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FUTURE SPACE EXPLORATION AT
ENTERTAINMENT ATTRACTIONS**

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PAST REALITIES VERSUS HYPOTHETICAL FUTURES: BRIDGING ACCURATE PERCEPTIONS AND INDIVIDUAL EXPECTATION GAPS IN RELATION TO FUTURE SPACE EXPLORATION AT ENTERTAINMENT ATTRACTIONS

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ABSTRACT

It has been more than forty years since the dawn of the space age and the notion of human space flight has settled comfortably into the human psyche. Yet there is disconnect between the cinematic representations of space exploration and long-term program plans of national space agencies. For entertainment attractions, too often these cinematic representations cloud public perceptions of the art of the possible in space exploration. The forecasts of personal hover mobiles, ubiquitous robots, and luxury cruises to the moon that were to be available to society at the end of the last century have turned out to be grossly exaggerated, resulting in public frustration and subsequent ambivalence. Yet the upcoming future can be showcased without defrauding the public's imagination. At the start of this century, new visions of the future are being prepared by various entertainment entities (e.g. movies, theme park attractions). This examination consists of a review of previous paradigms of translating space visions to the public. Given the background of the authors in conceptual space engineering, recommendations are made as to more scientifically credible attractions while maintaining the entertainment proposition.

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NOMENCLATURE

ET	External Tank
ISS	International Space Station
RLV	Reusable Launch Vehicle
SSP	Space Solar Power

INTRODUCTION

Even in this modern world with an ever more sophisticated audience, some topics always seem to generate excitement. Space exploration can arguably be classified as one such area. At this moment humanity has explored almost all reaches of the physical surface of the earth. The excitement of finding new rivers or valleys, present a few hundred years ago, seems trite in the current time. In a modern world where one can find out almost anything nearly instantaneously, outer space exploration still maintains an aura of the unknown. Within the darkness of space, the public can use its imagination to make anything seem to happen.

Yet, the field of space exploration over the last few decades is mired in multiple failures, having a root cause in a lack of sustained vision to implement revolutions. Space exploration has contained periods of "punctuated equilibrium" where events/projects have led to new capabilities of exploration. These include Sputnik, Apollo, and the Space Shuttle. Yet unrealistic expectations about the future have led to a present situation wherein space exploration is limited to a few robotic explorers and inefficient space transportation (the Space Shuttle) and infrastructure (the International Space Station, ISS).

MOTIVATION

It has been more than forty years since the dawn of the space age and the notion of human space flight has settled comfortably into the human psyche. Yet there is disconnect between the cinematic representations of space exploration and long-term program plans of national space agencies. For entertainment attractions, too often these cinematic representations cloud public perceptions of the art of the possible in space exploration.

The forecasts of personal hover mobiles, ubiquitous robots, and luxury cruises to the moon that were to be available to society at the end of the last century have turned out to be grossly exaggerated. This results in continued frustration and subsequent ambivalence of the public towards space. Eventually these misperceptions have a direct relationship to the level of support shown by legislative bodies towards public fiscal outlays for space exploration. The value proposition to society of space has changed, from one of transformational change (Apollo) to transactional apathy (the current Space Shuttle).

Entertainment media have given the public grandiose visions of the nature of space exploration. The general press has not blunted this perception either. The same media scrutiny given to U.S. Department of Defense (DoD) programs is lacking when the agency becomes the National Aeronautics and Space Agency (NASA). A general naiveté seems to follow press coverage of space agencies, focusing on the “science fiction” aspects of these endeavors rather than the “science fact.” Generally it seems that public misperceptions originate from lack of knowledge about the nature of space itself and humanity’s travels in it.

Cinematic (i.e. fictional) media representations of the environment of outer space have led many in the public to believe in fanciful “facts” about space, including examples such as artificial gravity, benign aspects of human exposure to space, and that long term habitation is easily possible. Many times familiar archetypes are used in outer space, representations to help the audience relate from their experience to the tale being told. Many times spaceships in these representations look similar to airplanes. This can relate a false impression that flying in space is very similar to flying in the terrestrial atmosphere. This leads to expectations that

it must be relatively easy to just go a little higher to get into space from the altitude of commercial airliners. The public also has general misperceptions about the nature of the United States Space Shuttle. Some members of the public often believe that the Shuttle can go to the moon (it cannot even get to a “high”, greater than 400 nautical miles altitude by itself), launches most of the world’s space payloads (the Space Shuttle launches only 4 to 6 times a year out of 60 to 70 global launches per year), and is robust enough to fly in the rain.

The past realities of the space program and the potential futures enabled by the current generation of space scientists and engineers will not be equivalent. Yet there is an opportunity to showcase the best of the upcoming future without defrauding the public’s imagination. At the start of this century, new visions of the future are being prepared by various entertainment entities (e.g. movies, theme park exhibits, museums). Misperceived notions of space exploration eventually appear in these entertainment and knowledge attractions. Obviously one should not expect the cinematic medium to obey the laws of physics on a consistent basis. However, entertainment and knowledge attractions can perform better in relating the actualities of space explorations while maintaining the entertainment value proposition.

PROCESS OVERVIEW

This examination will proceed with a brief review of previous images and icons that have helped to shape the public’s perceptions of outer space. The cinematic representations discussed herein are limited to those films taking place in a near term time frame. In addition the recommendations and criteria given are not limited to exclusively entertainment attractions such as theme parks but apply to museums and other similar institutions.

Subsequently, different scenarios of space exploration are presented as to potential futures and impact of these on next generation space exhibits. Criteria are given as to the characteristics of exhibits that can be robust enough for both the near term and will not fall into the trap of being outdated by actual events. Given the background of the authors in conceptual space engineering, recommendations are

made as to more scientifically credible attractions while maintaining the entertainment proposition.

PAST IMAGES OF SPACE

This examination will focus specifically on those images of space that contain the expectation of reality rather than visions of fantasy. This would consist of portrayals in theme parks, museums, and the general film industry that are set in a not too distant future time. These images are vast and diverse, falling into certain categories ranging from fact to fanciful. Perceptions of space often originate from cinematic representations and are subsequently translated into attractions. Given here are a few examples, not determined to be exclusive of the genre of space portrayal, but representative of major themes running throughout these works. Specifically these sources include films and images from the 1939 New York World's Fair, the Walt Disney-Wernher von Braun collaboration in the 1950s, and modern American cinema.

The 1939 World's Fair held in New York City was a landmark event that signaled the end of the period known as the "Machine Age" wherein representations of machines were evident throughout the culture and specifically through cinema. The age of industrial production and efficiency had promulgated throughout the world, and culture was reflective of that influence. Streamlined trains, art deco furniture, and skyscrapers were just a few of the physical manifestations of this phenomenon. Specifically the 1939 World's Fair was positioned to point to the new world enabled by the machines of tomorrow¹.

Approximately 800,000 people were accommodated every day at the fair with a total of over 25 million visitors in 1939 alone². The theme of the fair was "building the World of Tomorrow." Visitors were taken through exhibits sponsored by the largest industrial and electrical companies of the time to showcase the world of the 1960s with fast highways and robotic assistants. Norman Bel Geddes designed a Futurama ride for General Motors, putting the user in chairs that moved across a model of an idealized United States. The attraction moved the visitor from one coast to another as they flew across cities of the future, with cars on spacious roads and pedestrians on elevated walkways³. In addition, many hundred of

movies were produced or shown at the 1939 World's Fair. This was an event where the public was shown the marvels technology could enable, including the use of new devices known as televisions.

In the 1950s, Wernher von Braun collaborated with two major American institutions to promote the exploration of space. In the early 1950s, he was invited by Collier's magazine to translate his visions into articles for the public at large (Collier's magazine had a circulation of approximately 4 million at that point)^{4,5,6}. Von Braun, assisted by others, became a consultant to Disney in regards to the new Disneyland theme park in California that was to contain Tomorrowland. Von Braun made three of these films that detailed both general physics knowledge and specific missions in space using Disney animation. Dr. Ernst Stuhlinger (also a Disney consultant and shown in the series) stated in regards to Von Braun's work that:

Here von Braun was really on home grounds...He provided a wealth of information on technical details, from in-orbit fueling operations down to problems of cooking and eating under weightlessness⁴.

Von Braun had dedicated his time to interest the public through these avenues, working closely with the creative minds where the images were developed. These films also used von Braun himself in some scenes as representative of the engineering community, a persona to place in front of the public. These television shows ("Man in Space" – 1955, "Man and the Moon" – 1955, and "Mars and Beyond" – 1957) were very well received by the public and critics (an estimated 42 million viewers had seen the first episode in the series)⁴. Obtaining the ratings and broad demographics of these 1950s television shows will most likely not happen again. Modern audiences are more stratified in terms of such viewing options, in terms of both movies and television. However, the effort expended by the top space designers of the time to coordinate their visions with that of the image markers not doubt contributed to the growing interest of space during that era.

Modern images of space that reach massive audiences originate from the visual mediums of film and television. Movies that can be classified to accurately portray space exploration involve representations that maintain the entertainment

proposition but also do not defraud the public's imagination. Bad representations are those that generally do not obey the laws of physics or misperceive their effects and focus singly on lone individuals rather than the typical team that tackles crises in such situations. Specific well-done cinematic representations include "Apollo 13", "The Right Stuff", and "From the Earth to the Moon" series on the HBO cable channel. Specific bad representations include "Armageddon", "Space Camp", and "Red Planet". There are also classes of movies that generally seem credible three-quarters of the way through the film yet then deviate at the end. Example movies include "Space Cowboys", "Mission to Mars", and "Deep Impact". Example instances in these types of films include:

- "Space Cowboys": The astronauts for a modern space mission are shown as prototypical loner, corvette driving, and "bozo cowboys" than the advanced degree holding scientists and engineers who are actual astronauts. These may originate from stereotypes of the Mercury, Gemini and Apollo missions.
- "Mission to Mars": Initially, this rather credible story of the first human missions to Mars ends with the discovery of an advanced alien spacecraft hidden on the surface of Mars and holographic representations of crying aliens. It seems that the journey itself was not worth the effort since some fanciful reward besides "exploration" itself has to await these explorers.

PHYSICAL DISPLAYS OF SPACE

The above-mentioned images contribute greatly to the perceptions of outer space and the translations of these images to the attractions, museums, and exhibit that deal with space. Many times, these constructs replicate past achievements and point to perceived futures. Specific comments on various attractions based upon personal visits and reflections by the authors include:

- **Disney's Tomorrowland**
(Orlando, Florida, USA)
Old and rather staid visions of the future, not very tomorrow, more like the tomorrow of yesterday, rides and exhibits are out of date, repainting generally only major upgrade seen

- **Rose Center for Earth and Space at the American Museum of Natural History**
(New York City, New York, USA)
Functional blend of large and small size exhibits with some hands-on exhibits, every visual opportunity is taken to present some aspect of information including stairwells and painted imagery on ground, blend of very scientific information in an artistic type environment with vivid color, expansive street viewable glass walls, non-linear paths and displays, credible technical program with public series of lectures, entertaining video using film stars such as Tom Hanks, artistic displays of space imagery such as high resolution moon photos
- **Space and Rocket Center**
(Huntsville, Alabama, USA)
Outdoor historical exhibits (Saturn V, Space Shuttle) in a generally hot environment, dirt path with exhibits, not many benches outside to enjoy rocket displays, not many outdoor trees, most popular spot is underneath Space Shuttle mockup since shade is present there, not as elegant as some other museums such that adults may find it less cultured than children
- **NASA Marshall Space Flight Center (MSFC) "Starship 2040" mobile display**
(Huntsville, Alabama, USA)
High level of expectations given initial NASA marketing on various websites, various displays of interior of a space station, exhibit was physically well built even though at a high level had no deeper meaning or integrated message, indicated notions of high interactivity but hands-on functionality very limited, simple and non-unique vision of space habitat environment, generally lacking in exposing all but the most small children any credible information about space exploration
- **Cité de l'Espace**
(Toulouse, France)
Space museum in aerospace city of Toulouse housing outdoor historical space exhibits, non-linear multi-level interior with circular motifs, small but integrated displays, interesting visual associations with non-space related French cartoon styles

- **Palais de la Découverte**
(Paris, France)
General science museum, historical collection of machines, linear displays neatly arranged with vast variety of displays, interesting Mars display in 2001 had broad hanging collection of spacecraft above and rovers below with visual progression of spacecraft development, small collection of Russian space hardware
- **Smithsonian Institution National Air and Space Museum's Steven F. Udvar-Hazy Center**
(Dulles, Virginia, USA)
Currently constructing this permanent housing of air and space vehicle collection, most displays indoors including Space Shuttle display, lawns and organized paths around buildings, multi-dimensional displays at and above visitor eye level
- **Boeing Museum of Flight**
(Seattle, Washington, USA)
Interesting blend of past and present air and space vehicles mostly housed indoors, small and well-integrated display of one astronaut and life mementos as related to space program, multi-dimensional displays at and above visitor eye level, integration with operational Boeing air field next door
- **NASA Ames Research Center (ARC) Visitors Center**
(Palo Alto, California, USA)
Unique display of Space Shuttle related wind tunnel models, pedestrian display of artifacts in cramped space with some relatively unfinished displays

CONSEQUENCES OF PERCEPTIONS

One particular example of media perpetuation of false images of space exploration includes the Mars Society terrestrial habitats. In such haunts, members of the society pretend to be on Mars for certain periods of time and wear space suits whenever they venture out of small habitats. The media many times exaggerate the scientific importance of these particular endeavors versus other investigations. Obviously some of this results from marketing, and

lack of it from scientific investigators. Most likely, more important results can be obtained from Mir and ISS data on human habitation in enclosed environments than from these Mars Society studies. These programs do generate publicity but they may cause unreal expectations as to the ease of human Mars exploration.

The media's continued exaggeration of space projects is not limited to human space exploration. Specifically when the X-43A unmanned hypersonic scramjet propulsion flying prototype tests were being conducted some local metropolitan news media outlets reported that this small vehicle was actually a fully operational space plane.

The nascent field of space tourism is one area where the media often exaggerate claims without regard to a proper perspective, neglecting to put these events in context (i.e. the difference between suborbital and orbital flight). Space tourism is probably one of the most important future markets for reusable launch vehicles (RLVs). Discussions of recent space tourism neglect the historical record in the 1980s where a Saudi prince and some United States congressman flew on the Space Shuttle or in 1991 when Japanese Journalist Toyohrio Akiyama spent 10 days aboard Mir. In addition, when space tourism companies announce new vehicle developments, many times all are pasted with the same air of credibility. Generally the more informed space media are at selected news outlets and normally stationed at various NASA centers, especially at NASA Kennedy Space Center (KSC). Many times the members of the media that misinterpret these stories originate from non-space outlets.

A recent personal case study on public perceptions of space presented here by the authors involves the reactions at science fiction conventions to presentations about real space science and advanced space transportation. Some of these conventions include sessions where current and future space initiatives are discussed. Many times these sessions include obviously non-scientific presentations (the "Face on Mars", the "Pyramids of Mars", ESP, astrology, divine geometry of the Martian landscape, alien abductions, etc.). Thus credible science ideas are coupled with pseudo-science claims. Normally, the scientific community shuns these types of events as being beyond the pale of acceptable forums for scientific discussions to the public. However, these

attendees may be some of the most space enthusiasts amongst members of the general population. Obviously, many of them are not directly involved with the space program but many are members of space advocacy groups (National Space Society, Mars Society, etc.).

One specific instance involved specific presentations some of the authors made on space transportation to a large group (75+) at one such session during the DragonCon science fiction convention. Generally the audience was rather curious and somewhat knowledgeable about space. However, the audience had limited knowledge of NASA's plans including the Space Launch Initiative (SLI) or new nuclear power and propulsion initiatives. What the audience did seem informed about (as related by subsequent questions to the presenters) were the supposed construction of an operational space elevator within ten years (promised to reduce the cost of launching payloads down to tens of dollars per pound) and antigravity research being conducted by Boeing. After repeatedly hearing these questions (which are generally open to interpretation), the authors tracked it down to a cover story on the previous month's Popular Mechanics magazine and a BBC on-line article about Boeing anti-gravity based upon previous Russian research. The BBC article was just a summary of some conceptual designs being conducted. The anti-gravity research claim originated from a brief mention in a Boeing slide about long range concepts examined by engineers in the past (Boeing later provided clarification after the BBC article spread throughout the Internet).

Institutions representing NASA to the public are not innocent of sustaining embarrassing myths about space. One specific and troubling example includes the recent set of exhibits at the Space Center Houston near NASA's Johnson Space Center (JSC) in Houston, Texas⁷. The Space Center Houston is the related visitor's center to JSC. The center has been privatized but has catered to more pseudo-science type exhibits including ones related to the Roswell (New Mexico) alien crash stories and crop circles. Given the limited exposure of NASA's marketing presence in general, such co-optation of NASA's image to push almost anti-NASA and anti-science stances should come as an humiliation upon the agency and a sign of the un-coordinated marketing approach in the agency's image.

NASA itself has generally been unable to sustain coordinated approaches to marketing the agency to the public. A recent case study was the installation of a camera on the Space Shuttle external tank (ET) capable of showing live video during lift-off and ascent. This particular aspect of the mission (costing several hundred thousand dollars to implement) got as much if not more publicity than the hundred million dollar truss that was launched to the ISS. However, on the day of the mission, most Internet broadcast feeds were overloaded with users and unable to provide launch video (including of the new camera). This included sites for NASA, United Space Alliance (USA), and the website space.com. After spending over half-million dollars on content, NASA has not prepared enough delivery avenues. Trying to obtain online footage of the new camera's video a few hours after lift-off was difficult since the video file not found on NASA's main website or its main affiliated website (spaceflight.nasa.gov). Such popularity should have been much better anticipated. The press attention paid to this type of mission probably motivated many people sitting in offices in the United States to use the web to connect to NASA TV to see the launch. This may have been the only opportunity for these people to interface with any part of NASA during the year (with more people possibly interfacing with NASA TV through the Internet than on television). The end result experience was one of delay and frustration. This particular reaction can sour audiences to any future interaction with NASA and to question the technical competence of a space agency that cannot provide bandwidth for an anticipated Space Shuttle launch.

An example of creative approaches to space branding and imaging involve conventional translations of common known brands to space. One specific example includes the Lego[®] "Red Rover" Mars traveling display. This particular exhibit includes a 1:1 scale detailed display of a planned future NASA rover to Mars (looking in essence like a larger scaled up Mars pathfinder Sojourner rover). This display contains a 90 thousand-piece Lego[®] model weighing over 250 pounds. In addition, small and relatively responsive rovers are featured which can be remotely operating using joysticks and camera displays. In essence such a display is more impressive than a NASA "Starship 2040" display. This is due to the full-scale nature of the exhibit as well as the simple but powerful image of Lego[®] pieces constructing an intricate space machine. The populace does not know

the intricacies of a mass spectrometer on such a rover but they can relate to the scale and complexity of the Lego[®] pieces that make up that instrument on the model. The large static model is coupled with lower level models that can be manipulated by the visitor; a two tiered approach to interactivity.

RECOMMENDATIONS

Generational imperatives with the stratification of society have changed. Relevant changes include:

- Potential audience fragmentation: Society is much less homogeneous in terms of culture and education.
- A growing generational gap contrasts younger audiences of short attention spans with previous generation's interest in content and context.
- Education levels of audience. A much less gullible and keenly skeptical public demands a more sophisticated portrayal of space travel.

Based upon the collective experience of the authors, specific recommendations to changes in philosophy in regards to exhibits include:

- Use near actual scale future space vehicles (such as RLVs) that do not look like the Space Shuttle (see Figure 1).
- All displays that are indoors should have more information included with easier comprehension
- There should not be an attempt to replicate video games unless using industry companies. Such a concept may be doomed to failure and obsolescence if done indigenously.
- Holographic displays, using latest wearable and non-wearable technology, should be utilized (see Figure 2).
- There should be more examination and promotion of new missions and concepts on the edge of the imagined (such as Space Solar Power).
- Space science and engineering should be integrated in order to understand the ideal and practical aspects of exploration.
- Entertainment institutions including theme parks many times use possibly inappropriate sages (i.e. astronauts). Astronauts are very good at current programs. However, they are not involved in long range planning and thus may not be the

most optimum contacts for such long range strategic thinking.

- Archaic notions of linear exhibits and passive content should be forgotten. It is uniquely surprising yet unfortunately consistent that the most prized scientific institutions are so conservative in not only their approach but also their technological tools. Science cannot be displayed in the same way as a piece of art. Space must be experienced in order to make it relevant. The goal of interactivity still has not been met; the mostly unfortunate proliferation of kiosks does not indicate more knowledge transfer to the general populace. The same pedantic, yet admirable, societal naivety which drew visitors to sub-par comic book artist renditions of space and space travel no longer exist. Successful exhibit deployments need to accept and incorporate not only past accomplishments but today's realities in order to create timely yet persistent attractions (see Figure 3).

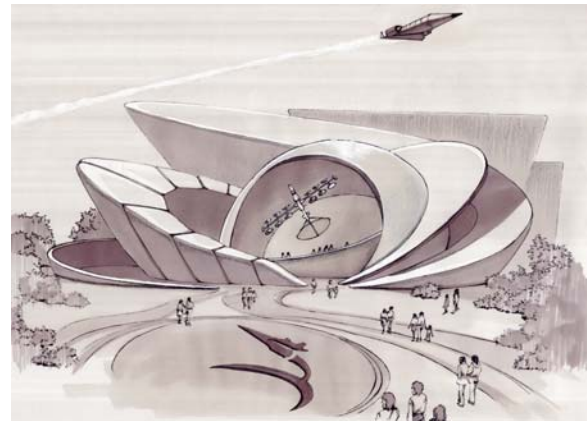


Figure 1. Sample Future Space Attraction

unforeseen advances. Paleontology has succeeded through dinosaur exhibits and animation to present the reality of science in a realistic yet still entertaining light. The space community should endeavor to follow this path. This begins with dispensing conservative conventions of science "museums" filled with motionless glass cases and outreach programs only reaching local high schools.

Hollywood has to be both courted and educated in order to move a new generation realistically into the world of space exploration. The one important corollary to this: people should be able to experience space travel. People should understand the realities of space so that they can understand the true possibilities available. Audiences have to be entertained and fascinated by the presentation of true realities. With such progress, the public will perceive more clearly the reasons and methods of space travel. Then a new generation of space exploration will have emerged: new groups who not only know why they are going into space, but how that journey takes place.

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