side capitulating; we can only observe whether it actually capitulated.20 How, then, can we begin to answer our original research question?

Quantitative research is designed for precisely this sort of situation. If we cannot directly observe whether we are holding a loaded six-sided die, for example, we can throw it many times, observe the result, and infer the underlying probability from the results. Throwing the die just one time would tell us little, since all six numbers are theoretically possible even if the die were loaded. Only after observing the pattern of results across many events can we determine the underlying probabilities of each number turning up.

The single-case approach Gavin proposes cannot cope with probabilistic events as effectively. Knowing that one smoker happened to die of cancer does not tell us much about the broader health effects of tobacco. Based on this single data point, we might conclude that smoking leads to cancer 100 percent of the time. Yet we know this to be false: there are heavy smokers who remain cancer-free, just as there are nonsmokers who still get cancer. The true relationship between smoking and cancer emerges only after looking at a large number of cases. Similarly, even if we determine that nuclear weapons appeared to “matter” from 1958-1962, we cannot safely infer from this observation that nuclear weapons influence crisis outcomes in general. Any relationships observed during this particular period could have been due to any number of chance events that might be unlikely to recur. Studying just one episode allows us to say much about that episode but little about the underlying relationships.

Fourth, statistical analysis allows researchers to uncover causal relationships in social phenomena even if the participants themselves do not record, record accurately, or understand these relationships. Gavin’s approach, in contrast, requires finding primary source documents and learning what participants themselves believed to be the relevant causal factors at play. His essay conveys an exceptionally narrow conception of how one should gather knowledge about the effect of nuclear weapons on international politics. Gavin believes that if one wants to “really understand” the effect of nuclear weapons on international politics,21 archival research is “the only way to get real insight.”22 While we agree that studying primary documents has great value, we believe that there are many other ways to generate useful knowledge, and that a narrow focus on primary documents can often lead a scholar astray.

#### The critique of truth-telling destroys global politics – their politics forecloses truth commissions and protests across the Global South focused on exposing governmental lies and atrocities

Kivisto ‘14(Peter, Richard Swanson Prof. of Social Thought, Chair of Sociology, Anthropology and Social Welfare @ Augustana College, “Postmodernity as an Internal Critique of Modernity”, *Postmodernism in a Global Perspective*, pp. 105-108)

Because signs no longer refer to real referents, because the real has collapsed into the hyperreal, meaning has evaporated. In a rather notorious instance of applying this thinking to a concrete event, Baudrillard (1991) claimed that the Gulf War was nothing more than a television and computer graphics spectacle—the difference between this war and the war games in a video arcade presumably having essentially disappeared. Of course, there is an element of truth to this claim. Indeed, a similar claim was made by Slavoj Zizek (2002: 37) about the war in Afghanistan that took place in the aftermath of September 11, 2001, which he depicted as “a virtual war fought behind computer screens.” Lost in Baudrillard’s vision, however, as David Lyon (1994: 52) pointedly noted, is the fact that there really (i.e., not hyperreally) were “blood—stained sand and bereaved families.” Lost, too, are beliefs about patriotic duty, geopolitical realities, the economics of oil, and similar very real considerations that lead nations into war. In his book on terrorism, which is described in the subtitle as a “Requiem for the Twin Towers,” Baudrillard (2002) describes Al Qaeda’s attack on the United States in terms of the “symbolism of slaughter” and “sacriﬁcial death” as a mode of challenging American hegemony. Again, he treats a bloody event only as a spectacle and not as the consequence of a complex interplay of political, economic, and social forces that underlie the spectacle. Incidentally, and not noted by Baudrillard, the architect of the Twin Towers was Minoru Yamasaki, who had earlier designed the ill-fated Pruitt-Igoe. My criticism of Baudrillard revolves around the obvious point that there is a reality that people experience, emotionally respond to, and attempt in some fashion to shape. There is a life outside of the television set and outside of cyberspace. The emotionless and meaningless worlds depicted in ﬁlms such as David Lynch’s Blue Velvet and Quentin Tarantino’s ﬁlms from Pulp Fiction to his more recent offerings, Inglourious Basterds and Django Unchained, are not synonymous with our lived experiences, nor do most people convolute the two (Denby, 2009; Bauman, 1992: 149-55; Best and Kellner, 1991: 137-44). Although it is certainly true that the world of consumerism has changed considerably in recent years, little evidence can be mustered to claim that we have left modern culture for postmodern culture. The continued potency of religious belief, for example, calls into question the pervasiveness of meaninglessness Baudrillard envisions. The existence of the new social movements concerned with such issues as the environment, peace, feminism, civil rights, and poverty also calls into question the extent to which people in advanced industrial societies have opted for political passivism and escapism. By claiming that we have moved from production to consumption, this version of postmodernism shows evidence of a serious blind spot. It is obvious that goods continue to be produced, although in a global economy this might mean that they are being produced in poor countries, where workers are paid abysmal wages and are forced to work exploitatively long hours in unsafe and unsanitary factories. The clothes purchased at the shopping mall and online are the products of this darker side of our contemporary culture. Moreover, as Alex Callinicos (1989: 162) has pointedly noted, not only are most of the world’s inhabitants excluded from the consumerism Lyotard and Baudrillard describe but also poor people in the advanced industrial societies have only a limited involvement in this kind of consumption. In a generous assessment of Baudrillard that appeared shortly after his death in 2007, Robert Antonio (2007: 2) pointed out that Baudrillard’s abandonment of leftist politics was a reflection of his assessment of the failure of the 1968 student/worker protests. This event led to his the abandonment of the Marxist dream of a radiant future. Unlike Zizek (2008), who some continue to describe as a Marxist, Baudrillard was not inclined to argue “in defense of lost causes.” Nor was he prepared to endorse the anti-utopian pragmatism of liberal democracy. Rather, in relentlessly promoting his often contradictory but deeply pessimistic diagnoses of our times, he became a media star, which included homage to him in one of the Matrix ﬁlms and a US lecture tour that was part of the Institute of Contemporary Arts’ “Big Thinkers” series. He played a major role in creating and sustaining the postmodern moment, but near the end of his life he claimed that the term that best deﬁned him was nihilist. Liquid Modernity Baudrillard was the most explicit and insistent advocate for radical postmodernism (Lemert, 2005: 36-40). Other postmodemists have offered more tempered assessments of the postmodern condition, viewing it in many respects as a new phase of modernity rather than constituting a radical rupture between past and present. No one better exempliﬁes this position than the Polish-born sociologist, Zygmunt Bauman, who has published a series of books explicitly devoted to postmodern concerns (Bauman, 1993, 1995, and 1997). Of particular emphasis in these theoretical reflections is an appreciation of the signiﬁcance of ambivalence in postmodernity. Peter Bielharz (2009: 97) sees a parallel between Bauman’s thought and that of Simmel, contending that in both one ﬁnds a commitment “to the idea of ambivalence as a central orienting device and motif of modernity." By the turn of the century, Bauman (2000) opted to replace the term postmodern with the idea of “liquid modernity.” Perhaps to avoid the confusions and incessant debates about postmodernism and perhaps also to distance himself from postmodernism’s more radical proponents, this original term can be seen as useful in carving out an intellectual space in which to articulate his own position. Agreeing with the claim that grand narratives had ceased to be compelling, Bauman (2007) sees the present as an “age of uncertainty.” The preceding stage of modernity can be characterized as “solid.” In contrast, the current stage is “liquid” insofar as patterned social conduct and the social structures essential to making such forms of everyday social relations durable no longer exist. Instead, we live during times in which these structures no longer keep their shape for very long, “because they decompose and melt faster than the time it takes to cast them...” The consequence is that structured forms today “cannot serve as frames of reference for human actions and long-term life strategies because of their short life expectations" (Bauman, 2007: 1). In short, people in the contemporary world are consigned to living out their lives with a far greater focus on the present and immediate future rather than with the “open horizon of the future" that Wagner (2008: 1) associated with the early phase of modernity. What makes Bauman so dramatically different from someone like Baudrillard is that his assessment of our current condition does not lead him to nihilism. On the contrary, he thinks that today, more than ever before, ethical conduct must be grounded in a sense of personal responsibility. We may live in uncertain times, but we don’t live in amoral times. It’s for this reason that Bauman continues to deﬁne himself as a socialist. He would thus likely agree with Bielharz (2009: 140) that socialism today should be viewed, not so much as an alternative economic system to capitalism, but as its “alter ego.”

#### Space policy scenario planning unsettles hegemonic perspectives more effectively than radically changing research agendas.

Adams, et al, 18—Lecturer in Urban Planning in the School of Geography, Earth and Environmental Sciences at the University of Birmingham (David, with Peter Larkham, Professor of Planning at Birmingham City University, and Dan Sage, Senior Lecturer in Human Resource Management and Organisational Behaviour at Loughborough University, “Planners in space?,” Town & Country Planning, 87 (8), pp.307-315, dml)

Writing some 40 years ago and against a background of the ‘limits to growth’ debate of the 1970s, Millward called for geographers, planners and other social scientists to explore seriously the possibility of moving to off-Earth space settlements.35 Although there is now a growing social science perspective on the possibilities and limits of future space visions, there are further opportunities for planners, geographers, architects and others involved with the design and management of places to respond to these debates, assimilating them into existing approaches, or creating new research areas specifically relating to the space ‘frontier’. One practical suggestion is that planners and geographers – perhaps working alongside engineers and architects – might study the feasibility of designing new Earth-based space launch megastructures. This would involve working through the possibility of improved space launches, including the impact on the surrounding population and environment, the proximity to major industrial and population centres, and the capability of existing power networks. Moreover, and considering the bleak scenarios outlined above, there are obvious parallels with how architect-planners, engineers, politicians, industrialists and leading scientists saw the urgent need to rebuild as an opportunity to reform or improve cities that before the Second World War had been suffering from different urban ailments.36 Infused by the image of a tabula rasa, the prospect of large-scale rebuilding offered the possibility to architect-planners to transform war-damaged cities and project their sometimes-radical visions of future cities. Discussions around possible space futures could, for example, unpick the way in which the sometimes lavish mid-20th century reconstruction plans offered a vehicle to boost the personal and strategic ambitions of politicians and other key decisionmakers.37 Are there lessons for entrepreneurial space enterprises in the way that powerful elites had to wrestle with bureaucratic frameworks, financial constraints, the peculiarities of a particular site, the availability of materials, the talent of architects, the desires of landowners, and, of course, the perspectives of inhabitants? Some in the planning and design community are also beginning to raise concerns over recent plans for the human inhabitation of Mars (and exploration of space, in a more general sense). For example, some are anxious that the ambitions set out by organisations such as Mars City Design® for human habitation on the ‘red planet’ represent an opportunity for architects and designers to project their visions on to a ‘blank slate’.5 This is a familiar story for planners. Since the mid-to-late-20th century, it has become almost commonplace to blame the ‘metaphysical fancies’38 of prominent white, middle-class, male experts for creating ‘alien’ spatial and temporal circuits of production, exchange and consumption that did much to eliminate spontaneity from urban life. Efforts to plan were from ‘high and afar’, informed by the empirical-analytical approaches of scientists, bureaucrats and engineers involved in the creation of large-scale rebuilding projects, and helping to realise a capitalist city in full flow. But not all reconstruction plans projected capitalist visions of the future, and some reconstruction proposals were heavily idealistic but also pragmatic. The motivations among those potential space settlers will likely differ from those agencies and space advocates pushing for the creation of permanent off-Earth settlement. So exploring the ‘cracks in the concrete’ of earlier planning visions,7 as individuals subverted ‘utopian’ narratives of the future urban environment to suit their own ends, might help to develop any discussion about human settlement of space. Second, while there are flaws in the argument about the vital, innate need to travel, there is an opportunity to nurture the human desire to cultivate a sense of inquisitiveness and fulfilment. Or to paraphrase Alfred North Whitehead, ‘physical wandering is important’, but ‘greater still is the power of [humankind’s] adventures of thought’ into ‘uncharted seas of adventure’.39 Ancient human migration brought people into contact with different customs of various cultures, philosophies, and political and social systems.1 It is, therefore, valuable to consider these perspectives to gain further insight into our own beliefs, perspectives and actions. Increased exploration of space would present a clear opportunity to further knowledge about the universe, which would stimulate human curiosity and potentially lead to some unpredictable social, economic and environmental discoveries, but would also help humankind to reflect on current and near-future Earth-based practices. Moreover, it is often said that people act and live out the past in the present. And planning tools such as maps, images, diagrams and future scenarios can certainly influence present and future action; but they can also shape how we think about the past.40 At some indeterminate point beyond the future horizon, people may be living in outer space and on other worlds, and since differing cultures stem in part from environmental conditions, it is possible that these individuals will be greatly different from earlier cultures, planning efforts, contexts, perceptions and attitudes. Hence, if a new age of space exploration marks our opportunity to ‘start afresh’, then there is the obvious possibility of examining capitalism, along with other economic models, and legal frameworks. Given that there will be long communication delays that may make MarsEarth governance cumbersome, regulatory and administrative functions will need to hold authority over new lands, efficiently administer public policy and urban planning, and take responsibility to create a society in space – a theme much explored in popular science fiction.26 Changes to civilisation in terms of technology, culture and everyday life make a strict interpretation of history something of an unreliable guide to speculative spatial imaginaries. For instance, development in satellite technology and space probes may significantly advance our knowledge and understanding of the universe, thus limiting the need for physical human wanderings. Nevertheless, there are several fundamental questions that planners might explore regarding the purpose of the colony, the motivations of colony founders, the possible location of the settlement relative to the Earth and Sun, and the size and characteristics of the object on which colonists wish to settle. Various academic works, popular histories, films and novels detail the why, when and how of frontier development, while the location of settlements and the links between regions are well established areas of enquiry for social scientists. In this sense, an exploration of the processes, agents and agency that create, shape and reshape urban form would help inform wider discourse on future space trajectories.41 However, planners, geographers and urban historians, for example, could enrich discussions on space by drawing on earlier research into the conditions necessary for permanent human settlement, and the economic, social and environmental contexts in which human habitation thrives or fails (i.e. the functions of defence, shelter, trade, and community).42 Although the design of a space colony would have to work within engineering and technological constraints, there are concerns that an eclectic mix of architectural styles would result in a ‘Disney-like’ settlement.5 What key planning principles might guide development? Could ‘established’ planning concepts of visionary urbanists such as Howard and his Garden City, Burnham’s view on the rebuilding of Chicago, Le Corbusier’s radiant city, Frank Lloyd Wright and his suburban city, and Abercrombie and Forshaw’s plans for London’s city-region be brought into dialogue with emerging visions for life beyond Earth’s limits? At the micro-scale, investigation of the geometric properties of earlier urban forms would also contribute to any wider understanding of the processes shaping urban form. There are many studies of urban components (streets, blocks, plots, buildings, land uses, agriculture, public spaces, services, and infrastructure) that could inform debates about future colony design. Moreover, planners’ interpretation of computational approaches and big data would also allow modelling of future off-Earth urban patterns at different spatial and temporal scales. And, at some point in the future, following the establishment of a colony, how will the insertion of new structures or other features affect the characteristics of a settlement? How might we manage fragile ‘historic’ areas like the Apollo 11 landing site when there are pressures to develop?5 This may stimulate a careful analysis of past examples of how to achieve the organic arrangement of the urban fabric, land uses, densities and human interactions to create a rich, diverse urban experience. Perhaps the most enticing prospect is that any plans to colonise asteroids, planets or even stars may be led by genetically ‘improved’ humans, cyborgs, or forms of artificial intelligence. This then opens up a completely new set of ways to think about planning in ‘post-human’ worlds. Conclusion Countless others have sought to dampen some of the more excited claims made about increased human encounters with space. There is no unifying intellectual consensus around the feasibility of moving large numbers of people off Earth: there is a lack of safe, attractive, reliable and cheap modes of transport to break through Earth’s atmosphere; for many, potentially world-changing space visions belong in the realm of science fiction, or are best left to the work of cosmologists, engineers, or those in the natural sciences; and many feel that any economic case and the recent wave of enthusiasm will eventually subside. More fundamentally, the importance of these points to those in the planning community might seem a matter of debate: if there are flaws in the messages typically presented by supporters of space exploration, so what? Planning, like other social sciences, contains a vibrant and eclectic mix of different schools of thought, where competing ideas jostle for prominence. Consequently, any bold call for radical changes to research agendas that contribute more to contemporary or near-future debates about space would require significant adjustments in bureaucratic structures, the attitudes of educators, research councils, conference organisers, learned societies, and the editorial boards of prominent journals. Simply put, for many social scientists, the potential economic, environmental and human impact of space exploration remains outside the ambit of other more pressing Earthly matters. Although the idea of focusing on space might invoke feelings of indifference, resistance or even enmity in some, this article does at least set out potential areas that may provoke interest from planners. The key message, though, besides thinking through the practical implications and possibilities of developing new launch sites, new satellites and off-Earth trade links, is that thinking about space stimulates the enabling and motivational facets of the imagination.7 This involves a mental shift away from being immersed in the present in our perceptions, perspectives and views. It certainly offers an opportunity to review earlier planning ‘imaginaries’, to use these ideas to set out new kinds of places beyond Earth, but also as a way of reflecting on how off-Earth innovations might benefit the ways in which planners and others approach the task of tackling some of the sustainability challenges here on Earth. There may be some truth in deGrasse Tyson’s34 view that ‘nothing spurs cross-pollination of ideas like space exploration’; hence there is opportunity here for imaginative planning ideas to penetrate the discussions on space that might otherwise be reserved for entrepreneurs or cosmologists. Perhaps this needs to happen before the boarding gates open…

**Nuanced debates about the intricacies of space policy are key to preventing militarization – narrowing debates intellectual aperture to meta-theories for governmental behavior makes constructive advocacy impossible**

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Plus, there’s the **larger question** of whether a more **aggressive approach** is in the best interest of all of America’s space organizations, including the burgeoning **commercial space sector.** We live in an age of **proliferating anti-satellite capabilities.** There is a growing body of evidence that China is actively developing at least two hit-to-kill **ASAT** weapon systems. The development process has included at least **five tests** of these systems, including one that created thousands of pieces of space **debris**. Russia has fielded operational ASAT capabilities in the past, and Russian officials have recently stated that development work has started again on an **air-based ASAT** system. Not to be outdone, elements of the Indian government have also **signaled** interest in developing both missile defense and ASAT **capabilities** themselves. The United States and many of its allies in Europe and Asia are fielding missile defense capabilities that have significant ASAT capabilities, as demonstrated by the United States’ use of the same missile defense system to destroy a non-functioning satellite in 2008. The number of other countries that already possess ballistic missile and space launch technology—and could thus develop their own crude ASAT capabilities—is growing. The U.S. national security space community sees this shift towards a more “contested” space environment as a very worrisome trend. There are currently more than 150 U.S. military and intelligence satellites in orbit, providing important national security capabilities such as precision navigation and timing, global communications, missile warning, and intelligence, surveillance and reconnaissance. The proliferation of ASAT capabilities and the **threat** they are thought to pose to these space systems presents a **serious challenge** to the **U**nited **S**tates’ military and intelligence capabilities. The concern extends not only to the ability of the United States to defend its own national security interests, but also to its ability to continue to contribute to the defense of its **allies**. The United States announced a new National Security Space Strategy in early 2011 that detailed five strategic approaches for dealing with a more “congested, competitive and contested space environment.” The strategy includes a strong push for developing and promoting responsible norms of behavior in space, increased partnership and cooperation with allies and commercial firms and a shift toward making U.S. national security space capabilities more resilient to attacks. The strategy also includes preventing and deterring aggression on U.S. national security space systems, and, should deterrence fail, defeating attacks on said systems. Since the release of the strategy, the U.S. government has been relatively public about how it will implement the first three approaches, but less so about the last two. That has now changed. Congress has included language in the National Defense Authorization Act for the 2015 fiscal year, the primary piece of legislation that authorizes and directs the activities of the U.S. military, calling on the U.S. national security space community to report to Congress how it plans to deter and defeat adversary attacks on U.S. space systems. The NDAA language requires the Secretary of Defense and the Director of National Intelligence to produce a study on the role of offensive space operations, and specifies that the majority of the $32.3 million that Congress gave to the Space Security and Defense Program in 2015 must be used for “the development of offensive space control and active defensive strategies and capabilities.” The NDAA language does not stipulate what is meant by offensive or active defensive capabilities, but when combined with recent academic writings from within the U.S. military, it suggests that America’s strategy for protecting its satellites is taking a more aggressive turn. This essay discusses the evolution of U.S. national security space community’s approach to using space and protecting space assets over the last several decades, and explains why some in the community are now contemplating a more aggressive approach. It frames the discussion through four established schools of thought on the military uses of space: sanctuary, space control, high ground and survivability. These schools were first developed as potential space power doctrines by David Lupton in an article for Strategic Review in 1983, and more fully fleshed out in his 1988 book On Space Warfare: A Space Power Doctrine. They were re-conceptualized as schools of thought, rather than doctrine, by Peter Hays in his 1994 doctoral dissertation. In Hays’ view, the four schools of thought are less codified and have more overlap between them than a strict doctrinal definition. U.S. policy on national security space is a **conglomeration** of the **four schools of thought**, with one school of thought usually prioritized over the others. This conglomeration is a result of the interagency process for creating policy on national security issues, and the bargaining that takes place between the different agencies involved in the decision. The U.S. government is not a **unitary actor**, and the perspective of each of the **many agencies** within the **interagency decision-making process** usually reflects a preference for one of these **schools** over the other. As a result, **decisions** made by the U.S. government on national security space policy often reflect a **compromise** between **multiple schools of thought**, rather than a **strict adherence** to one **over all the others**. Why choose to contextualize this issue from the **perspective of the military** when space activities encompass much more than just the military? The **reason** is that in the realm of policy, and space policy in particular, **national security** has **dominated decision making** since the very beginning of the Space Age, and still holds a **privileged position** in space **policy debates**. This dominance is seen in the size of the U.S. national security space budget—nearly $27.5 billion compared to NASA’s $17.8 billion in 2012—but also in the use of the National Security Council process to make many space policy decisions. Finally, it is important to understand why the **focus** of this essay is on the policies and activities of the **U**nited **S**tates and not on the **other countries** involved. The intent is not to place **blame** for the current strategic instability in space solely on the **U**nited **S**tates. The situation is the result of the actions of **several** different **countries**, as well as the overarching **geopolitical dynamics** present in the world today. As a result of America’s **democratic** and **pluralistic nature**, its policies and actions are **subject** to more **scrutiny** and **debate than others**. That should be seen as a **virtue and not a defect**. The United States is still the world leader in space, in terms of both soft and hard power. The intent of this essay is to encourage **constructive debate** on this **important issue** in the hope that it leads to **policies** and **actions** that continue to enable the **U**nited **S**tates to be a **force for good** and a world leader for the foreseeable **future**.

#### Student debates over responses to suffering are critical to effective politics and overcoming status quo apathy

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Inherent in the politics of pity in the modern period is the problem of dealing with suffering from a distance and the "massification of a collection of unfortunates who are not there in person" (p. 13). Although contemporary media may have "dramatized" the spectacle of distant suffering in the past 30 years, they neither invented nor caused this condition. Historical examples also bolster Boltanski's claim that the media did not inaugurate the politics of pity - rather, its logic was set out more than 200 years ago. Boltanski carefully examines this logic and the paradoxes it creates in the book's three sections. Part 1 lays out the argument. Part 2 relies heavily on literary sources to analyze the "topos," a term he borrows from rhetoric, of the idea of pity and suffering. The third section deals with the question of pity and misfortune, drawing primarily on historical and contemporary examples, such as the work of Doctors Without Borders and the clash in the late 1950s between Sartre and Merleau-Ponty. Each chapter is replete with insight, making this a difficult book to summarize. Every word and every argument is so intricately intertwined with the next that paraphrasing seems a travesty.¶ The third section should be of interest to those located in the disciplines of communications or media studies. Here it is important to recall the subtitle of the book, Morality, the Media and Politics. Boltanski returns to the question of the spectator and the anxieties of those who wish to do something about what they see unfolding on their screens. He asks: "[H]ow might the contemporary spectators' anxiety be reduced without averting their gaze from misfortune or by abandoning the project inherent in the modern definition of politics of facing up to unnecessary suffering and relieving it[?]" (p. 159). What could political action be, given the fact that suffering does occur at a distance and that not every struggle can be taken on with equal commitment? First, he argues that there is a political, technical, and moral necessity to open up a discussion of commitment and ideology, although what he means by ideology is not adequately explained. Second, he contends that witnessing suffering means that morally we are asked to act. Commitment is commitment to some kind of action. Third, he promotes the idea that speech is action. "One can commit oneself through speech; by taking a stance, even when alone, of someone who speaks to somebody else about what they have seen" (p. xv). By speaking - to others and even to oneself - we recognize and acknowledge that speech must be understood as a form of action (p. 154).¶ One of the conditions of Boltanski's argument is a clear distinction between the world of representation and the world of action. He writes: "Informed by representation, words must really be deployed in the world of action in order to be effective" (p. 154). He is critical of deconstructionist criticism, primarily meaning the writings of Jean Baudrillard, which blurs this distinction to too great an extreme, thereby "holding the order of action" at arm's length or making it illusionary (p. 154). He contends that this position makes the very intention to act nothing but a naïve illusion creating an "empire of suspicion" (p. 158). Boltanski does not claim that we remain without an emotional commitment to causes, but rather that "to prevent the unacceptable drift of emotions close towards the fictional we must maintain an orientation towards action, a disposition to act, even if this is only by speaking out in support of the unfortunate" (p. 153).¶ What then are the properties of effective speech? Boltanski turns to phenomenology and semantics, concluding that effective speech involves: (a) intentionality; (b) incorporation in bodily gestures and movements; (c) sacrifice of other possible actions; (d) the presence of others; and, (e) a commitment (p. 185). Intentionality involves an intention to speak meaningfully, not just engage in idle chatter. Action and intention are connected to each other in effective action realized in the world. Intention incorporated in action is "expression." This kind of expressive political speech must involve risk for spectators - they may be chastized, they may be contested, or they may be at physical risk in authoritarian regimes. Boltanski goes on to classify different types of action as strong and weak, collective and individual. He builds an argument for local chapters of groups supporting humanitarian movements, such as Amnesty International, for they enable one to avoid the alternative of either on-the-spot involvement or distant spectacle. They are one way to breach the schism between abstract universalism and communitarian withdrawal: "The humanitarian claim for more or less distant causes can thus avoid the alternative of abstract universalism - easily accused of being fired up for distant suffering the better to avert its eyes from those close at hand - or of communitarian withdrawal into itself - which only attends to misfortune when it affects those nearest - by being rooted in groups and thereby linked to preexisting solidarities and local interests" (p. 190). In other words, expression is most "authentic" for Boltanski when made manifest in actions, like participating in a demonstration or protest, which incarnates our beliefs and displays our commitments. By incorporating an action, the person communicates an observable tendency.¶ But is this enough? Boltanski is concerned by apathy and asks us to consider that we are doomed, inevitably, to imperfection in our politics. Despite this, we must make the attempt to be "moral subjects" - that is, committed and engaged subjects. Because he recognizes the difficulties of negotiating these contradictions, he avoids moralizing. He is no Habermasian trying to outline the conditions for an ideal-speech situation. In Boltanski's book, we live in imperfect worlds and we must contend with this. He asks that we resurrect compassion into our politics, which he says is always particular and practical, as it is oriented toward doing something about a situation. Unlike pity, it engages with the person suffering. But pity isn't always a bad thing in this analysis. Pity generalizes in order to deal with distance, and in so doing one may discover emotion and feeling for others that may translate into speech or action. A spectacle of suffering may end with a commitment to involvement.¶ Boltanski realizes the challenge, yet remains optimistic that humans are capable of such a move. There are, as he notes, an "excess of unfortunates" in our world. The problem remains to whom we extend aid or pity, given their great numbers (p. 155). This is true both in the realm of action, but also in the realm of representation. So many people are suffering and there is not enough media space for them all (p. 155). Boltanski does not prioritize causes or instances of grief. He does, however, suggest that the media represent any unfortunate groups taking action to confront and escape their distress. It is unethical to only depict them in the passive act of suffering (p. 190). He acknowledges that the mediatization of suffering may incite action. For example, it may protect populations against their own rulers, if only temporarily, for such depictions do not necessarily change the internal political situation. His analysis assumes that spectators, who are democratic citizens, have a role to play in lobbying and pressuring their own governments to take action (p. 184). Again, while aware that public opinion may be manipulated, he argues that public-opinion polls are powerful tools. Answering a poll is depicted as a potentially effective form of speech and an "adequate response to the call for action" (p. 185).¶ Distant Suffering thus describes, in sometimes painful detail, a wavering between selfish egoism and altruistic commitment to causes. Boltanski describes how we may, unfortunately, cultivate ourselves by becoming absorbed in our own pity when looking at the spectacle of someone else's suffering, a phenomenon that has been far too present since the September 11 bombing of the World Trade Center in New York. Boltanski tries to lead us out of this self-absorption into the world of effective political action by offering a range of involvement. While advocating commitment and debates about morality as part of the solution, this is no smug celebration of the "return to kindness" or an easy denunciation of the perverse delight of spectacles of suffering. In considering distant suffering as the "logical consequence" of the introduction of pity into politics over 200 years ago, we are asked to concern ourselves with the present.¶ Boltanski ends his fine treatise by exhorting us to quit looking to past injustices, to stop anticipating future injustice, and to stay focused on the present. "To be concerned with the present is no small matter. For over the past, ever gone by, and over the future, still non-existent, the present has an overwhelming privilege: that of being real" (p. 192). Naive? Perhaps. Boltanski does not provide simple or quick answers to the dilemma, but leaves one with the hope that pity might lead to compassion, commitment, and social change - even if such measures do not end all suffering once and for all. As such, this translation from the original French