

Understanding the Social Impact and Global Consequences of Space Exploration

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Christopher Carlos Camacho

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Pedro A. P. Francisco, Department of Engineering and Society

Introduction

With the passing of the Space Race, world governments recognized a need to establish common laws regarding the use of our orbit and outer space. There were multiple treaties and principles established by the United Nations Office for Outer Space Affairs (UNOOSA) that prevent illicit uses of outer space, encourage transparency among nations when it comes to orbital installations, and detail a general plan for exploration and development (Cross, 2019). These treaties hold accountable all signatories but realistically work in most part due to the threat of retaliation, perhaps nuclear, by other countries, or the threat of a new Space Race to establish superiority throughout orbit. Since the power of these treaties lies not in the treaties themselves, but an unspoken agreement on consequences. The question proposed by this paper is if these unspoken norms stand for equality and preservation of our orbit if there are no official ramifications of breaking them. Will global powers face the same consequences of breaking the status quo the same way a smaller nation would? What future exists where major nations hold immunity from the law and have weapons placed in orbit? This paper will analyze the history of space exploration, its advancements, and relationships between nations, paired with a literature review to understand how the current state of the field came to be, and to analyze how this current structure affects the social, political, and economic states of both major powers and developing countries, along with the implications that the allowance of space weaponry will have in future international relations and potential future conflicts. The historical analysis will provide the perspective which the paper operates from, with the literature review serving to introduce topics surrounding each sphere of societal impact and help elaborate on those points being made to the reader.

Background & Significance

Within the history of space exploration and the endeavors to occupy it, there have been two major powers that have held influence, the United States and Russia. Beginning with the Space Race, each nation has moved to outdo one another for the sake of political gain and global favor (Darrin et al., 2009). As a result, these states created a strong infrastructure for future installations and orbital occupation, something that many nations still struggle with today. With this difference in power, it is important to analyze whether all nations benefit in the same way from space exploration, as the expansion into space might create a scenario where certain nations will be left out of the new frontier (STOJANOVIĆ, 2021). Along with this, current practices in space exploration are due to shared norms, highlighting the lack of influence that treaties and legislation hold while also introducing the problem that stands if a nation has enough power to stand above the law. Ignoring societal impact and defiance of laws and norms both have vast impacts on the efficiency and longevity of space exploration, which serves as the main point of this paper. The future of space exploration hinges on the preservation of our orbit, as described by research into small object density in our orbit and the consequences if the orbit becomes heavily polluted with them (Kessler et al., 2010) along with the consideration of all actors, public and private, that exist to endeavor into orbit and beyond and the harm each party might cause if unregulated. With the existence of dominant nations and private parties, both with considerable wealth and power, venturing forth into space, there exists the potential of direct and indirect damages both in orbit and on the ground, as not all nations stand to become a part of the new space age, and that actors with the potential to advance into space left unchecked can cause permanent negative impacts to society. Understanding and highlighting these effects is critical for all people of Earth to benefit from and participate in the benefits that exist in orbit and beyond.

Methodology

Introducing a historical analysis of space exploration from the Space Race until the current day provides the reader with the understanding to think about how certain dynamics were formed within today's sphere of space exploration. Along with this, a literature review stands to support personal arguments made towards the volatility that exists if current practices continue with regards to installations placed in orbit and the human factor on the ground. Pairing these two serves as the best format to give any reader the ability to think critically on their own about the impacts that come with space exploration and how it is conducted. Understanding the vast and complex network of space exploration and the parties involved is best done with Actor-Network Theory as it will provide the foundation to best explain the connections between each actor and their influence on space exploration and the societies that influence it. With this, it is possible to even group certain actors, allowing for more concise conclusions to be drawn about said interactions. Actors such as the United States, Russia, other space capable nations, and private sector parties all exist to influence space flight through their own means, thus allowing the analysis of each party but also the entire group as a group with indigenous space capabilities. Another group of actors are those that hold indigenous launch capabilities but rely on other nations to supply the materials and structures for rocketry, making this party part of the new space age but not to the same capabilities as those on the top, those with the power to move off-world or even install weaponry that can ignite future wars and cause devastation previously unseen. Lastly, a group can be denoted as those that do not have the ability to launch and do not have the resources to develop such capabilities or even rely on other nations. In a potential future where weaponry installed in orbit is commonplace, what will become of nations left behind in the new space age? Nations with neither the means to counter defend from this weaponry or to

install their own into orbit will have to exist at the mercy of more powerful nations, potentially creating a form of neo-colonialism. Analyses made for the current structures of each actor, actor grouping, and the interactions between them currently and historically will, hopefully, fully expand on how space exploration and its implications hold effects for the entire globe in the future but can also be used as an embodiment of social structures and current climates on the ground. Through a historical analysis of space exploration and a literature review of sources that help explain the social, political, and economic circumstances behind the scenes, the argument that space exploration must be handled with the utmost care to preserve the longevity and safety of both our orbit and beyond, but also to allow the benefits of space exploration to be a benefit to all, not just those at the top who wish to seek more power.

Literature Review & Analysis

In the field of space politics, there has been rapid change since the end of the Space Race and Cold War era due to many advancements in technology and other changes in the global political climate. Throughout the years, there have been shifts in the main priorities associated with the developments in space exploration. A summary of the history is that after World War II, the United States announced that they planned to launch artificial satellites in orbit, prompting the Soviet Union to respond by beginning their own initiative to place their own satellites into orbit. What followed were endeavors aimed to be cold war propaganda weapons to convince the world of the merit of either democracy or communism (Darrin et al., 2009). Through this era, nations aimed to outdo one another by launching unmanned and manned launches to place satellites and people into orbit, until eventually the United States succeeded in putting astronauts on the moon. During this era of the rapid occupation of our orbit, there emerged the understanding that a major

priority of all nations was determining the governance of this new frontier, something that was not going to be easily accomplished. Since the beginning of space legislation, it has been known that one major weakness of any legislation is that it must be futureproof (Bookout 1959). Another major weakness described by Bookout (1959) is that legislators can create as many laws as they find fit, but it is ultimately up to the nations to follow any guidelines established through law. As time has progressed, the conduct of nations has mostly been based on unspoken norms that countries informally agree upon, as each nation has come to have different interpretation of major treaties, such as the Outer Space Treaty (STOJANOVIĆ, 2021). The climate of space exploration is one of both formal and informal guidelines, something that presents a danger as there can be lasting effects if there are no consequences for damage to the orbital environment or due to a difference of interpretations.

One major technical effect of non-adherence that was introduced by Kessler and Cour-Palais is something dubbed “Kessler Syndrome” (Kessler et al., 2010). Kessler syndrome is a phenomenon where the density of small debris in orbit will lead to the destruction of current orbital installations and the prevention of future installations, something that would permanently change society, such as the irreversible effect of losing satellite benefits such as GPS and telecommunications. Solutions to Kessler syndrome described are adherence to guidelines and small object retrieval (Kessler et al., 2010), both of which are contested subjects today. Adherence from nations has been mostly through informal norms, one of which being the understanding to prevent as much unnecessary pollution of our orbit. This norm was ignored in 2007, however, after China destroyed a satellite in orbit, creating 3,000 pieces of debris that will continue to orbit for many decades (NASIC, 2018). Along with ignorance by nations, the commercialization of outer space has allowed private companies to fulfill their own interests at the expense of the preservation

of the orbital environment (Lai 2021) and (Paikowsky 2017), something that begs the question if the benefit of private-sector funding outweighs the potential negatives that come with allowing non-government entities into orbit. One example being Starlink satellites that Elon Musk and SpaceX are currently launching into orbit, installations that received major scrutinization at the beginning of their deployment. The massive number of satellites planned for installation would both hinder space observation by astronomers but also needlessly increase the number of objects in orbit. The lack of concrete consequences and guidelines, since these operations are mostly monitored through informal norms, allows for nations to cause major damage to the longevity of space operations. In the realm of small object retrieval, there is concern of how the necessary technology for operations could be a threat as something such as a robot arm can alter or damage another party's satellite (NASIC, 2018). Along with the misuse of retrieval technology, nations have continued the development and deployment of anti-satellite weaponry, something that may counter the peaceful use of our orbit, but something that is not strictly forbidden by current treaties (Moltz 2024), and is outlined by (STOJANOVIĆ, 2021) when describing that nations will not easily agree to any treaty that would prevent them from gaining power and an advantage over another nation. This type of interference can be associated with the danger that exists once space weapons become commonplace, where one major conflict in orbit could cause irreversible damage, something described in (Kessler et al. 2010) as an "ill-planned rapid expansion", something that would accelerate the growth of objects in orbit, and increasing the potential that the Kessler Syndrome happens before nations implement object clean-up technology.

Another major concern that the rapid exploration of space exploration are the effects that it has on the ground. A main tenet of advancements in space exploration is the belief that it should be used for the shared benefit of humanity. But is this true? Are countries that do not have

indigenous capabilities for orbital launches, thus relying on other nations, hold the same power as the nations they rely on? Do the nations that lack the resources for neither self-launch nor external launching even have a place at the table? What aspects of history have led to the current situations that prevent certain nations from participating in the new space age? During the Space Race, many nations participated, but we remember two major nations, both of which held extreme wealth in both power and resources, and whose efforts in the original Space Race sowed many seeds for efforts today. In today's climate, there are more actors in the new age Space Race, but it is still very clear that many nations are being left behind while the top nations in the world continue to grow through their access of this new frontier (STOJANOVIĆ, 2021). This exacerbates the issue of non-adherence, as powerful nations with more impunity can bend the rules and change interpretations for their own gain. One such case is the use of high-resolution imagery satellites and GPS, something that is considered a common benefit for humanity, but also allows for nations to gain a militaristic edge (Sariak, 2017). As explained, the overwhelming advantage that the United States held in the Gulf War can be attributed to their advancements into high-resolution satellite imaging (Paikowsky, 2017), something that was unique and highly exclusive for the time and was virtually impossible to counter. Such a case can be explained as those with and those without, the main argument from (Paikowsky, 2017) where it is explained that there are social constructs he names "nation clubs", something that exists much like cliques in human society. These clubs, he describes, exist both formally (OECD) and informally (Space Club). These clubs operate to compete, thus gaining status that will attract other nations seeking to join. Nations not in these clubs want to join, and nations in the club know that including them may come with the added benefit of being able to impose their norms and rules onto the new member, along with any benefits both informationally and materially. The cooperation fostered within one of these clubs

accelerates progress to those with the privilege, and in most cases denies outsiders from advancements through these tactics. These actions serve to advance the powerful and allow them to keep their status within the world, hindering the advancements of those considered beneath them. History between many developed nations and developing nations serve as the explanation for the difference in technological advancements, and create a case where a past of slavery, colonization, and general disruptions have created the environment that do not allow certain nations to develop space capabilities, and these nations should always be kept in mind when pushing forward, never allowing them to be left behind. Combined with this, as agreed on by (Cross, Mai'a, 2019) and (Paikowsky 2017), is the emergence of the major actors from the private sector and the potential for devastating harm that they might have. Along with the potential to crowd the orbit as stated before, we must think, what would the world look like if a private corporation were to have access to their own store of space weapons? Private endeavors led by those with more wealth than entire nations hold the potential to act recklessly and have the world suffer the consequences. The existence of inclusion and exclusion in the new frontier goes against the belief that the new frontier should be a shared space and must be addressed if the concept of a free outer space wants to be upheld.

Conclusion

In conclusion, an unfettered advancement into space will lead to lasting consequences both socially and technologically. With the absence of concrete treaties that applies to modern technology and its uses, there is a reasonable concern that the actions of those seeking technological advancement will be short-sighted and will, as a result, create lasting consequences for future space exploration. Large amounts of small debris in our atmosphere would shred

through all installations, crippling the highly technological society we live in today. This can be mitigated through strict adherence to guidelines and with retrieval technology. Retrieval technology is valuable and necessary, but it poses a grey area where the satellite can be used both helpfully and harmfully. Additionally, the presence of non-government entities in space can accelerate the future of Kessler Syndrome, something that brings into question if private parties should even have their own infrastructure for orbital installations. The presence of unwanted orbital installations may also prompt an era of militarization in our orbit, with nations racing to control space through weaponry and force rather than legislation and diplomacy, something that will potentially lead to an increase in the technological and economic gap that exists between developed and developing nations. Allowing the advancements into space to widen the gap between nations goes against the belief that all should benefit from the utilities of our orbit and beyond. Along with technological dangers, there is a present danger of how the future of space occupation will change social structures on Earth and damage the livelihoods of those living in nations that lack the capacity to participate, creating a potential future where the Earth is deemed as a place only inhabited by those without the ability to live off-world, where those remaining are deemed as less than. This scenario will be exacerbated through the existence of orbital weaponry, creating a new form of danger that hangs above the heads of many people. Such a fear can be used to control masses of people, and can lead to a new age of control and colonialism enabled by advanced space capabilities. A future war waged on the ground will be assisted by weapons placed into orbit, something that will be untouchable by many nations and introducing a war with record numbers of casualties. Through strict adherence to preservation practices, a persistent effort to make space exploration inclusive, checks and balances on both public and private sector actions, and a restriction of the militarization of space, the longevity of space

exploration can be secured and exploration can be done efficiently through collaboration and trust.

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