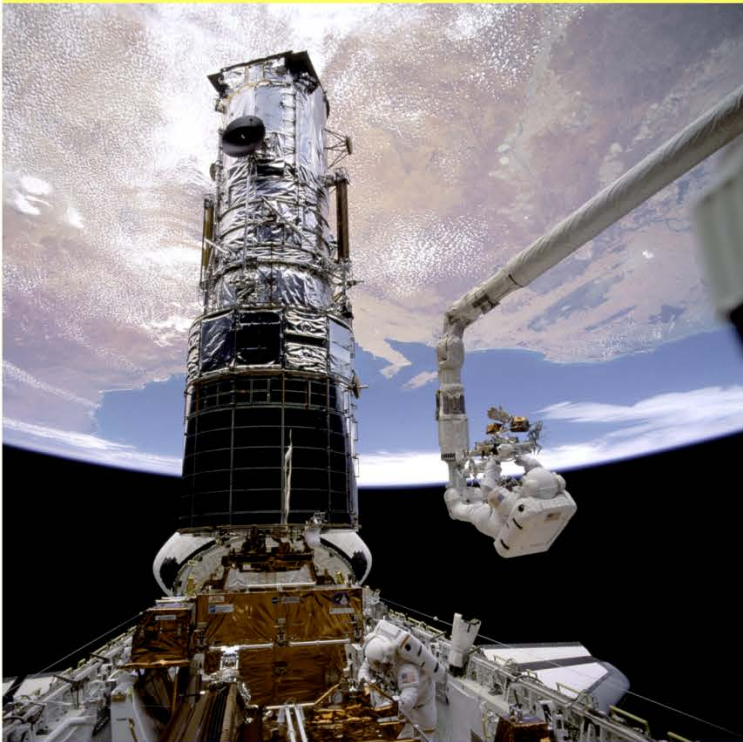


The Journal of Astrosociology



Volume I

Astrosociology Research Institute

THE JOURNAL OF ASTROSOCIOLOGY

VOLUME 1



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THE JOURNAL OF ASTROSOCIOLOGY

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THE JOURNAL OF ASTROSOCIOLOGY

Volume 1 (2015)

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Introduction to the Inaugural Issue

Welcome to the inaugural issue of *The Journal of Astrosociology*! The field of astrosociology has come a long way since Dr. Jim Pass first introduced it in 2004. To support the study of astrosocial phenomena (*i.e.*, the social, cultural, and behavioral patterns related to outer space), Dr. Pass founded the Astrosociology Research Institute (ARI) in 2008. Since then, ARI has collaborated and affiliated with top researches, scholars, and institutions across a wide variety of disciplines that study outer space and its effects on human societies, cultures, and individuals. Whether through the lens of the hard sciences, law, policy, history, philosophy, literature, or any other field or discipline of study, ARI seeks to encourage a multidisciplinary approach to the investigation of the two-way relationship between outer space and humanity. To induce growth in astrosociological research, ARI has therefore expanded its role in the pursuit of knowledge with the publication of *The Journal of Astrosociology*.

While the study of astrosocial phenomena has existed in one form or another for a very long time, the terms astrosociology and astrosocial phenomena are a relatively new convention. Mainstream sociology and the other social science fields and disciplines have resisted expending very much time, energy, and other resources to the study of space-related issues. Nevertheless, individuals have tackled such issues since before the dawn of the space age. For example, science fiction writers like Jules Verne, Arthur C. Clarke, Isaac Asimov, and others have contemplated such issues, often made amazing predictions, and even helped unravel a few social and technical problems. The creation of the field of astrosociology, and later ARI, occurred to facilitate and guide the development of this social-scientific approach to the study of space issues in a formal and organized manner. ARI and *The Journal of Astrosociology* exist to formalize this process in a coherent and easily recognizable manner. Can we bring astrosociology into the mainstream among the social sciences? We at ARI believe that we can, and this journal represents a most important tool to make it happen. So welcome to the astrosociological frontier!

By building on the successes from the publication of the astrosociology special issue in the journal *Astropolitics* in 2011 and the publication of ARI's newsletter *Astrosociological Insights* beginning in 2012, progress accelerated at a disciplined pace towards the creation of this journal. Of course, garnering support and providing announcements in the social media have had their impact as well. Yet greater progress continues to take place among too few scientists and scholars in both the social and physical sciences. Our aim with this journal is to continue the expansion of supporters and participants who wish to grow the astrosociological community and add the human dimension to space education and research for the benefit of all.

Before exploring this first volume of the journal, it would be helpful for the reader to understand what astrosociology actually is. Astrosociology is the scientific study of astrosocial phenomena, defined as the social, cultural, and behavioral patterns related to outer space. What this boils down to is a focus on the various ways in which outer space impacts on all aspects of societies and people. Therefore, this journal is committed to a focus on the human dimension of space, including how astrosocial phenomena affect individuals, cultures, subcultures, social groups, entire societies, and the relationships between, and among, nations. It does not matter where people live, in space or on Earth, because astrosocial phenomena have become nearly ubiquitous in all of our daily social lives, even if we fail to recognize them.

How is this possible? Consider that what we observe as celestial phenomena can inspire those who prefer to go “off the grid,” such as when witnessing a shooting star pass through the night sky or simply starrng at the stars overhead. These experiences can have profound impacts on individuals – and certainly such observations have affected entire societies and cultures, as well as individuals in the past. Thus, astrosocial phenomena do not depend on our understanding of science or technology to affect us, nor do they require us to recognize them as such. In a sense, these astronomical phenomena transform into astrosocial phenomena when a person observes them.

It is important for future readers of, and contributors to, this journal to understand that we at ARI hold a strong belief that not everyone interested in pursuing or learning about space education and research issues must be a physical or natural scientist. Many people choose not to become “hard” scientists for a variety of reasons. The very reason Dr. Pass founded the field of astrosociology was to invite social scientists, behavioral scientists, humanists, and artists interested in space to find and build a community of like-minded individuals to work within a professional capacity as well as share their passion for space. This includes those already working on space-related issues who do so largely apart from the mainstream of their disciplines and fields and one another, and those who wish to pursue astrosociology, especially scholars and students, who favor a social-scientific approach.

Additionally, we at ARI believe strongly in the necessity to continue building bridges to the traditional space community, to natural and physical space scientists, in order to encourage collaborative interdisciplinary work among those traditionally separated within the two branches of science. Formalized collaboration such as this can result in synergies that create breakthroughs and insights that scientists working within single disciplines and fields in either scientific branch cannot achieve alone. The multidisciplinary structure of astrosociology therefore emphasizes interdisciplinary efforts between hard and soft scientists. I believe the collection of manuscripts contained in this first volume is truly representative of an astrosociological approach. This volume is only the beginning and I invite interested persons to contribute and help grow this timely and unique approach to the study of a wide variety of social-scientific problems inherent in the field of astrosociology.

The inaugural issue of *The Journal of Astrosociology* consists of two articles, two essays, and one student essay. The first article entitled “Astrobiology: Where Science Meets Humanistic Inquiry” is written by Dr. Albert A. Harrison. The article explores the nexus between the study of astrobiology and astrosociology. As Dr. Harrison states in the article’s abstract:

Astrobiology studies the origin, distribution, and future of life in the universe. Although purely a scientific effort, astrobiology touches upon great questions of human existence long considered the province of philosophy and theology. Where did we come from? Are we alone in the universe? What will become of us? NASA’s astrobiology program, as set forth in the NASA Astrobiology Roadmap, combines physical, biological, and social sciences, and recognizes enormous implications for society. As such, astrobiology provides fertile grounds for astrosociology, the interdisciplinary and multidisciplinary study of social, cultural, and behavioral patterns related to outer space. Central topics include the origins and evolution of life, the search for life and its precursors beyond Earth,

environmental ethics, establishing ourselves as a multi-planet species, and protecting ourselves from global catastrophes and extinction-level events. This paper introduces the psychology of worldviews as a conceptual tool to further our understanding of people's reactions to astrobiological discoveries. Worldviews are the cognitive frameworks and psychological processes that shape perceptions of reality, influence the kinds of evidence that people accept, and makes it possible to cope with unpredictable and potentially dangerous conditions.*

The second article entitled "Exploring How Social Media Can Be Used to Promote Space Awareness: A Case Study of the Yuri's Night Web 2.0 Strategy" is written by Dr. Alan Steinberg, Jeffrey Alles, and Dr. Ryan L. Kobrick. The article presents a case study of how social media is used to promote Yuri's Night and awareness about space advocacy. As the authors' abstract states:

Despite the importance of social media as an inexpensive and efficient means of communication, it is not clear to what degree space advocacy groups are making a strong organized effort to use the resources available to them. Moreover, there is no previous literature that specifically examines the use of social media tools by space organizations. This study seeks to start a larger dialog regarding how the space advocacy community can make use of these tools to promote their mission. Using a case study approach, this article focuses specifically on the organization of Yuri's Night to explore how this group is using social media to accomplish its mission of building general space awareness. In addition, this article evaluates the organization's social media presence as well as the role social media has played in the organization's ability to accomplish its mission. Other space advocacy groups can use the lessons learned here to improve their own social media strategies.†

Written by Geoffrey Landis, the first essay is entitled "Spaceflight and Science Fiction" and explores how science fiction throughout history has influenced the development of spaceflight. As the abstract states:

From the very beginning, science fiction and spaceflight have had a very close relationship, with science fiction both stimulating and in turn being stimulated by developments in real-world science. For example, Johannes Kepler's novel *Somnium* (ca 1634) was both a work of science fiction, and also one of the earliest works of lunar astronomy; while Jules Verne's 1865 *De la Terre à la Lune* ("From the Earth to the Moon") anticipated the Apollo missions; and "The Brick Moon," by Edward Everett Hale (1869) anticipated the use of satellites for navigation. This essay discusses some of the history, and presents some of the

* Albert A. Harrison, *Astrobiology: Where Science Meets Humanistic Inquiry*, 1 J. ASTROSOCIOLOGY 11 (2015).

† Alan Steinberg, Jeffrey Alles, and Ryan L. Kobrick, *Exploring How Social Media Can Be Used to Promote Space Awareness: A Case Study of the Yuri's Night Web 2.0 Strategy*, 1 J. ASTROSOCIOLOGY 31 (2015).

remarkable parallels and shared inspiration between science fiction and spaceflight.[‡]

The second essay written by Dr. Elizabeth Song Lockard is entitled “Beyond Habitation in Space: The Need to Design for Adaptation.” Dr. Lockard explores issues about how humans will need to adapt to new environments beyond Earth. As Dr. Lockard’s abstract states:

As human space exploration goals have evolved and expanded, so has the domain of “human factors” research. The earliest missions to the Moon were concerned exclusively with survival; research objectives of the present phase focus on work performance and functionality; and the efforts towards habitation on Mars in the future take into account considerations for quality of life and well-being. Creature comforts and leisure activities alone, however, are not sufficient habitability criteria. What is missing is the perspective of long-term adaptation to the environment, which entails not only a physiological dimension, but also a psychological and a social dimension. Unlike physiology, however, psychological processes are not objective but subjective, and depend on individual perception rather than the actual characteristics of the physical world itself. A more comprehensive understanding of adaptation – beyond the presently established conditions for habitability – requires the development of familiarity, empathy, and a sense of home. This cannot be achieved by shielding the crew from the harsh exterior, but rather through promoting engagement with their environment. Only through the processes of negotiation will humans develop the resilience that will make them more likely to endure and prosper in space.[§]

The student essay is written by Ana Kilbryde. Her essay is entitled “Space Travel as a Means for Re-Enchantment, Unification, and Spiritual Fulfillment” and explores the philosophical and psychological issues regarding space travel. As her abstract states:

The literature surrounding the topic of space travel acknowledges that the concepts of dis/re-enchantment and narcissism help to explain an individual’s desire to travel to space, but the analysis does not delve deep enough into these ideas and tends to place too much emphasis on space travel as a negative experience. By expanding on Dickens’ and Ormond’s application of “re-enchantment to space travel” and by using Weber’s theory of disenchantment, Freud’s theory of narcissism, and phenomenological analyses of astronauts’ experiences of space, this essay investigates whether the theory of disenchantment would encourage the individual to seek spiritual unity and re-enchantment through space travel. The emptying of the individual of any soteriological significance and the prominent presence of dualist ideologies of the cosmos and humanity provides insight into a longing for unification. However, this discussion argues that when this feeling of unification is achieved there still lays an inherent need to rationalize the experience. The conceptualization of “spiritual narcissism” contributes to the understanding of why one needs to explain this profound

[‡] Geoffrey Landis, *Spaceflight and Science Fiction*, 1 J. ASTROSOCIOLOGY 57 (2015).

[§] Elizabeth Song Lockard, *Beyond Habitation in Space: The Need to Design for Adaptation*, 1 J. ASTROSOCIOLOGY 69 (2015).

phenomenon and Erik Fromm's "two modes of being" elucidates the urge to possess the experience rather than accept it. The individual appears to have grown weary of the rationalized world we reside in and yearns for something that cannot be rationalized or theorized. This discussion found that the search for unity and enchantment can not only be considered an abandonment of theory, a rejection of dualities and secondary narcissism, but also as spiritual narcissism – an individualized attempt at identity formulation – as one attempts to possess the experience rather than simply accept it.**

As Editor-in-Chief of *The Journal of Astrosociology*, I personally thank the Executive and Assistant Editors, the Editorial Board, and authors for contributing their time and effort in support of the journal. I also personally thank Dr. Pass for his vision in developing and growing the field of astrosociology. They have all made this endeavor a success. I now appeal to the reader to contribute to the cause this journal sets forth, either through submission of manuscripts, reading about and supporting astrosociology, or passing along our contributions to the physical and social sciences to others.

Thank you for your support.

Christopher M. Hearsey, M.S., J.D.

Editor-in-Chief

The Journal of Astrosociology

** Ana Kilbryde, *Space Travel as a Means for Re-Enchantment, Unification, and Spiritual Fulfillment*, 1 J. ASTROSOCIOLOGY 83 (2015).

Dedication to Albert A. Harrison (1940-2015)

We are mourning the passing of Dr. Albert A. Harrison who left us early in February of this year, much too early at the age of 74. We dedicate this issue to him, and we have plans for additional forms of remembrance that this pioneering social scientist and friend justly deserves. Very soon, we will post a dedication page at www.astrosociology.org that will bring together his important works that greatly helped to construct the foundation on which astrosociology is built. Perhaps this is why he viewed the effort to develop astrosociology so positively. His support and encouragement since the beginning, before I even contemplated the incorporation of the Astrosociology Research Institute (ARI), coming from such an influential social scientist who dedicated a great portion of his career to the study of space issues from a social science perspective, was a true inspiration to me and everyone connected to the development of astrosociology.

Dr. Harrison supported the development of astrosociology from the moment I approached him with the idea. He demonstrated his support as early as 2005 when he joined me as part of an astrosociology session at a regional sociology conference in California. Keep in mind that I introduced astrosociology in 2004, so Dr. Harrison was indeed a very early supporter. The title of his presentation and paper is “Overcoming the Image of Little Green Men: Astrosociology and SETI.”* He was quite aware of the difficulties that SETI and astrobiology had experienced during their development, which often took the form of criticisms that tied their fields to UFOs and other pseudoscientific efforts. To his credit as a friend and supporter, he wanted to remove such ties to astrosociology at an early point in its development. I firmly believe that his stature in the areas of SETI and astrobiology, and the application of social science to space research, did a great deal to assist us in avoiding much of that inevitable disparagement.

Allow me to elucidate a bit on the above referenced conference paper, which takes a sociological perspective based on the audience and my early thought that astrosociology would become a sociological sub-discipline only. Not too long after our presentations, it became clear that a social scientific multidisciplinary approach was the superior path. In his paper, Dr. Harrison made a clear distinction between a belief in extraterrestrial-based UFOs and a sociological scientific approach. He wanted to keep astrosociology away from the fringe where pseudoscientific approaches lurk. I really appreciated that at the time, and I still do.

Al Harrison demonstrated his continued support once again with his backing of ARI since its inception in 2008, and I hasten to add that he readily agreed to become a very early ARI Advisor. His guidance provided ARI officers and board members with extremely valuable input that assisted us in moving forward in a logical and realistic manner. Moreover, he took advantage of many opportunities to write pieces for ARI when his schedule allowed, to all of our benefit. He was extremely busy for a man in his “retirement” years, and seemed always to be juggling several projects at once. Despite this, he found the time to discuss astrosociology with others, and me, and he was always gracious in his interactions with everyone. Please indulge me in providing a few pertinent examples. In 2011, he wrote an article in the journal *Astropolitics*, which was a dedicated special issue devoted to astrosociology, where he continued to

* Available at http://www.astrosociology.com/library/pdf/submissions/overcoming%20lgm_harrison.pdf.

demonstrate his strong support for the development of astrosociology. Dr. Harrison's contribution to the special issue is entitled "The Search for Extraterrestrial Intelligence: Astrosociology and Cultural Aspects."[†] The final sentence in Dr. Harrison's abstract indicates a lot about his belief in astrosociology's positive role to play in the future: "The current challenge for astrosociology is not gaining entrée to SETI; rather, it is one of increasing the interest of more social and behavioral scientists in the search and its potential effects."[‡] His comment speaks to the fact that too few social and behavioral scientists have historically chosen to study SETI issues, or any issues that involve outer space. It is a great shame that he cannot continue with us on this journey to make astrosociology more accessible to the "softer" – or what he and others have called the "harder" – sciences. I know that he would be excited about the future of astrosociology and *The Journal of Astrosociology*.

In 2013, Dr. Harrison wrote an article for the third issue of our newsletter *Astrosociological Insights*. The topic and title of the piece is "Asteroid Mining and Space Development."[§] It briefly discusses issues regarding the efforts of NewSpace entrepreneurs and the study of their efforts. Again, he touches on the idea that many social scientists are hostile to the idea of human sociality in space even while their input remains critically needed.

Dr. Harrison voiced his support for this journal to me on many occasions, at first when it was no more than a proposed idea that would not come into being until this year. I am extremely delighted that he had the opportunity to write an article for this inaugural issue of our journal. Titled "Astrobiology: Where Science Meets Humanistic Inquiry," the focus is on the psychology of worldviews as applied to the search for life and, more importantly, what happens when extraterrestrial life is detected. What happens when such a discovery challenges various worldviews? How will humans react? He provides a nice history of SETI, CASETI, and astrobiology, along with the societal roadmap and a number of related issues that cover a great deal of ground. This article is a good representation of Dr. Harrison's comprehensive approach to anything he undertook. His article is a most welcomed gift.

While he can no longer advise us on future decisions, his influence has helped us develop our own roadmap that has greatly assisted us to pave the way toward accomplishing the various elements that make up ARI's mission to develop astrosociology as an academic field. Our newsletter and this journal reflect integral components in this effort. We greatly miss him, but we are very glad that we knew him, and we definitely plan to make sure that we build on his seminal foundational work.

Jim Pass, Ph.D.

Chief Executive Officer

Astrosociology Research Institute

[†] Harrison, A. A. (2011). The search for extraterrestrial intelligence: Astrosociology and Cultural Aspects. [Special issue: Astrosociology]. *Astropolitics*, 9(1), 63.

[‡] *Ibid.* at 82.

[§] Available at http://www.astrosociology.org/Library/PDF/Newsletters/ARI-Newsletter_Vol-2_Iss-2_05-2013.pdf.

ARTICLES

Astrobiology: Where Science Meets Humanistic Inquiry

Albert A Harrison, Ph.D.*
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ABSTRACT - Astrobiology studies the origin, distribution, and future of life in the universe. Although purely a scientific effort, astrobiology touches upon great questions of human existence long considered the province of philosophy and theology. Where did we come from? Are we alone in the universe? What will become of us? NASA's astrobiology program, as set forth in the NASA Astrobiology Roadmap, combines physical, biological, and social sciences, and recognizes enormous implications for society. As such, astrobiology provides fertile grounds for astrosociology, the interdisciplinary and multidisciplinary study of social, cultural, and behavioral patterns related to outer space. Central topics include the origins and evolution of life, the search for life and its precursors beyond Earth, environmental ethics, establishing ourselves as a multi-planet species, and protecting ourselves from global catastrophes and extinction-level events. This paper introduces the psychology of worldviews as a conceptual tool to further our understanding of people's reactions to astrobiological discoveries. Worldviews are the cognitive frameworks and psychological processes that shape perceptions of reality, influence the kinds of evidence that people accept, and makes it possible to cope with unpredictable and potentially dangerous conditions.

I. Astrosociology as an Interdisciplinary Field

The primary purpose of this paper is to explore the interactive and synergistic relationship between astrosociology and astrobiology. The secondary purpose is to introduce and apply the psychology of worldviews to better understand controversies that are evident in discussions of astrobiology's focal interests: the origin, distribution, and future of life in the universe. Astrosociology is the study of social, cultural, and behavioral patterns related to space (Pass, 2011, 2012; Pass, Hearsey and Caroti, 2010). Initially formulated by sociologist Jim Pass to bridge space sciences and sociology, the field expanded over the years, first to embrace all social and behavioral sciences and then to accommodate the humanities and arts. Astrosociology encourages interdisciplinary and multidisciplinary research on space exploration and settlement, searches for extraterrestrial life, defending Earth from space-borne threats, and other topics at the juncture of space, life, and humankind. Astrosociology has both academic and applied components, promoting the development of new theories and finding practical solutions to the problems associated with interacting with space ecologies, establishing ourselves as a multi-planet species, and redefining our place in the universe in light of a succession of new

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discoveries. In 2011, a special issue of *Astropolitics* helped delineate the scope, prospects, and goals of astrosociology, including research, outreach, and education elements (Hearsey, 2011).

Although astrosociology melds different interests, each field brings its own characteristic organizing concepts and research tools to the table. Anthropologists draw on culture, an amalgam of technology, symbols, and meanings as an organizing and explanatory concept for their efforts. Sociologists dwell on societies and their institutions such as government, economy, religion, family, and education. Sociologists are interested in both abstract social structures and processes, and in their representations within the individual. Psychologists are interested in cognition, emotion, attitudes, behaviors, and interpersonal relationships, among other topics.

II. Astrosociology and Astrobiology

As Jim Pass has demonstrated, astrobiology is a fertile ground for astrosociology (Pass, 2011, 2012). Astrobiology is NASA's program for studying the origins, distribution, and future of life in the universe. As explained by the historian Steven J. Dick, astrobiology has been consistent with the NASA Charter since 1958, and the life sciences, including biology and medicine, have been prominent in NASA-sponsored research (Dick, 2013; Dick and Strick, 2005). One early NASA program – exobiology, the study of life beyond Earth – was built on a combination of physical science (e.g. astronomy, planetary science, and geology) and biological science (e.g. evolutionary biology, microbiology, and genetics). In the late 1990s, astrobiology emerged at NASA-Ames Research Center (NASA-ARC) in the course of a NASA-wide reorganization (Dick and Strick, 2005). This was an exciting era marked by the discovery of the first extrasolar planets, rapid progress in genetics including modeling the human genome, and accelerating searches for extraterrestrial life. The introduction of a NASA Astrobiology Roadmap presented a new conceptual framework, organizational structure, governing principles, and goals for studying life in the universe (Des Marais et al., 2008). Most importantly, it added the social sciences and humanities to the intellectual mix, recognizing that astrobiology has enormous implications for cultures, societies, and people (Dick and Strick, 2005). A revised NASA Astrobiology Roadmap was unveiled in 2008, and it is this version that is in force today (Des Marais et al., 2008).

a. The Science Roadmap

The NASA astrobiology science roadmap recognizes that astrobiology is a multidisciplinary effort. It encourages keeping Earth and other planets alive and healthy, and promotes education and outreach to inspire the next generation of scientists and inform the citizenry (Des Marais et al., 2008). Astrobiology includes not only most or all of “the fundamental questions in biology, physics, and chemistry, but also in philosophy, psychology, religion, and the way in which humans interact with their environment and each other” (Dominik and Zarnecki, 2011: 369). Of course, NASA is not alone in such interests. From its inception, NASA's Astrobiology Institute (a virtual institute) has included international partners (Dick and Strick, 2005). The European Space Agency has a comparable program known as the Cosmic Vision Plan (Fridlund, 2011). In the UK, the British Interplanetary Society has done much to further the interests of space exploration and the search for extraterrestrial life (Macauley, 2012)

and the British Royal Society hosted a symposium on astrobiology to help celebrate its 350th birthday (Dominik and Zarnecki, 2011).

Nobel Laureate Baruch Blumberg heralds astrobiology as a new age of discovery, analogous to that era when adventurers and scientists undertook sea and land-based expeditions of discovery (Blumberg, 2011). Like James Cook, Alexander von Humboldt, and Lewis and Clark, astrobiologists set forth to explore new ground, following in the tradition of past explorers who sought new routes, scientific discoveries, and material resources. Past exploration was made possible by ambitious sovereigns and governments, committed visionaries, better ships, improved instruments, high motivation, and developing scientific skills. Many early explorers had spent years studying topics like biology, geology, and meteorology, which allowed them to make sense of their fresh discoveries. “The sense of wonder,” he adds, “generated by the explorations of the Age of Enlightenment is also part of contemporary research and exploration” (Blumberg, 2011: 515). Blumberg speaks from experience since he personally traveled to remote field sites with only the equipment that he could squeeze into his backpack (Dick and Strick, 2005).

b. The Societal Roadmap

Although a purely scientific effort, astrobiology applies the theories and methods of science to three great existential questions. These are: “Where do we come from?” “Are we alone?” “What will happen to us?” Traditionally these questions have been the province of philosophy and theology. Because of astrobiology’s far reaching implications for humanity, NASA’s Astrobiology Roadmap spurred a parallel effort now known as the “societal roadmap” published by Race et al. (2012) in the peer-reviewed journal *Astrobiology*. This publication is an outgrowth of interwoven activities including a meeting held in 1999 at the NASA Ames Research Center (Harrison and Connell, 2001) and a meeting ten years later at the SETI Institute (Race et al., 2012).

The 2009 meeting included 43 participants broken into three affinity groups: Philosophy and Ethics, Science and Religion, and Social Sciences. As described in the conference report “Astrobiology and Society: Building an Interdisciplinary Research Community,” the task of the 2009 conference was to identify and explore sociocultural issues; invite participation of historians, social scientists, theologians, and humanists in the overall astrobiological enterprise; and encourage dialogue with physical and natural scientists and the public at large (Race et al., 2012). While the societal roadmap is a communal effort independent of NASA, both roadmaps are intended to orient researchers and help them work across interdisciplinary lines. In 2013, societal issues became a focus group within the NASA Astrobiology Institute. The societal roadmap sets five tasks (Race et al., 2012):

1. Explore the range and complexity of societal issues related to how life begins and evolves.
2. Understand how astrobiological research relates to questions about the significance and meaning of life.
3. Explore the relationships of humans to life and environments on Earth.

4. Explore the potential relationships of humans with other worlds and types of life.
5. Examine life's future – for humans and other forms – on Earth and beyond.

The societal roadmap points to the importance of anticipating new discoveries, and how people with different worldviews are likely to react to them (Race et al., 2012). What might be done to communicate new findings to diverse audiences? Will these new discoveries be accepted or rejected by the public, and, if accepted, how will they be incorporated into existing cultural and subcultural narratives? What impact might they have on space entrepreneurs and industrialists? What kinds of social change might we expect? How can new findings be turned into building blocks for understanding discoveries yet to come? And how can we keep our minds open to discoveries and interpretations that may run counter to our present theories and findings? The societal roadmap provides a useful resource for researchers at the juncture of astrosociology and astrobiology.

As we follow the societal roadmap, I will introduce and apply the psychology of worldviews to help explain people's views on life in the universe. "Worldviews" is commonly used as a simple descriptive term, but as Clement Vidal recently explained, the concept has a long and rich tradition in philosophy, and academic and scientific discussions of worldviews have been complex and nuanced (Vidal, 2014; 2015). He proposes a 26-dimensional model of worldviews as a framework for people's perceptions of and likely reactions to extraterrestrial life, ranging from microbial specimens to super-advanced technological civilizations. In the course of this, Vidal organizes much of the past discussions of extraterrestrial life and its discovery, and explains why we should pay more attention to some contact scenarios than others. He also identifies key variables that seem likely to ease our transition from a pre-contact to post-contact civilization, if that becomes necessary.

Here, worldviews are presented as psychological constructs with both structural and dynamic properties that have implications for the astrosociological aspects of astrobiology (Koltko-Rivera, 2004). More specifically, worldviews are cognitive or mental frameworks that organize the ways we perceive and think about reality, frame questions and search for answers, establish standards of truth, perform evaluations, and set and execute courses of action. Worldviews are based on comforting assumptions and the psychological tools that help people navigate in an uncertain and dangerous world (Janoff-Bullman, 1992; Zimbardo, 1999).

Worldviews are based in large part on widespread and deeply held assumptions that we live in a benevolent, meaningful, and just world, and that we have reason to feel good about ourselves (Janoff-Bullman, 1992). Studies repeatedly show that even people who are dystopian and pessimistic about the state of the world, including politics, the economy, and international affairs, remain optimistic about their personal futures (Janoff-Bullman, 1992). If these assumptions are challenged, we become anxious; if they are shattered, we become traumatized. People can repair damaged worldviews, or eventually develop new ones, but the process is likely to be long and difficult.

Threats to worldviews come from people "who are not like us," information that runs contrary to our understanding of how things work, and from traumatic and anomalous experiences (Zimbardo, 1999). In the context of astrobiology, threats could come from the exigencies of living in an insecure off-world environment, uncertainties and doubts raised by the

discovery of extraterrestrial life, and growing recognition that we are at risk of extinction from an approaching asteroid. Such cosmic threats (like their mundane counterparts) tend to be denied, but if this simple psychological defense fails, force painful re-evaluations of our physical and social environments, and our situation in life. Threats to worldviews create anxiety, even terror, and lead to a predictable series of defenses intended first, to suppress anxiety and second, to disperse anxiety. The activation and failure of worldview defenses are associated with a long list of psychological and social problems (Zimbardo, 1999).

The discussion that follows makes repeated reference to scientific and non-scientific worldviews. Non-scientific worldviews draw on ideas outside science, that is, they look beyond nature and draw upon the paranormal or supernatural. Prominent among non-scientific worldviews are those based on religion, which is clearly based on the supernatural. There is also a distinct UFOlogical worldview (that extraterrestrials are already here) that many adherents do not see as related to religion and that critics claim is based on paranoia, pseudoscience, and make believe history. I will not wander into that morass here. For present purposes, contrasts between scientific and religious worldviews are handy examples, but should not obscure the central theme that many different worldviews shape overall reactions to astrobiology.

III. Origins and Evolution

Although we may be convinced that we know life when we see it, the very concept of life and separating life from non-life are elusive. Are tiny organisms that have shown no metabolic activity for decades dead or alive? If a change in temperature or humidity restarts their metabolic processes, have they returned from the dead? Does the union of sperm and ova define human life as the “pro-life” people advocate, or does human life depend upon a certain incubation period as “pro-choice” people insist? At what point do we consider someone dead, or at least close enough to shut off artificial life support? And, is a super-smart self-aware computer alive? Many definitions of life are based on checklists (metabolism, reproduction) but a useful, simple one is a “self-sustaining chemical system capable of Darwinian evolution” (Benner, 2010:1023).

Understanding definitions of life, the separation of life and non-life, and their implications for religion, ethics, and law are important societal issues. For Christians and Jews, the story of creation is told in the Bible, where God is the supernatural power. Genesis tells us that in seven days and completely independent of the material world, God personally created the world of nature and history with all of its inhabitants from nothing. By creating Adam and Eve in his own image, he set people above the animals (Peters and Hewlett, 2003). For astrobiologists, it all began with the “Big Bang.” Scientists do not know when and where life first appeared, but they are sure that physical and chemical processes eventually gave rise to simple forms of life that, later, gave rise to countless species that populate Earth today. In astrobiology, Darwinian evolution and its variants account for the origins, rise, diversification, and fall of species. The fossil record, DNA analyses, and other evidence attest to the power of environmental conditions, genetic variation, natural selection, adaptation, and speciation to shape and transform life.

The theory of evolution and its acceptance required a major conceptual breakthrough in science, perhaps fairly defined as a paradigm shift. Two centuries before Darwin, the brilliant scientists that formed the British Royal Society were not equipped to unlock the secrets of life by empirical means (Dolnick, 2011). The Royal Society’s founders sought to find a few simple

principles that could account for a wondrous and complex universe that ran with clockwork precision, and did not think that there was room for random events. More importantly, they believed that the clockwork universe was invented and set in operation by God. The collective work of the Royal Society's founders "bristled with mathematics and focused on remote, unfamiliar objects like planets and comets. Darwin's theory of evolution dealt in ordinary things like pigeons and barnacles. [His] 'easier' theory proved harder to find because it required the idea of abandoning God [as] the designer (Dolnick, 2011: 127)." Two centuries before Darwin the world's top scientists would never have considered this.

Darwin's ideas stimulated great interest and debate – in science, religion, philosophy, and politics. The prominence and details of these debates have waxed and waned over the years as a function of time, culture, and field of study. Front and center was a conflict between science and religion, which persists today. One of Darwin's biographers, David Livingstone, points out that Darwin had a strong sense of religion as well as a deep awe for the wonder of nature and was ambivalent about the idea of abandoning God (Livingstone, 2009). He writes:

On the face of it, Darwin's theory posed challenges of epic proportions to Christian belief at every turn. It mythologized the Mosaic narrative of special creation; it smashed through the practice of using biblical genealogies to date earth history; it removed the idea of divine design from nature by demonstrating how species came about through the ordinary, hum-drum processes of natural selection; it revealed that humans were, in some fundamental sense, no different from animals; it rooted moral sensibility not in the human subject dignified as God's image bearer but in the primitive impulse of a struggle for survival...(Livingstone, 2009:350).

Evolution is one of the most robust theories in science. As such it is a rallying point for atheists and those scientists that seek to challenge beliefs at the heart of religion. Yet, demolishing the story of creation does not bother all theologians or religious scholars, as it is quite possible to believe in God and accept the theory of evolution (Barbour, 2000; Peters, 2013; 2014; Peters and Hewlett, 2003). Evolution does, however, conflict with Christian fundamentalist interpretations of the Bible, especially interpretations which include the idea that creation took place in the last 10,000 years.

Non-fundamentalist Christians understand that the Bible is an unreliable historical document, and treat much of the content as metaphorical. This leaves them in a better position to accommodate science. For example, both God and evolution are embraced under the theistic model where billions of years ago God created "an autonomous world of nature replete with law and chance that can be thoroughly studied by scientific means" (Peters and Hewlett, 2003:119). This allows the theologian to assert both divine action and natural selection, operating on separate levels. God is the primary cause and nature is the secondary cause. God works through nature, and science studies nature. This model makes it possible to accommodate divine action, common descent, and natural selection. It applies to a universe that is approximately 14.5 billion light years across and our 4.5 billion year old planet.

The conflict between creationism and evolution is a conflict between worldviews, the former powered by ancient needs and the latter by recent science. The religious worldview emerged 30,000 to 50,000 years ago (Rossano, 2006). The astrobiological perspective (which builds on earlier ideas about science but also on such notions as evolution and random events)

has been with us for decades. Religion points people to creation stories based on the supernatural, while the astrobiological worldview points to explanations characterized by testable hypotheses and empirical evidence. The stereotyped fundamentalist response to evolution has all of the earmarks of a worldview under attack. This includes denial and rationalization to dismiss the significance of the paleontological record and other evidence of evolution. It also includes political action to suppress or distort the dissemination of scientific truth, and generating arguments and data that objective referees would consider flawed. As is often the case in worldview defense, rather than using external reality (the data) to evaluate personal values and opinions, internalized standards are used for evaluating empirical reality (Zimbardo, 1999).

IV. Searching for Extraterrestrial Life

At present, two types of searches are underway to find extraterrestrial life. The first hunts for non-intelligent biological specimens within our solar system. Much of this hunt consists of seeking environmental conditions conducive to life (such as the presence of liquid water), chemical activities suggestive of life, and fossils. Chris McKay points out that although the discovery of any extraterrestrial life would be thrilling, scientists hope to find life that is truly alien in that it formed completely independent of life on Earth and is not related to the terrestrial tree of life (McKay, 2011). This discovery would constitute proof of a “second genesis,” a demonstration that life began twice in our solar system. Two different biochemistries, both capable of initiating evolving life, would show that life on Earth is not simply a fluke and hint strongly that life is scattered throughout the universe. While the discovery of an extraterrestrial fossil would be of great interest, its origins might be difficult to discern. Scientists need actual biological material to compare with life as it is found on Earth. This means either bringing extraterrestrial life to Earth or studying it in its natural environment. And this means either going in person or sending automated devices to the Moon, Mars, or other destinations to conduct research.

As explorers, researchers, industrialists, and settlers, how will we comport ourselves on Mars? Should we feel free to alter the local landscape or ecology to meet human needs? Should we respect bacteria, molds, and vegetation? Then, there is our propensity for putting interesting animals in zoos, plucking them from their natural surroundings, placing them in confined areas typically with little or nothing of interest to them to do, and breaking their families apart. The societal roadmap observes:

Any discussion of possible extraterrestrial life must be linked with extensive literature and research on human and environmental ethics. The existence of life beyond Earth would raise possible questions about “rights” and “personhood,” similar to current debates over complex or intelligent non-human life on Earth. Likewise, the prospect of finding microbial [extraterrestrial] life in the solar system raises questions of its moral standing and our obligations toward it. In addition, there are numerous questions about the morality and ethical implications of expanding life’s range onto other celestial bodies, with or without indigenous life, either deliberately or by accident (Race et. al, 2012).

a. SETI

SETI, the scientific search for extraterrestrial intelligence outside of our solar system, began in 1960 when theoretical calculations and advances in technology prompted Frank Drake to initiate a radio telescope search (Drake, 2011). Today, while microwave radio searches remain dominant, SETI has expanded to include optical telescope searches for extraterrestrial laser beacons or messages. Each strategy seeks an indicator – a focused radio beam, a pinpoint of light – that is identifiable as advanced extraterrestrial technology as distinct from purely natural phenomena (such as pulsars or quasars) or human artifacts (such as an unexpected transmission from a “lost” satellite). Both strategies require sifting through huge volumes of data, hoping to find candidate signals that can withstand tough scrutiny.

b. Cultural Aspects of SETI

Among SETI researchers, the astrosociological component is known as “the cultural aspects of SETI” or CASETI. As defined by John Billingham, CASETI includes “all thinking about ETI [extraterrestrial intelligence] going back to the classical era, the immediate [consequences] of detection, and indeed the science and engineering of SETI as set in the context of human activity” (Billingham, 1998: 711). Within a year of Drake’s first search, the National Science Foundation sponsored an interdisciplinary workshop at the National Radio Astronomy Observatory, and within the first ten years, SETI had recruited scholars from anthropology, archaeology, linguistics, history, and sociology to join the conversation. Based on workshops held at NASA – Ames Research Center in the 1970s, a comprehensive report on SETI included commentary on religion, societal responses, and the kinds of studies that might be done in preparation for contact (Morrison, Billingham and Wolfe, 1976). By the 1990s, CASETI had become a regular part of annual International Astronomical Federation conferences, and were featured in special issues of the peer reviewed journal *Acta Astronautica*. Over the years, the cultural aspects of SETI have been the focus of many conferences and have surfaced in new venues, including regional sociology meetings and national anthropology conventions. This is astrosociology in action.

There is an abundant literature on CASETI ranging from comprehensive overviews (Billingham et al., 1999; Harrison, 1997, 2007; Harrison and Dick, 2000; Michaud, 2007; Tough, 2000) to in-depth examinations of specific topics such as cognitive limits on our ability to identify and understand extraterrestrial life (Baird, 1987), the link between space exploration and SETI (Finney and Jones, 1984), interstellar altruism (Vakoch, 2014), and the role of mathematics in interstellar communication (De Vito, 2014).

Most CASETI research falls under one or more of four broad categories. The first is the organization and conduct of the search. This includes building public support for the effort, coordinating search activities, attempting to minimize anthropocentric and ethnocentric biases that could unnecessarily limit the search, and expanding the hunt with new technologies and procedures. The second category involves interstellar communication. Topics include signal decryption and interpretation, and composing interstellar messages, including figuring out what to say and how to say it. Originally such messages were planned as replies to incoming messages. Now it includes METI (also known as active SETI): messaging extraterrestrial intelligence. Under METI, Earthlings would initiate the sequence of communication with

powerful broadcasts to unseen audiences. This is controversial because announcing our location in the universe might attract predators rather than benign bystanders or new friends.

The third type of CAsSETI research focuses on the human response to the discovery of extraterrestrial life. This includes preparations for contact, and both the short-term and long-term impact of the discovery on cultures, societies, and worldviews. The fourth category is the analysis of extraterrestrial societies, political systems, institutions, and organisms (or their non-biological equivalents). James Grier Miller's Living Systems Theory, which cuts across geologic and historical epochs, cultures, and species, may provide a point of entry for this (Miller, 1978; Harrison, 1997).

c. *Human Responses to Extraterrestrial Life*

People's reactions to the discovery has been a topic of interest ever since widespread but overstated newspaper reports following Orson Wells' 1937 Halloween broadcast led some people to believe that Martians had landed in New Jersey and were advancing on Manhattan (Cantril, 1940). Panic and other reactions have been portrayed in various ways in science fiction films and are the source of much scholarly and popular speculation. Some writers suggest that attempts to anticipate human reactions will fail or have counterproductive effects (Denning, 2013). The most formidable barrier to prediction is that people's responses will depend on many factors such as nationality, demographics, religion, the unfolding of the contact scenario (protracted or instantaneous), and the nature of the "other" (humanoid or unfamiliar, benevolent or malevolent, open or secretive). Thus, it is tempting to walk away from this problem on the basis that we do not know enough about extraterrestrials to make guesses as to how people will react. But through historical precedents, case studies, public opinion polling, and other techniques, we may be able to educate our guesses (Harrison, 2011a). We already know something about people's beliefs about the existence of extraterrestrial life, their perceptions and representations of aliens, and how they think they and other people will respond to a confirmed discovery.

Recently, Steven J. Dick has discussed the role of analogies in astrobiology (Dick, 2013; 2014). This involves looking to something we have experienced (the analogue) that resembles to some degree an anticipated future event (the target). Thus, we look to research conducted in isolated and confined environments such as in submarines or at polar research stations to help plan for space missions which also involve teams working under conditions of isolation and confinement (Harrison, 2001). As another example, in the nineteenth century many people believed that engineers had constructed canals on Mars and this analogy might inform our expectations about how present-day people will respond to the detection of an interstellar beacon. Dick points out analogues have to be carefully chosen to get the best match between the analogue (spying evidence of intelligent life on Mars) and the target event (discovering, from Earth, evidence of advanced technology in another solar system). Dick offers a "Goldilocks Principle" that analogies must not be so broad and sweeping as to be meaningless, or so specific that they are unlikely to match up with a plausible target event.

People's expectations will play powerful roles in initial reactions, especially under conditions of uncertainty and ambiguity, as is likely to be the case if contact consists of intercepting a content-free beacon or indecipherable message (Denning, 2013; Harrison, 1997, 2011a). In the case of a SETI detection, about all we will know is that "they" exist, so the initial

effects are likely to be based on human culture and psychology rather than on the aliens themselves. This reliance on expectations and imagination could continue for as long as non-definitive bits and pieces of information straggle in. Understanding other contact scenarios (such as the discovery of an extraterrestrial probe within our solar system or an approaching flying saucer armada) may be more challenging because the extraterrestrials themselves will play a larger role, but it is not necessarily impossible. What astrosociologists can do is flesh out a few basic scenarios (Harrison, 2011a), and find tools for rapid assessment and problem solving following a discovery. Despite the large number of variables and unknowns, it behooves us to address the possible consequences of contact before the event rather than twiddling our thumbs until a crisis falls in our laps.

d. Potential Impact on Worldviews

The discovery by itself could threaten the worldviews of people who are absolutely convinced that we are alone in the universe. A glimpse of alien philosophy, science, and technology could shake many people's understanding of reality. In the extreme, the widespread teetering or collapse of consensual reality would cause an epidemic of psychological and social problems, and drag down the social institutions, such as government and religion, that normally prop up conventional worldviews. In an appeal to his fellow professionals, Mark Neal recently advocated applying risk analysis and disaster management to SETI and challenges to people's worldviews may be one of the risks (Neal, 2014).

The 1961 report prepared by the Brookings Institution for Congress on the peaceful uses of outer space identified two groups that they thought might be high risk in the event of a discovery (Committee on Science and Astronautics, 1961). The first of these is anti-scientific fundamentalist religious sects. Fundamentalists worship an anthropomorphic God; humans are the centerpiece of God's creation, and the events that define the religion (such as the teachings and prophecies of Jesus and his death on the cross to atone for human sin and guarantee his followers eternal life) took place on Earth. Consequently, the discovery of sentient extraterrestrial entities that have no knowledge of an anthropomorphic and anthropocentric God, his disciples, or messages, and who do not see humans as the centerpiece of the universe, would threaten fundamentalist assumptions. However, non-fundamentalists who accept evolution would have more elbow room to accommodate the discovery and should be less intimidated, as shown by the views of liberal theologians and results of preliminary surveys (Peters, 2013, 2014). Since different religions rest on different philosophies, historical documents, and interpretations, we should expect variations in the ways that different religious groups should respond to the discovery that we are not alone.

One key to differences is anthropocentrism, the extent to which a religion considers people as the core purpose of the universe. E. M. McAdamis found that conservative Christianity, conservative Islam, Conservative Judaism, Zoroastrianism, primal-indigenous religions, and African traditional and diasporic religions are the most anthropocentric and, hypothetically, the most likely to react badly to contact (McAdamis, 2012). The least anthropocentric and presumably most receptive world religions are Chinese traditional religions, Shintoism, Jainism, Rastafarianism, Unitarianism, Buddhism, Hinduism, and secular or non-religious traditions. Religions that do not see humans as the epitome of existence find it easier to accommodate the idea of extraterrestrial life. Perhaps they are less threatened by competition on

the great ladder of beings. David Weintraub's findings are largely consistent with those of McAdamis, but also showed tremendous variability across Christian groups (Weintraub, 2014). In Weintraub's view, some religions could be put to the test if extraterrestrial life is *not* found to exist. Joseph Smith, the founder of Mormon theology wrote, "We are not the only people that the Lord has created; we have brothers and sisters on other worlds" (Weintraub, 2014: 153). Under Mormon theology, human bodies are mortal, but human spirits lives on as gods on these other worlds.

Worldviews are not to be confused with individual attitudes or beliefs, which are symptomatic of, but not always rooted in, worldviews. Rather, worldviews are complex dynamic systems such that an attack on a particular manifestation of the worldview sometimes threatens the worldview as a whole. Relinquishing a faith-based belief in creationism or an absolute certainty that humanity is central to God's design is not simply a change of opinion (Goode, 2011). It is tantamount to walking away from the religion of people you know and love and dropping out of a supportive community. It is acquiescing to an assault on revered religious leaders and texts, retracting repeated affirmations of faith, renouncing a habitual and comfortable way of life, and, in some cases, abandoning hope for salvation and eternal life. Waffling in the face of dissonant information makes the world seem less benevolent, less meaningful, and less fair, and casts doubt over one's place in the grand scheme of things.

Should we be surprised that attacks on beliefs that lay close to a person's mental construction of reality are dismissed or met with a counterattack? While people differ in terms of their openness to new ideas and experiences, it is doubtful that many welcome the destruction of ingrained core beliefs that give them a sense of security and comfort under alarming conditions. Collapsed worldviews have been linked to Post-Traumatic Stress Disorder (Janoff-Bullman, 1992). Over time, perhaps alone or more likely assisted by therapy, it may be possible to construct a new worldview built around new realities, but the process is painful and time consuming and the outcome uncertain.

Religious fundamentalists are not the only group put at risk by the discovery of extraterrestrial life. Discoveries or claimed discoveries that are inconsistent with today's science are typically dismissed as observational errors, fabrications, or anomalies of little consequence. For most scientists, claims of the paranormal such as extrasensory perception, out-of-body experiences, and UFOs cannot be taken at face value because there is no "good" (i.e. scientific) explanation for them. Rather, they are attributed to magical thinking, the operation of supernatural powers, and supernatural powers do not exist. Therefore, such phenomena are impossible. But what would happen if future discoveries show that the universe is not so neatly ordered as we currently think? What if extraterrestrial science was beyond our comprehension or ran counter to our present rational-empirical views? Scientists were the second group mentioned in the congressional report. Buried away in a footnote, Jeff Levin (2012:274) found the following:

It has been speculated that, of all groups, scientists and engineers might be the most devastated by the discovery of relatively superior creatures, since these professions are the most clearly associated with the mastery of nature rather than with the understanding and expression of man. Advanced understanding or nature might vitiate all our theories at the very least, if not also require a culture and

perhaps brain inaccessible to earth scientists (Committee on Science and Astronautics, 1961: 225).

Constance Bertka suggests that the debate over contact's impact on religion consists mostly of scientists pronouncing that the discovery of extraterrestrial life will be catastrophic while theologians argue to the contrary (Bertka, 2013). She suggests that this discussion needs to be informed by broader discussions of science and religion and by the sociology of religion. Outside of academia, the effects of contact on religion are likely to be varied and uncertain.

Most of the astrosociological research on the hunt for extraterrestrial life has taken place in North America. The societal roadmap urges greater penetration into other cultures and traditions (Race et al., 2012). Any such discovery will raise questions about our ethical, legal, and cultural systems, their extraterrestrial counterparts (if any), and possible relationships between terrestrial and extraterrestrial versions. In SETI as in other areas, astrosociologists will play important roles in information sharing and education. As noted by Harrison and Connell (2001), Jim Funaro stated:

Some scientists may assume that if extraterrestrial life is discovered science will be validated while religion will suffer irreconcilable difficulties and perhaps even collapse. If so, these scientists are underrating religion's survivability and its usefulness as an adaptive tool. The discovery may stimulate a worldwide resurgence in religious activity. Religion may have an advantage over science as we attempt to adapt to strong and widespread emotional impact. . . . Religion has already had considerable experience dealing with ETs. . . . Religion can answer questions that science cannot. . . . Religion provides a built-in, self-activating mechanism for responding to widespread societal stress. In the actual event of encountering extraterrestrial life, some of the needs of humanity as a whole may require the kind of non-scientific solutions provided by religion. Given the number of unknowns in the contact equation, we should not ignore the potential value of any of our adaptive resources (Jim Funaro, Harrison and Connell, 2001, p. 29-31).

V. Life's Future on and Beyond Earth

The future of every species on our planet, including humankind, depends on three factors. The first is our success at maintaining the health of our own planet Earth. The second is our ability to protect ourselves from existential risks: mega-catastrophes so powerful that they could wipe us out. The third is our spacefaring capabilities: developing options to ensure humanity's survival by dispersing throughout the solar system. Setting up housekeeping on Mars is important because it would prove that we can become a multi-planet species.

a. Planetary Stewardship

Planetary stewardship refers to keeping Earth (and, perhaps someday, other planets) alive. Stewardship involves managing environments in ways that maintain that environment's health while tapping the resources needed to support life and welfare. The concept of stewardship implies that despite mortgages, land titles, and other legal documents we do not

really “own” land. Planetary stewards are not forbidden from the use of natural resources but are admonished to avoid plunder and destruction and needless waste. Populations that expand beyond the carrying capacity of the environment rapidly deplete non-renewable resources, pollute soil, water and air, harm ecologies, and put future generations of humans at risk. Thus, astrobiologists who are interested in the rise and fall of species and the long-term fate of humankind have an affinity with fields such as ecology, environmental protection, and environmental health. Environmental health depends in part on science and technology, but also on politics, institutional relationships, and worldviews.

Worldviews shape perceptions of climate change and what (if anything) should be done about it. Here we find divisions between mainstream or consensual scientists who believe that climate change is real and contrarian scientists who deny it, as well as divisions among the general public. Political orientation is one of the best predictors of acceptance of climate change as real. Environment-loving, Gaia-worshipping liberals are likely to accept data which shows that anthropogenic factors are causing dangerous levels of global warming and that intervention is warranted. Conservatives, on the other hand, are more likely to reject the data, denigrate environmentalist efforts, abhor regulation of any kind, and push for business as usual. Climate-change denialists tend to be conservative, Republican, and associated with the new religious right (Grant, 2011; Gauchat, 2008, 2012). Distrustful of scientists in general, many support other conservative causes, such as creationism. As in the case of the evolution-creation “debate,” the climate change “debate” seems to be quintessentially American, with Americans squabbling over unassailable evidence while other people around the world accept the verdict of science and take pro-active measures. Joane Nagel argues that in the final analysis, US public opinion may not matter. The reason is that the military and powerful economic institutions worldwide accept the reality of climate change as a security threat and are taking action, such as relocating navy bases from eroding coastal areas and raising insurance rates. Complain all you want, insurance rates against crop failure are increasing (Nagle, 2011).

NASA’s Planetary Protection Program (PPP), designed to prevent the transfer of harmful biota from one environment to another, seeks to minimize both forward and backward contamination (Conley and Rummel, 2008; Race, 2008). Forward contamination is the transfer of terrestrial organisms from Earth to Mars or other locations where they might survive to do damage. One justification for preventing this is to maintain pristine conditions at research sites, which is necessary to determine second genesis. Allowing extraterrestrial evolution to proceed unhampered will give us useful comparison points for better understanding life on Earth. Backward contamination refers to allowing extraterrestrial biota to harm astronauts or life on Earth. Extraterrestrial bugs could make astronauts sick, trigger an epidemic, or crowd valued forms of terrestrial life. Sterilization of equipment, use of clean suits and other protective gear, and quarantine are the basic tools for combatting backward contamination.

Contamination will be even more difficult to prevent when humans explore the surface of Mars, because humans will carry viruses and bacteria to stay alive. Rather than use all protective methods for all missions, the PPP undertakes risk assessments, focusing on locations that may be conducive to life. After splashdown, the Apollo astronauts were quarantined in a house trailer on the deck of the recovery ship, and the crane used to bring the samples on board was swabbed down with iodine, practices that were abandoned soon after everyone agreed there was no life on the Moon. Thus, the Moon is a good place to practice planetary protection procedures.

Whereas life has not been discovered on Mars, there are areas where the temperature and moisture fall within ranges that might support life. In these areas, strict procedures will be put in place. So what would happen if astronauts returning from Mars came down with some sort of mystery illness? “Safeguarding the Earth from harmful backward contamination must always be the highest planetary protection priority” (Conley and Rummel 2008: 1027). The worst case scenario for astronauts is getting marooned in space or sacrificed on re-entry, but watch for this in science fiction, not in the evening news.

b. Planetary Defense

Astronomers, planetary scientists, and other physical scientists that study the asteroid threat have shown remarkable interest in contributions from social scientists. This is evident in the International Academy of Astronautics Cosmic Study Group’s report on *Dealing with the Threat to Earth posed by Asteroids and Comets* edited by Ivan Bekey (2009). This includes chapters on societal matters (Organizing for the Task, Behavioral Factors and Planetary Defense, and Policy Implications). Thus, the scientific and technical agendas include identifying potentially hazardous near-Earth objects, calculating and recalculating orbits to estimate when (and to a lesser degree, where) they will strike, and inventing and deploying devices to deflect or destroy the object. The societal agenda includes promoting international planning, performing risk assessments that take subjective evaluations and emotions into account, and preparing for warnings and evacuations, an initial emergency response, and long-term recovery efforts (Race et al., 2012). Cosmic threats, asteroid impacts, and other major disasters may be interpreted with reference to core beliefs about apocalypse and Armageddon. That is, there is an eerie similarity between apocalyptic visions and scientific accounts of the death of planet Earth (Harrison, 2007).

c. Becoming a Multi-Planet Species

The future of human life depends in part on establishing ourselves as a multi-planet species, migrating in numbers to create off world communities of sufficient size so that humans (perhaps in radically altered forms) as a whole can survive an event that kills everyone left behind. This raises myriad questions ranging from governmental and economic support for space activities and settlement, through the development of laws and organizational principles for operating large societies in space, to the nitty-gritty of getting along with one another under conditions of isolation and confinement (Finney and Jones, 1984; Harris, 2009; Harrison, 2001, Vakoch, 2013). Should we expect stripped down governments, martial law, and rough-and-tumble justice? How might our new extraterrestrial perspective affect religion? Can we develop educational curricula that offer a broad humanistic education where long hours of hard work and well-learned trades are required for day-to-day survival? How might families be restructured to bring about a rapid growth in population to assure long-term group survival? Then there are questions regarding the relationship between the mother society and its offspring. Although initially, the home culture will have a powerful sway over emigrants, from the moment of departure on, the two cultures will begin to diverge. What are the processes that might lead to the settlement’s culture becoming dominant and how long will this take? Ethical issues include consigning generations of unborn children to multi-generation missions, and the acceptability of suicide in a resource-strapped community.

Whereas spacefaring might seem to be a purely technological endeavor, if we take a panoramic view, we also find telltale signs of religion (Harrison, 2013; 2014; Launius, 2013). Non-scientific, populist, religious, and quasi-religious motives fuel people's interest in space exploration. Russian cosmonauts such as Konstantin Tsiolkovsky sought to gather up the dust of all past generations, resurrect them (by purely scientific means), and let them populate other planets where they would live forever in solidarity (Harrison, 2013). They also hoped that through space exploration and settlement they could achieve perfection and attain everlasting life. During the great race to the Moon, god-fearing American astronauts were pitted against godless cosmonauts (Harrison, 2014). Astronauts read scripture and took communion in space. Two Bibles made bureaucratically perilous journeys to be left on the Moon (Mersh, 2011). Today, astronaut religious activity is muted by the separation of church and state, but before departure, cosmonauts receive blessings from Russian Orthodox priests, and carry religious scripture and icons on the International Space Station. For space aficionados, outer space is a promised land, which offers life without limits, solutions to Earth's problems as well as transcendent experiences and salvation from oppression and drudgery on Earth. Typically, people involved in space exploration insist that they are scientists and their work is not related to religion, but Roger Launius argues that it is precisely because spaceflight *is* a secularized religion that human spaceflight continues despite tepid results (Launius, 2013).

Eventually, as a result of immutable physical processes, stars will die, the universe will collapse, and all life will come to an end. Perhaps right now in our supersized universe, many civilizations have come and gone, others are in the process of rising and falling, and others are yet unborn. Physical, biological, and social factors will affect their longevity, just as they will affect ours. Although it may be tempting to think that advanced extraterrestrial civilizations will have solved all problems through technology, at present this is pure speculation (Peters, 2014).

VI. Moving Forward

Astrobiology explores and integrates ideas from the physical, biological and social sciences, and the humanities. Its origins stretch back to antiquity, but only recently has it emerged as a framework for organizing research on the origin, distribution, and future of life in the universe. Astrobiology promotes multidisciplinary and interdisciplinary research and discussion, and is a possible platform for consilience, or the unification of knowledge (Finney, 1992; Dick, 2013). Additionally, the field includes an array of educational and outreach activities to attract and train the next generation of scientists and to inspire the public.

It is important to broaden discussions of astrobiology to include constituencies such as space entrepreneurs and industrialists whose activities such as developing solar power, asteroid mining, and space tourism will alter extraterrestrial environments. It is important also to include legislative and administrative groups that control human activities in space, and here we should include military and intelligence communities. Additionally, since astrobiology has implications for people around the world, it is crucial to increase international participation. And these discussions should not be limited to elites.

The psychology of worldviews shows promise for understanding people's views of astrobiology and its findings. Worldviews make it possible for people to organize their thoughts, separate the real from the not real, the important from the unimportant, and maintain their

bearings in changing environments. Attitudes that are rooted in worldviews should not be confused with off-hand opinions. Worldviews are part of an integrated and largely self-correcting system. People defend themselves against threats to their core beliefs and if these beliefs fall, we might expect cascading effects under worst-case scenarios leading to, for them, a collapse of reality. This is a matter for future research. In any event, rather than trying to force people to accept astrobiological “facts,” we should find ways to help people accommodate new discoveries within their pre-existing worldviews, and help them repair old worldviews or develop new ones if necessary. And if, as astrosociologists we try to do so, we should be aware of our own preferences, biases, blind spots, and imagination, and do the best we can to take these into account.

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Exploring How Social Media Can Be Used to Promote Space Awareness: A Case Study of the Yuri's Night Web 2.0 Strategy

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Yuri's Night

ABSTRACT - Despite the importance of social media as an inexpensive and efficient means of communication, it is not clear to what degree space advocacy groups are making a strong organized effort to use the resources available to them. Moreover, there is no previous literature that specifically examines the use of social media tools by space organizations. This study seeks to start a larger dialog regarding how the space advocacy community can make use of these tools to promote their mission. Using a case study approach, this article focuses specifically on the organization of Yuri's Night to explore how this group is using social media to accomplish its mission of building general space awareness. In addition, this article evaluates the organization's social media presence as well as the role social media has played in the organization's ability to accomplish its mission. Other space advocacy groups can use the lessons learned here to improve their own social media strategies.

I. Introduction

Building awareness of space related achievements and milestones is an important aspect of encouraging public understanding and engaging people with aspects of science and technology; it is part of the mission of a number of space advocacy groups.¹ While many organizations play a role in championing space education, policy, and exploration, Yuri's Night is an organization dedicated to championing basic space awareness. Known as the "The World Space Party," it is a human spaceflight advocacy initiative embodied in an annual global

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¹ Examples include the National Space Society, Mars Society, Moon Society, Planetary Society, Yuri's Night, and others.

celebration and exploration of the history, present and future of human spaceflight. For over a dozen years, Yuri's Night events have taken place to celebrate the achievement of human spaceflight with events held across all seven continents between 2001 and 2013. The overall success of Yuri's Night as a concept is dependent on reaching beyond audiences in the science and aerospace fields. Connecting with groups in the arts, music, cultural, and educational fields are critical to creating a global phenomenon that transcends socio-economic characteristics as well as ethnicities and borders.

Social media comprise a relatively new set of tools that many of these organizations are embracing to get their message across and communicate with the public at large. These tools can comprise a hybrid component for an organization's promotional strategy whereby both the organization and the consumer play a role in building awareness.² For most of the organization's existence, Yuri's Night has relied on internet communication technologies to get its message out to the public. For the last seven years, social media has played a major role in the communication strategy for the organization. It is likely a major source of the organization's successful growth. Entering the realm of social media on December 19, 2007, with a simple tweet, "getting ready to Rock the Planet," the organization quickly branded its social media presence through promotion of its organization mantra.³ The slogan – "Rock the Planet" – defines the mission of Yuri's Night as an organization that seeks to celebrate and commemorate space exploration milestones. By doing so, it seeks to increase public interest in space exploration and inspire a new generation of explorers through the use of music, dance, fashion, and art.⁴

During the five years after its launch, the organization continued to engage the public through social media. This study explores the utilization of various social media tools to facilitate the distribution of information about Yuri's Night events and space awareness, provides a qualitative evaluation of the success of the social media strategy Yuri's Night has been using, and identifies best practices that can be used for other space-related groups.

a. Social Media as a Promotional Tool

Social media exists for more than just advertising. Instead, one can view it as a framework of functional blocks that include organizational identity, conversations, relationships, and more.⁵ Additionally, one can characterize it as an ecosystem where promoters can utilize

² Mangold, W.G., and Faulds, D. J. (2009). Social media: The new hybrid element of the promotion mix," *Business Horizons*, 52(4), 357-365.

³ Yuri's Night, Twitter post, (2007, December 19, 12:59 p.m). Retrieved from <https://twitter.com/YurisNight/status/515542302>.

⁴ The "Rock the Planet" slogan has been used by Yuri's Night for almost a decade and is often a way Yuri's Night volunteers say goodbye (similar to Mr. Spock's famous "Live Long and Prosper" in Star Trek.) The oldest written mention of "Rock the Planet" can currently be traced back to a 2005 article on Space.com. See Hidalgo-Whitesides. L. (2005, April 6). *Yuri's Night Set to Rock the Planet*. Retrieved from <http://www.space.com/930-yuri-night-set-rock-planet-april-12.html>.

⁵ Kietzmann, J. H., Hermkens, K., McCarthy, I. P., & Silvestre, B.S. (2011). Social media? Get serious! Understanding the functional building blocks of social media. *Business Horizons*, 54(3), 241-251.

platforms such as YouTube, Facebook, and Twitter in harmony with one another to engage and inform.⁶ Furthermore, the use of social media can enhance a promotional strategy through content sharing and social networking.⁷

Despite past research showing that social media is a useful promotional tool, the majority of research focusing on the space community's use of social media focuses on opinions and theory without the examination of data.⁸ There has been little data-driven examination in how space advocacy groups have used social media and to what degree they have found success with its use. Even within the business world, many organizations fail to determine means to measure success of social media marketing.⁹ This has led to the need for creative non-data driven metrics that were only possible to develop by first examining single cases within the advertising industry and attempting to draw broad conclusions.¹⁰ This article will examine Yuri's Night as a case study of a space advocacy organization and identify metrics to measure social media marketing success that can be used in future research to evaluate the efforts of other similar organizations.

b. About Yuri's Night

Yuri's Night, "The World Space Party," is a human spaceflight advocacy initiative embodied in an annual global celebration and exploration of the history, present and future of human spaceflight. Since 2001, Yuri's Night events have been celebrated around April 12, the date of the first human spaceflight by Yuri Gagarin in 1961 and the first launch of the Space Shuttle in 1981. Over 2,400 independently organized Yuri's Night events have been held during the last 13 years across all seven continents, in over 70 countries, in virtual reality, and aboard the International Space Station. Attendance figures have ranged from over 12,000 people at a two-day space festival to small groups of friends at star gazing events.¹¹

Events have been held in wide range of places from kindergarten classrooms to science museums. Individual event organizers and attendees come from a plethora of cultures given the international presence of the organization and a wide variety of occupations ranging from schoolteachers to astronauts. Staying true to the collegiate environment from which Yuri's Night originated, party-centric events occur on college campuses and in various kinds of clubs each

⁶ Hanna, R., Rohm, A., & Crittenden, V. L. (2011). We're all connected: The power of the social media ecosystem. *Business Horizons*, 54(3), 265-273.

⁷ Thackeray, R., Neiger, B. L., Hanson, C. L., & McKenzie, J. F. (2008). Enhancing promotional strategies within social marketing programs: Use of Web 2.0 social media. *Health Promotion Practice*, 9(4), 338-343.

⁸ See, for example, Sandu, O. & Lindberg Christensen, L. (2011, July). Outrageous outreach – Unconventional ways of communicating science. *Communicating Astronomy with the Public Journal*, 11, 22-30; and Verteai, J. (2010 December). Tweeting spacecraft: Communicating space science in the age of Web 2.0. *Communicating Astronomy with the Public Journal*, 10, 30-33.

⁹ Michaelidou, N., Siamagka, N. T., & Christodoulides, G. (2011). Usage, barriers and measurement of social media marketing: An exploratory investigation of small and medium B2B brands. *Industrial Marketing Management* 40(7), 1153-1159.

¹⁰ Russell, M. G. (2009), A call for creativity in new metrics for liquid media. *Journal of Interactive Advertising*, 9(2), 44-61.

¹¹ About Yuri's Night. Retrieved from <http://yurisnight.net/#/about>.

year, while other events focus around educational activities or even a 5 km walk, as has been taking place annually in Houston, TX for the last few years.

Since 2009, Yuri's Night has relied almost exclusively on social media-based advertising supplemented through e-mail lists accumulated over the years and the independent efforts of outreach volunteers.¹² Before social media, the organization would mostly use e-mail listservs and the social networks of the individual volunteers to direct people to the official Yuri's Night website in order to provide relevant information.¹³ Yuri's Night co-founder Loretta Hidalgo-Whitesides stated, "We promoted through SEDS, ISU, and SpaceGen . . . those were all thriving communities that we [as individual volunteers] were deeply involved in. We also had limited access to traditional media, such as NPR, MTV, KCRW, and Space.com."¹⁴

As part of the Yuri's Night mission, the organization has engaged other space advocacy groups in social media campaigns. For instance, the "Get Curious" project was coordinated with partner company Explore Mars to draw both social media-based and real life, interactive interest toward the landing of NASA's Curiosity rover.¹⁵ This project saw a worldwide social engagement with the landing of the rover and showed an overall increased penetration of outer space into social media.¹⁶

c. History of Yuri's Night

After being just an idea for four years, Yuri's Night, the World Space Party, sprang into existence at the United Nations' Space Generation Advisory Council (SGAC) Conference in Graz, Austria, during September 2000. Trish Garner, George Whitesides, and Loretta Hidalgo-Whitesides announced the kickoff of the event and released the first version of the organization's website.¹⁷ Seven months later, they had a team of space activists who coordinated the hosting of

¹² Steinberg, A., Alles, J. W., Finnvik, S., Hanton, R., Russ, R. B., Kobrick, R. L., & Baily, T.J. (2013, September). Cultivating a multicultural online audience: A study of the effectiveness of social media for Yuri's Night." (Presented at the 64th International Astronautical Congress, Space Education and Outreach Symposium, Space Network: Social Media and Digital Resources. Beijing, China. Paper ID: IAC-13,E1,9,2,x20020).

¹³ Alles, Jeffrey W. (2014, March 1). Interview by author.

¹⁴ Hidalgo-Whitesides, Loretta (2014, March 3). Interview by author.

¹⁵ About GetCurious. Retrieved from <http://getcurious.com/about-getcurious-com>.

¹⁶ See Bailey, T., Higginbotham, C., Kobrick, R. L., Alles, J. W., Schlutz, J., Russ, R.B., Steinberg, A., & Zabala-Aliberto, V.A. (2012). Yuri's Night: Engaging new audiences and inspiring public participation in space exploration. (Global Space Exploration Conference. Participatory Exploration for Inspiration and Education Symposium, Engaging Citizens: Results and Future Concepts Session. Washington, D.C. Paper ID: GLEX2012.12.1.3.X12443); Steinberg, A., Alles, J. W., Finnvik, S., Kobrick, R. L., Russ, R. B., & Bailey, T. (2013). Cultivating a multicultural online audience: A study of the effectiveness of social media for Yuri's Night" (abstract). (64th International Astronautical Congress 2013, Beijing, China. Paper ID: 20020); and Finnvik, S., Kobrick, R. L., Alles, J. W., Russ, R. B., Bailey, T., & Belle, C. (2013). Yuri's Night gets curious – Dreaming, exploring, and celebrating (abstract). (44th Lunar and Planetary Science Conference. The Woodlands, TX, Abstract Reference: 3045).

¹⁷ Alles, Jeffrey W, (2014, March 1). Interview by author.

65 events around the globe in celebration of the 40th anniversary of Yuri Gagarin's entry into space on April 12, 2001. The focus of Yuri's Night has always been about the first human in space and human spaceflight accomplishments in general to encourage global participation and to generate excitement by embracing our past and imagining our future by celebrating where we are today.¹⁸

Serendipitously, the first Space Shuttle launched on the 20th anniversary of Gagarin's flight, solidifying April 12 as an international date for space celebrations. Media outlets of all sizes and statures from around the world have covered Yuri's Night. The date received official notoriety from the United Nations in 2011, the 50th Anniversary of Human Spaceflight, when the General Assembly declared 12 April as the "International Day of Human Space Flight."¹⁹

A team of volunteers has always run the Yuri's Night Global Executive Team regularly via internet and tele-presence technologies. The team maintains the website, runs event registration, engages the public through social media, and creates partnerships and competitions with other space-vested groups. Yuri's Night eventually grew large enough to become self-contained and separate from other SGAC programs. At the request of SGAC, the US-based Yuri's Night Global Executive Team officially separated the project and incorporated as a 501(c)(3) nonprofit corporation in California in 2010.

Events usually contain both entertainment and educational aspects involving space, science, and/or astronomy. The event demographics (ages, number of attendees, educational backgrounds, and personal interests) are as diverse as their locations, which have included extreme space analogue environments (Antarctica, the Mars Desert Research Station, and the Hawaii Space Exploration Analog and Simulation (HI-SEAS)), culturally humorous city names (Batman, Turkey), remote locations (star gazing parties in India and Africa), government facilities (NASA Ames Research Center, California), and even orbiting our fragile oasis on board the International Space Station.²⁰

¹⁸ Kobrick, R. L., Russ, R. B. & Bailey, T. J. (2011, July). Yuri's Night: Linking the world together with an international space celebration. (Paper presented at the 41st International Conference on Environmental Systems, Session ICES308: AIChE Education Outreach, Portland, Oregon, USA. Paper ID: AIAA 2011-5175).

¹⁹ United Nations (2011, April 7). 65/271. International Day of human space flight. Agenda item 50 at the 65th session of the United Nations General Assembly, A/RES/65/271. Retrieved from http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/65/271.

²⁰ Bailey, T., Higginbotham, C., Kobrick, R. L., Alles, J. W., Schlutz, J., Russ, R. B., Steinberg, A., and Zabala-Aliberto, V.A. (2012). Yuri's Night: Engaging new audiences and inspiring public participation in space exploration. (Global Space Exploration Conference. Participatory Exploration for Inspiration and Education Symposium, Engaging Citizens: Results and Future Concepts Session. Washington, D.C. Paper ID: GLEX2012.12.1.3.X12443. See also, Alles, J. W., Kobrick, R. L., Russ, R. B., Finnvik, S., & Bailey, T. J. (2013). No borders - Bridging cultures through Yuri's Night. (64th International Astronautical Congress. Space Education and Outreach Symposium, Space Culture: Innovative Approaches for Public Engagement in Space Session. Beijing, China. IAC-13-E1.8.4).

d. Study Design

This study explores the utilization of various social media tools to facilitate the distributed, decentralized organization of these events through three means of analysis: number and frequency of posts, types of posts created, and responses to the posts by the public. By analyzing postings and responses through Twitter, YouTube, and Facebook from December, 2007, through May, 2013, this study specifically explores the ability of the Yuri's Night Global Executive Team to engage the public over the course of a five-plus year period.

This is accomplished by first highlighting metrics that can be used to measure the social media engagement of the organization and then by comparing it to a series of success metrics. For the study, we focused on the organization's Twitter, YouTube, and Facebook use as a metric of social media and used party counts and website visits as metrics of success. Moreover, it is important to see how much social media engagement translates into accomplishment of the Yuri's Night mission, which is to increase space awareness overall.

Given the difficulty in estimating that outcome, one can measure metrics of success through the number or people who attend Yuri's Night events or otherwise become aware of Yuri's Night and partake in the organization's offerings. Since the organization is primarily concerned with building awareness of human spaceflight, the increase in the number of people who gain knowledge from the website and the more events held worldwide are both means by which to measure greater awareness of the population as a whole.

Collection of social media data occurred from August 1, 2007, through July 31, 2013. The data is broken into year-long August 1 through July 31 sets, identified as the 2008 through 2013 seasons, and is all publically available from Twitter, YouTube, and Facebook. The organization directly provided information regarding the number of Yuri's Night website views and Yuri's Night events.

II. Social Media Use

The first social media tools that Yuri's Night used were Twitter in 2007, and YouTube and Facebook in 2009. These three tools are very different from one another in both their reach and their content. Twitter is primarily a means to pass short messages (140 characters or less) to an individual's (or in this case organization's) followers. For the most part, a person must already be aware of Yuri's Night in order to follow the messages on Twitter by the organization. Therefore, there are better metrics to examine than simple follower counts. What is more important is how the organization uses Twitter, and how the Twitter community responds to the organization.

YouTube is a different social media tool focused on the sharing of videos. While people can subscribe to the organization on YouTube, the value comes from the views of non-subscribers, those people who were not aware of the organization and its mission, but found the videos through other means, such as through web searches or due to videos being shared among their social network. Therefore, we use both the number of views per video as well as identify key characteristics of videos in order to evaluate if particular styles or types of videos lead to different viewership behavioral patterns.

Facebook is the most limited of these social media tools as the information posted by Yuri's Night only reaches people already aware of the organization and its mission and the information shared there is not found in search engine results. However, Facebook information can be easily and quickly disseminated among users who have liked Yuri's Night on Facebook and have subsequently shared the information within their own social network on Facebook. Within this medium, we want to consider the number of likes various posts get in order to determine the type of posts the organization's followers and supporters find most interesting or useful, as well as to look at which posts get shared the most. This will aid in understanding what information people are most likely to pass along to their social network.

a. Twitter

Twitter is the social media tool that Yuri's Night has been using the longest. The organization has posted on Twitter with different frequencies over the years and these variations in usage allow for an examination of community engagement and response. In this section, we focus on the number of tweets the organization makes, the topics of the tweets, and the response from the Twitter community measured in retweets and mentions.

i. Twitter: 2007-2008

Yuri's Night entered the world of social media on December 19, 2007, via Twitter²¹ when the organization set up its Twitter account and made its first tweet, announcing to other Twitter users that it was "getting ready to Rock the Planet!" The first 17 tweets focused on promoting Yuri's Night 2008, and the next 18 provided a live Twitter feed of the organization's Houston Event. These initial tweets provide a framework to examine two of the most useful aspects of Twitter to Yuri's Night, which are promotion and engagement. Over the next five years, the organization would continue to use Twitter primarily for these two functions.

ii. Twitter: 2009

For the 2009 season, Yuri's Night made much more use of Twitter. From August 1, 2008, through July 31, 2009, it tweeted 193 times. This season also led to the first use of retweeting by Yuri's Night. Eighteen of the 193 tweets were retweets of the messages of other people, which implies that the organization was paying attention to other Twitter users and becoming more engaged in the Twitter community. Additionally, the organization's tweets included 17 mentions or shout-outs. In the Twitter community, the use of mentions implies that the organization is not just talking aloud but referencing specific other users. This metric also shows the organization's engagement with the Twitter community. However, none of the Yuri's Night's posts received retweets by others. This could be because few people paid attention to what the organization was tweeting about or because they did not characterize the information as significant, and thus did not share it.

²¹ Yuri's Night, Twitter post. (2007, December 19, 12:59 p.m.). Retrieved from <https://twitter.com/YurisNight/status/515542302>.

iii. Twitter: 2010

During the 2010 season, Yuri's Night again showed a marked increase in Twitter traffic and engagement, including the use of the *YN2010* hashtag. Over the course of the season, the organization tweeted a total of 312 times; the average increased from .53 tweets a day to .85 tweets a day. The organization retained a low rate of retweeting other people, with only 23 retweets. In addition, most of the retweets were internal (i.e., the organization retweeting a person involved or engaged with the organization). However, the organization's rate of mentions significantly improved, with 110 incidents or an average of .3 mentions per post. This implies that the organization was either targeting or relating responses toward specific users. From this, one may interpret a greater degree of engagement within the Twitter community. The Twitter community became more aware of the organization's presence, as 109 of the 312 tweets were retweeted by other people. This implies that Twitter users did not deem the information important enough to share. However, on average, each post was only retweeted by 1.65 people. The low rate consists primarily of people working with Yuri's Night who did most of the retweeting to their personal accounts.

iv. Twitter: 2011

The 2011 season, which was the 50th anniversary of Yuri Gagarin's flight, showed a large leap forward in the organization's use of Twitter through both the organization's use of the social medium and the community's engagement with the organization on Twitter. Over the course of the 2011 season, the organization posted 603 times, with 48 of the posts being retweets of other users and 92 mentions of others in the Twitter community. These rates of retweets and mentions actually seem lower than the previous year, but this should not be seen as disengagement as over half the 2011 posts were only being used to announce the addition of Yuri's Night events to the website. Each of these posts mentioned the city and state (or country if international) and the chronologically assigned event number with a link to more information about the event on the organization's website. Therefore, the additional posts in this season were of a different style of communication. This change in style may actually have been a benefit in regard to event awareness and engagement of other Twitter users. 236 of Yuri's Night's posts (36%) were retweeted, which was over a two-fold increase from the previous year. In addition, the organization instituted a second hashtag in order to promote both #YN2011 and #yurisnight via the organization's Twitter posts.²²

v. Twitter: 2012

The total post count in 2012 (291) was down from 2011 (603), due to the decision not to tweet about each party listed on the website. The 291 posts included 194 original content messages and 97 messages retweeting an even wider variety of people than in years past. In addition to retweeting, the organization's posts included 217 mentions, more than doubling the

²² At this time, information about the use of the hashtags by the Twitter community in general is not available as there is no reliable way to search for all uses of a hashtag historically in Twitter. Twitter search API provides only a non-random sample of global hashtag use. For more on how Twitter APIs work see: <https://dev.twitter.com/rest/public/search>.

number from the 2011 season. The 2012 Yuri's Night season saw a new Twitter milestone reflected by the post:

“Happy Yuri's Night everybody! 51 years ago today a new era of humanity launched with Vostok 1! Let's celebrate! #YN12 #YurisNight.”²³

It was retweeted by 144 people. Prior to this, the largest repost of original content was 25 retweets with original content posts in the previous season averaging less than one retweet per post. Not counting an outlier post, the 2012 season averaged 1.5 retweets of original content posts. Additionally, over half of the original content messages were retweeted by other Twitter users, and over 32% of the original content was retweeted by two or more members of the Twitter community. These increases show that Yuri's Night was not only paying more attention to the Twitter community, but that the Twitter community was paying more attention to Yuri's Night.

vi. Twitter: 2013

In 2013, the organization's post count was up from 2012 and almost as high as 2011. The organization made 512 posts, of which 177 were retweets and 335 were original content. The 512 posts included 306 mentions. The organization purposely more strongly engaged Yuri's Night with members of the Twitter community than in years past, evidenced by the 150 mentions directly from the organization connecting to other users. 471 (92%) of the Yuri's Night posts were retweeted. More importantly, 253 of the 335 original content messages (76%) were retweeted by other Twitter users. In addition, the average rate of retweets was up to 3.2 retweets per retweeted post, implying that a larger number of people were involved in sharing the information across the Twittersphere.

Year	# Tweets	# Mentions ²⁴	% Retweet
2007-2008	35	NA	NA
2008-2009	193	17	9.326%
2009-2010	312	110	7.372%
2010-2011	603	92	6.965%
2011-2012	291	217	33.33%
2012-2013	512	150	2.892%

Table 1: Twitter²⁵

²³ Yuri's Night, Twitter post. (2012, April 11, 11:32 p.m.). Retrieved from <https://twitter.com/YurisNight/status/190296234051899392>.

²⁴ Mentions are a count of times Yuri's Night mentioned another entity, not the number of tweets mentioning Yuri's Night; they also demonstrate the organizations attempts to engage with other Twitter users.

vii. Twitter: Summary

Over the last five years, Yuri's Night has clearly improved their Twitter-based social media engagement. There is a trend each year toward more posts and increased engagement with the Twitter community. This engagement comes through both the increasingly large array of information being retweeted by the organization to bring content to their followers and the posts mentioning members of the Twitter community to communicate specialized messages. Engagement with Yuri's Night is increasing as more users retweet their posts, especially original content; a larger degree of their posts are seen by the organization's followers as important enough to share with other users.

b. YouTube

Yuri's Night hoped to use YouTube to further emphasize the cultural and arts aspects of the organization's mission and to appeal to younger consumers with a taste for multimedia experiences through use of public personas and contests.²⁶ Examination of YouTube is somewhat tricky as views are over the lifetime of the video and information is not available to know when the views took place. Therefore, it is prudent to consider comparing videos across the same year as opposed to videos across time. While someone is unlikely to stumble upon an old Tweet or Facebook post and engage with it, a person can easily find and watch older YouTube videos.

i. YouTube: 2009

Yuri's Night has made use of YouTube since January 22, 2009.²⁷ The first video the organization posted was a space history music video that, to this date, has only generated 127 views. However, the second video, posted immediately after the first, features the band *Big Head Todd and the Monsters*. A montage of space videos appears in the background as they play their song "Blue Sky." This second video has had more success with over 17,000 views to date. Discussions with Yuri's Night Executive Director (and co-author) Jeffrey Alles suggests that the organization's collaborative arts/human interest videos always draw more interaction and attention.²⁸ The organization's first post on Twitter clearly communicated its mission, and these first videos on YouTube equally demonstrated its purpose. The higher number of views the second video received suggests that the use of celebrity endorsement, or at least using personalities that the public recognizes readily, can boost overall awareness of Yuri's Night and space exploration.

²⁵ The Yuri's Night Year is used here. For example, Yuri's Night 2008 includes portions of calendar years 2007 and 2008, enumerated in the table for reader convenience. Yuri's Night year runs from June 1 – May 31st.

²⁶ Alles, Jeffrey W. (2014, March 1). Interview by author.

²⁷ Yuri's Night (2009, January 22). Retrieved from https://www.youtube.com/watch?v=8JkDXJCu0_8. For other videos, Yuri's Night's YouTube account available at <http://www.youtube.com/yurisnight>.

²⁸ Alles, Jeffrey W. (2014, March 1). Interview with author.

ii. YouTube: 2010

In 2010, the organization's use of YouTube greatly advanced, as the organization now used the medium not to just promote the organization as a whole, but to provide viewers a glimpse of what happens at Yuri's Night events. This included a video of Yuri's Night San Francisco that included a party at the California Academy of Sciences, a video of Yuri's Night Bay Area's Education Day event where over 3,000 kids came to learn about space and science, and a video of a Yuri's Night event in Romania that showed children presenting a science project. While none of the videos garnered more than a few hundred views, the video of the San Francisco party was the most popular.

In 2010, Yuri's Night also arranged for a series of 32 video podcasts; space and science personalities made short toasts in honor of Yuri's Night. These videos were available to event hosts to present via a free iTunes podcast to allow easy downloading. The organization released them on YouTube after Yuri's Night 2010. These videos received views ranging from a handful to over 1600. The most popular video showed the toast by scientists at the South Pole. Two lessons are evident from this set of videos. The first is that a party-type atmosphere draws more attention to a Yuri's Night event. Second, the use of space and science personalities has only mixed effects. Organization leaders took these lessons into consideration the following year. The results show that posting content directly to YouTube can allow better tracking of views while making videos more easily searchable than a podcast.

iii. YouTube: 2011

The organization expanded its use of YouTube in 2011 as a media push to bring attention to the 50th anniversary of human spaceflight with a video contest that offered a \$500 cash prize. The public could create tribute videos for the 50th Anniversary of Human Spaceflight to share at Yuri's Night events around the world. The design of the *OpenLuna Video Contest* encouraged the public to use an assortment of six new video interviews with space and science personalities, including Bill Nye the Science Guy, and a collection of astronaut videos from the Association of Space Explorers. The goal was for contestants to use them to create mash-up videos. An expert panel voted on the videos, and took into consideration the number of views, the comments, and the distribution rate.

Two hundred to one thousand people viewed each of the six raw interview videos, even without promotion. The most viewed Yuri's Night video featured an interview with Astronaut Ron Garan, Jr. about the impact of spaceflight on society. This interview took place before his mission to the International Space Station (Expedition 27/28, from March 16 to September 16, 2011). To date, the Garan video has received over 135,000 views. Additionally, a separate video advertised the contest itself using clips from all the interviews; it has logged about 3,000 views. The year 2011 culminated with a video uploaded on April 11 showing the International Space Station (ISS) crew sending their messages to the world and wishing everyone a Happy Yuri's Night, with all the crewmembers wearing Yuri's Night t-shirts. This video has received over 22,000 views. Ron Garan, Jr., awarded the 2011 Spirit of Yuri's Night Award, delivered his acceptance speech from the ISS. The use of a space celebrity endorsement video style paid off for Yuri's Night in 2011.

iv. YouTube: 2012

In 2012, the organization focused more on user-generated content. This was an attempt to get the public more involved with the organization and its content. The organization did this by sharing a series of videos entitled “I celebrate Yuri’s Night because,” which featured 18 different people sharing their 30-60 second answer. They garnered between 29 and 425 views apiece. While 2012 marked a change in the use pattern of YouTube for the organization, the overall viewership decreased compared to previous years. This downturn suggests that style endorsement messages rather than user generated content may provide a better means for more engagement though such engagement might not be as in-depth.

v. YouTube: 2013

Yuri’s Night kicked off the 2013 season of YouTube videos by posting a video about the first Yuri’s Night in 2001. Despite only about 300 views, it is perhaps the video that best represents what Yuri’s Night is all about. The 2013 season only had six new videos, many of which featured notable people talking about Yuri’s Night. These included Canada's Greatest Know-It-All winner Andrew Rader (62 views), Canadian Astronaut Chris Hadfield wishing people a happy Yuri’s Night from the International Space Station (5,465 views), and actor LeVar Burton (711 views). The other video from 2013 was a promotional video for a Yuri’s Night event in the Netherlands, showing once again the international reach of the organization.

The lesson to be learned from 2013 may be that celebrity endorsement videos alone are not enough, or perhaps that the public needs a different type of enticement. Perhaps Yuri’s Night should embrace current cultural fads in order to increase viewership and/or collaborate with other organizations on the production and sharing of videos. Another possible source of YouTube video materials could come from Yuri’s Night event organizers who were encouraged to upload their photos and videos to Yuri’s Night Live (hosted on Tumblr) after the events occurred.

Year	# Videos	Total Views	Avg. Views/Video
2008-2009	2	18,313	9,156.5
2009-2010	36	4,991	138.6
2010-2011	8	164,085	20,510.6
2011-2012	18	2,370	131.6
2012-2013	7	9,778	1,369.8

Table 2: YouTube²⁹

²⁹ The Yuri’s Night Year is used here. For example, Yuri’s Night 2008 includes portions of calendar years 2007 and 2008, enumerated in the table for reader convenience. Yuri’s Night year runs from June 1 – May 31st.

vi. YouTube: Summary

With the conclusion of the organization's 2013 season, the "Yuri's Night" channel contained 72 videos, 200 subscribers, and over 193,000 views. This seems like a small number of views, since there are hundreds if not thousands of individual videos on YouTube with more views. However, the organization appears to be getting more bang for their buck, so to speak, since other space organizations have fewer total views with more videos. (For example, the Mars Society currently has 172,303 views over 300 videos, and the National Space Society has only 121,030 views over 200 videos). The organization is certainly doing something right by giving the public (rather than its fans) what they want to see.

c. Facebook

With the growth in the use of Facebook in 2008 and 2009 Yuri's Nights, many of whose volunteers were already Facebook users, decided to create a Yuri's Night page on Facebook to better reach out to and interact with the public. Facebook represents a means for the organization to post news and announcements in a venue where the information would be more readily accessible to interested parties and thus be more easily be shared among people's social networks.³⁰ The key metrics for Facebook include how the organization uses Facebook as evaluated by the number, styles, and types of posts, as well as through how the public responds via likes and shares.

i. Facebook: 2010

The organization joined Facebook on October 7, 2009, in order to promote Yuri's Night 2010.³¹ The organization made 65 posts between October 7 and July 31, including links to its own YouTube videos, general space-related videos, news and web links, and reminders and information about upcoming Yuri's Night events. A majority of the early posts were rather random. However, after announcing that event registration had opened on December 17 for Yuri's Night on April 12, the majority (22) of the subsequent (38) posts included updates on the total number of events registered, locations of registered events, and advertising for registered events, 15 of which were cross-posted on Twitter. Responses on posts ranged from zero to 24 likes, with 61 posts getting at least one like, and all posts averaged 6.53 likes. The styles of posts represented a wide range of options, including seven videos, six podcasts, six posts making use of uploaded images, and 27 uses of external links.

ii. Facebook: 2011

The 2011 season had a much-increased number of posts, both by Yuri's Night and by the public. Starting on January 6, 2011, fans of the Yuri's Night Facebook page could post on the page rather than just respond to organization posts. From that first post until the end of the season on July 31, 2011, Yuri's Night fans contributed 406 posts. Nearly half (196) of the fan posts were made during the run up to Yuri's Night from April 1 through April 12. As an organization, Yuri's Night made 439 posts during the same January-July timeframe, out of 470

³⁰ Alles, Jeffrey W. (2014, March 1). Interview with author.

³¹ Yuri's Night's Facebook Page is available at <https://www.facebook.com/yurisnight>.

during the 2011 season. As part of the 50th anniversary celebration, the organization held a contest in which anyone could create and upload a Yuri's Night advertisement style image to the Yuri's Night Facebook page, and this contest generated 114 posts from early March to mid-April.

Unlike the 2010 season, the initial posts by Yuri's Night discussing the number of registered party events started in August and made up over 80% of the posts, 25 of 31, from August 1 to December 31, 2010. The average number of likes across these 31 posts was 4.13, and the average likes for party count announcements during this time was 3.4 per post. However, by January, the average likes for party count announcements had dropped to 2.9 per post and continued to decrease throughout the rest of the season. On April 6, they suspended posting individual announcements and links for parties, after posting 65 such announcements between April 1 and April 6 that received an average of 0.77 responses each.³²

iii. Facebook: 2012

The 2012 season started with a post on September 20, 2011, and while only 8 posts were made between this time and the end of 2011, these posts averaged 12 likes apiece and 3 of the 8 were shared a total of 19 times. There was a reduced number of posts by Yuri's Night 2012, with 27 leading up to the event (Jan 1-April 11), 4 from April 12-14, and 22 between April 15 and July 31. The entire season consisted of 62 posts averaging 14.68 likes apiece, and just over two shares a piece. The highest number of shares came from only a handful of posts.

Determining the most shared posts is important. The following posts received the most sharing activity:

- a registration drive that included the potential of a prize received 16 shares
- a contest to win a prize for sharing a link to the Yuri's Night homepage garnered 14 shares
- a post of a link to a YouTube video from the International Space Station received 13 shares
- a post about the Venus transit across the Sun combined with a call for volunteers for the 2013 season received 11 shares, and
- a post about the death of Sally Ride with a link to a Space.com article received 11 shares.

A potential take away from the 2012 season is that sharing contests and space-related news may be good ways to reach a greater audience than internal information about Yuri's Night. On the other hand, fewer posts may actually indicate a greater reach, for Yuri's Night Facebook followers are more likely to like and share information when they receive posts less often rather than more often. However, the increased numbers of likes and shares may be due to a growth in the number of people following Yuri's Night on Facebook, and the 2013 season data supports this secondary conclusion.

³² The leadership decided during an internal discussion that the effort to keep up with the posts was too high, given the low return benefits, because few people were responding to them.

iv. **Facebook: 2013**

The 2013 season began with a post on August 3, 2012, announcing that Pete Worden would receive the Spirit of Yuri's Night Award. There were 38 more posts made by the end of 2012; 41 posts during 2013 leading up to April 12; and 31 posts from April 12 until the end of the season for a total of 111 posts, almost twice as many as the 2012 season. Posts averaged 40.45 likes a piece suggesting significant growth in response compared to previous years. The 2013 season also saw milestones of 8,000 Facebook fans on April 7 and 9,000 on April 13. Multiple posts had over 100 likes, including 927 likes for the April 3 post:

“We now have over 200 events! Go to yur.is/findParty to find the closest event to you today! Here's a map of them.”³³

Other posts with high like counts included the following:

- 99 likes on the August 25 post regarding Neil Armstrong's death
- 103 likes for the August 6 post regarding the Curiosity rover
- 141 and 160 likes on two posts on October 14th about Felix Baumgartner's space jump
- 100 likes on an April 5 post about finding a party
- 107 likes on an April 7 post that included a picture of “astronaut and explorer Scott Parazynski with a Yuri's Night patch at the summit of Mount Everest”
- 100 likes for the April 9 post of hitting 300 events
- 438 likes for the April 10 post of a video by Canadian Astronaut Chris Hadfield Wishing the World a Happy Yuri's Night, and
- 384 likes for the April 11 post about a Yuri's Night party on Mars.

With this data, it is of note that the most likes relate to events about Yuri's Night that co-mingle with currently popular space topics, along with other noteworthy celebratory events.

Year	# Posts	Avg. Likes/Post	# Shares ³⁴	Avg. Shares/Post
2009-2010	65	6.53	NA	NA
2010-2011	439	3.33	NA	NA
2011-2012	62	14.68	92	1.48
2012-2013	110	40.45	830	7.55

Table 3: Facebook³⁵

³³ Yuri's Night, Facebook post (2013, April 3). Retrieved from <https://www.facebook.com/yurisnight/photos/a.301991185081.325916.301968645081/10152701873685082>.

³⁴ The ability for someone to share a post was gradually rolled out in Fall of 2011.

v. Facebook: Summary

For the 2013 season, posts averaged 5.49 shares apiece. Highly shared posts included the following:

- 25 shares on an image/link to an article about the ISS turning 12 years old
- 34 and 39 shares on the April 3 and April 5 posts, respectively, about finding a Yuri's Night party
- 47 shares on the April 6 post stating that Yuri's Night 2013 (which is the largest event second only to the 50th anniversary in 2011)
- 46 shares of Chris Hatfield's video
- 51 shares of the April 11 post about the Yuri's Night party on Mars, and
- 38 and 29 shares of the "find a party" link on April 11 and 12 respectively.

Shares seem to follow a similar pattern as likes, though sharing "find a party" information seems to be popular, especially as time gets closer to Yuri's Night each year.

Overall trends suggest that high post numbers do not negatively influence average numbers of likes or shares per post, other than the major exception of event notifications noted above. Additionally, high share posts may be the key to growing the Yuri's Night fan base. With this in mind, there should be a major focus on the style and context of highly liked and highly shared posts in order to both grow the Yuri's Night Facebook base and to keep those within the base sufficiently engaged.

III. Success Metrics

Compared to the low and medium levels of engagement via social media as presented above, high engagement – i.e., the social media users who actually take part in the organization's offerings – is the major focus of the effectiveness of social media for a space advocacy organization.³⁵ Therefore, the best metric of success would be to know the number of individuals who celebrated Yuri's Night. However, as the organization does not require events to report statistics other than estimates at the time of initial registration of an event, the closest proxy available to measure the success of Yuri's Night as an international organization is through the number of Yuri's Night celebrations that take place each year. Another possible metric to use is the number of page views of the Yuri's Night website. Social media tools appear to be more sophisticated with the passage of each year, and each year Yuri's Night attempts to take advantage of them. From the data and discussion above, Yuri's Night appears to be learning lessons and having success. However, social media success metrics such as retweets, views, likes and shares are difficult to correlate directly to other (non-social media) metrics of success. While we would expect that 2013 was more successful than previous years given the social media data,

³⁵ The Yuri's Night Year is used here. For example, Yuri's Night 2008 includes portions of calendar years 2007 and 2008, enumerated in the table for reader convenience. Yuri's Night year runs from June 1 – May 31st.

³⁶ Neiger, B.L., Thackeray, R., Burton, S. H., Giraud-Carrier, C. G., & Fagen, M. C. (2013). Evaluating social media's capacity to develop engaged audiences in health promotion settings: Use of Twitter metrics as a case study," *Health Promotion Practice*, 14(2), 157-162.

it is difficult to know the degree to which social media is helping Yuri's Night accomplish its mission.

One reason that we can connect the changes in social media use to changes in these success metrics is that, for the most part, other aspects of the organization remained the same over these years. However, internal dynamics such as changes in team structure or the make-up of the individual volunteers may also influence the outcomes in ways for which we cannot control. With the exception of the outside influence of 2011 as the 50th anniversary of Yuri Gagarin's trip into space, no other drastic changes in the organization's operations took place from 2008 through 2013, other than changes in the use of social media.

a. Event Counts

The organization tracks the number of events per annum and the number of countries in which events take place in order to look at year-to-year growth. This dual metric provides two ways of measuring awareness of the event. This data is tracked as events are registered on the Yuri's Night website.³⁷ Each year, the Yuri's Night Global Executive Team sets goals for both the number of parties and number of countries with the hopes that these increases will lead to a subsequent increase in both the number of people reached as well as the diversity of the people reached. Because parties can be open to the public or privately held, organizers deemed it necessary to add a new metric in 2004. Starting that year, announcements of public events could include a website for users to find more information about the event. This provides an insight into how many larger scale events were taking place.

Also added in 2004 were continent counts. The concept behind this was to show that Yuri's Night events are truly global and not just taking place in North America and Europe. Since 2004, Yuri's Night events have been held on every continent with the exception of Antarctica (in 2005, 2007, and 2009). Starting in 2011, yet another symbolic metric was introduced – the number of celebrating “worlds.” The celebration of Yuri's Night 2011 occurred on “two worlds” due to virtual events that took place in Second Life. In 2013, Yuri's Night reported that events took place on “two planets.”³⁸ The Mars Rover tweeted to build awareness of recent space exploration milestones (see Figure 1).

³⁷ Technically anyone could hold a Yuri's Night event without registering it, but only registered events are officially recognized and counted in this analysis.

³⁸ Alles, J. W., Kobrick, R. L., Brice, R. B., Finnvik, S., & Bailey, T. (2013). No borders - Bridging cultures through Yuri's Night.” (64th International Astronautical Congress 2013. Beijing, China, Paper ID: 17699).

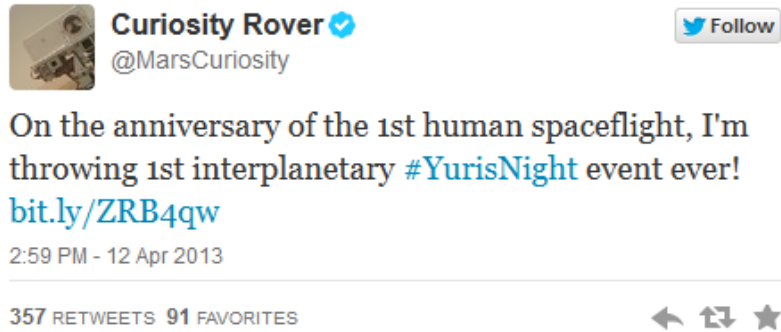


Figure 1: Tweet by Mars Curiosity Rover

The event count trends follow a pattern as expected as depicted in Table 4. With each year from 2007 to 2013 (sans the outlier of 2011), there was an increasing number of events. There are more parties, and therefore it is likely more people are becoming aware of Yuri's Night. These numbers show the organization's growing success. With 2011 marking the 50th anniversary of human spaceflight, the publicity of that event and of Yuri's Night was at an all-time high, supported by various traditional media outlets that normally would not provide a high degree of coverage. Therefore, the 2011 high event count and country count is most likely an outlier. Many of those events were one-time celebrations, rather than events sustainable from year to year. These data do indicate, however, that there is interest in some of these remote countries and that the Yuri's Night's Global Executive Team should strive to connect with space interested communities there to further their mission.³⁹

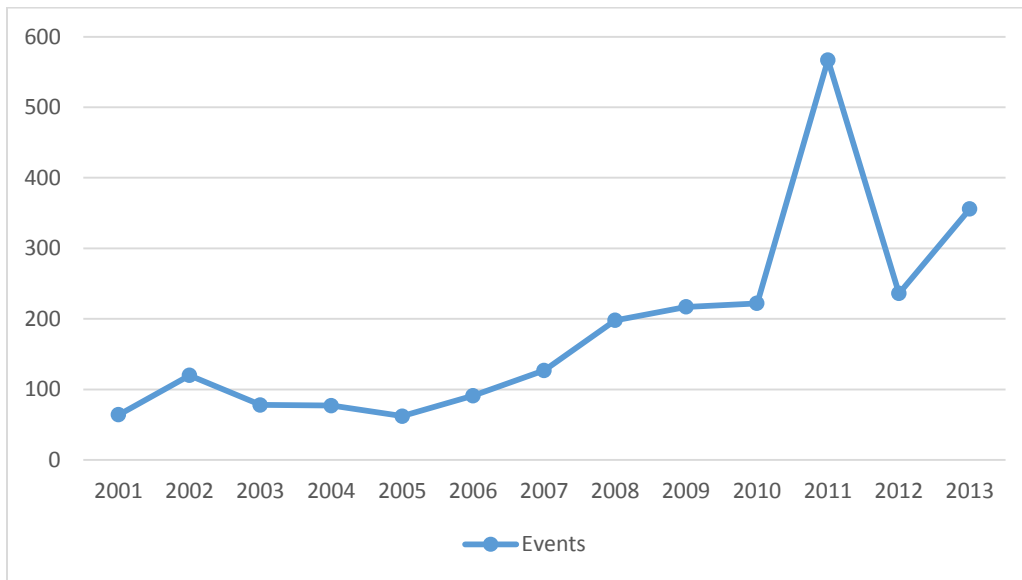


Table 4: Number of Events by Year

³⁹ For additional information about the goals of expanding Yuri's Night to new countries see, Alles, J. W., Kobrick, R. L., Brice, R. B., Finnvik, S., & Bailey, T. (2013). No borders - Bridging cultures through Yuri's Night. (64th International Astronautical Congress 2013, Beijing, China. Paper ID: 17699).

Year	Events	Countries	Websites
2001	64	28	N/A
2002	120	45	N/A
2003	78	36	N/A
2004	77	34	19
2005	62	21	17
2006	91	33	25
2007	127	36	62
2008	198	51	44
2009	217	47	44
2010	222	67	104
2011	567	75	249
2012	236	52	130
2013	356	57	222
All-time	2,415	-	1,080

Table 5: Event, Country, and Website Counts by Year

On the downside, the number of countries hosting events has somewhat plateaued. Based on the available data, there is a general increase from 2007 through 2011, but after that point the international reach of Yuri's Night has been reduced slightly. In the website data presented below, a discussion, concerning the reasons for the data patterns will receive attention. At this point, however, it is not clear whether this slowdown will continue in subsequent years.

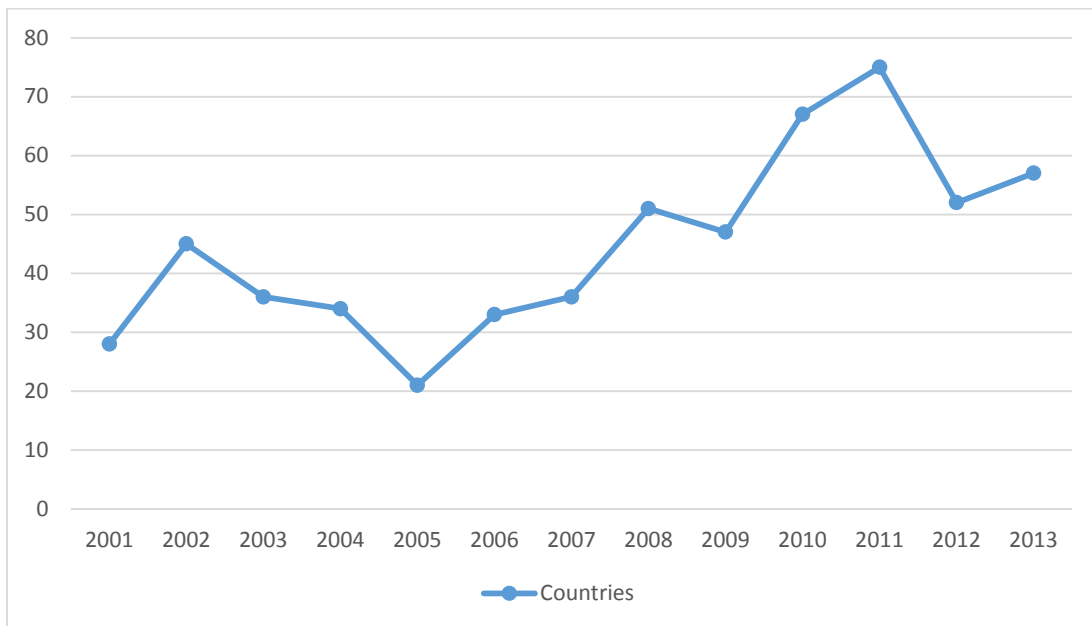


Table 6: Number of Countries Holding Yuri's Night Events

The number of events with websites also seems to follow an increasing trend, but this is more likely due to the increasing availability of web-access and the simplicity of creating a page for each event on sites like Facebook rather than due to anything Yuri's Night is doing. Short of providing a free web host for local event organizers to host event information, it is unlikely that the organization could influence this metric.⁴⁰

b. Website Visits

Traffic to the website is another metric useful for measuring the success of Yuri's Night social media outreach. While the social media messages themselves can provide important and useful information, they exist to keep in touch with members of the Yuri's Night community and to encourage more people to visit the website in order to look up and register information about local Yuri's Night events. The website has existed since August 2010. Through May of 2013, the website welcomed 604,810 unique users from a total of 649,453 visits. Additionally, most Yuri's Night web traffic occurs on the day of Yuri's Night itself, April 12. This may suggest that the vast majority of visitors only come to the site a limited number of times, presumably in an attempt to find a Yuri's Night event near them.

Yuri's Night website visitors truly are global. While more visitors to the website come from the U.S. (167,393 visits) than from other countries, U.S. visitors account for fewer than 26% of the total visits. Large numbers of visitors, 10,000 or more, came from: Iran (11.56%), India (10.64%), Pakistan (5.75%), Indonesia (2.53%), United Kingdom (2.54%), Canada (2.35%), Russia (2.33%), and Germany (1.65%). Visitors have come from 210 countries. Figures 2 and 3 below provide a better idea of where the visitors to the Yuri's Night website originate.

On April 12, 2011 (the 50th anniversary of Yuri Gagarin's flight), the Yuri's Night website clocked 34,959 visits. This was not only the most visitors the website has ever had on a single day, but also represents almost 5.4% of the website's total visitors from the period of 2011 to 2013.⁴¹ More people were probably interested in celebrating the 50th anniversary milestone rather than Yuri's Night on a yearly basis.⁴² April 12 in 2012 and 2013 witnessed significantly fewer visitors, with 9,862 and 11,710 visits respectively. Looking at each cycle, the total number of visitors was 257,445 in 2011, 192,843 in 2012, and 226,994 in 2013. Given the lack of availability of web traffic data for Yuri's Night before August 2010, and the outlier effect of 2011, we can really only compare web traffic from the 2012 and 2013 cycles. There was a 15% increase in visitors in 2013 over 2012, but this was 13.4% below the 2011 visitor counts. (see Table 7).

⁴⁰ Yuri's night has discussed the potential of doing this, and the concept is still under consideration. However, it may not be necessary since the growth of Facebook events are being used to do this in a much cheaper and simpler way.

⁴¹ The 5.4% metric is current as of December 2013 but constantly dropping as the Yuri's Night website currently averages 10,000 views a month.

⁴² There is no way to be sure of users intentions given the scope of this study.

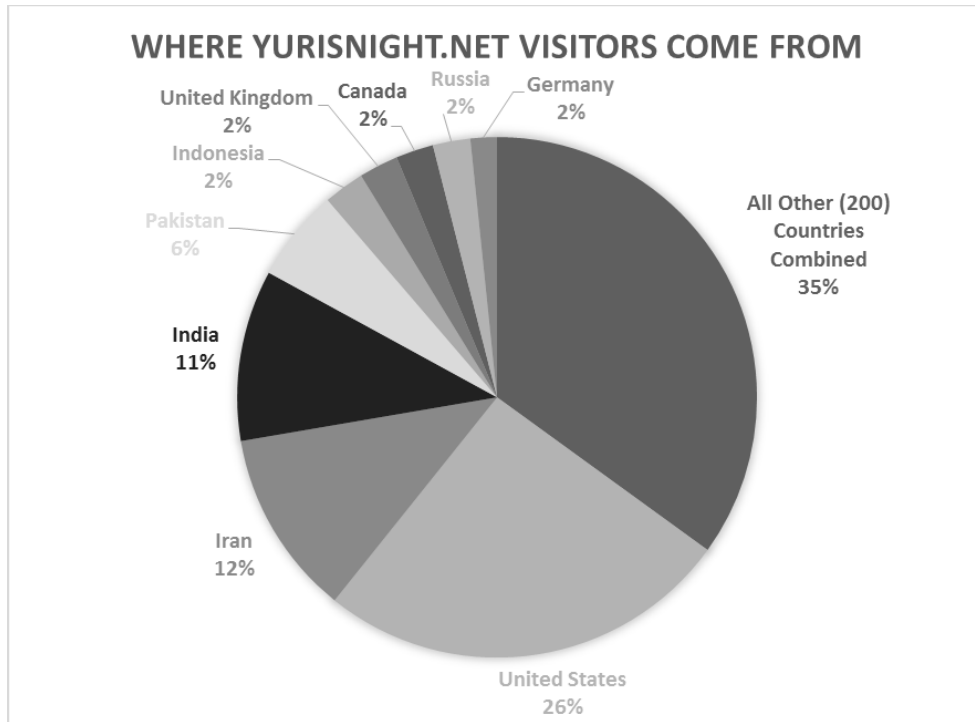


Figure 2: Country of Origin of Yuri's Night Website Visitors by Frequency

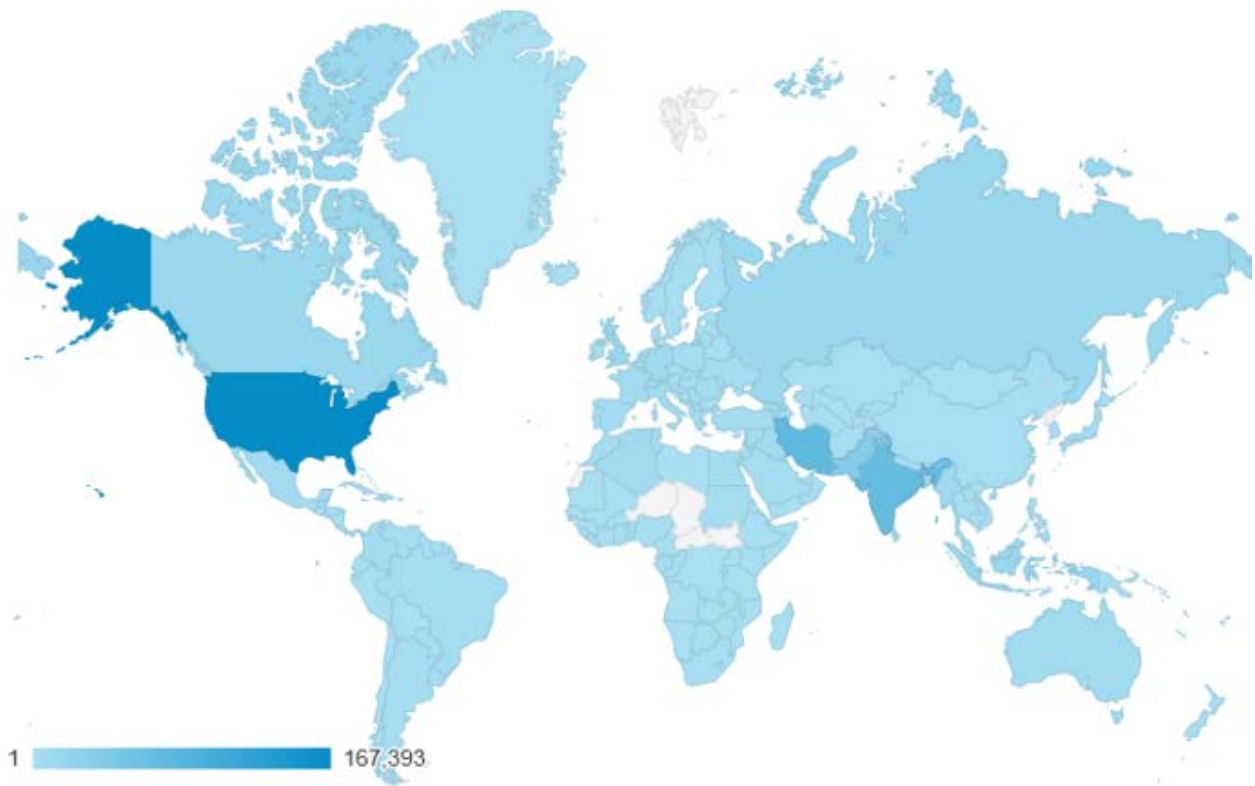


Figure 3: All Time Website Visits by Country

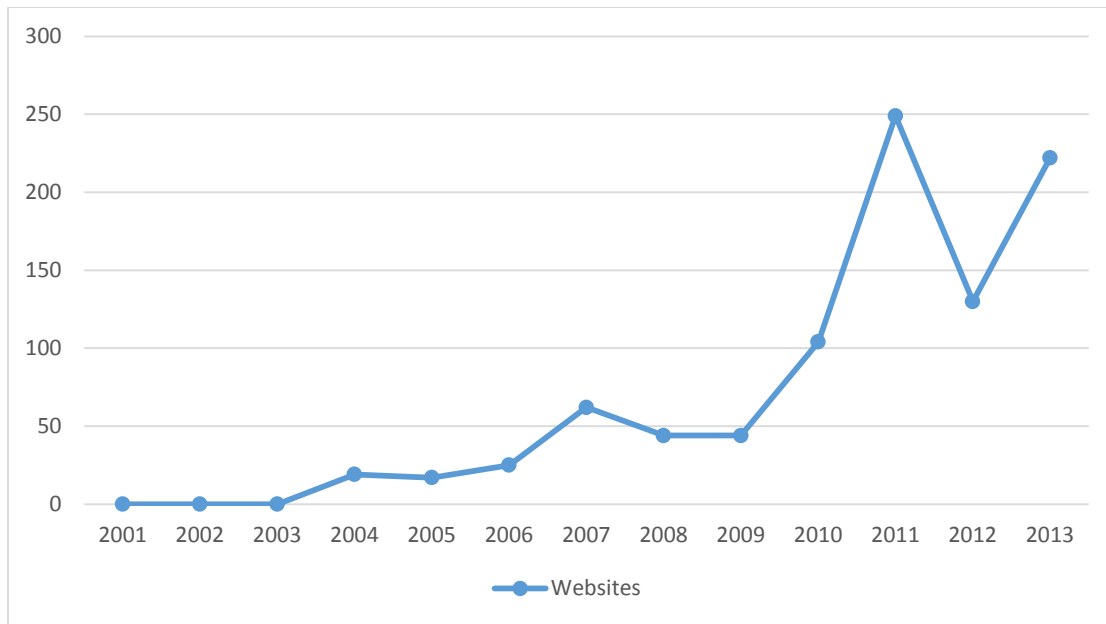


Table 7: Number of Yuri's Night Event Websites

IV. Conclusion and Implications

As space is becoming increasingly mainstream, and to some perhaps routine; thus it is important for space advocacy groups to leverage all resources at their disposal. This case study demonstrates that there is indeed a correlation between social media efforts and obtaining desired outcomes of space related outreach. Yuri's Night has made an impact with its use of Twitter and YouTube, as determined by the somewhat increasing number of views of its YouTube videos and the clear rise in retweeted information by the Twitter community. Metrics of success, as measured through event counts and web-traffic, also support the assertion that the organization is making a larger impact each year and increasing the population's awareness of human spaceflight. Social media is clearly helping Yuri's Night accomplish its mission.

While some of these metrics are somewhat limited, this report provides a platform for further investigation. The next step includes attempting to examine the organization's use of social media tools with lower adoption rates such as Google+ and Flickr, as well as a more in-depth look at current tools to determine reaction to various styles and types of messages by the public as well as Yuri's Night's base of supporters.⁴³ Additionally, the metrics of success examined here are somewhat limited. In the future, Yuri's Night hopes to track more metrics of engagement by encouraging local event organizers to report information about individual events such as accurate attendee counts.⁴⁴

⁴³ The Yuri's Night social media footprint extends to Google+, Tumblr (Yuri's Night Live, previously hosted on Posterous), Pinterest, Flickr, Foursquare, and several others are not discussed in this analysis.

⁴⁴ Alles, Jeffrey W. & Kobrick, Ryan (2014, June 17). Interview by author.

The most important observations are how to improve the effectiveness of Yuri's Night's social media presence, and what lessons other space advocacy groups can learn from this study. What we have seen is that integration into the Twitter community rather than just posting messages leads to people becoming more interested in sharing the organization's message. Additionally, retweeting popular information rather than just reporting rote organizational information allows for a more successful engagement within the Twitter community.

For YouTube, the conclusions are less clear due to the limited data provided by Google. A handful of videos appear to be driving the total views. Meanwhile, Yuri's Night seems to be doing well with Facebook, given that there were over 3,000 new fans in the last 12 months (over one quarter of the total Yuri's Night page fans). The organization should focus on giving the public what it wants, by targeting posts to a more mainstream audience in the geographies in which Yuri's Night is most popular, rather than catering specifically to the space community, by studying the highly liked, shared, and watched posts on these social media platforms in order to determine what makes specific posts comparatively popular.

As evidenced by events such as Felix Baumgartner's sponsored stratospheric, supersonic skydive, billed as a "jump from the edge of space," space is again, if slowly, becoming more interesting to the public. For example, the YouTube video of this event has gathered over 35 million views⁴⁵ which is over 100 times as many views as the NASA YouTube video of the final shuttle landing, STS-135, only a few years earlier.⁴⁶ The effective use of social media and continued analysis of social media efforts allow space advocacy organizations to help make space common in the minds of members of the public by leveraging these events and connecting these events with the public in an interesting and accessible way. These efforts will not exist in a vacuum. Instead, the possibility exists that these social media initiatives could catalyze space events themselves.

Continued exposure to social realities such as regular suborbital tourism flights, mining asteroids, and sending increasingly smaller, cost effective payloads to space via social media may increase space interest and thus space activity. Additionally, an elevated social interest in space may be due to a revived interest in space by the entertainment industry. While it is not possible to prove anything about the public's interest in space beyond this conjecture, it remains an avenue for future research. For example, shows and movies such as the revived Cosmos series, *Interstellar* (2014), *Gravity* (2013), and *The 100* (2014-Present) use space as a plot device. Continued societal exposure to space, enhanced by social media saturation, could have sweeping effects on society as a whole.⁴⁷

⁴⁵ Red Bull (2012, October 14). Felix Baumgartner's supersonic freefall from 128k' - Mission highlights. Retrieved from <https://www.youtube.com/watch?v=FHtvDA0W34I>.

⁴⁶ National Aeronautics and Space Administration (2011, July 21). Atlantis's final landing at Kennedy Space Center. Retrieved from <https://www.youtube.com/watch?v=HLDG5sNMX2M>.

⁴⁷ Kate Lanau writes in a softer piece on astronaut Chris Hadfield that the use of social media from space has proven an effective way to introduce space into the mainstream and engage new and diverse audiences, while reconnecting with the usual audiences (e.g. teachers). Lanau, K. (2013, March 11). Canada's man in space gets a little help from home. Retrieved from <http://www.macleans.ca/society/life/our-man-in-space>. In addition, some support is provided through the lens of NASA. See Friedman, P. (2014, August 13). How to Make NASA Cool

Meanwhile, other space organizations could learn from the efforts of Yuri's Night in terms of their use of social media efforts to further their own missions and success. The metrics of success identified here are only a starting point. Future research can compare the lower and medium success metrics between organizations, such as comparative numbers of likes or followers, to better identify what styles and contexts provide more engagement success than others do. Additionally, this study serves as only one means to measure social media success by one space organization. Hopefully, it will serve as an inspiration for others to continue to explore the communication efforts of space advocacy organizations.

There are many astrosociological questions left unanswered, yet worthy of further research, some of which focus on the general attitude toward and interest in space within the social media sphere. For example, can social media make space cool again? Can space interest groups actually affect space policy? What effects might space related multi-media have on public opinion towards space exploration? Moreover, it appears that many space organizations and groups have invested significant effort in increasing space awareness through social media as evidenced by the growing number of space groups embracing multiple avenues of social media. This leaves us wondering what the future effect will be of social media use by space organizations and its impact on space exploration. We speculate that as the twenty-first century unfolds and space becomes commonplace, there will be an increased amount of space references in pop culture and social media efforts regarding space will thus become less focused on science and history and instead more integrated into daily life. However, there is no way to know if that will lead towards greater subconscious space interest growth, or if the signal will just get lost among the noise.

Again. *Popular Mechanics*. Retrieved from <http://www.popularmechanics.com/science/space/nasa/how-to-make-nasa-cool-again-17087616>.

ESSAYS

Spaceflight and Science Fiction

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ABSTRACT - From the very beginning, science fiction and spaceflight have had a very close relationship, with science fiction both stimulating and in turn being stimulated by developments in real-world science. For example, Johannes Kepler's novel *Somnium* (ca 1634) was both a work of science fiction, and also one of the earliest works of lunar astronomy; while Jules Verne's 1865 *De la Terre à la Lune* ("From the Earth to the Moon") anticipated the Apollo missions; and "The Brick Moon," by Edward Everett Hale (1869) anticipated the use of satellites for navigation. This essay discusses some of the history, and presents some of the remarkable parallels and shared inspiration between science fiction and spaceflight.

I. Science Fiction and Space Flight

From the very beginning, science fiction and spaceflight have had a very close relationship, with science fiction both stimulating and in turn being stimulated by developments in real-world science.

The astronomer Johannes Kepler – famous primarily for discovering the laws governing the orbital motion of the planets – published a novel *Somnium* ("Sleep") in 1634.¹ The work was first written in 1609, but only published by his heirs after Kepler's death.² This work predates the advent of science fiction in the modern sense, in that the character Duracotus does not make use of technology to affect space travel. He travels, by means of a sleeping draught and occult powers, into space, arriving at the moon, where he discusses gravity, and how the view of the heavens is modified viewed from the moon. The book was thus both a work of science fiction, and also one of the earliest works of lunar astronomy, in which Kepler elucidated the Copernican theory by comparing the movement of the heavens as viewed from the Moon with the observed view from the Earth.

Incorporation of ideas of spaceflight into fiction was followed by works such as Francis Godwin's *The Man in the Moone, or, a Discourse of a Voyage thither by Domingo Gonsales*, first published (in Latin) in 1629, which described the moon as a world similar to Earth, which the protagonist traveled to with the aid of a flock of geese, and Voltaire's "Micromégas" (1752), a short story about the visit to Earth by an inhabitant of a planet of the star Sirius, with a

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¹ Kepler, J., & Kepler, L. (1634). *Mathematici olim imperatorii Somnium, seu opus posthumum De astronomia lunari Sagani*. Frankfurt: Silesiorum. Excerpt in Derleth, A. W. (Ed.) (1950), *Beyond Time and Space*. (Bleiler, E. F., trans) (p. 65). New York: Pellegrini & Cudahy.

² "Kepler, Johannes" (2011). Entry in encyclopedia of science fiction. Retrieved from http://www.sf-encyclopedia.com/entry/kepler_johannes.

companion from the planet Saturn. These works, like other fantastic voyage stories such as *Gulliver's Travels*, primarily used spaceflight as a tool for social commentary, but also served to firmly cement in the public mind the concept that the planets were actual places, not merely dots in the sky, places to which people could, in principle, travel.

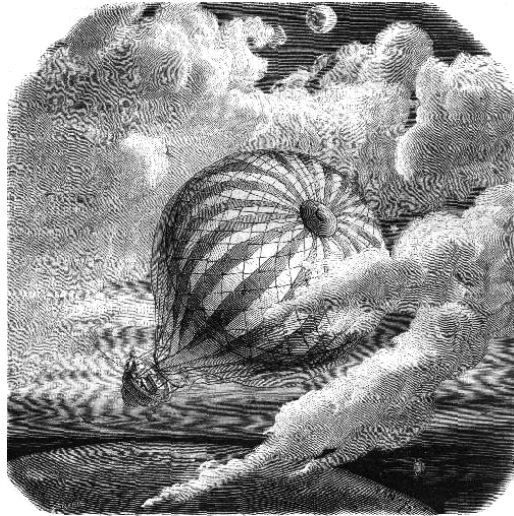


Figure 1: An illustration (1835) for Edgar Allen Poe's "Adventure of Hans Pfaal," with the balloon at an altitude high enough for the curvature of the Earth to be clearly seen.

Edgar Allan Poe's 1835 story "The Unparalleled Adventure of One Hans Pfaall" is one of the earliest works in which the author made more than a cursory attempt to justify spaceflight in terms of an actual technology, in this case describing a trip to the moon by use of a balloon. While spaceflight by balloon may seem unbelievable by modern standards, in Poe's time, flight by balloon was still a relatively new technology. By the time Poe wrote the story, the Earth's atmosphere was well understood not to extend all the way to the moon, but Poe explained this away by a statement that the atmosphere, although "rarified," does not decrease to perfect vacuum, and explained that lifting gas in the balloon was a previously-undiscovered gas "of density about 37.4 times less than that of hydrogen." (The existence of a gas so much lighter than hydrogen may not seem credible today, but Poe's story was written fifty years before the discovery of the periodic table of the elements). Pfaal is able to breathe in the rarified atmosphere by use of "a very strong perfectly air-tight, but flexible gum-elastic bag" fitted around the gondola, with "one of M. Grimm's apparatus for the condensation of the atmospheric air" to pressurize the air.

II. From the Earth to the Moon

The modern era of science fiction about spaceflight began with Jules Verne's 1865 novel *De la Terre à la Lune* ("From the Earth to the Moon"), and the 1870 continuation, *Autour de la Lune* ("Around the Moon"). In *From the Earth to the Moon* a realistic description is given of the preparations for the launch of a projectile to the moon, using the technology of the day: an extremely large cannon. Verne is, apparently, the first author to be fully aware of the enormous scale of the enterprise required; the launch is put together as a project by an engineering team,

which, for the first time, accurately accounted a trip to the moon as a large-scale engineering project, and not an afternoon's jaunt by an individual. The cost of \$5.5 million dollars cited by Verne would come to \$183 million if corrected to a 1969 cost based on production worker salaries, which rose by a factor of 33.2 from 1865 to 1969.³ This is remarkably close to the launch cost of a Saturn-V, estimated at \$185 million dollars per launch in 1969 dollars (about \$1.1 billion in 2010 dollars).

The "Columbiad" cannon described by Verne is enormous: 900 feet (274 m) long, with a nine-foot diameter bore, and a weight of 68,000 tons (61,700,000 kg). The propellant is 200 tons (180,000 kg) of gun cotton.

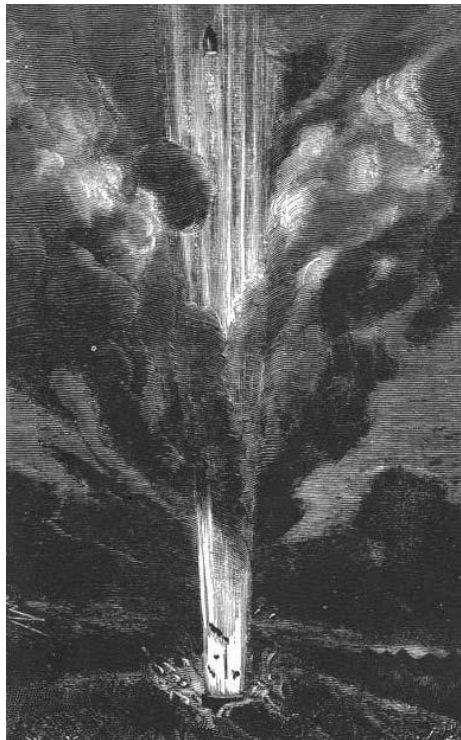


Figure 2: Launch of Columbiad, from Jules Verne's 1865 novel.

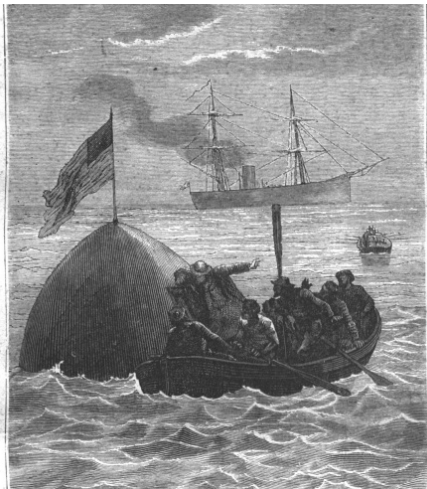
From the Earth to the Moon anticipated the Apollo missions in many remarkable ways, with the flight of the capsule launched by Columbiad a near duplicate of the Apollo 8 mission around the moon. Some of these remarkable similarities are shown in the comparison below:

³ Measuring Worth. (2011). *Seven ways to compute the relative value of a U.S. dollar amount, 1774 to present*. Retrieved from <http://www.measuringworth.com/uscompare>.

<i>From the Earth to the Moon (1865) and Around the Moon (1870)</i>	<i>Apollo spacecraft (1968-1969)</i>
<ul style="list-style-type: none"> • Capsule launched by “Columbiad” cannon 	<ul style="list-style-type: none"> • “Columbia” capsule launched by rocket
<ul style="list-style-type: none"> • Launch site in Florida 	<ul style="list-style-type: none"> • Launch site in Florida
<ul style="list-style-type: none"> • Mission circled past the moon and returned to Earth 	<ul style="list-style-type: none"> • Orbited the moon and returned to Earth (Apollo 8)
<ul style="list-style-type: none"> • Crew: 3 	<ul style="list-style-type: none"> • Crew: 3
<ul style="list-style-type: none"> • Material: Aluminum 	<ul style="list-style-type: none"> • Material: Aluminum
<ul style="list-style-type: none"> • Mass: 9.7 tons 	<ul style="list-style-type: none"> • Mass: 13.1 tons
<ul style="list-style-type: none"> • Diameter 2.74 m 	<ul style="list-style-type: none"> • Diameter: 3.9 m

Table 1: Comparative Chart between Verne’s Approximations and Apollo Missions

Verne’s novel was well celebrated in popular culture, and was undoubtedly one of the major influences on H. G. Wells *The First Men in the Moon*, as well as much later science fiction. It also was a main inspiration for one of the earliest motion pictures, the 1902 film *Le Voyage dans la Lune* (“A Trip to the Moon”) by Georges Méliès, which was the first science-fiction film.



**Figure 3: Science Fiction –
From Earth to Moon (1865);
Capsule splashdown in
Pacific, recovered by USS
Susquehanna.**



**Figure 4: NASA Reality – Apollo-11
(1969); Apollo Capsule splashdown in
Pacific, recovered by USS Hornet.**



Figure 5: Image from the 1902 film *Le Voyage dans la Lune*, showing the cannon being loaded for the Moon shot.

While Verne anticipated the Apollo missions, at about the same time, Edward Everett Hale, in “The Brick Moon” (1869), described the orbit of an artificial satellite, and explained the use of satellites as an aid for navigation. Although the details of his use of satellites for navigation – visual acquisition of the satellite for triangulation on the surface – were not used, it followed the navigational principles of its day, by astronomical observations using transit and sextant. The advent a century later of satellite navigation systems, evolving from the early transit system into the global GPS system currently in use, owes a small debt to science fiction.

Following the turn of the 20th century, spaceflight became a more popular topic in fiction, with H. G. Wells’ two novels *War of the Worlds* (serialized in 1897; in book form in 1898) and *First Men in the Moon* (1901) and Kurd Lasswitz’s *Auf Zwei Planeten* (“On Two Planets”) in 1897 leading the way in bringing the concept of spaceflight into the public imagination; along with (now) more forgotten works such as *Edison’s Conquest of Mars* (serial 1897; in book form 1947), and George Griffith’s “Stories of Other Worlds” (serial 1900; in book form as *A Honeymoon in Space*, 1901).

Hugo Gernsback, who founded the first science-fiction magazine, *Amazing Stories*, in 1926, explicitly viewed science fiction as a tool for explaining science and for stimulating interest in science and technology in young people, describing an ideal story as “75 percent literature interwoven with 25 percent science.”

By the late 1920s, concepts of science fiction and spaceflight diffused increasingly into the popular culture, moving from books and short stories into the mainstream media with the Buck Rogers comic appearing in newspapers in 1929 and on the radio in 1932, and Flash Gordon appearing in the comics in 1934. Interestingly, these comics, and the later movie serials, gave the idea of travel by rockets such a “comic strip” feeling that when the original GALCIT rocket experimenters at Caltech, nicknamed the “suicide squad,” formed an organization to work on contracts to develop rockets for the military applications, they named their organization the “Jet Propulsion Laboratory” (JPL) because the word “rocket” would have invited derision.⁴ The original JPL founders were, however, well aware of science fiction outside of the comic strips, and were friends and colleagues of the California science fiction writers of the day, including, among others, Robert A. Heinlein and L. Ron Hubbard.⁴

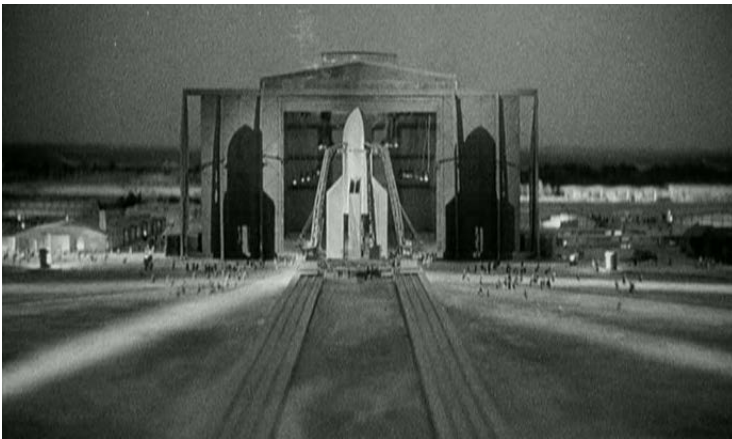


Figure 6: Still image from *Frau im Mond* (1929). Note the remarkable resemblance of the assembly building and transportation tracks here to the Vertical Assembly Building built for the Saturn V.



Figure 7: Moon landing from *Frau im Mond*. Although it attempts more accuracy than earlier Sci Fiction films, the moon voyagers in the film still wear no space suits on the surface.

III. The V-2 Era

Science fiction had a direct impact on the space program, most notably in the form of its impact on Wernher von Braun. von Braun read science fiction, and in interviews has given credit to Lasswitz’s 1897 *Auf Zwei Planeten*; a book that is also credited with having inspired astrodynamist Walter Hohmann. Remarkably, for a novel which has great popularity and influence in Germany, no English translation was published until 1971.

In Germany, the well-known film director Fritz Lang made the film *Frau im Mond* (“Woman in the Moon”) in 1929, one of the first full-length science fiction films, and the first film to consider spaceflight seriously (released in the U.S. under the title “By Rocket to the Moon.”), *Frau im Mond* is credited with the invention of the count-down for a rocket launch.

⁴ Pendle, G. (2005). *Strange angel: The otherworldly life of rocket scientist John Whiteside Parsons* (p. 233). Orlando: Harcourt.

German rocket pioneers Hermann Oberth and Willy Ley were science advisors on the film. As a publicity stunt, Lang hired Oberth and Ley to build a real rocket to launch, timed to coincide with the film's opening. The rocket project did not succeed in building a rocket in time for the film, but Oberth and Ley continued their work with the German amateur rocket club *Verein für Raumschiffahrt* (VfR – literally the “Club for Space-ship travel”), launching their first liquid fuel rocket in early 1930. Wernher von Braun joined the VfR at about this time, and by 1934, the group was launching liquid-fueled rockets to altitudes of over 3 km.

With World War II, of course, the German rocket group led by von Braun built a series of rockets leading to the *Vergeltungswaffe 2* (V-2), the first rocket to be built on an industrial scale, used for long-range bombing of England and the Netherlands. Reputedly, von Braun's comment on the news of the successful use of the V-2 for bombing London was: “The rocket worked perfectly except for landing on the wrong planet.”

The V-2 brought the reality of rockets public in a highly visible way; rockets were no longer comic-strip stuff, but real and highly-visible tools of warfare and, presumably, spaceflight. Following the end of the war, the rockets on science fiction magazine and covers now all looked remarkably like the V-2, and science fiction entered a golden age, with spaceflight stories written by a number of classic writers such as Robert Heinlein, Arthur C. Clarke (who was also noted for inventing the concept of a geosynchronous communications satellite), Isaac Asimov, and Andre Norton reaching new audiences.



Figure 8: After the public exposure of the V-2 rocket in World War II, the rockets seen in science-fiction cover art began to develop a marked resemblance to the V-2.

von Braun was not merely inspired by science fiction, but also wrote it. Following his arrival in the US, he wrote a short science fiction novel (in German) about a trip to Mars, in which the spacefarers travel in a spacecraft with as much technical accuracy as von Braun could imagine, encountering, on their arrival, intelligent Martians with an ancient, dying civilization. The book was complete with an extensive technical appendix. The novel itself was rather simplistic by the standards of science fiction, which had become more sophisticated since the adventure stories of the 30's, but the technical appendices to the book were separated, and published as a book, *Das Marsproject* (1952), in English as "The Mars Project" (1953). The ideas in this book were to have a major influence on the goals and methods of the American space program. The original science fiction novel was not published in von Braun's lifetime, although it eventually saw print in Canada from specialty-press Apogee Books⁵ in 2006, primarily for its historical interest.

IV. The Space Age

With the coming of the space age, spaceflight and science fiction maintained their close relationship. The Clarke/Kubrick collaboration on the book and movie *2001: A Space Odyssey* in 1968, for example, shadowed the Apollo lunar landings in 1969, and looked forward to an era of space stations, extravehicular activity, and an orbital space station. Less accurately, it predicted a moonbase by the year 2001; and while a Jupiter mission was, in fact, in progress by 2001, the Galileo mission was entirely robotic, and with a computer of considerably less power than the HAL-9000 envisioned by Clarke. Nevertheless, by 2001 the Galileo mission was revealing astonishing details of the Jupiter system and moons, making it, in its own way, a far more fascinating place to explore than the Jupiter envisioned by Clarke.



Figure 9: Pan Am Space Clipper (science fiction) from *2001: A Space Odyssey* (1968).



Figure 10: Space Shuttle Atlantis (2007).

In some respects the space program was a disappointment to science fiction. Spaceflight has not become as simple and ubiquitous (nor as cheap) as science fiction predicted. The cratered Mars revealed by the Mariner and Viking missions was not nearly as colorful a setting for science fiction as the Mars of Percival Lowell, with its canals and ancient, dying civilization; the furnace of the Venus surface revealed by Russian and American probes was not nearly as picturesque a setting for science fiction as the earlier swampy or even ocean-covered Venus hypothesized by astronomer when all that could be seen were clouds. Even the moon, dry and

⁵ von Braun, W. (2006). *Project Mars: A Technical Tale*. Burlington: Apogee Books.

grey and mostly lacking in resources, was a disappointment. As a result, much of the science fiction of the mid 1960's and beyond looked outward, to interstellar flight toward destinations that could not easily be debunked by space probes, or else turned toward social or psychological exploration.

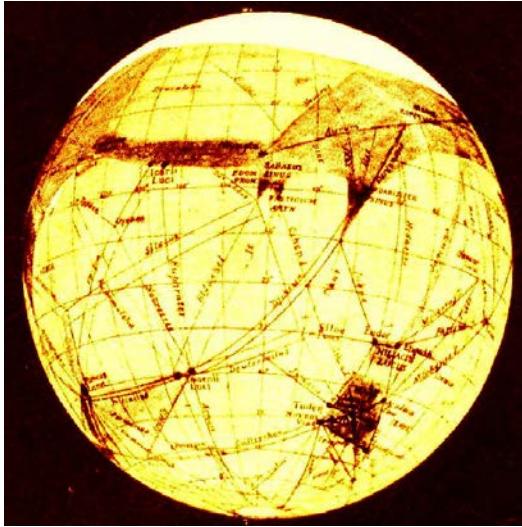


Figure 11: The Mars of Percival Lowell (1908), a planet of canals and an ancient, dying civilization.



Figure 12: The surface of Mars as revealed in the images from the Mariner-4 spacecraft (1964), a nearly airless, cratered desert.

In recent years there has been a revival of interest in science fiction set in the solar system, with stories attempting to make use of the most recent knowledge of the planets, but this setting has become much less prevalent than it had been in the golden age of science fiction in the 1930's through 50's.

V. The Golden Apples of the Sun

In a more modern example of science emulating science fiction, and vice versa, consider the case of the Solar Probe Plus mission.⁶ Missions to the sun have a great history in science fiction. In Ray Bradbury's well-known story "The Golden Apples of the Sun" (1953), a solar mission dives into the outer layers of the sun to bring back the secrets of fusion energy. Bradbury is more interested in evocative prose than in the actual technology of such a mission, but his story became a classic. Later, David Brin's 1980 novel *Sundiver* explores the idea of a solar probe in more detail, explaining the technology of the mission as including a highly reflective

⁶ Kinnison, J., Guo, Y., Dantzler, A., Vernon, S., DeBoy, C. C, Drewry, D., Eisenreich, P., Fraeman, M., Harvey, R., Mehoke, D., Monaco, C., Parr, S., Persons, D., Roufberg, L., Shapiro, H., Trela, M., Weir, D., Wirzburger, M., Landis, G. A., Schmitz, P., Simons, R., Hickman J. M., & Donegan, M. M. (2008, September 29 - October 3). "The Solar Probe+ Mission: A New Concept for Close Solar Encounters." (Presentation at the meeting of the 59th International Astronautical Congress. Glasgow, Scotland).

spacecraft, and a concept for refrigeration of the spacecraft using a laser (the refrigerator concept used – unfortunately for spacecraft designers – requires a violation of the second law of thermodynamics to function).

In terms of actual spaceflight, the concept of a solar probe has a long history in spaceflight, first discussed in the “Simpson’s Committee” of the Space Science Board⁷ in 1958, shortly after Sputnik. This became a JPL mission concept study, Solar Probe,⁸ later “Star Probe,” which evolved into the “Fire” portion of the “Fire and Ice” proposed missions,⁹ using a Jupiter gravity-slingshot in reverse to remove the spacecraft’s orbital angular momentum and allow it to drop in to a close pass to the near-sun environment of the solar corona. To make the mission possible, the spacecraft itself is hidden behind a sun shield made of high-temperature carbon composite, allowing the body of the spacecraft to remain at moderate temperature as the shield is heated to incandescence. These design concepts eventually became reality with the upcoming mission Solar Probe Plus,¹⁰ which will launch in 2018 to fly to within 7.5 solar radii of the surface of the sun.¹¹



Figure 13: Solar Probe Plus, a (real) mission to the corona of the sun. The carbon heat shield protects the spacecraft from the high-intensity thermal environment of the sun.

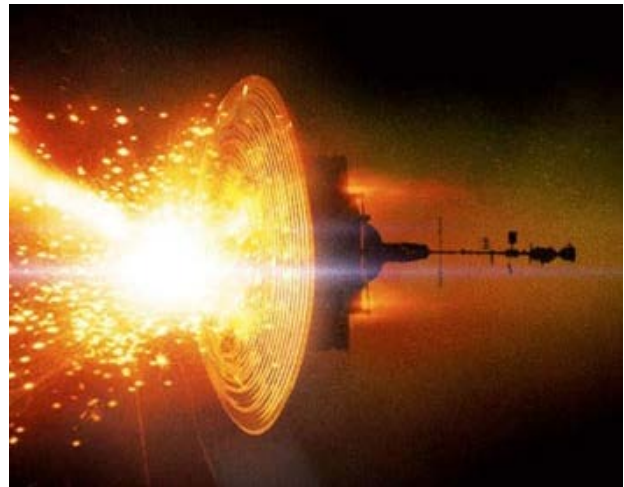


Figure 14: Spacecraft from the film *Sunshine* (2007), a movie in which the refractory solar shield protects the spacecraft on a mission close to the sun.

⁷ Simpson, J. A., Goldberg, L., Rossi, B.B., Van Allen, J.A., Urey, H.C., et al. (1958, October 24). Proceedings of the Space Science Board at the National Academy of Sciences. Washington, D.C.

⁸ Randolph, J. E. (1996). NASA solar probe mission and system concepts. *Advances in Space Research*, 17(3), 3-12.

⁹ Staehle, R. L., Brewster, S. C., Carraway, J. B., Chatterjee, A. K., Clark, K. B., Doyle, R. J., Henry, P. K., Johannesen, J. R., Johnson, T. V., Jorgensen, E. J., Kemski, R. P., Ludwinski, J. M., Maddock, R. W., Mondt, J. F., Randolph, J. E., Terrile, R. J., & Tsurutani, B. T. (1999). Ice and fire: Missions to the most difficult solar system destinations on a budget. *Acta Astronautica*, 45(4-9), 423-439.

¹⁰ *Supra* note 6.

¹¹ *Ibid.*

This concept for a solar probe was re-imported back from spaceflight to science fiction with Danny Boyle film *Sunshine* (2007), where, like the Solar Probe Plus mission, a space mission to the near-sun environment is designed with a large solar shield behind where the spacecraft can remain at moderate temperature.

VI. The Future

Science and science fiction continue to maintain their dialogue, with many, perhaps a majority, of scientists and engineers working in the aerospace field admitting to an inspiration in science fiction, while science fiction writers continue to have a fascination with the space program. Science fiction has continued its press outward into the future, with visions of travel far beyond the destinations yet visited by spacecraft. The technological predictions of science fiction include relatively “near term” visions such as human missions to Mars and beyond, space colonies, artificial intelligence, space elevators, bio-engineering and nanotechnology; and much longer term visions including interstellar travel by warp drives and wormholes, time travel, teleportation, and alternate universes, along with concepts of a technological singularity, in which the very nature of humanity may be changed. There is certainly no end of inspiration left in science fiction, and a large number of concepts left for scientists and aerospace engineers to explore.

Beyond Habitation in Space: The Need to Design for Human Adaptation

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ABSTRACT - As human space exploration goals have evolved and expanded, so has the domain of “human factors” research. The earliest missions to the Moon were concerned exclusively with survival; research objectives of the present phase focus on work performance and functionality; and the efforts towards habitation on Mars in the future take into account considerations for quality of life and well-being. Creature comforts and leisure activities alone, however, are not sufficient habitability criteria. What is missing is the perspective of long-term adaptation to the environment, which entails not only a physiological dimension, but also a psychological and a social dimension. Unlike physiology, however, psychological processes are not objective but subjective, and depend on individual perception rather than the actual characteristics of the physical world itself. A more comprehensive understanding of adaptation—beyond the presently established conditions for habitability—requires the development of familiarity, empathy, and a sense of home. This cannot be achieved by shielding the crew from the harsh exterior, but rather through promoting engagement with their environment. Only through the processes of negotiation will humans develop the resilience that will make them more likely to endure and prosper in space.

I. Evolution of Human Factors

Throughout the brief history of human spaceflight, exploration objectives for traveling to space have changed and so has the way in which spacecraft have been designed to meet occupant needs. In the earliest days of the space program, when propulsion technologies were in their nascence, the paramount concern was protecting the lives of the crew, from the moment of launch to the point of return. The onerous technological demands of both escaping Earth’s gravitational field as well as preserving human life allowed little else to be considered regarding human needs. In the first generation of manned space exploration—the series of Apollo missions—a crew of three men was confined to an interior space of approximately 218 cubic feet (equivalent to a 6 by 6 by 6 foot room) for the entire duration of the mission, which lasted up to several days (See Figure 1). Physical movement or activity, outside of operating the spacecraft, was extremely limited inside the command module.

The second phase of human space exploration saw the first stations—Skylab, Mir, and the International Space Station—placed in low-Earth orbit (See Figure 2). As these missions began to take on a scientific agenda, the modules were outfitted to accommodate research and work activities that required the use of a variety of tools and equipment. Functionality and

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practical considerations took precedence over the inclusion of other amenities, which neither the limited volume of internal space nor cost would permit. Mission durations during this phase increased from several days to several months. This raised a new set of concerns for the safety and welfare of the crew, due to prolonged exposure to cosmic radiation and microgravity as well as psychological and social issues arising from extended periods of isolation and confinement. These concerns brought greater attention to the need to address a wider spectrum of human factors in the design of the spacecraft.



Figure 1: Interior of Apollo Capsule¹

¹ National Aeronautics and Space Administration, Apollo Space Capsule Interior, Apollo Command Module, available at www.imgbuddy.com/apollo-space-capsule-interior.asp.



S122E008911

Figure 2: Interior of ISS (Columbus Module)²

Given the high degree of risk involved in space travel—along with the machismo of American Cold War politics, the military-trained all-male crew, and the spirit of patriotic adventure of that era—an ethos of heroism became entrenched in the culture of space exploration. Astronauts were expected to have the “right stuff”: a blend of stoicism, courage, and a high tolerance to stress and discomfort (Dudley-Rowley, et al., 2001). This mindset has been pervasive in the space program, continuing to inform both the selection of American astronauts as well as the design of the most recent generation of space vessels. But as we embark on the next chapter of space exploration—establishing civilian outposts and eventually permanent settlements on Mars—this aura of heroism will only serve to jeopardize the success of longer-duration voyages and must be replaced with another type of sensibility, one in which more emphasis is placed on acknowledging more than just basic human needs. Durations in space will extend from months to years, and therefore design criteria must likewise expand to incorporate conditions for habitability in which psychological and social issues will be as critical as the

² National Aeronautics and Space Administration, STS 122-E-008911 (15 Feb. 2008), original caption – “European Space Agency astronaut Hans Schlegel, STS-122 mission specialist, continues work aimed toward readying the agency's new Columbus laboratory for duty aboard the International Space Station. A pictorial guidebook assists the astronaut in installing the lab's experiment racks”, available at <http://spaceflight1.nasa.gov/gallery/images/shuttle/sts-122/html/s122e008911.html>.

physiological ones (Suedfeld, 2000 and 2010; Dator, 2012; Stuster, 1996; Kanas and Manzey, 2008).

II. The Era of Habitability

NASA has, in fact, already recognized the need for broadening design parameters to encompass conditions for habitability, and developed the STD-3001 to that end. This document defines habitability as “a measure of the degree to which the environment promotes productivity and well-being” (Preiser, 1991, p. 150), entailing three levels which roughly correspond to past goals (level one), present goals (level two), and the future goals (level three) of human space exploration. The first priority focuses on the safety and health of the crew, which must override all else. The second priority emphasizes function and task performance. The third priority cites the need for physical and psychological comfort and satisfaction. This level includes aspects such as personalized spaces, privacy, leisure and recreational activities, and positive social interaction. However, despite the inclusion of criteria found in recent human factors research to be aimed at well-being and comfort, there is little evidence in the current generation of space habitat modules that reflect any significant influence by the research (See Figures 3 and 4); one has only to look at current habitat simulations to see that they still provide only the bare bones, hardly informed by any aesthetic sensibility at all (Vogler and Jorgenson, 2004; Harrison, 2010; Preiser, 1991). Design criteria for habitation are qualitatively very different from those of exploratory missions. First, habitation implies long-term durations in space, whereas durations for missions are short-term. Second, habitability requires more extensive adaptation strategies; short-term missions demand only some degree of physiological adaptation, but long-term durations demand psychological and social adaptation as well. Third, objectives of exploration entail scientific research and data acquisition; it is the process of searching and discovering, with no final or end destination. Objectives of habitation, on the other hand, require a sense of place and destination; it is the process of dwelling, of being at home somewhere. Given the substantive differences between their respective goals, each must address a distinct set of human factors issues. The transition from ‘missions to space’ to ‘habitation in space’ requires a shift in the design paradigm from what is referred to as the ‘spam in a can’ model to a quality-of-life model (Dudley-Rowley et al., 2003). “Rather than focusing exclusively on how humans *endure* [in the short-term]—the criteria for which are based on designing for tolerances—the emphasis has shifted to how humans *thrive* [in the long-term]—the criteria for which are based on designing for optimization” (Lockard, 2014, p.14. Italics are in the original).



Figure 3: Habitat Demonstration Unit³



Figure 4: HI-SEAS Mars Habitat Simulation⁴

³ National Aeronautics and Space Administration, Desert RATS 2010 Complete 13th Annual Field Test, original caption – “Desert RATS crew member Dr. Jacob Bleacher works inside the Habitat Demonstration Unit (HDU). The habitat is used for engineering, medical and science testing”, available at http://www.nasa.gov/images/content/567087main_drats_2011science_hires.jpg.

Despite numerous anecdotal reports from habitat simulations and analog studies, research from social scientists and architects, and even acknowledgment from within the space industry, there is little evidence that the third level of habitability has been given serious consideration in the current generation of habitat design proposals. Most of them still emphasize efficiencies over optimization, likely because: 1) thresholds between minimum tolerances and optimal levels are not so easily assessed, and 2) it is easier to justify the need for adequate workspace or sufficient water supply, but harder to make the case from an economic perspective for the need for places of leisure and relaxation, or aesthetic experience. (One exception is the recent NASA-sponsored study on food and menu development for the three-year round-trip journey to Mars conducted by HI-SEAS on the Big Island of Hawai‘i.) The focus on mitigating the psychological and social stresses of spending long durations in space has been addressed almost exclusively from the perspective of crew selection and training, rather than on environmental factors (Binsted et al., 2010; Bishop et al. 2010; Dudley-Rowley et al., 2001 and 2002; Carrere et al., 1991; Gushin et al., 1999; Harrison et al., 1991; Shea et al., 2009; Suedfeld et al., 2009; Kanas et al., 2006).⁵ Integrating an architectural perspective could help remedy many psychosocial problems to a significant degree—especially those stemming from isolation and confinement. (Vogler and Jorgenson, 2004; Seguin, 2005; Harrison, 2010; Preiser, 1991). The neglect of espousing such an approach is at best a missed opportunity, but at worst a dangerous oversight.

III. A Phenomenological Approach

While physical requirements for survival are not only objective and quantifiable but also universal for all crew members (e.g., the percentage of oxygen needed in the air or the degree of air pressurization), the notion of well-being, in contrast, is highly subjective and cannot necessarily be empirically verified. For example, an interior space that provides sufficient privacy for one individual may be inadequate for a different individual. How much privacy a person needs to feel comfortable depends on several factors: gender, age, cultural norms, specific activity, and personal preference.

Moreover, a design approach that treats the environment (both the natural and the constructed) as a purely external, objective condition overlooks the way in which our surroundings are perceived and interpreted, as well as the role that our faculties of perception play in the process of adaptation. “A more comprehensive understanding recognizes that

⁴ Sian Proctor, Hawai‘i Space Exploration Analog and Simulation, HI-SEAS Habitat, *available at* <http://hi-seas.org/?p=1278>.

⁵ Given this neglect of environmental factors, it is ironic to note that there has been greater concern about the outward appearance of the habitat simulations—that they should look more like something associated with space travel than be reminiscent of anything on Earth—although the exterior is not a feature that the crew who will be living in the experimental habitat will experience on a regular basis. This mentality of stylization reduces the importance of architecture. While building iconography is symbolically and culturally important, stylistic imagery cannot be merely imposed, lest it become a ‘sci-fi’ caricature. Architectural identity can only emerge and evolve from the confluence of several factors, such as the technologies of that era, the response to the environment in which it is sited, prevailing cultural aesthetic values, and its historical context.

habitability is an interactive and subjective condition, that living environments are not just physical spaces with objects in them, but are places that have a temporal aspect by virtue of human presence, and are interpreted and experienced differently by each individual” (Lockard, 2014, pp. 34-35).

The actual physical character of an environment and how that physical environment is perceived are two separate issues that require different sets of responses (Dator, 2012). For example, standing in front of a bare window at night tends to make one feel uncomfortably exposed, whether that window overlooks a heavily populated city street or a remote, uninhabited forest; though the environmental characteristics are polarized opposites, they both elicit the same sensation of vulnerability. Conversely, a fortress could be experienced as a place of security by one person, but as a place of incarceration by another, depending on the occupant’s perspective. Therefore, when designing our living spaces it is imperative that both the subjective (perceived) and the objective (actual) characteristics of the environment be taken into account. Psychologist Peter Suedfeld also cites the importance of this distinction in his research:

Designers “should think in terms of experiences within environments rather than of environmental characteristics. The relations between environmental features and behavior must be studied in terms of interaction, not mainly effects. As several investigators have pointed out, the environment has no direct impact on human beings. Rather, it is filtered through their psychological and physiological information-processing systems. In consequence, the crucial determinant of the response is not an environment, but an experience, this being defined as the environment *and* its meaning to the individual. Researchers should, therefore, adopt some new ways to gain an understanding of environmental impact on people. The most obvious one is to measure not only how individuals behave in the environment but also how they perceive it” (Suedfeld, 1991, pp.137-138).

The acquisition of data is the rational and objective means by which we come to intellectually know the physical world around us; but it is through experience that we come to feel connected to our surroundings. Experience is by nature visceral in that, unlike information, it comes through the various sensory apparatus of the body; and it is also subjective in that empirical realities are filtered through the individual’s consciousness. Thus to understand how humans experience their surroundings, a phenomenological perspective—one which examines how values, history, and culture have bearing on how we perceive and interpret spatial phenomena—must be adopted. Though not crucial to immediate survival or even processes of physiological adaptation, establishing connectedness, belonging, familiarity, and empathy are essential to the longer-term processes of adaptation entailed by habitation. According to psychologist Abraham Maslow (1943), these are needs of a higher order that, while not perhaps necessary on a daily basis, are nevertheless indispensable in the long term in order for humans to feel both content and fulfilled (See Figure 5). This perspective addresses such aspects as the experience of beauty, developing an attachment to our surroundings, a sense of belonging and territory, how we ascribe meaning to the places we inhabit, and creating environments that nurture, fulfill, and give its occupants a sense of purpose. These aspects of human experience cannot be properly addressed by a purely rational approach. To meet those needs, strategies for psychological and social adaptation are required; however, higher order needs also require

conditions that go beyond those specified in current habitability models that at their most extensive, stipulate only conditions for comfort and well-being. As crews will foreseeably spend years in space—and eventually lifetimes or generations—a new level of adaptation must address our longevity and subsequent evolution.

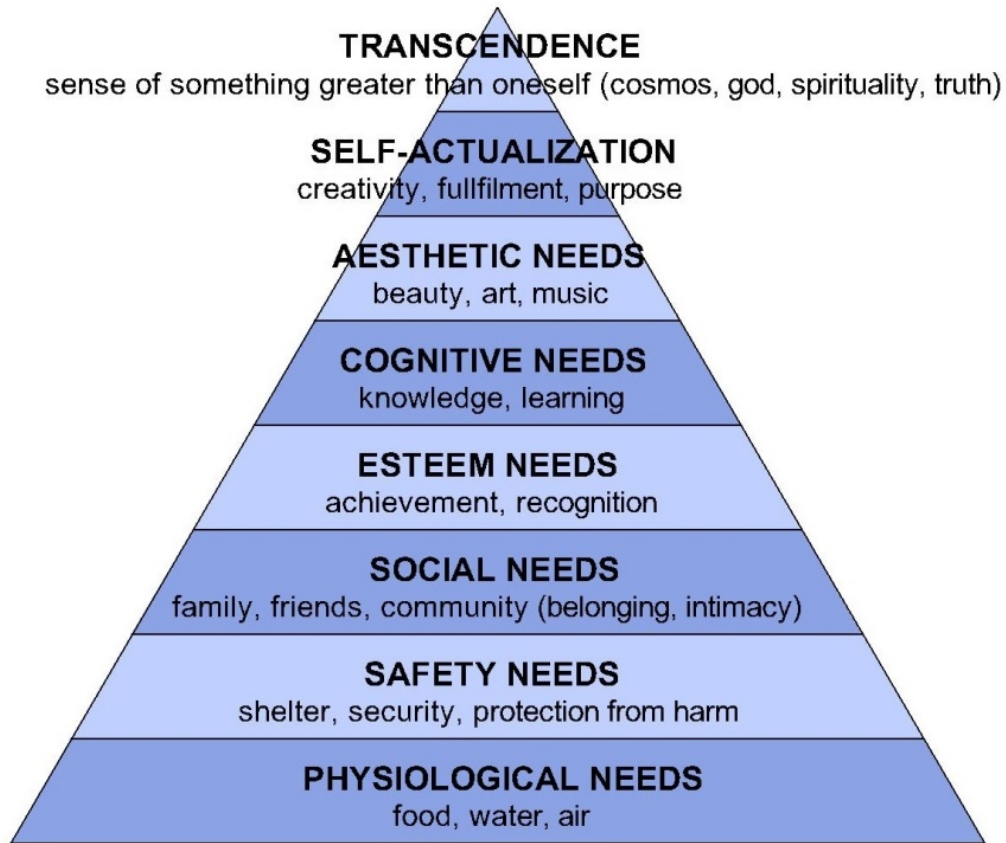


Figure 5: Maslow's Hierarchy of Needs⁶

To that end, a fourth level of habitability should be added to NASA's existing standard: one that speaks to how we adapt to our environments—not just physiologically and psychologically, but also evolutionally, as migrating to space will be the greatest catalyst for human transformation (Finney, 1986). The design features that must be cultivated in order to promote this level of adaptability should instill qualities of resilience, robustness, and durability—in short, what is required not just for habitability, but also for longevity once we have migrated beyond the protective atmosphere of Earth.

IV. Observations

What differentiates traits of a fourth level of habitability from those typically associated with habitability revolves around the degree of engagement. Well-being, comfort, and quality of life are generally passive conditions, which to some extent can be achieved through a shielding

⁶ Image by Elizabeth Song Lockard.

from the hazardous conditions of the environment. Conditions that promote evolutionary adaptability, on the other hand, require an active engagement and negotiation with the resistant elements of the environment. Adaptation, by its nature, cannot occur in circumstances void of stress or demands. Through confrontation with the physical surroundings and through overcoming obstacles, all living things “grow hardier and more capable; thus they are more likely to endure” (Lockard, 2014, p.39). This directive makes imperative the need to create negotiative mechanisms to encourage increased interaction with the physical environment which leads to greater familiarity, reduced feelings of alienation and hostility, and a sense of belonging (Lockard, 2005 and 2006; Gallagher, 2001). If we are truly thinking in the long-term—not just months and years, but lifetimes and generations in space—then we would be remiss not to consider the conditions that will help us develop the ability to endure, not just survive.

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STUDENT ESSAY

Space Travel as a Means for Re-Enchantment, Unification, and Spiritual Fulfillment

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ABSTRACT - The literature surrounding the topic of space travel acknowledges that the concepts of dis/re-enchantment and narcissism help to explain an individual's desire to travel to space, but the analysis does not delve deep enough into these ideas and tends to place too much emphasis on space travel as a negative experience. By expanding on Dickens' and Ormond's application of "re-enchantment to space travel" and by using Weber's theory of disenchantment, Freud's theory of narcissism, and phenomenological analyses of astronauts' experiences of space, this essay investigates whether the theory of disenchantment would encourage the individual to seek spiritual unity and re-enchantment through space travel. The emptying of the individual of any soteriological significance and the prominent presence of dualist ideologies of the cosmos and humanity provides insight into a longing for unification. However, this discussion argues that when this feeling of unification is achieved there still lays an inherent need to rationalize the experience. The conceptualization of "spiritual narcissism" contributes to the understanding of why one needs to explain this profound phenomenon and Erik Fromm's "two modes of being" elucidates the urge to possess the experience rather than accept it. The individual appears to have grown weary of the rationalized world we reside in and yearns for something that cannot be rationalized or theorized. This discussion found that the search for unity and enchantment can not only be considered an abandonment of theory, a rejection of dualities and secondary narcissism, but also as spiritual narcissism—an individualized attempt at identity formulation—as one attempts to possess the experience rather than simply accept it.

I. Introduction

Throughout the centuries, humans have shared a powerful relationship with the universe. The cosmos has set a context for major institutions such as religion. On an ontological level, cultures viewed the cosmos as a realm of spirits and divine entities. Ancient civilizations such as the Aztecs and the Mayans believed that the souls of their dead followed a path linked to the cosmic movement of the Sun (Nash, 2001). It was Zeno of Citium, the founder of Ancient Greek Stoicism, who expressed that everything is a component of the same system – namely, nature (Hadas, 1961). Similarly, the Ancient Egyptians perceived the cosmos to be comprised of the present world and the gods, and it was the role of the King to link their society to these Gods in the cosmos (Naydler, 1996). Historically, there appears to be no division between human society

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and Earth and the rest of the universe; instead, society seemed inherently integrated with the cosmos. To identify this connection, one simply need examine the roots of the Latin word for religion – *religare*, which translates into “to bind strongly” (Cicero in Sarah, 1912; Partridge 1958). Buddhism, Taoism, and Ancient Greek Stoicism are among the religions that embrace this connection by binding themselves to the cosmos and by leading a virtuous life in harmony with the universe (Hadas, 1961; Matthews, 2007; Hohne, 2009).

Although we still maintain a strong relationship with the universe today, mysticism and myth have largely given away to rational scientific understanding. Western society has become modernized, bureaucratized, and secularized – it is a place where knowledge is more valued than belief and has undergone a process of “disenchantment,” which is a term borrowed by Max Weber in *The Science of Vocation* (1919) from Friedrich Schiller (1974). We live in a society of rationality and logic; where acceptance is not sufficient; where the individual is challenged to rationalize even his or her inner life (Lasch, 1979); where the devaluation of mysticism weakens our natural connection with the cosmos; and where modern binaries promote dualist ideologies. The rational search for answers cannot answer existential questions related to the human connection to nature. The result is the lengthening of the spiritual separation between the universe and us, which science alone cannot accomplish (Jurgen, 1987).

This essay will explore whether the process of disenchantment evokes a longing in the individual to seek spiritual unity and re-enchantment. It will investigate whether fulfilling this longing through space travel is possible and aims to highlight the connection between re-enchantment and the individual’s desire for wonder, awe, and enchantment. The focus is on the argument that space travel is perceivable as a spiritual experience, not only for the narcissistic individual who seeks validation or self-affirmation (Lasch, 1979), but also for those who are weary of this rationalized world and simply want to ‘feel’ something that cannot be scientifically explained or theorized. Perhaps this is why the narcissist would want to go to space, selfishly seeking affirmation and personal gain. Additionally, this argument will further examine whether the quest for re-enchantment and unity through space travel could be a manifestation of narcissism, using Freud’s (1913) theory of primary and secondary narcissism and the concept of *spiritual narcissism*, a term developed from spiritual materialism (Ferrer, 2002; Lahood, 2010).

In evaluating these concepts and their implications on space travel, identifying what type of individuals want to go to space, analyzing people’s experiences of outer space travel, and developing upon arguments already proposed by theorists within and without this field of study, this essay aspires to interpret whether the individual could achieve *re-enchantment* and *unification*, being the unity between humanity and absolutely everything else in the cosmos, through space travel. Definitions of these latter two major concepts follow below.

II. Spiritual vs. Rational Society

Friedrich Schiller (1759-1805) wrote about the ‘de-divinization’ of the world. His concept of the de-divinization of the world in one sense indicates that our world cannot identify with, nor is a part of God or any other divine entity; and in another sense, at its most extreme, it means there are no longer traces of God in the world. Weber considered the concept of disenchantment to be a result of scientific progress and de-sacralization (or secularization) and applied it to modernized, bureaucratized and secularized Western society. This scientific

progress, he thought, was becoming more valued than faith or belief, with a particular emphasis on rationalization. He argued that feelings of disenchantment would steadily grow as scientific thinking increased. Central to this concept is the notion of de-sacralization, a mediation of salvation (Weber, 1930, p. 20). Although Weber did not discuss his theory of disenchantment in *The Protestant Work Ethic and the Spirit of Capitalism*, the secularization of the West was deliberated upon at length, which is paramount to the disenchantment of the world. This rejection of sacrament was aroused when institutions that encouraged collective identities by channeling spiritual belief into rituals came under threat and diminished in popularity.

For Weber, this transposition of values from the spiritual sphere to the secular sphere would lead to the devaluation of spirituality where one seeks rationality in life. Our trust in the rationalization of the world has sustained this transposition, as it “distinguishes the formal rationality of the economic, legal and bureaucratic systems which subsume decisions under general rules and so allow [the individual] to calculate the likelihood of a particular outcome” (Carroll, 2011, p. 118). With this reliance on scientific understandings and rationality, our belief in anything that one cannot rationalize disappears, which deprives the individual of any soteriological significance. That is, the individual no longer strives for salvation or religious redemption, and rationalization takes hold even in one’s inner life. The consequence of this is the dualist separation between human spirituality and nature/the universe. Dualism means that the universe can no longer mediate human spirituality and human action in compliance with spirituality.

Hegel, an 18th century German philosopher (cited in Russon, 1993, p. 72), argues that rationality and rationalized ideas of the self-indicate a dualism of “reason and nature, of inner and outer, of identity and difference”. This form of dualism posits the self and body as an independent existence from nature and thus the universe. In the context of space travel, the words “inner” and “outer” space implies a disconnection between the humanity and the cosmos, respectively. It therefore widens the separation between the observer and the observed and deteriorates the monist ideal of the cosmos and us as one entity. These dualist ideologies are inherently rooted in us and expressed even in our language.

In *Against Method*, Feyerabend (1975, p. 22) questions whether scientific rationalization is truly capable of explaining the complexities of life and argues that its epistemology has been defied time after time again. That is, science has been disproved countless times in the sense that when something is discovered the previous knowledge we held as truth is practically thrown out the window. Paradigms shift. Similarly, Polanyi (1946) argues that the scientific method cannot produce truth unchangeably. Scientific rationalization ultimately advances to more rigidity, “to a new, masked form of dogmatism that is the enemy of human freedom, spontaneity and creativity” (Bernstein, 1983, p. 5). This raises the idea that space travel may appeal to disenchanted individuals for whom rationalization and analyses have become too overwhelming without providing any consolable explanations and perhaps it would allow this sort of individual to regain the feelings of “freedom, spontaneity and creativity” that Bernstein believes we have lost. If it is true that both the scientist and mystic seek unity with both humanity and the cosmos through space travel, then perhaps the very search for unification is caused by a sense of separation due to one’s binary thought process, a separation between oneself as the observer and the world as the observed. “A human being is part of the whole called by us universe, a part limited in time and space. We experience thoughts, our feelings, and ourselves as something

separate from the rest” (Einstein in Rad, 2010, p. 41). This separation and the dualist ideologies of scientists are reflected by their methods and hypotheses and it seems as though they view themselves and the universe as two separate entities, which is where the problem may lie. By supplementing the scientific image with spirituality and promoting the notion that unification is achievable through space travel, it may be possible to overcome disenchantment. However, the question arises: what can fuel this lust for enchantment and unity if not the rationalization of modern society?

III. Re-Enchantment

In recent years, contemporary theorists have discussed that disenchantment can cause an individual to try to regain a sense of awe in their lives, challenging Weber’s paradigm by a process of “re-enchantment.” One may view re-enchantment as a measure to recover myth, awe, and a sense of wholeness (Berman, 1981). The urge to fill the vacuum that disenchantment may have caused may take form in one opting to find solace beyond the material, explainable or visible world. Gellner (1992) argued that many people cannot endure a disenchanted world and therefore opted for what he called “re-enchantment creeds” (Malesevic, 2007, p. 262). Scientific rationalization may well be important for the development of the cosmos, in terms of space exploration and related endeavors. However, when reviewing the responses into why an individual would want to travel to space, the answer most likely heard is not scientific but emotional (Thomas & Island, 2007). There is a desire to feel something and to wonder about space: “I want to look at the stars, I don’t want to study astrophysics” (Thomas & Island, 2007, para. 1). This leads to the following question: could space travel be another “re-enchanting creed”? Dickens and Ormrod (2007, p. 133) acknowledge that the individual may seek re-enchantment through space travel, but their analysis does not delve deep enough into what this enchantment is, and there seems to be too much emphasis placed on space as a tourist destination.

IV. Seeking Spiritualism in a Rational World

Throughout history, humans have been trying to achieve unity through religion, psychoactive drugs, meditation, and so on, and it appears there is no exception to this in our contemporary society. For example, sociologist Robert Bellah (1976, p. 347) expressed that the “countercultural criticism of American society is related to the belief in non-dualism.” It is apparent that many of us seek unity and yearn for “awe,” this is reflected in the large percentage of spiritual/religious people worldwide, the quest for world peace (Jacobs et al, 2014), and the popularity of awe-inspiring movies, books, and television programs, and this search may intrinsically relate to the search of re-enchantment.

“Space, Science and Spirituality” is the title of a two-year project conducted between 2011 and 2013 at the University of Florida. The project consists of a group of scientists, philosophers and scholars in the humanities who collectively investigate the “effects of outer space travel on the inner space of experience.” The following definitions of ‘awe’ and ‘wonder’ are taken directly from surveys conducted on astronaut’s experiences of outer space travel as a part of this project. They express ‘awe’ as a “direct and initial feeling when faced with something incomprehensible or sublime” and ‘wonder’ as a “reflective feeling one has when

unable to put things back into a familiar conceptual framework” (Space, Science and Spirituality Project). These definitions of the experiences of astronauts, coupled with phenomenological and thematic analyses of such, indicate they underwent perspectival change, overwhelming feelings of humility, awe and wonder, and a sense of external unity and contentment.

Definitions of “awe” and “wonder” were taken from surveys on astronauts’ experiences in space, which describes that they experienced perspectival change. For example, before traveling to space, Apollo 14 Astronaut Dr. Edgar Mitchell had settled on the idea that every planet, star, and object in the cosmos was distinct and separate. However, when he arrived in space, he *felt* something, though schematization was not possible. He felt the Sun, the Earth, and his relationship to them all, without boundaries and distinctions. He described what he felt as an “ecstasy of unity” (Carrano, 2009, p. 279). After returning to Earth, Mitchell would consult theologians, philosophers, and scientists in order to explain what he had encountered in space. He even went on to found the Noetic Institute so that he could bestow his experiences upon other people in hope of benefiting society (Mitchell & Williams, 1996).

V. Unification

One may describe this sense of unification with the universe as something incomprehensible and sublime. It certainly cannot fit into any existing framework, as non-dualism is a primordial, organic consciousness without subject or object (Katz, 2007, p. 3-14). Moreover, attempting to categorize a sense of unity into a theoretical framework requires recognition of an object, which implies a duality between the object and the subject. After all, the argument here is that the search for unification results from a sense of separation brought about by dualist ideologies and binary modes of thinking. This “ecstasy of unity” runs parallel to what Abraham Maslow (1976, p. 6-16) deemed ‘peak experiences’. These are mystical experiences of egoless amalgamation with the world. They are experiences of wholeness and integration in which the individual existed effortlessly in the here and now.

Both these peak experiences and experiences of unity are comparable to ideas inherent in East Asian religions such as Confucianism and ideas such as Zen. These experiences of unity hold no definitions of the world or distinctions between us and the cosmos, and assumedly neither do feelings of enchantment, as its adversary, i.e., disenchantment, is a consequence of rationalization. In *Ideas and Opinions*, Einstein wrote that “The true value of a human being is determined by the measure and the sense in which he has attained liberation from the self” (Einstein, 1954, p. 12). Therefore, one may view enchantment through unification as an abandonment of one’s identity, self, and ego, and as an appreciation of a unified existence.

A notion incredibly similar to the ‘ecstasy of unity’ is the concept of the ‘Overview Effect’, which is a term formulated by Frank White (1987) in his book *The Overview Effect – Space Exploration and Human Evolution*. White’s interest lies with the experiences astronauts encounter when looking upon the Earth from space, which has been described as a cognitive shift in one’s awareness (White, 1987). Astronauts have claimed that during this time, the conflicts that divide our society vanish, boundaries disappear, and there is an inherent urge to create a unified planetary existence. They also claim to possess a new appreciation for the preciousness and size of our planet and a will to protect this ‘pale blue dot’ (Sagan, 1994) becomes clear and critical.

Flight experience has spiritually transformed an increasing number of astronauts, and reports indicate that this change in attitude often remains long after they return to Earth. Rusty Schweickart, Chris Hadfield, Mike Massimino, and Tom Jones are among the astronauts said to have experienced the effect (Sato, 2008). In recent years, space psychologists commenced research upon the salutogenic aspects of space flight (Suedfeld, 2005), that is, focusing on the benefits that arise from stressful or somewhat negative experiences during space programs. Suedfeld et al. (2010) investigated the memoirs of 125 space travelers and found that from stressful and somewhat negative experiences in space, these individuals developed greater levels of appreciation for others and nature, enhanced spirituality and power over that spirituality, and enhanced personal strength. This finding indicates that space travel has the potential to foster enlightenment and unification.

Scientific discoveries have painted a picture of an infinite universe with the potential for endless discoveries and countless possibilities, and this potentially arouses enchantment and awe. However, does this re-enchantment serve as a prelude to, or even a manifestation of, narcissism? It is not dismissible, as Christopher Lasch (1991, p. 13-15) recognizes a rising level of self-awareness, self-identity, self-reflexivity, and celebrity status and acclamation in today's society. The concept of narcissism that Lasch is referring to is not the same as the definition in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), although they do share characteristics. Instead, the focus here is upon Lasch's idea of the narcissist in an ever-growing capitalist society. Among incessant self-awareness, reflexivity and self-affirmation, the narcissist tends to seek meaning in every aspect of their lives, their cravings have no limits and they never seem to be satisfied. This implies that the search for unification may well be the narcissist seeking self-fulfillment, that it is superficial rather than spiritual and may just be another thing they want to attain. Similarly, Dickens and Ormrod "have argued that members of the pro-space movement exhibit a form of adult narcissism" (Ormrod, 2007; Dickens & Ormrod, 2007, p. 137).

Space travel, capital, and industry could be viewed as an attempt to regain feelings of omnipotence similar to that felt at the stage of primary narcissism whereby the mother and the rest of the world is seen as an extension of the infant's self, so he therefore mistakes this dependence on his mother as his own supremacy (Freud, 1973). Dickens and Ormrod (2007, p. 138) make comparable links between experiencing space and primary narcissism, e.g., the feeling of weightlessness in space is similar to the feeling experienced in the womb and argues the journey to space is a representation of a universal urge to detach themselves from the mother.

The emergence of new technologies such as the Hubble telescope, satellite technology, nanotechnology and other advancements have triggered a cosmological vision in which human recognition and intelligence are central to the development of the cosmos. In this sense, our understanding of the universe constitutes the absolute truth of what is "out there;" but if scientific knowledge of the universe has taught us anything, it is that we are certainly not omnipotent and the cosmos is in possession of forces much more powerful than we are. It is for this reason that Dickens' and Ormrod's (2001, p. 138) idea that space-travel "denies the break from primary narcissism," is being argued against here because the separation and the diminishment of omnipotence has already taken place when astronauts leave Earth.

Instead, one may better understand the quest for enchantment and unity through space travel as a stage of *secondary narcissism*, whereby the individual attempts to annul the pain of disappointed love (our separation from the mother/universe), to abolish our lack of control and

redirects this love back to themselves rather than external objects. Dickens and Ormrod (p. 136) provide an example of astronaut Russell Schweickart in which he claims he viewed his “mother” (the Earth) very differently when he was in the womb and that he was more equipped to take responsibility for her when he travelled to space and returned. This statement communicates that traveling to space embodies a process where one acknowledges the mother as an independent being, an entity for whom they feel a responsibility, thus redirecting this responsibility onto the self. The need to protect this “pale blue dot” (Sagan, 1994, p. 7) could also be viewed as secondary narcissism, as the adolescent may be trying to rectify feelings of separation and disappointment experienced at the break of primary narcissism. Lasch (1979, p. 34) argues that every society tries to solve the universal trauma of separation from the mother and the fear of abandonment, which is in hindsight exacerbated by scientific understandings and rationalization. This attempt to solve this trauma may be through social conformity, or according to Lasch, through pathological illnesses (i.e. narcissism). However, he argues that each individual will do this uniquely, and space travel could well be one of the ways to resolve this issue.

VI. Space Travel and Spirituality

According to Sussex Universities’ Mass Observation (MO) data, that is open-ended questions designed to encourage participants to write about their opinions, experiences and observations regarding space travel (Dickens & Ormrod, 2007, p. 9), space travel seems less appealing to the elderly, women, and individuals in working-class occupations. The trip seems most agreeable to middle-aged men in professional occupations. This indicates, as Dickens and Ormrod (2007, p. 139) recognize, that space travel does indeed appeal to those parts of the culture of narcissism consisting primarily of middle-aged professional men according to Lasch (1979). However, what does it tell us of the individuals who do not favor space travel? Ecofeminism, a term coined by Françoise d’Eaubonne (1974, p. 274), supports the idea that women are more mystically connected to the universe and believe this unification stems from the affiliation between lunar cycles and menstruation, childbirth, creation, and so on. A survey conducted by Live Science of 35,000 U.S. adult women revealed that they are more religious/spiritual than men and it appears that “older people...have always been more religious than the young” (Davie and Vincent, 1998, p. 101). Does this signify that these people may be more enchanted, spiritually fulfilled, and unified? The likelihood of middle-aged men traveling to space due to re-enchantment is high due to their disenchanting backgrounds. As discussed above, one could perceive re-enchantment as stages of narcissism. Dickens and Ormrod (2007, p. 130) acknowledge that we are not all narcissists on a quest for a sense of self. However, producers of outer space commodities are assuredly noticing narcissistic tendencies among consumers resulting in the marketing of space travel as a life changing and ultimate spiritual experience. For example, an advertisement put forward by Space Adventures Ltd. allure the narcissist into enjoying “the feeling of weightlessness... to earn the respect and admiration of your colleagues and home nation and to achieve worldwide celebrity status” (Dickens & Ormrod, 2007, p. 135).

Traditionally, the definition of spirituality has encompassed a practice of personal transcendence, which conforms to religious beliefs. However, it now generally implies something separate from religion. Fuller’s (2001) implication is that spirituality now includes not simply just emotions, but method, action, community, and discipline. In other words, spirituality

is not a construction or a concept; rather, it is an experience. It is a connection with something profound outside of ourselves. It transforms how we act, think, and feel. Practices in spirituality tend to become narcissistic when the ego-self, or an egotistical version of self, is at the center of the process by assuming it is the object of the narcissistic fulfillment of the self. If self-fulfillment through unification with the cosmos becomes the main ambition of space travel, then this unity becomes something to be possessed rather than experienced. It transforms itself into something to attain, much like wealth or status. This egocentric spirituality combined with “individual competitiveness and consumer capitalism” results in what is called “spiritual narcissism” (Ferrer, 2002, p. 36). The achieved and then exclaimed unification could now be perceived as a bloated spiritual persona, one that claims to be further established, advanced and evolved.

This leads to an important question. Is unification something we seek to possess in order to promote a grandiose self, or do we seek it to be a part of something? Fromm (1976) addresses this desire to possess unification (p. 57-70) and this desire to be a part of something (p. 70-87). He refers to this as the two modes of being. He begins by quoting two poems involving the relationship with an individual and a flower. In the first poem, British poet Tennyson (Fromm, 1976, p. 14) sees the flower, admires its existence and then picks it so he may take it home for himself, but in the process, he evidently kills the flower. In contrast, the Japanese haiku writer Basho (Fromm, 1976, p. 14) recognizes not only the flower’s existence but also his unity with it, therefore leaving it as he first found it. This acceptance of being where “one neither has anything nor craves to have something, but is joyous, employs one’s faculties productively, is made one with the world” (Fromm, 1976, p. 16), runs parallel to the unification felt through space travel.

However, the individual still does not seem to be satisfied with a ‘mere’ experience of unity, the experience must be exclaimed and is “consumed and brought back into one unified being with the self” (Dickens & Ormrod, 2007, p. 138). Astronaut Edgar Mitchell exemplifies this in his attempts to rationalize his “ecstasy of unity” through scientific, religious, and philosophical theorization. If unification is possible through space travel, are we truly capable of experiencing it due to our rationalized mindset and our incessant need to seek the truth by dissecting life? Or does our egocentrism indicate that the quest for unity is a product of spiritual narcissism? Johnson (1976, p. 42) would dispute that unification is feasible at all, if “each individual is urged to pursue a personal state of ecstasy” separately. Furthermore, if the importance of unification may be subject to question, one must look at the benefits it would have to the entirety of the world. Division causes conflict, and conflict causes strife. The division of the world is responsible for countless negative ailments upon our planet and its inhabitants (e.g., war, the degradation of our environment, and religious conflict). Additionally, to consider the benefits they have attained from this, one can simply look at those who have achieved this unification, such as Buddhist monks and astronauts who have experienced the ecstasy of unity.

To truly experience this unity, the concept of an ego and self must be abandoned as it implies a distinct dualism between the cosmos and us, and it is possible that this very dualist ideology fuelled the process of disenchantment. Thus, when the individual does ‘experience’ unification, the search for unity is no longer there, nor is the seeker there in a very fundamental sense. That is, based on Katz’s (2007) concept of non-dualism, there cannot be any separation between the observed and the observer, so when achieved it results in an amalgamation of both, without subject or object, rather than an awareness of a specific achievement.

VII. Conclusion

Humans have always held a curiosity towards the cosmos and, as previously argued, have felt inherently connected to the universe. Moreover, although today we live in a highly rationalized society, a sense of mysticism permeates through human thought and identity. The importance of technology, rationality, and logic in late modernity highlights a society in which scientific understanding is more highly valued than belief – factual knowledge triumphs mysticism and imagination, and Weber’s concept of disenchantment is more applicable to our modern day than ever before.

The concept of disenchantment illuminates our feelings of separation with the universe, and the binary perspectives from which we view the cosmos unmistakably widens this separation and creates a sense of dualism. The mundane, bureaucratized world we reside in may inspire a quest for re-enchantment, and space travel could be a considerably important outlet for an individual to experience a sense of wonder and awe, and to regain a feeling of unity. This quest for enchantment could well be elucidated through secondary narcissism, but new-age religions as well as thematic and phenomenological analyses of astronaut’s experiences of space strengthen an overall sense of a desire for unity, particularly because of the emphasis on ‘feeling’ and acceptance rather than understanding. However, the scientific community is not satisfied with a mere “experience of unity”, but seeks unification in theory and some theorists question whether an experience of unity can exist at all. Nevertheless, science and unification can be compatible if one takes on a paradigm of new quantum theories, which allows paradoxically for both to be valid.

This discussion has attempted to shed some light on the desire for a sense of enchantment. Freud’s notion of primary and secondary narcissism is useful in understanding the individual’s longing for unification and connectedness, and Lasch’s utilization of this concept to the development of capitalism certainly supplies some insight into the individual’s aspiration to yearn for more. The idea proposed in this argument, that the individual has simply grown weary of the rationalized world we live in and craves something that is not scientifically understandable, is not an outlandish one. The human race has been trying to achieve unification and enchantment for centuries through a variety of means such as religion, meditation, and hallucinogens; and now space travel could possibly be another means to achieve this state of being. However the chase for unity and enchantment can not only be viewed as an abandonment of theorization, secondary narcissism and omnipotence, but also as spiritual narcissism – an ego-centered quest for identity – as one tries to possess the experience rather than accept it.

Studying and promoting these feelings of unity experienced in outer space outside of spacefarer’s traditional contexts (such as religious institutions) has the potential to revolutionize human practice by making these experiences and their values the ultimate goals of our society, in turn transforming it to become one with nature and therefore the entire cosmos. If people believed that unification with the universe is achievable and that institutional and personal boundaries could be demolished, then there may be fewer conflicts between religious and other societal groups. Perhaps the answer lies in shedding one’s identity, in changing our perspective of how we experience the cosmos, or in spirituality, defined by Evans as a “basic transformative process in which we uncover and let go of our narcissism so as to surrender into the mystery out of which everything continually arises” (Evans, 1993, p. 4). In any case, it would require significant social and cultural change; that is, increased movement toward a spacefaring society

(Pass & Harrison, 2007). Space must become more relevant and significant to the lives of citizens in terrestrial societies before people can widely internalize the cosmos as part of an individual's self-identity. Only then, can humanity limit disenchantment and thereby make unification and re-enchantment with the universe possible through space travel.

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ABOUT THE ASTROSOCIOLOGY RESEARCH INSTITUTE

The Astrosociology Research Institute (ARI) is a registered 501(c)(3) organization and California nonprofit public benefit educational corporation dedicated to the development of astrosociology as a multidisciplinary academic field consisting of the social and behavioral sciences, humanities, and the arts. Astrosociology is defined as the study of astrosocial phenomena (i.e., social, cultural, and behavioral patterns related to outer space). ARI seeks to build and foster cutting-edge astrosociological research, support the development of astrosociology into academia, and provide students interested in astrosociology with opportunities to contribute to the study of astrosocial phenomena. ARI's development of astrosociology serves to unite interested theoreticians, researchers, scholars, and students together so they may more easily collaborate on space issues from a broad social-scientific perspective that is, a concentration on the human dimension. Moreover, the Astrosociology Research Institute is not a space advocacy group. Rather, ARI dedicates itself to conducting science and to helping others do the same so that we may all construct a coherent astrosociological body of knowledge and related literature, and place the field of astrosociology into academia as a permanent fixture.

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INSTRUCTIONS FOR AUTHORS

The Journal of Astrosociology is the first academic journal dedicated to the study of the two-way relationship between human society and the outer space environment. The journal seeks to promote research into *astrosocial phenomena*, i.e., social, cultural, and behavioral patterns related to outer space. The journal seeks to publish inter- and multi-disciplinary research, as well as essays that fall into the sphere of astrosociology (see **Suggested Topics**). The journal also accepts book reviews that relate to astrosociological topics as well as space and society issues.

Submission of Manuscripts

Authors are requested to email their manuscripts to the Editor-in-Chief at joa@astrosociology.org. Manuscripts must be drafted using a MS Word readable format, e.g., .doc or .docx. Authors are responsible for ensuring that their manuscripts conform to the journal's formatting and citation requirements. *Please do not send PDF copies for review or previously published manuscripts.* However, the journal will consider publishing conference papers provided the Author has retained sole copyright in the manuscript. It is the policy of *The Journal of Astrosociology* not to publish previous works, but the Editor-in-Chief retains the discretion to make reasoned exceptions in consultation with copyright holders. If an Author desires to publish a conference paper, please acknowledge in the correspondence with the Editor-in-Chief that the paper has been previously published and state the person or institution that retains copyright. In addition, if the manuscript is under consideration with another publication or journal, please inform the Editor-in-Chief when submitting the manuscript. Failure to notify the Editor-in-Chief of a manuscript's previous publication or consideration by another journal or copyright status shall be considered a potential breach of contract with the Astrosociology Research Institute and may result in denial of publication.

When submitting your manuscript, please provide your name, affiliation, contact address, phone number, and names and emails of all co-Authors. If material is translated from another language into English, please provide the name of the translator. Please note that *The Journal of Astrosociology* does not provide translation services, but is willing to assist Authors who wish to publish in a language other than English.

Student Submissions

Students currently enrolled in a full- or part-time program of study can be published with the journal provided a submitted manuscript meets editorial standards. *The Journal of Astrosociology* is dedicated to assisting students who wish to engage in astrosociological theory and research. To that end, the journal will dedicate exclusive space in the journal to students. Students are encouraged to publish with the journal and the editorial staff will assist students to the greatest extent possible to get their work published. The journal will accept any original research, essay, or class paper for publication. Students are also encouraged to submit book reviews. If you are a student and wish to publish with the journal, please contact the Editor-in-Chief directly at joa@astrosociology.org. Include in the subject line of the email "Student Submission" and include in the body of the email your abstract, contact info, program of study, graduation year, and attach your manuscript as a Microsoft Word readable document.

Editorial Procedures

The Editor-in-Chief makes the final decision on publication of submitted manuscripts. To determine whether a submitted manuscript meets the standards for publication, each manuscript (except **book reviews**) undergoes a blind peer review conducted by members of the Editorial Board. Members of the Editorial Board shall conduct an objective and anonymous review of manuscripts submitted to them by the Editor-in-Chief. Once the Editorial Board provides a recommendation to the Editor-in-Chief regarding publication, a manuscript is managed by the journal's editorial staff. The editorial staff will review each manuscript to ensure that it meets the journal's editorial standards, as well as the relevant aims and goals of *The Journal of Astrosociology*. The Editorial Board and editorial staff will review a manuscript for analytical rigor, spelling, grammar, style, length, and relevance to the field of astrosociology. The Editor-in-Chief, upon recommendation from the editorial staff, may require an Author to make reasonable changes and corrections as appropriate. An Author's failure to agree to reasonable changes could result in delayed publication. All disputes between an Author and the editorial staff shall be resolved by the Editor-in-Chief and conducted in good faith.

Once the Editorial Board has provided a recommendation for publication, the Editor-in-Chief will designate the manuscript provisionally accepted. At that time, the Editor-in-Chief will require the Author to sign, date, and return a license to publish with *The Journal of Astrosociology*. The license to publish forms a contractual relationship between the Astrosociology Research Institute and the Author that binds the Author to publication with the journal. Once the Editor-in-Chief receives an Author's license to publish, the editorial staff will begin the editing process and periodically keep the Author informed of the status of the manuscript and citation review. Following the editorial review, the Editor-in-Chief will transmit the final edited copy back to the Author for approval prior to publication. Publication of the final reviewed manuscript will occur after Author approval. However, the Editor-in-Chief reserves the right to withhold publication for suspicion of plagiarism, mischaracterization, or misrepresentation of material, unethical behavior by the Author, use of potentially libelous statements, substandard grammar and analytical rigor, failure to obtain a license or waiver to publish copyrighted material, or discovery of past publication. In addition, the Editor-in-Chief also reserves the right to hold a manuscript over for publication in a subsequent issue. However, the Editor-in-Chief will first consult with an Author to ensure the decision does not prejudice the Author.

Submission Types and Standards

The Journal of Astrosociology accepts three types of manuscripts: **articles**, **essays**, and **book reviews**. Criteria for each are as follows:

- **Articles** are submissions between approximately ten thousand (10,000) and twenty thousand (20,000) words of original research
- **Essays** are submissions generally under ten thousand (10,000) words that advocate a viewpoint or normative position

- **Book Reviews** may not exceed three thousand (3,000) words consisting of an objective critique of another Author's work.

An Author may seek a waiver on a manuscript's word limit upon a timely petition to the Editor-in-Chief. The Editor-in-Chief will weigh the recommendation of the editorial staff against the Author's argument for the page limit waiver.

Formatting

Articles, essays, and book reviews must be formatted according to the journal's standards. A person who submits a manuscript to the journal must ensure that it conforms to **general formatting** standards and **specific formatting** standards for their submission type. Editors will not retype manuscripts that do not conform to the journal's standards. Failure to properly format a manuscript using the journal's standards will result in a publication delay and/or withholding from publication until the manuscript conforms to formatting requirements.

General formatting requirements include:

- Double Spacing
- Text in 12-point Calibri font
- One-inch (1"/2.5 cm) margins
- Submission Title, Name(s) of Author(s), and Affiliation(s) of the Author(s)
- Titled section breaks including an introduction and conclusion(s)/recommendation(s) sections. For each new section, provide a title for the section and use roman numerals (I, II, III, IV, ...) in consecutive order starting at "I" for the introduction section
- A zero footnote with contact information of the Author(s) such as email or institutional address and, if desired, acknowledgements
- Every page numbered at the top, right-hand corner starting with the number "1" and numbered consecutively
- Footnotes (*see* **Publication Integrity and Citations**).

Specific formatting requirements include:

- **Articles and Essays**
 - An abstract limited to no more than three hundred (300) words
 - If applicable, Appendices ordered using arabic numerals (1, 2, 3, ...)
 - If applicable, figures (*see* **Figure Formatting**) with appropriate labels or captions
- **Book Reviews**
 - Name of the Book Reviewed
 - Where applicable, Name(s) of Book Author(s) or Editor(s), and/or Translator(s)
 - Name of Publisher and Year of Publication
 - Number of Book Pages
 - Retail Price of Book

Figure Formatting

An Author may include a figure, e.g., picture, graph, table, map, diagram, and/or chart, which supports any premise or thesis, illustrates an example, or provides essential data in the manuscript. If an Author embeds a figure into his/her manuscript, s/he must attach a standalone copy of each properly labeled figure along with the manuscript when submitting to the Editor-in-Chief for publication consideration. Within the manuscript, each figure must be clearly labeled, consecutively numbered starting with the number one (1), and given an appropriate caption that succinctly describes the figure and its relevance to the material presented in the manuscript. Finally, each figure must appear on the page that first references the figure along with a proper corresponding reference in the manuscript text.

Any figure considered an image, e.g., a picture, map, drawing, or diagram, should be formatted as an uncompressed *.jpeg* file. All other figures should be formatted as a separate Microsoft Word, Microsoft Excel, or Rich text Format file. Figures must not be tinted or photo-shopped from its original format. All digital files should be in *300 dpi or greater* resolution and sized no larger than *4 x 7 inches*.

All figures must either be the original work of the Author or an Author must obtain a license or waiver to publish copyrighted material or must notify the Editor-in-Chief that the figure is fair use material (*see Legal Notice and Policy*).

Publication Integrity and Citations

The Journal of Astrosociology is dedicated to publishing high-quality, original manuscripts that cover theory, research, literature review, or normative essay. To that end, manuscripts submitted for publication undergo a blind peer-review conducted by preeminent and scholarly members of the Editorial Board. In addition, the journal uses CrossCheck™ to ensure that manuscripts are devoid of unoriginal material, if warranted. All Authors who submit a manuscript for publication agree to these necessary originality reviews so that the journal can maintain its status as a leader and publisher of astrosociological-based research and thought. Any Author found in violation of this covenant will have his/her manuscript removed from publication. An Author found in violation of this covenant through clear and convincing evidence will be prevented from future publication in the journal. The Editor-in-Chief also reserves the right to publish a notice regarding an Author's violation of this covenant in a subsequent issue of the journal.

Because of the inter- and multi-disciplinary nature of the journal, an Author is permitted to select *one* method of citation from the list below that covers most scholarly fields. The journal will accept the following citation systems for use in a manuscript:

- The Bluebook
- Association of Legal Writing Directors (ALWD)
- Canadian Guide to Uniform Legal Citation
- Modern Language Association (MLA)
- American Psychological Association (APA)

- The Chicago Manual of Style
- Turabian Style
- American Political Science Association
- American Anthropological Association
- American Sociological Association
- American Institute of Physics
- Institute of Electrical and Electronics Engrs. (IEEE)

All references should be in footnote format and numbered consecutively with corresponding superscripts in the body of the manuscript, except where provided as part of the rules of a particular citation system (e.g., embedded citations in APA and ASA). Do not use endnotes, scientific notation, or bibliographical references as citations. *Use only one of the above citation methods for references.*

SUGGESTED TOPICS

Acceptable Topics for The Journal of Astrosociology

The Journal of Astrosociology is the official journal of the Astrosociology Research Institute and the primary resource for astrosociological theory and research. The unique approach expected for contributions to this journal involves a specific reference to *astrosocial phenomena*. It is this focus on the human dimension of space, i.e., the relationship between space and humanity, which sets astrosociology apart from other approaches. Contributors are asked to incorporate the field of astrosociology into their research and focus in some recognizable fashion on *astrosocial phenomena*. To assist Authors, the Astrosociological Research Institute offers free access to astrosociological resources in our Virtual Library (<http://astrosociology.org/vlibrary.html>).

The major acceptable topics, discussions, and related questions to be addressed for journal manuscripts and other submissions are listed below. The questions and statements below are only examples to stimulate ideas among our potential contributors and many aspects of each can be combined into a single approach or discussion.

1) Definition of Astrosociology

Discussion: The baseline definition of astrosociology – that is, the scientific study of *astrosocial phenomena*, or the social, cultural, and behavioral patterns related to outer space – serves as a fundamental starting point. Defining the human dimension of space exploration, settlement, and resource exploitation, which involves the two-way relationship between humankind and space, is a critical area of scientific investigation. Suggested research questions/issues include:

- What does the astrosociological approach, based on the definition above, contribute to traditional approaches in the space community?
- How does the approach of astrosociology as a multidisciplinary academic field affect the development of the definition and the field itself?
- In what ways can the base definition of astrosociology be modified? How would such modifications improve astrosociological investigation?

2) Astrosociological Education

Discussion: The various issues covering astrosociology in the classroom are of great importance to the development of the field. The educational process is critical for informing professionals in the space community as well as younger students about astrosociological issues and how the social sciences can provide original contributions to human space exploration and related substantive areas. Studies that cover the impact of space in the social and behavioral sciences, humanities, and the arts in the classroom are of significant interest for present and future human society. Alternatively, non-classroom based outreach is also an important method to help educate and is of particular interest to the journal. Suggested research questions/issues include:

- What are the various possible educational models? How do they work, and what are their benefits and disadvantages?
- What are some ideas regarding a workshop for existing professionals and the ramifications of developing an astrosociological community?
- Why is integrating astrosociology into existing programs and courses as an intermediate goal a cornerstone of the development process?
- What are the potential student roles in astrosociology education and the field development process?
- How might one establish astrosociology courses, programs, curricula, and departments, including actual efforts and plans for implementation?
- How might one recruit high school and college students to pursue astrosociology?
- What types of methods do/can educators use or have used that incorporate(s) STEM education with the social sciences? How important is it to teach both aspects to students?

3) **Theoretical Astrosociology**

Discussion: Like any academic field, astrosociology progresses through the interaction between theory and research. The development of astrosociology requires the construction and sharing (for testing) of conceptualizations that focus on *astrosocial phenomena*. Suggested research questions/issues include:

- What are the epistemological limitations of astrosociology?
- How can the astrosociological paradigm be modified to better reflect observations of *astrosocial phenomena*?
- What types of theoretical model(s) and/or hypotheses characterize various types of *astrosocial phenomena*?
- What are the connections between the astrosocial sector, which includes societal elements that involve *astrosocial phenomena*, and the non-astrosocial sector, e.g., what are the connections between NASA and politics?
- How do various facets of *astrosocial phenomena* affect societies? What is their importance to cultural and social change?
- How may space exploration analogs provide new insights and avenues for future research endeavors?
- What literature already exists that addresses areas of astrosociological theory?
- What are some recommendations for future research projects based on theory?

4) **Astrosociological Research**

Discussion: The testing of hypotheses and theoretical models through various forms of investigation allows for the development of astrosociology. Suggested research questions/issues include:

- What empirical investigations touch on *astrosocial phenomena*, both new research and/or summaries of past investigations?

- What are some tests for astrosociological theoretical models and hypotheses? What modifications could be necessary?
- Review research addressing analogs to space exploration in its various forms, and/or provide new research findings in this area.
- Provide a literature review that summarizes some area of past research that relates in some way to astrosociology.

5) **Applied Astrosociology**

Discussion: Practical approaches that take advantage of *astrosocial phenomena* for the benefit of societies, communities, and the lives of individuals serve as important contributions of astrosociology. This focus consists of social scientists (including astrosociologists) studying such contributions by others as well as their own participation in such activities. Suggested research questions/issues include:

- What are some examples and/or future possibilities in which the utilization of space assets contributes to the mitigation of social problems on Earth?
- Discuss research that touches on both space and sociocultural and/or psychosocial efforts that contribute to improving social life in terrestrial societies.
- Discuss space spinoffs/technology transfers and their impacts on various social institutions, groups, and categories of individuals.
- How do media and the arts that focus on outer space issues affect human culture? What comparisons can be made cross-culturally that describe how different societies view outer space technologies and activities?

6) **Medical Astrosociology**

Discussion: Space medicine focuses almost exclusively on the biomedical aspects of space activities such as the effects of microgravity on the human body. Space psychology is also addressed to some extent. However, the social and cultural issues that arise among members of a crew, and in the future among citizens in space ecologies, require a greater focus. These are astrosociological issues that require attention in order to understand the social effects of going into outer space and the ramifications it has on social stability and individual health. Suggested research questions/issues include:

- Discuss various aspects regarding the social, cultural, and behavioral aspects of space medicine.
- What are some of the ethical implications of medical decision-making in space ecologies?
- Discuss the relationship between behavioral health and medical astrosociology.

7) **Planetary Defense**

Discussion: Planetary defense typically involves the detection and defense against a celestial object impacting humankind's home planet, Earth. These areas of concern are important for astrosociologists. However, the social sciences are also well equipped to

study the third component of planetary defense; namely, disaster relief efforts following an asteroid or comet strike. Preparation for the aftermath of a strike would become an issue if defense failed and humankind had time to react before a strike. Suggested research questions/issues include:

- Focus on issues involving detection, defense, and protection of terrestrial life as three different stages or as one united approach.
- Discuss the differences between protecting Earth and protecting human societies and cultures. What are the implications of success, partial success, and failure – and how are these different outcomes defined?
- What level of preparedness is prudent (or too little or too much) to respond to a real threat?
- What actions must be taken, or what actions are necessary, for coping with a strike by asteroid, comet, or other space phenomena? Discuss disaster relief efforts in the aftermath of a strike.
- What types of planning has occurred or should occur to mitigate any potential harm to Earth, human societies, or the human species?

8) **SETI and Astrosociology**

Discussion: SETI, the search for extraterrestrial intelligence, involves listening to radio signals – and more recently other types of emissions and planetary features – from alien civilizations. Astronomers and others seek such signals without any guarantee of success. Social scientists have also played a role in theoretical discussions regarding the potential presence of alien life and the likely responses to the actual discovery of extraterrestrial life. Suggested research questions/issues include:

- What is the cultural impact of the effort itself to detect alien life?
- How does humankind benefit from SETI even before detecting extraterrestrial life?
- Provide analysis and/or profiles of the work of those who carry out the search.
- What are some of the major issues related to constructing and sending messages to potential alien civilizations?
- What are the astrosociological implications of actually detecting alien life?

9) **Astrosociological Implications of Astrobiology**

Discussion: Astrobiologists continue to discover new organic molecules in space and various forms of extremophiles in a variety of environments, both natural and human-made. Suggested research questions/issues include:

- Discuss how the search for extraterrestrial life has impacted human society and our species place in the universe.
- How does astrobiological research on Earth affect societies and their various components?
- What is the relationship between astrosociological research and astrobiological theory and research?

- How could astrobiology inform astrosociology as it relates to the rise of social groups among various organisms?

10) Space Law

Discussion: Space law exists to regulate the behavior of social actors, i.e., persons, groups, organizations, and states that operate and conduct activities in outer space. As new space technologies strain the international legal system and the enabling national laws that govern states, we can expect and do see social responses to the use of space technologies. Space technologies bring people closer together and also separate societies who have such space capabilities from those states that do not. Given the social pressures that inherently arise from the technological development to access outer space, space law serves as the regulating mechanism to defuse lawlessness (or anarchy) and provide rules for social actors engaged in space activities. The study of space law, both at the individual, national, and international level, provides a significant backdrop by which to engage in astrosociological research, i.e., at the nexus of law and astrosociology (*see, e.g.,* Hearsey, C.M., *The Nexus Between Law and Astrosociology*, *Astropolitics*, Vol. 9(1) at 28, 2011). Suggested research questions/issues include:

- What are some of the social and cultural aspects of legal issues related to outer space in terrestrial societies?
- How should states organize law-making and jurisprudential systems for outer space?
- Can or will outer space law be described as a postmodern legal system?
- How will outer space law continue to function or evolve?
- Will extraterrestrial societies, i.e., human societies not on Earth, be held together by a consensus of legal values or by coercion?
- How does outer space law fit into the social construction of law?
- How are rules for outer space connected to the natural law whose content is set by nature and has universal validity? Or is outer space law derived from basic norms?
- Are there aspects of outer space law that constitute peremptory norms? If so, how will that affect social systems that arise beyond Earth?
- How will non-binding rules affect the development of space law going forward? What impact will it have on any aspect of society?

11) Space Policy

Discussion: Policy is a general prerequisite to law and a fundamental aspect of decision-making that encompasses all aspects of social life. As applied to astrosociology, space policy has a wide variety of topics that intersect with the study of astrosocial phenomena. Suggested research questions/issues include:

- What is the status of space exploration in various nations?
- How does governmental space policy affect real efforts in space?
- What impact do private space companies have on governmental space policy?
- Discuss the role of space advocacy groups in affecting space policy.
- How is “New Space” affecting humankind’s progress in space?

- Discuss the details of international cooperation in the pursuit of space exploration.
- How do the benefits/costs of space policy (or law) affect segments of human society not engaged in space activities?

12) Space History

Discussion: Space has played a significant role in societies throughout history. It is therefore beneficial to study the historical developments in astronomy and space exploration and their social impacts at every level of analysis. Since the history of human and robotic space exploration in the modern era has lasted over fifty years, there have been great achievements, bitter disappointments, tragedies, and some argue lost opportunities. Moreover, the scientific and exploratory aspects considered at the heart of the space exploration have been shaped by politics and other social and cultural forces that resulted often in detrimental outcomes and extraordinary achievements. Furthermore, past human societies have been affected by what happens in outer space and, in some cases, human history has been shaped by celestial events. Suggested research questions/issues include:

- Discuss the space history, or a portion thereof, of societies in any recorded area of study.
- How did space affect ancient societies/pre-historical cultures – e.g., pre-historic Britain, China, Egypt, Africa, Samaria, etc.?
- How have celestial events affected the development of human society? How could expected future events shape the future of human society and what could be the social benefits/costs?
- What impacts did major developments in astronomy, planetary science, rocketry, or space exploration have on societies or groups of people?
- What historical analogs describe current endeavors to venture into outer space?

13) Space Economics

Discussion: Generally, economics is the study of how the production, distribution, and consumption of goods and services operate in a society. As technology enables humans to consume space based resources, such activities will significantly affect human society on and off Earth. For Example, satellites are playing a large role in how resources are consumed on Earth. Studying the economic effects of space technologies and activities is therefore an important and underdeveloped topic of inquiry. Suggested research questions/issues include:

- What types of phenomena are observed or could be observed due to human activities in outer space? How do these phenomena affect human society's consumption of space based resources?
- How will the consumption of space based resources change the dynamics of economics on Earth?

- How has technology changed the way resources are used and consumed on Earth? What types of space based assets are important to human society and what are their economic and social benefits/costs?
- Will consuming outer space resources change economic systems? If so, how? If not, why?

14) Literature and Astrosociology

Discussion: Oral traditions and literature have played a large role in the development of the social consciousness related to outer space. From stories about gods in the heavens to science fiction about trips to the Moon and Mars, outer space as a subject or backdrop in story-telling has had a significant effect on human society. Suggested research questions/issues include:

- How has space related literature affected human's drive to go into outer space? How has it shaped the social consciousness?
- How does literature create social constructs in human societies to explain our place in the universe?
- What sources of literature have influenced humans to venture into outer space? What themes or lessons are portrayed? What conclusions can society draw from literature?
- How does storytelling through movies or art shape our understanding of space issues?

15) Space Societies (including Crews, Micro-Societies, Mini-Societies, and Communities)

Discussion: Human groups living in isolated space ecologies within space habitats – whether on planets, moons, or orbiting a space body – require social-scientific consideration even though very few human beings live in space at one time. Suggested research questions/issues include:

- What are the major issues involving social and cultural aspects of social groups living in non-terrestrial ecosystems/habitats?
- A focus on the definitions of space environments, ecosystems, and space ecologies. How do they differ and how are they related to one another?
- What types of social relationship will emerge between humans that stay on Earth and those who leave Earth to venture out into the Solar System or beyond?

16) Spacefaring Societies

Discussion: The future of humankind on Earth is likely to be characterized by a growing influence of space in the lives of citizens as well as social institutions, groups, categories within societies, and international relations among nations. A spacefaring society is one in which the effects of space are omnipresent on a number of different social, cultural, and physical levels. This term refers to an ideal type of society that is impossible to emulate in reality, but represents a potential state that societies can strive toward. Though this possibility can only occur in the distant future, if at all, this topic is open to both theoretical speculation and practical research. Suggested research questions/issues include:

- Discuss studies covering social and cultural change that focus on the possibility of space influencing social groups and social institutions on a greater level.
- Speculate about milestones that may signal movement toward, and/or retreat from, progress toward spacefaring characteristics.

17) Hard Space Sciences and Astrosociology

Discussion: The status of collaboration between the “hard” sciences and “soft” sciences relating to space exploration, settlement, and exploitation of space resources is best characterized as limited, though it is increasing. Suggested research questions/issues include:

- What is the status of collaboration between the “hard” sciences and “soft” sciences relating to space exploration, settlement, and exploitation of space resources?
- What are some examples of, and protocols for, collaborative efforts?
- Describe how the collaboration between the physical and social sciences can result in synergistic breakthroughs impossible by either approach alone.

18) Other Topics

Discussion: The Editor-in-Chief and Editorial Board of *The Journal of Astrosociology* will consider manuscripts covering other areas that address astrosociological issues not covered in this document. Analysis, research, and discussions should involve approaches that address astrosocial issues; that is, social, cultural, and behavioral concepts related to outer space. These issues are common to the social and behavioral sciences, humanities, and the arts. The journal also seeks perspectives from non-social scientists who present credible theories and/or research that ties their work to *astrosocial phenomena*. Failure to address astrosociological topics shall in no way prejudice a potential Author from publishing with the journal, but some topics may be beyond the scope of issues the journal is willing to accept. All questions regarding topics should be addressed to the Editor-in-Chief.

THE JOURNAL OF ASTROSOCIOLOGY
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- Space Policy
- Space History
- Space Economics
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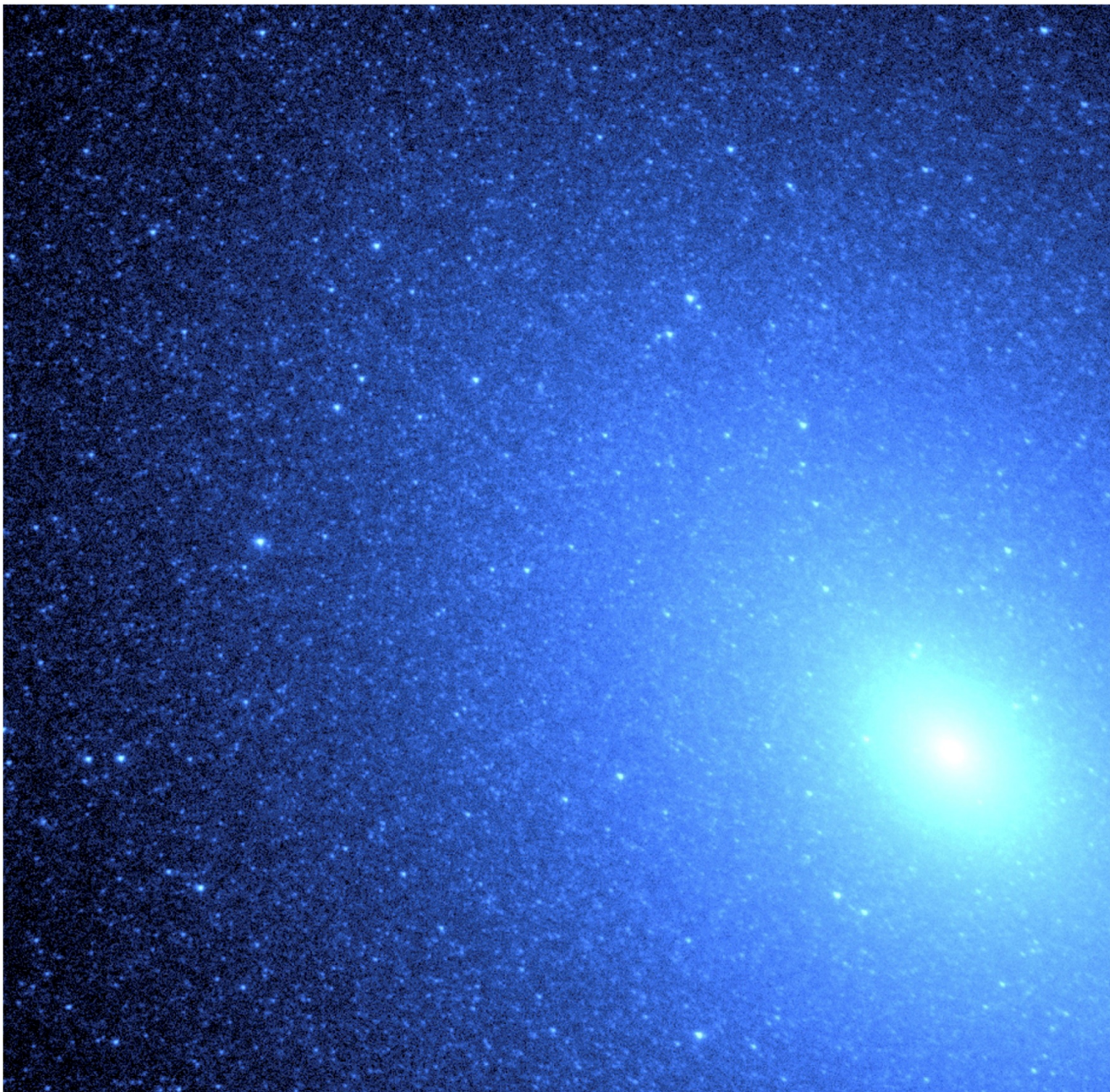
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