RIDE OF A LIFETIME:

A NETNOGRAPHIC RESEARCH TO UNVEIL THE LEISURE EXPERIENCE ATTACHED TO ORBITAL SPACE TOURISM

by

Jingning Ao

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Dissertation Committee:

Dr. Joey Gray, Chair

Dr. I-Chun (Nicky) Wu

Dr. William Compton

ABSTRACT

People tend to have different motivations when selecting a travel destination. While traveling to space becomes increasingly feasible as the technology advances, there is relatively few research communicates what people can experience about leisure travel in space. Understanding the leisure properties of space travel could potentially help the business development of space tourism. Therefore, the primary purpose of this study is to explore the following: When people travel to outer space, what properties of leisure experiences attached to orbital space tourism could potentially attract tourists? In this study, leisure perception serves as the theoretical foundation; the theory of a multi-phase experience provides an analytical tool to construct the experience of space tourism. A netnographic research method is applied to obtain authentic descriptions about space travel experience from the most popular Tweets posted by 36 NASA astronauts in Twitter.

The selected 3,468 Tweets indicate that the public shows interests in both in-space and off-site experiences. Moreover, research findings highlight the trip to space as a dynamic and multi-phasic experience with its context. Specifically, the identified key patterns, including training, liftoff, in-space, reentry, and memory, are formed into five stages of orbital space travel. Each stage has its unforgettable experiences and unique leisure attributes. This study hopes to fill the gap in current academic literatures of space tourism, and lay the foundation for formulating marketing strategies for space tourism business. Therefore, people do not have to be fully competent as professional astronauts to desire space travel in the future. Instead, a space tourist as amateur astronaut can expect her space trip with multi-phasic leisure experiences as the ride of a lifetime.

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CHAPTER ONE: INTRODUCTION

"*I have learned to use the word 'impossible' with the greatest caution.*"

—Wernher von Braun

Background of the study

A few decades ago, the last man walked on the moon. Have people lost interest in space since then? No. Human beings have never ceased imagining about the cosmos and space travel. Simply look at the science fiction films: space exploration movies were produced in every decade since the 1960s, such as *2001: A Space Odyssey* (1968), *The Black Hole* (1979), *Explorers* (1985), *Contact* (1997), *Solaris* (2002), *Prometheus* (2012), *Interstellar* (2014), and *The Martian* (2015). In the movies, humanity leaves the earth and heads to the stars and beyond. Someday public space tourism may come true and push human desires out into the universe.

Space is not an unlikely place any more since the first human orbited our planet in 1961. But, how long until people will travel in outer space for tourism? In 2001, the world's first-ever space tourist, Dennis Tito funded his own trip into space for 7 days, 22 hours and orbited earth 128 times with a reported price of $20 million in total. In 2002, the world's second space tourist, Mark Shuttleworth self-funded a space voyage for 9 days, 21 hours with similar costs as Tito. Both followed extensive astronaut training and spent an extremely high price for the experience. However, an early space tourism market survey conducted in Japan showed that people were only willing to pay approximately $40,000 to $80,000 U.S. dollars for a two-day tour in orbit (Collins, Stockmans, & Maita, 1996). Another survey which took place in the U.S. in 1997 suggested that the average price that people were willing to pay for a two-week vacation in space was only $10,812

(O'Neil, Bekey, Mankins, Rogers, & Stallmer, 1998). Recent studies indicated ticket price per person ranged from $200,000 (Webber, 2010) to $250,000 (Chang & Chern, 2013) at least. Clearly, despite our fascination with space travel, affordable commercial space tourism is quite a way off.

Optimistically, advanced technology has made public space tourism increasingly feasible. On March 30, 2017, SpaceX, an American space transport services company, made history in the aerospace industry: a used rocket Falcon 9 was successfully launched and recycled. SpaceX spent $60 million to make the Falcon 9, and $200,000 to fuel it. A re-launched rocket only needs to be fueled, theoretically. As Elon Musk, the founder of SpaceX, remarks on the SpaceX webpage, "If one can figure out how to effectively reuse rockets just like airplanes, the cost of access to space will be reduced by as much as a factor of a hundred" (SpaceX, 2015). Therefore, public space tourism seems to be achievable by virtue of technological innovation.

Statement of the problem

In academia, the majority of space tourism studies either provide general narratives about this fledging industry ranging from vehicle design to legal considerations, or estimate the future market size and potential tourists' willingness to pay. For the latter, market research surveys, including interviews, online and paper-based questionnaires, and telephone inquiries, are the main methods used to uncover people's opinions toward space tourism. Without justifying the foundations of the questions, especially the leisure properties used in these surveys, however, it is less convincing to have delivered an accurate message about space tourism for potential customers. Furthermore, there are very few published research studies, for example, Reddy, Nica and

Wilkes (2012) named only five journals articles and three books that touch upon this basic question: what kind of leisure experience could motivate people to desire travel to space? Understanding the leisure nature of space travel could build a convincing foundation for market research surveys, which will potentially help the business development of space tourism.

Purpose of the study

In fact, the recent development of space tourism in business, for instance Virgin Galactic, "the world's first commercial spaceline" as the company claims (Virgin Galactic, 2017a), uses the term "Virgin Galactic astronauts" to describe the tourists who will be onboard of its sub-orbital flights by the end of 2018. Being a private astronaut for only a few minutes, has attracted over 700 people from over 50 nations with paid ticket prices reaching $250,000 each; Virgin Galactic promises an "amazing, life-changing experience, as they earn their astronaut wings". (Virgin Galactic, 2017b, 2017c).

Apparently, Virgin Galactic plans to send average people up to the fringe of earth's atmosphere, making them non-government astronauts and using private astronaut as the key value proposition in its business model. True, the title "astronauts," and the unique space travel experiences only astronauts have undergone, are so intertwined that it is impossible to separate astronaut from space travel. When people desire to be astronauts, it is logical to assume that they want to travel in space; conversely, when people experience space tourism, they automatically become entitled as astronauts, since astronaut wings are traditionally rewarded to those who fly above the altitude of 50 miles above sea level (National Air and Space Museum, 2017; Virgin Galactic, 2017c). That is,

learning about the outer space experiences that amaze astronauts the most could potentially attract people who fascinate space tourism and want to become astronauts.

Consequently, examining astronauts' life in space could provide detailed value proposition to a space tourism business model, and build the foundation of future marketing inquiry. Abundant facts about the real-time life in outer space published by astronauts have been vividly recorded by social media planforms, mainly on Twitter. Moreover, research based on Twitter posts has been conducted and has proved Tweets to be very useful data (Claster, Cooper, & Sallis, 2010; Macy, Mejova, & Weber, 2015; Osmond, 2017; Shimada, Inoue, & Endo, 2012; Shimada, Inoue, Maeda, & Endo, 2011; Simpson, 2017; Statista, 2017; Wang, Hernandez, Newman, He, & Bian, 2016; Yadlin-Segal, 2017).

Therefore, this research aims to explore the properties of leisure experiences attached to orbital space tourism from astronauts' Twitters that could potentially attract tourists. Through this study, the researcher hopes to fill the gap in current academic literatures of space tourism, and build the foundation of leisure properties in formulating marketing strategies.

Significance of the study

The practical importance of space tourism has been demonstrated broadly by several studies, and this study shares a similar attitude toward space tourism. Basically, research efforts regarding space tourism could contribute to economic, humanity, learning and knowledge, environmental, cultural, social, organizational, and general importance.

The economic significance includes: to bring massive money from space tourists to the further development of commercial space programs (Belij & Tadic, 2015); to have

an unprecedented limit of growth once it achieved a certain scale, for instance, orbital space tourism with a growth rate as a few million tourists in a year could generate over 118 billion dollars per year (Collins & Autino, 2010), or a single-person return ticket between $10,000 and $20,000 could achieve a scale of $10 billion in annual revenue and 1,000,000 participants in a single year (Collins et al., 1996); to mitigate the heavy reliance of space industry on governmental funding and to become a major support for economic development as an aviation industry (Collins & Autino, 2010); and to be a huge potential in economic growth despite current public ignorance (Collins, 2001).

The humanitarian considerations are: to shape the ambition of future generations (Cater, 2010); to accomplish a worldwide desired ambition (Collins et al., 1996); to weaken some political issues (such as unemployment friction and financially profligate weapon race) and to bring a flourishing Renaissance-like influence on humanity in terms of science, culture and education (Collins, 2006); to be the economic developmental instrument to secure survival resources from outer space (Smith, 2000); and to provide the reasoning and channel to solve key questions in terms of human settlement of space (Maryniak, 2000).

From learning and knowledge perspectives, its significance is summarized as: to understand the earth and the universe (Reddy et al., 2012); to engage with popular knowledge and to access the popular science—for example, as a branch of "low science", space tourism making sophisticated manned space exploration accessible and intelligible to non-astronauts (della Dora, 2010).

In terms of environmental importance, space tourism business could raise environment awareness and enhance environmental protection, such as space-based solar

power supply, space projects to ameliorate inclement weather, and to stabilize climate (Collins & Autino, 2010; Reddy et al., 2012).

Moreover, the importance of culture can be reflected that commercial space tourism extends the culture of crossing touristic frontier and pursuing new adventures (Cater, 2010). Space tourism will impact social development by creating enormous job positions for space tourism and related industries with an unlimited prospect (Collins & Autino, 2010). Meanwhile, from an organizational point of view, the private space tourism market will greatly shape future operations in the National Aeronautics and Space Administration (NASA) (VanSuetendael, Hayes, & Birr, 2008). The general importance is: to maintain the educational value, cultivate the need for a new global renaissance, promote world peace, and preserve human civilization (Collins & Autino, 2010); to consider four essential reasons, "as an end in itself [to become a huge space business field], as a means to achieving other space ends, as a facilitator of other space activities, as a clear expression of our society's character" (Rogers, 2001, p. 540).

In addition to the aforementioned practical benefits, this study first aims to help fill the gap in space tourism literature by analyzing astronaut experiences to extrapolate leisure properties they may have experienced in space. Astronaut experiences were chosen as the primary data source as the overwhelming majority of visitors to space have been astronauts, 522 astronauts to be exact (counted on October 26, 2017). Further, astronauts have well documented their experiences in books, blogs, articles, and social media. Thus, providing a social scientific foundation regarding leisure properties of space tourism for market research in the future will be the practical contribution of this study. That way, when marketing surveys provide a more precise list of possible leisure

activities in outer space, the corresponding market research could better delineate the potential of the space tourism industry and its business model. Moreover, a multi-phase experience, a leisure theory, is applied in order to examine if this theory could explain a frontier form of leisure or what properties this theory may not be able to cover; therefore, an enrichment to the field of leisure experience is the theoretical contribution of this dissertation.

Definition of terms

Several important terms are mentioned in the title and content of this dissertation: netnography, leisure experience, space tourism, space tourist, orbital space tourism, astronaut, average person, and wealthy people.

- Netnography is defined as a participant-observational research based in online fieldwork (Kozinets, 2012), a naturalistic method (Kozinets, Dolbec, & Earley, 2014), and an ethnographic study of internet behaviors (Bastick, 2016). Netnography sheds light on broad issues in the social sciences (Kozinets, 2012), due to the fact that internet had become a key area of study (Bastick, 2016). Therefore, netnography is a digital ethnographic approach to conduct social scientific research.
- Leisure experience is described as multifaceted, transient and multi-phased phenomenon (Lee, Dattilo, & Howard, 1994). Leisure, on the other hand, is characterized as time, activity, and state of mind (Kleiber, Walker, & Mannell, 2011), as well as "a distinguishable context of relative freedom wherein preferred immediate experience has priority over instrumental outcomes" (Kleiber, Walker, & Mannell, 2011, p. 100).

- The term space tourism refers to "[the] practice for traveling into space for recreational purposes" (Oxford Dictionary, 2017).
- Space tourists represent people who traveled "into, to, or through space or to a celestial body for pleasure and/or recreation" (Freeland, 2010, p. 98). A space tourist is also known as a private space explorer or a private astronaut (Belij & Tadic, 2015; Reddy et al., 2012).
- Orbital space tourism, as the center of public interest and popular imagination (Beard & Starzyk, 2002; Collins & Funatsu, 2000) as well as the dominant space tourism in the long term (Ziliotto, 2010), must maintain a velocity as 28,000 kilometers per hour with an altitude between 200 kilometers (Freeland, 2010) and 350 kilometers (Cater, 2010).
- The term astronaut, originally obtaining the meaning as space sailor in Greek, is a career profession that represents the crew member taking spacecraft to the orbit and beyond (NASA, 2017c).
- An average person, here, indicates a normal type of human being with common features as the rest of the general population.
- Wealthy people, or "the wealthy" describes the individuals located at the top end of income distribution, including "top executives; investment bankers and hedge, private equity, and mutual fund inventors; corporate lawyers; athletes and celebrities" (Kaplan & Rauh, 2006, p. 1004).

Theoretical framework

Specifically, the study of individual leisure experience falls in the field of leisure perception, and such an approach examines leisure experience in the qualitative and

interpretive perspective (Mannell, Kleiber, & Staempfli, 2006). Moreover, serious leisure theory indicates a person takes a hobby seriously as a professional career (Stebbins, 2007), theory of a multi-phase experience demonstrates a set of phases in a particular leisure experience (Hammitt, 1980), and flow theory illustrates optimal experience (Csikszentmihalyi, 1990), are examples of theories in this field.

Therefore, leisure perception serves as the theoretical foundation of this research. The theory of a multi-phase experience provides an analytical tool to construct the experience of space tourism.

Research question

The primary purpose of this study is to explore the following: when people travel to outer space, what properties of leisure experiences attached to orbital space tourism could potentially attract tourists? Therefore, this study aims at collecting astronauts' Twitter posts to investigate a set of properties of leisure experiences attached to orbital space tourism.

Limitations

Unfortunately, the authentic experience of orbital space travel may be out of reach by the researcher, since only professional astronauts and very limited paid passengers have gone through that journey, while the researcher is none of the above. However, substantial ongoing posts published by astronauts on Twitter record the details of space travel experience. The researcher recognizes this limitation, and considers Twitter posts to be helpful to answer the research question.

As a highly selected profession, people with a job title of astronaut do not hold a large sample size. Up to date, around 522 worldwide astronauts have travelled into outer

space; it is still a relative small number compared to the world population. So the lack of a large population with the targeted experience is another limitation. The good news, however, is that popular interest and public imagination about space travel pay enormous attention to astronauts and their unique trips. A substantial number of interviews, news reports, videos, and social media posts gather the information about these people's journey together. Twitter, as a platform where everyone can generate their own knowledge, has attracted NASA and most of the astronauts to register and update information. The larger amount of Twitter posts makes up to some degree the limitation of the paucity of astronauts.

A third limitation of this study falls in the fact that only the astronauts with Twitter accounts will be considered during data collection. This study does not deny the importance of traditional archives of astronauts' experiences recorded by books, newspapers, and interview videos. Instead, comparing the experiences recorded by different media can be one idea of future research directions. In addition, not all Tweets published by selected astronauts will be covered. In order to better serve the purpose of answering the research question, the most popular astronauts' Tweets will be collected, and more will be added until data saturation is reached.

Delimitation

Space tourism is a fledging industry, with a broad range of topics discussed in academic publications and practical considerations. For example, aviation is strongly suggested to study as a parallel industry to space tourism; this idea, however, focuses on the industrial level and does not fit the researcher's interest and resource, so this recommendation is not considered as the main purpose of this study. In Chapter Two, this

topic is given attention and some degree of description as an important historical background. The first endeavor of delimitation is to limit the scope of research questions in exchange for a targeted research.

Moreover, space tourism has many forms. This study focuses on orbital space tourism because it is the center of current popular culture and public interest as well as a feasible, important and sustainable future sector; when the term space tourism is mentioned, it usually refers to the orbital space tourism and beyond. Other areas, such as cyber space tourism using virtual reality and terrestrial space tourism which already has a large number of customers and supporters, may shed light on the development of space tourism industry, but could hardly offer direct and convincing data in terms of leisure experience in outer space.

Third, majority of all perspectives of journal articles and academic publications in terms of space tourism are carefully read and examined, because they form an infrastructure, a historical background, and an overview of this nascent industry. They could support the justification of the rationale of leisure experience in orbital space tourism. In comparison, literature in aviation, spaceflight, and general tourism is considered to be important supplements but due to a limited time factor and the focus of this study, they are given less coverage in Chapter Two.

Fourth, the theoretical perspective is picked based on the nature of this study, the leisure experience. Psychological perceptions as a useful angle to examine leisure has gained popularity in leisure studies. It fits well with the research question and serves as a critical tool to investigate the experiential attributes.

Lastly, selection of method, data, the population and its criteria are carefully adopted, under the consideration of the nature of orbital space travel and overall existing research of space tourism. Critically speaking, the current market research, which occupies a large portion of all studies in space tourism, simply gather survey or interview results from random local residents or sometimes wealthy people by asking straightforward questions. For example, they ask "do you want to travel in space?" And "how do you rank these recreational activities in space?" The current market research estimates the market size and price, without a sound theoretical foundation or a social scientific explanation about where these attributes are from and why they are used in the survey or interview. It is understandable since the lack of data is an existing issue for space tourism studies. Hence, astronauts and their official Twitter accounts are selected in this study due to the fact that they are authentic space travelers and real-time reflection of their experience in space respectively.

Criticism may lie in the argument that astronauts are not space tourists. Indeed, an astronaut's primary reason for traveling to space is work, so they cannot represent the general population. However, astronauts work and also live in space. For long periods of time in space, astronauts need recreational activities to keep them physically fit, and they require leisure time to release pressure from risky work, even though the main objective in space is often work. In fact, they often make full use of their free time for leisure in space, including doing flips and playing with floating food. Evidences about astronauts' leisure activities are shown in NASA website. According to NASA, "living in space is not just all work and no play. Astronauts like to have fun, too" (NASA, 2015), indicating what the experiences that the future space tourist will encounter. Furthermore, a large

number of astronauts globally, so far 522, have orbited the earth. But less than 10 extremely wealthy and lucky people have toured the earth orbit as space tourists and have contributed to some scientific understandings about space program as private astronauts. But how many average persons have achieved it? None. Moreover, once tourists reach the sub-orbit or the orbit, they will earn the title of astronaut. For instance, Virgin Galactic will provide sub-orbital tourism in 2018 and guarantee an award of astronaut wings to its travelers. Hence, it is very possible that future private space travelers may favor the title astronaut instead of space tourists, and they can conduct educational or scientific projects during their trip in space which in turn makes the space travel more fun and more meaningful as the real astronauts.

Therefore, in terms of experience in space, an astronaut's account or story is the only data source that is large, practical, convincing, and reliable. Due to a relatively slow technological development in space science, astronauts' experience in space may not vary dramatically from year to year. Moreover, some journal articles do use a small portion of astronauts and their experience to support their arguments, and most responses from their studies indicate average persons' quest for an astronaut-like experience, or an "envy of astronaut" as this dissertation names it. In conclusion, these are some self-imposed boundaries, more are discussed in detail throughout the dissertation.

CHAPTER TWO: LITERATURE REVIEW

In order to answer the research question, this chapter summarizes and examines literatures surrounding the space tourism and related topics. The literature review is presented under the following angles: a) Space tourism from an aviation perspective, b) space tourism from a spaceflight perspective, c) space tourism from a tourism perspective, d) space tourism from a leisure perspective, e) current trends of space tourism, and f) chapter summary.

Space Tourism from an Aviation Perspective

History of aviation. The history of aviation has its origins in visual fantasy and a profound jealousy of flying creatures, evolving slowly through the amalgam of human effort and talent through the centuries into what we now call air travel. As early as millennia ago, ancient peoples imagined what it would be like to fly, clearly envying the soaring freedom of birds, and with their imaginations described the earth and heavens in legend, designing religious wherein gods used the magic of flight to lift themselves up through the sky (Gibbs-Smith, 2003). Subsequently, ceaseless efforts were taken in approaching the dream of flight throughout history: the first recorded tool of human flight belonging to the ancient Chinese: the kite. It became the documented forerunner of the airplane (Gibbs-Smith, 2003) followed by an illustrious number of names, such as Lu Ban (450 BCE), Archytas (400 BCE), Zhuge Liang (180-234), Abbas Ibn Firnas (875), Eilmer of Malmesbury (circa 1005), Leonardo da Vinci (1500s), Francesco Lana de Terzi (1670), Bartolomeu de Gusmão (1709), Emanuel Swedenborg (1714), Henri Giffard (1852); all involved in “the process humanity took in its progression towards breaking the bonds of gravity” (Danelek & Davis, 2011, p. 188). Finally, as a culmination of their

years of study and achievement (Danelek & Davis, 2011), the Wright brothers became the first men to fly the practical power-driven and controlled aircraft on 17 December 1903. Human flight, symbolized as ecstasy, forbearance, courage and heroism, turns over a new leaf in history (Gibbs-Smith, 2003).

Indeed, aviation is more than a transport tool. As Gibbs-Smith (2003) delicately summarizes:

> For flying has never appeared to its devotees as a mere method of transportation, faster or more convenient than travel by land or sea; nor was it finally achieved by any pressure of economic need. Aviation has drawn its strength from an appeal to the emotions; an appeal to the longing for escape, or to the desire for exhilaration and power. Some have simply seen it has a symbol of aspiration. Desire for rapid locomotion came later. (p. 11)

Similarly, the human desire to fly higher and higher can be safely assumed as a call of the heart. It is the escape, the excitement, the prestige, and pride of ambition that are most at the essence of space travel. We as humans always want something more, bigger, better; and space flight and tourism are the natural next step in the human quest to conquer and adventure.

Space tourism and aviation industry. Space tourism studies pay special attention to the development of aviation and attempt to discover a panacea in order to energize the space tourism industry. For instance, the history of the predominately commercialized and global aviation industry can serve as an analogue to approximate the development of space tourism or at least to provide some lessons. In particular, the

aircraft industry in the 20th century is a good example for space tourism. Surrounding issues include medical instructions, space traffic control, flying reusable engines, realizing passenger-carrying travel, collecting funds from early adventures and investing them to develop new technology for a growing industrial need (Cater, 2010; Collins, 2001, 2006; Collins & Funatsu, 2000; Laing & Crouch, 2004; Lyles, 2000; Maryniak, 2000; National Space Society, 2009; Reddy et al., 2012).

The development of aviation, however, may not be entirely parallel to spaceflight due to the fact that air travel and spaceflight have many differences (Collins, 2001; Peeters, 2010): The first major difference is duration. Fifteen years was taken from the first test airplane to a commercial air service for transporting passengers, while over 40 years were spent between the first astronaut orbiting the earth and the first space tourist. The second difference is support. Commercial passenger service in aviation is well-developed with public-private-partnership support, while space tourism is not even close to achieving that level of partnership. Third, customer positioning. Aircraft is tailored to consider the visual perception of customer's seat, but it was just proposed in space tourism not long ago. Finally, passenger-carrying vehicles. Aerospace industry has abundant experience in piloted vehicles, but as to spaceflight since the Cold War, unmanned vehicles is favored due to safety concerns.

Summary. Space travel is a higher and harder endeavor than air travel in terms of flight duration, essential support, passenger positioning, and transporting vehicles. Space tourism, however, can learn meaningful lessons from the aviation's success in commercialization. Though aviation industry is a great case study to compare with the

nascent industry of space tourism, this dissertation does not plan to map out the whole industry for space tourism.

Space Tourism from a Spaceflight Perspective

History of spaceflight. Just as Apollo 11 astronaut Edwin "Buzz" Aldrin landed on the moon in 1969 and proclaimed "We are today where the Wright Brothers were in 1903" (Smith, 2000), a few decades after the emergence of powered aviation, spaceflight emerged and had a higher ambition. The first man-made space object Sputnik 1, was launched and sent to outer space by the Soviet Union in 1957. In the following year, the United States established the National Aeronautics and Space Administration (NASA), the space race was officially on (Smith, 2000). Human spaceflight programs were established in the late 1950s and ignited a determination of sending humans into space and to the moon during the 1960s and 1970s thanks largely to the Cold War space race (Johnson, Chamberlin, Sturdevant, Sturdevant, & Leverington, 2010). Two big players were in the space race: the United States and the Soviet Union (Hansen, 1999). They even named their spaceflight crewmembers differently: calling them astronauts in the United States and cosmonauts in Russian (Bimm, 2014). The Soviet Union won the start of the race: Human spaceflight turned from fiction to reality when Yuri Gagarin orbited the earth in 1961 (Bimm, 2014), which made the Soviet Union the first country to put a man in space (Johnson et al., 2010). As for the United States, with limited ability to build rockets at the close of World War II, the American military did not fully join the space program until launching their first flight in 1961 (Bimm, 2014), a full month later than Yuri Gagarin's spaceflight. Each country's space agenda was led by natural born leaders: John Kenney in the United States and Nikita Khrushchev in the Soviet Union (Foster,

2006). Nikita Khrushchev, however, diverted efforts to propaganda campaigns for Soviet space program and that weakened the potential of technological progress; the Soviet Union tried hard but that did not prevent their loss when the manned lunar landing brought the race to an end (Hansen, 1999). In 1969, the United States pushed ahead of the Soviet Union, landing the Apollo 11 and two crew members on the moon, thus creating a landmark for themselves in spaceflight history (Foster, 2006). After the cold war, many industries and companies underwent massive reorganization, particularly decreasing financial allotments to defense and satellite communications; the funding for human spaceflight, however, remained the same (Collins & Funatsu, 2000).

In order to further serve the complex requirements of astronaut training, spaceflight research as well as launch operation and control, several human spaceflight centers have been established in the United States, Russia, Europe, and China, such as Johnson Space Center (United States), Kennedy Space Center (United States), Marshall Space Flight Center (United States), Mission Control Center (United States), Yuri Gagarin Cosmonaut Training Center (Russia), European Astronaut Centre (Germany), and Jiuquan Satellite Launch Center (China) (Johnson et al., 2010). In the United States, the Kennedy Space Center is a major operation center for NASA and has handled missile launches, and most of NASA's human spaceflight missions including Mercury (1958-63), Gemini (1962-66), Apollo (1960-75), Skylab, the Space Shuttle and the International Space Station, and including the Challenger and Columbia accidents in 1986 and 2003 respectively (Weitekamp, 2008). After the accidents took place, human space programs evolved into less challenging but more routine missions (Bimm, 2014), while the safety

of spacecraft operations experienced a dramatic upgrade during the grounding period after the tragedy (Rogers, 2001).

In terms of private development of space, traditional commercial space applications range from navigation and remote sensing to satellite communication, and telecommunications industries (Johnson et al., 2010). As a result, an increased awareness of the burgeoning of spaceflight experience to the public has been gradually noticed in the market (Maryniak, 2000).

Early trials of tourism in space. The idea of tourism in space has been discussed and practiced since the beginning of space race: During the mid-1960s, in the eras of the Mercury, Gemini, and Apollo, tourism in space was vaguely imagined as a natural profession to the space race, provided that space technology would advance and the Cold War would end (Rogers, 2001). In 1967, Barron Hilton presented his plan of building an orbiting hotel and even a hotel on the moon; later, Hilton went so far as to test their practicability with academic help from Cornell University (Johnson et al., 2010). In 1968, close to 100,000 people signed up for a waiting list on First moon Flights Club organized by Pan American World Airways to board spacecraft described in the movie *2001: A Space Odyssey* (Johnson et al., 2010; Launius & Jenkins, 2006). In 1969, Samuel C. Phillips, director of NASA Apollo program, predicted commercial space tourism as early as 1987 (Launius & Jenkins, 2006). Presentations and papers about market predictions of space tourism, orbiting space hotel and spacecraft design were presented at the International Astronautical Federation in 1986, 1987 and 1989 (Johnson et al., 2010). In 1990, Toyohiro Akiyama, a Japanese TV journalist, was paid between $12 to $14 million by the Tokyo Broadcasting System to board a Soyuz spacecraft and stayed at Mir Space

Station (operated by the Soviet Union and later by Russia) for 7 days 21 hours (Johnson et al., 2010). In 1991, Helen Sharman—British chemist, paid by a British consortium—became the first British woman to board Mir Space Station (Johnson et al., 2010). In 1996, Peter Diamandis established X-Prize Foundation to encourage the design of a reusable launch vehicle which was held until 2004 (Johnson et al., 2010).

Some serious discussions about space tourism took place among the space community. For example, in 1998 and 1999, NASA collaborated with Space Transportation Association and co-published two detailed reports on general public space travel and tourism (O'Neil et al., 1999, 1998). A study in 2000 proposed that tourism in space was estimated to become an establish reality by 2025 and provide a routine passenger service by 2040 (Lyles, 2000). And between 2001 to 2009, seven space tourists made eight trips to the earth orbit (Chang, 2015), although there is still somewhat of a controversy regarding the first tourist as well as the total number of tourists in space so far.

Early space tourists. Scholars have yet to agree on the early beginning of private space travel or even on the exact number of space tourists to date. Reddy et al. (2012) argue the start of commercial space market is on the one hand believed to be since 1970; whereas, Change (2015) and Freeland (2010) maintain it began on April 28, 2001. The Reddy et al. (2012) take the commercial space applications such as satellite-based services and multiple market players as well as economic potentials into consideration. While Change (2015) and Freeland (2010) narrow the scope down specifically to orbital space tourists. Both perspectives are correct. Military and scientific use of space since the 1960s have developed significant amount of commercial applications with space

technology, but only since the first space tourist orbited the earth has space tourism been brought into the real world (Freeland, 2010).

Webber (2010) maintains it is still arguable that Dennis Tito, as well as Toyohiro Akiyama could be defined as the first space tourist. If Akiyama's space exploration in December 1990 is regarded as the first, then total number of space tourists comes to a minimum of ten. However, Dennis Tito's journey in April 2001 has received a higher global recognition as the first individual paid space flight. That way, in total, seven space tourists have successfully taken eight trips to the orbit (Chang, 2015), they are: Dennis A. Tito, Mark R. Shuttleworth, Gregory Olsen, Anousheh Ansari, Charles Simonyi, Richard Garriott, and Guy Laliberte. At this point, space tourism is "a luxury market segment that caters to customers seeking adrenaline and boasting rights, its appeal is going to be exclusive but limited" (Gurtuna, 2013, p. 39). However, if the space industry can target the general public for a regular tourism purpose, the space tourism will be a massive market (Gurtuna, 2013).

Private organizations for space tourism. Now that multiple tourists have successfully adventured into outer space, commodification of space appears to be burgeoning into a promising future. Nevertheless, an early but pessimistic argument could be made that the private sector has been slow in catching on to the space tourism industry (Laing & Crouch, 2004), which may due to a lack of financial and governmental support. In fact, private investment has been identified as the biggest obstacle in space tourism (Reddy et al., 2012), and is also considered to be the greatest influencing factor affecting the space tourism industry financially (Cater, 2010). Moreover, governmental agencies were established during the Cold War to accomplish government space projects

and have limited operation experience of serving private travelers (Collins & Funatsu, 2000). Therefore, expecting that governments would work on public interest in space tourism seems like what could be described as pure naiveté (Collins, 2001). Thus, the ability to create space tourism business is left to the private sector. For example, Virgin Galactic has collected deposits from 700 people for sub-orbital trips which will take place by the end of 2018 (Bailey, 2017; Virgin Galactic, 2017b), and SpaceX has announced to send two private citizens to the moon in 2018 (SpaceX, 2017b).

Despite these hurdles, there are possibilities that the private sector could promote a successful future for space tourism. For example, good news in this new frontier was celebrated when it became known that a number of private companies successfully served transportation in cargo, astronauts, and tourists to the International Space Station (Webber, 2010). Indeed, several commercial space organizations have marked their significance in the history of space tourism. These companied include Russian commercial spaceflight company MirCorp, Space Adventures of USA, Boeing and SpaceX (funded by the US government), Virgin Galactic, XCOR Aerospace Company, Orbital Sciences, SpaceShipOne, Airbus Defense & Space, Blue Origin, SNC, Swiss Space Systems, Bigelow Aerospace, Rocketplane-Kistler, Orbital ATK, United Launch Alliance. Before space tourism develops into a successful market, vehicle design and legal issues are the main challenges for these space tourism companies.

Vehicle for space tourism. The first step many of these private space organizations might possibly take is to build or borrow a vehicle for space tourism. As Reddy et al. (2012) indicates, the competitive power in the future of the space tourism market will lie not only within the trip duration supported by the spacecraft, but by the

small distinctions of the spacecraft designs themselves. Fortunately, several vehicle considerations have already been addressed by the space community regarding this exciting prospect.

Radical innovation might prove to be the first step in satisfying the needs of building a sophisticated spacecraft for travelers. Built in 1981, Space Shuttle was the first generation of reusable launch vehicle. Three more advanced generations of spacecraft have been proposed to achieve a safety level of four orders of magnitude (Lyles, 2000), demonstrating once again the imperative of technological innovation. Furthermore, a hypersonic spacecraft has been suggested for orbital space tourism, with more advanced engines, thermal and stability control systems than sub-orbital flight vehicles, while vehicle system may vary based on its function as carrying cargo, passenger, or both (Webber, 2010). Specific requirements inside the spacecraft have also been addressed, such as the G-force adjusting chairs, visible windows, safety bar for reentry, communication equipment for each seat, video-recording system, suit and helmet for space passengers (Webber, 2010). What's more, treatment facilities for medical emergencies are suggested for all kinds of space transporting tools (Marsh, 2006). The radical technological innovation in the space industry is essential to the development of space tourism business.

Some scholars hold a negative attitude as to the probability of further technological breakthroughs. For example, breakthrough in cargo service by SpaceX Dragon cannot guarantee a viable human spaceflight within the predicted future (Launius & Jenkins, 2006). Another example would be that a radical innovation in propulsion units may open space access to ordinary people, but until then, orbital space flight could still

be years away (Launius & Jenkins). However, a technical study regarding the design of spaceplane for space tourism explains that the development of a reusable space booster can possibly be built using advancing technology, the barrier being not so much about technology, but the mindset for change of system design (Penn & Lindley, 2003).

There is no doubt that difficulties exist in this frontier business. For example, the interrelation between space tourism service and spacecraft design (Peeters, 2010), highlights the complexity in design of space vehicles for space tourism that the more market requirements would add in each phase, the more complicated the vehicle system would be. Hence, it is not a surprise that there is a call for global cooperation.

Indeed, support from international and governmental-corporate collaboration are indispensable for developing a feasible vehicle for any future space passengers. In terms of technological innovation, markets outshine governmental agencies in leading the changes, but this is not necessarily the case in space programs worldwide (Maryniak, 2000). For example, while the Soyuz rocket sent the first space tourist to the International Space Station, the Boeing and SpaceX's Dragon Program, as well as the Chinese Shenzhou spaceships are generally believed to contain the hope of turning the next page in history of human spaceflight (Chang, 2015; Reddy et al., 2012). These space vehicles are either fully or partially built by governments. Therefore, a multinational collaboration in private space projects has been proposed to promote the commercial success of space tourism (Collins et al., 1996).

Laws and regulations for space tourism. From a legal perspective, space tourism represents the third era in the history of human exploration in space. In the first era, a few governments and public agencies launched, operated and controlled space

objects with limited help from private entities in manufacturing; hence, the legal considerations mainly covered the governmental use of space; in the second era, the private side played a role in launching and operating space objects, but under the legal control and supervision from the government; in the third era, space tourism became fully privatized and the commercialization of manned spaceflight became a reality, simultaneously bringing up new legal aspects to contemplate and explore in the brave new world of space tourism (Von der Dunk, 2011); for example, the relationship between sovereign state and the outer space, several legal issues, and a call for regulations for orbital space tourism.

As the third era evolved, the old space law became antiquated while space tourism progressed. Because outer space does not belong to any sovereign state, the use of outer space should in theory be unencumbered and unrestricted. Space tourism, however, launches from and returns to the earth, requiring the use of air space to remain a legal status (Freeland, 2005). For example, a number of legal issues, such as liability, passenger informed consent, regulatory process for space vehicle certification and authorization, environment consideration, celestial property rights, as well as export control, need to be discussed well in advance (Freeland, 2005; Laing & Crouch, 2004; Marsh, 2006; Peeters, 2010; Reddy et al., 2012). Furthermore, there is apparently a lack of legal and regulatory support for orbital space tourism (Chang, 2015).

Fortunately, the development of regulations and laws in space tourism has attracted several academic publications: there is a quest for consent on a governmental (Reddy et al., 2012) and personal level (Knutson, 2007), a quest for air and space law (Hobe, 2010; Von der Dunk, 2011), a quest for international law (Collins, 2006; Freeland,

2010), and a quest for insurance (Elgart, Shavers, Huff, Patel, & Semones, 2016; Laing & Crouch, 2004; Ziliotto, 2010).

The governmental consent for launching tourism spaceship has been more promising in the United States than in Europe, after NASA shifted its strategy towards civilian space flights and away from a misuse of resources towards what promises to be a huge potential to benefit space agencies (Reddy et al., 2012). In terms of individual consent and informed consent, one legal study suggests that this industry has a legal responsibility of notification due to its unquestioned demand to share the risks with passengers, and passengers could decide on their own and be prepared for risks during their involvement in space tourism (Knutson, 2007). As to air law, regulations and laws must be coped with on an international level as in air law, both sub-orbital and orbital flights call for a space traffic management (including certification, registration, liability, authorization and continuing supervision) since both types of space flights go beyond the domestic level (Von der Dunk, 2011). As to international law, Freeland (2010) discusses the legal status of space tourists, rules of liability for death and damage, celestial property rights, pollution and ethical issues, protection of heritage sites (Collins, 2006), all found under the international law. In terms of air and space law, a mixture of them may be requested even though they are fundamentally different. Therefore, several legal aspects need to be addressed, such as the need to determine the boundary of airspace and outer space, to distinguish aircraft and spacecraft in a legal perspective, to authorize and register space vehicles, and to define liability for passengers in case of injury or death as well as for carriers in terms of damage (Hobe, 2010). As to insurance, space business is generally exposed to a high risk circumstances (Elgart et al., 2016). Both the Challenger

and Columbia disasters impacted space tourism activities (Laing & Crouch, 2004), and any accident in this fledging industry can put its prospects off for decades (Ziliotto, 2010), calling for the identification of risks and strategies to minimize the loss in the industry of insurance. However, the potential sector of space tourism is a puzzle to the insurance industry challenged with building a sound space tourism industry. Many questions abound in the crafting of damage insurance for spacecraft, such as: What is the nature of risks attached to new technology in space tourism? How to cope with the limited historic statistics? As well as the opportunity that insurance would be a significant enabler for the sound development of space tourism (Bensoussan, 2010).

Summary. The space race pushed the rapid development of human spaceflight as well as the practical idea of space tourism. Although there is a debate as to the origins of space tourism and that to date, only a few privileged and wealthy people have achieved the dream of outer space. Fortunately, private organizations consider commercial space travel as a promising business venture. However, before they can make any true progress, issues including vehicle design and international law may be deemed essential. Both technical and legal discussions are important subjects as they can impact the leisure experiences of the space traveler.

Space Tourism from a Tourism Perspective

History of tourism. Tourism is an activity that has been enjoyed since ancient times (World Tourism Organization, 1995). Homo erectus, our early human ancestors known as upright man, relocated substantially from Africa to the Middle East and to Asia approximately one million years ago; following that tradition of migration, the evolution of travel may be seen developing along the Mediterranean Sea during 2000 B.C.E. to

C.E. 500 (Goeldner, Ritchie, & McIntosh, 2000b). The earliest record of tourism is an Egyptian cruise which took place in 1480 B.C.E. in the name of peace; in 150 B.C.E. roads were first built by Romans, some of which, amazingly enough, are still in use (Goeldner et al., 2000b). In the later 5th century, the Parthenon was developed as a religious attraction by the Athenians; later, the silken thread that tied the East and the West was originally begun by Marco Polo's visit from Italy to China in the 13th century; tourism in France and Italy took place for the purposes of diplomacy, trade, and knowledge during the Grand Tour from the 17th to the 18th century (Goeldner et al., 2000b). Historic tourism was not as prolific as what we enjoy today until the birth of the seaside leisure consumption in the early 19th century through which modern tourism took root; although tourism was later altered by technological innovation, it managed to survive the process from stagecoach to steamboat, from railways to automobile, from Pan-Am to outer space, to the commodification and consumption (Meethan, 2001) of a formation of an industry of travel. The travel industry did not experience another giant step until the end of World War II, largely due to factors including an increasing amount of leisure time for people in the 20th century, shortened working hours, convenient and affordable transportation, and technological development (Edgell, 1996). By the late 20th century, the significance of tourism had been widely recognized (World Tourism Organization, 1995).

As experience economy emerges and information technology advances, new consumers appear, experience becomes the foundation of tourism products (Gretzel & Fesenmaier, 2004), that is, travel is a product of experience, and tourism is the industry of experience (Pine & Gilmore, 2014). So far, job opportunities in travel industry have

covered transportation, cruise, lodging, food and beverage, travel agencies, sales, health care and other specialties including law, photography, film, literature, higher education, design, and translation fields (Colbert, 2004). A recent report shows that the worldwide total number of international tourists has reaches 1.2 billion (World Tourism Organization, 2016). Furthermore, tourism contributes to 10% of the world GDP, creating one in ten jobs globally, and generating 1.4 trillion US dollars in exports from international tourism (World Tourism Organization, 2017). Tourism matters to the contribution of economic development. And the ability to create tourism market in space is important to "the future of humanity" (Gurtuna, 2013, p. ix).

Tourism and its nature. Tourism is defined as "activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure business and other purposes" (World Tourism Organization, 1995, p. 1). Here, the person participating in a tourism activity is called a tourist, and in academic writing and popular culture, the term *tourist* is not considered the same as the term *traveler* (Wearing, Stevenson, & Young, 2010).

According to Goeldner, Ritchie, & McIntosh (2000a) and Wearing et al., (2010) there are five perspectives in terms of tourism: The tourist is to spend their leisure time on mental or physical activities at self-decided vacation spots; the business is to provide service and goods to support tourists' demands and make profits out of it; the government, to regard tourism as strong economic factor; the host community is to utilize tourism for publicizing local culture and increasing employment; and the phenomenon is to impact economy, society and culture throughout the world.

In essence, tourism requires three elements from a tourist perspective: financial investment at one's discretion on travel for leisure, free time for leisure travel, and supportive infrastructure in transportation, accommodation and recreation facilities (Launius & Jenkins, 2006). Additionally, the nature of tourism goes beyond a mere pleasant memory, and brings visitors the benefits of new knowledge and awareness of sustainability. For example, in the United States, spectacular geological wonders in national parks attract tourists from all over the world. While tourism sites like these parks, however, hardly balance the willingness to please tourists and the mission to preserve the natural beauty, which brings forth the fact that the essence of tourism should be far more than happy photos in visitors' album (Runte, 1998).

The nature of tourism may explain the importance of space tourism. One element of the nature of tourism takes into consideration the sited knowledge or socially constructed knowledge which is deeply embedded within its location, so that mobility and travel have educational purpose, that is, to enhance visitors' level of practical knowledge and to fulfill their professional expectation and curiosity (della Dora, 2010; Riley, 1996). For example, many space tourist's primary reason for space travel may be for educational purposes; the weightlessness nature of space tourism can teach the participants about how humans take gravity for granted. Another element of the nature of tourism has scientific purposes: imagination about tourism sites raises the awareness and necessity of protecting a natural environment so that the scientific studies in plants and animals can be supported (Runte, 1998). Pang (1993) notes space tourists' interests could include unique trips, for example an eclipse expedition, could test and enrich the existing

knowledge in science. And a trip to the boundless space, could also inspire curiosity in space science. Tourism in space, has both educational and scientific contributions.

Another important part of tourism is marketing, especially tourism promotion activity. Academic research has shown interest to the topic of tourism marketing as early as the 1970s. For example, early tourism psychology had summarized four fundamental travel motivators including a physical motivator (to rest, relax and exercise for health), a cultural motivator (to know new culture), an interpersonal motivator (to social and escape), and a status and prestige motivator (in terms of ego needs and individual growth) (McIntosh, 1977). Another example is about inquiring as to tourists' motivation in traveling to some destinations, a conventional method was applied to ask tourists to rank identified features prior to their visit (Dann, 1996). Indeed, motivation is an important concept in market studies. Motivational concepts and theories have been broadly studied, such as Maslow's hierarchy of needs (Pichère, Cadiat, & Probert, 2015) and escape-seeking dichotomy (Dunn Ross & Iso-Ahola, 1991). Scholars also developed the framework of tourism motivation, including a hypothetical extreme of tourism value (Przeclawski, 1985) and travel career ladder (Pearce & Lee, 2005). Some of the theories have been applied to understand adventure tourism motivation, for instance, the push-pull factors (Crompton, 1979; Crompton & McKay, 1997; Dann, 1977, 1981). Other adventure tourism studies address the primary motivation factors as real risk and physical danger, risk and thrill, and complex factors (Giddy & Webb, 2016). In academia, abundant motivational theories have enriched the research for tourism. However, as to a frontier type of tourism, for example, space tourism, it is barely possible to clearly depict

the market as well as participants' motivation before the space tourism business really begins.

Tourism in space. Tourism in space is one example of frontier tourism which is characterized as high cost, unformed infrastructure, little resident population, participants-bore safety and responsibilities, unique experience, and unknown destinations (Laing & Crouch, 2005). When space tourism compares to other established tourism forms, no tourism components have matured enough for public space trips, there is no doubt, however, that space could hold its own space in the tourism industry (Launius & Jenkins, 2006).

***Definition of space tourism*.** Academic literature does not acknowledge the definition of space tourism with only occasional attempts to clarify the concept. Freeland (2010) explains that space tourism can be defined as commercial activities of serving experience associated with space travel, and space tourist is expounded as people who travel "into, to, or through space or to a celestial body for pleasure and/or recreation" (p. 98). The definition of space tourism is usually compared to private spaceflight. However, "space tourism" is not technically a precise expression compared to the term "private spaceflight." First, space tourism is expected to be privately funded, but not all private spaceflight is the same as space tourism. For example, a private company may pay for a space flight for a science mission, but then it no longer contains tourism. Second, since the current space tourists have used Soyuz spacecraft (public) and have stayed at International Space Station (public), only the tourist himself is the private element. If the tourist conducts military or science activities during the flight, the trip cannot be easily labeled by space tourism (Von der Dunk, 2011). Private spaceflight is then defined as

"flights of humans intended to enter outer space (a) at their own expense or that of another private person or entity, (b) conducted by private entities, or (c) both" (Von der Dunk, 2011, p. 147). Therefore, space flight does not directly refer to space tourism. This dissertation uses the definition of space tourism given by Freeland (2010).

Classification of space tourism. Likewise, there is no standard classification of space tourism either. Space tourism can be divided into five broad areas of virtual, terrestrial, near-space, sub-orbital, and orbital market (Chang, 2015; Laing & Crouch, 2004). Virtual space tourism, use virtual reality or other latest technology to come alive the experience of space travel for the public, in order to stimulate people's interest with lowest cost.

Terrestrial space tourism includes NASA museums, Smithsonian National Air and Space Museum, eclipse tours, space camps, and rocket launch sites. At this level, people can experience recreational training and simulators, learn the history of space programs, and observe stars in a planetarium. Terrestrial space tourism has been a huge and ongoing public space travel market though it is entirely earthbound (Rogers, 2001). In addition, terrestrial space tourism is regarded by space travel agents as an important foundation for beyond-earth activities (Cater, 2010) due to its ability to develop potential customers for orbital spaceflight, and for shaping latent market segments (Crouch, Devinney, Louviere, & Islam, 2009). For example, Kennedy Space Center at Florida has developed a mature tourism destination for space fans, functioning for scientific, educational, entertaining, and ecotourism purposes, and plans to develop potential weightlessness and sub-orbital flights in the future (Cater, 2010). Moreover, another kind of terrestrial space tourism is specifically designed program, such as astronomical observatories, that connects tourism

and astronomy science with sophisticated instruments and modern sites for massive professional, amateur, and space science fans (Belij & Tadic, 2015; Fayos-Sola, Marin, & Jafari, 2014). Near space tourism takes participants to a high-performance jet for short-term weightlessness, or to a verisimilar training aircraft for microgravity experience.

Sub-orbital space tourism reaches an altitude to sightsee the black sky and the earth's curved surface. It is an active concept in the beginning of 21st century but not yet a reality. According to Collins (2006) , a ticket for sub-orbital space tourism has been quoted for $200,000 for a single person. Sub-orbital space tourism could be the most affordable space tourism experience (Cater, 2010; Launius & Jenkins, 2006) and a flourishing market (Beard & Starzyk, 2002; Peeters, 2010). Chang (2015) shares the same vision, but adds that several traffic tools have been developed including Lynx Suborbital Vehicle, Airbus Spaceplane, and Dream Chaser. Freeland (2010) also believes that the most frequently used type will be sub-orbital space tourism with an altitude of from 100 to 200 kilometers.

Orbital space tourism has already garnered more public interest and attention due to a more extensive experience (Beard & Starzyk, 2002; Collins & Funatsu, 2000; Ziliotto, 2010). The last among these five categories, orbital space tourism could be the most expensive, riskiest, and longest duration (from one day to several weeks). A hotel in orbit or a holiday destination on the moon or Mars may be possible pending unprecedented technological and entrepreneurial efforts. A certain degree of orbital velocity and altitude must be maintained to successfully orbit, for example, 28,000 kilometers per hour with an altitude of 200 kilometers (Freeland, 2010). Russian Soyuz spacecraft is the only option for orbital tourism, further advancements are required to

utilize potential choices including governmental space programs or commercial spacecrafts (Beard & Starzyk, 2002). Both the sub-orbital and orbital space tourism attract the most attention in academic articles of space tourism. This dissertation focuses on the orbital space tourism, but also takes sub-orbital form into consideration.

Sub-orbital and orbital space tourism. Among all the categories sub-orbital and orbital have attracted heated debate in the space tourism community. They are also the important topics in this dissertation. Both terms include "orbital", but they are mutually exclusive. Scholars have demonstrated several differences including orbital space flight needing more than an order of magnitude or 25 times more advanced technology and training (Maryniak, 2000) than required for a sub-orbital spaceflight (Launius & Jenkins, 2006). In detail, orbital space flight needs 64 times the propulsive energy than a sub-orbital spaceflight (Collins, 2006). Moreover, Chang (2015) summarizes three other major distinctions between the two concepts. First, Sub-orbital space tourism will depend on spacecraft provided by private organizations, while orbital space tourism will use transporting vehicles developed by public or governmental agencies. Next, tourists will spend very less time in sub-orbital space compare to a longer duration in low earth orbit; for example, sub-orbital flight may only experience weightlessness up to six minutes when engine closes down. Finally, the cost of single trip in orbit may be a hundred times more than in sub-orbit. Sub-orbital space tourism, like the first three categories (virtual, terrestrial, near-space tourism), is still technically earthbound. Sub-orbital travel will take passengers to the edge of space for only a short period of time which is a form of flight more analogous with aviation (Von der Dunk, 2011). A study conducted by Ziliotto

(2010) reveals that a priority of space destination is the moon and orbital spaceflight, sub-orbital space tourism is inevitable but will not be sustainable.

Given the study of space tourism is still in its infancy, it is paramount to make a concerted effort to adequately define the types of space tourism. This study focuses on the classic type of space tourism, orbital space tourism, since it is more sustainable and has attracted more public attention than the other types. This study may also derive some information from sub-orbital space tourism as it is an inevitable stage of the experience.

Research of space tourism. This dissertation is far from the first study about space tourism. Building on the knowledge of existing research, this dissertation aims to fill the gap in the literature by explaining the authentic leisure experiences attached to orbital space tourism. After all, space travel has only been a written form in the literature until the year of 1961 when Yuri Gagarin became the first human to tour the earth orbit.

Space travel is not a concept that just emerges in the 21st century. References to space travel appears in literature as early as the late 19th century and early 20th century, such as *De La Terre a la Lune* (1865), *Autour de la Lune* (1870), *Armageddon-2419* (1928), *Airlords of the Han* (1929), (Smith, 2000). Indeed, literature since the 19th century favors the subject of space travel, so does popular culture as people long for a trip into space. However, the overall number of academic publications are very limited; few scholars' interests are devoted to space tourism (Crouch, 2001; Laing & Crouch, 2004; Reddy et al., 2012; Rogers, 2001); nor do they give enough critical examination to this nascent industry (Cater, 2010). Of the few academic publications on space tourism, the majority are on market research. However, the surveys and questionnaires used in these space tourism market studies neglect the foundations of the questions. In particular, it is

necessary to justify the leisure properties of space travel experiences before using them in survey or interview questions. Therefore, this study aims to investigate a set of leisure properties by extracting authentic space travel experiences from astronauts.

Overview of the research in space tourism. The good news is that academic attention to space tourism is progressing. Acta Astronautica Journal and UniGalactic Space Travel magazine are two examples of current publications (Chang, 2015). Several space tourism symposiums have been organized to recognize latent obstacles and to judge the general feasibility of public space travel, such as the first international symposium on space tourism held in Germany in 1997, and a symposium held by International Academy of Astronautics in 2008 and in 2011 (Chang, 2015). Additionally, space tourism workshops, and competitions, such as Space Tourism Society, Space Frontier Foundation, and X-Prize, have been held for some years (Laing & Crouch, 2004). Academic interest in space tourism has gradually developed, and it will potentially promote the space travel business.

Given the rise of academic interest in space tourism, it is only natural that space studies would also become more visible in higher education settings. Space Camp located in Huntsville, Alabama serves as an education site for space science, so do a number of undergraduate and graduate programs in universities all over the world; for example, the International Space University in France functions as a teaching organization (Smith, 2000). Universities including China University of Science and Technology in Taiwan, Keio University in Japan, and Rochester Institute of Technology in New York offer courses in space tourism (Chang, 2015); they have made a leap in cultivating interests in space tourism in higher education.

Lastly, the current research in space tourism recommend a wide range of research topics, such as the concept of space tourist, market demand, the awareness of space tourism, motivational exploration, health and insurance issues, training factor, risk, legitimation issue, socio-economic values, and environmental concern (Reddy et al., 2012). In terms of data collection, the current research demonstrates that narratives and marketing research are the main themes in space tourism studies. However, in current literatures, a critical gap exists and requires more academic attention.

Data collection of space tourism studies. Two interesting conclusions can be drawn from the types of data collected in published space tourism studies. The types are as follows: (1) The summary of literature and narrative (Ashford, 1997; Belij & Tadic, 2015; Bensoussan, 2010; Cater, 2010; Chang, 2015; Chang & Chern, 2013; Collins, 2001, 2006; Collins & Autino, 2010; Collins & Funatsu, 2000; Crouch, 2001; Fayos-Sola et al., 2014; Freeland, 2005, 2010; Gast, 2010; Knutson, 2007; Laing & Crouch, 2004; Launius & Jenkins, 2006; Marsh, 2006; Nagatomo, 1992; National Space Society, 2009; Peeters, 2010; Rogers, 2001; Smith, 2000; Von der Dunk, 2011; Webber, 2010), (2) surveys from the public (Collins, Iwasaki, Kanayama, & Ohnuki, 1994; Collins et al., 1996; Crouch et al., 2009; Depasquale et al., 2006; Le Goff & Moreau, 2013; Reddy et al., 2012), surveys from wealthy and/or adventurous people (Beard & Starzyk, 2002; Ziliotto, 2010), and telephone questionnaire from random individual (Collins et al., 1996), (3) technical data (Abitzsch & Eilingsfeld, 1992; Isozaki, Taniuchi, & Yonemoto, 1995; Koelle, 1999; Penn & Lindley, 2003), (4) interview from space tourism operator and travel agents (Cater, 2010; Reddy et al., 2012), interviews with residents (Le Goff & Moreau, 2013).

When sorting out academic publications by the data collecting method, there are two interesting conclusions. First, the dominant amount of research gives a general description in every aspect of space tourism, covering history review, market estimation, motivation and drive, media coverage, potential passenger, legal issue, technical consideration, and prospects. On the one hand, these studies do a great job in delivering a narrative and a summary of literature. They map out the whole picture of space tourism and serve well for a general understanding of space tourism industry as a whole. On the other hand, because each topic receives an equal coverage and no specific effort is devoted in detail, these studies end up with less help in inspiring future research or practical development of space travel industry.

The second interesting conclusion is that data collected from interviews and surveys is used specifically for market research of space tourism. In fact, the very first study from 1994 was conducted for the purpose of estimating market size and residents' expectations in the future space tourism market (Collins et al., 1994). The positive side is that market research is spread-out from the 1990s to recent years. This research demonstrates people's preferences of such a frontier leisure activity and reveals the sensitive demands due to the extreme high price for a ticket. Meanwhile, these studies somewhat market space tourism with their sample population. The downside is, however, none of the market research could really predict the future, though it is meaningful for practical consideration by offering some insights. Furthermore, the questions from all these surveys and interviews are not grounded empirically in social science practices. For example, asking a subject "Do you want to go to outer space for fun?" without providing a sound description of what it would be like to experience leisure space travel; or listing

several properties of the space tourism experience and letting interviewees make an order of preference without beforehand justifying the authenticity and feasibility of these attributes is inadequate. Therefore, this study aims to fill this critical gap in space tourism research; that is, to conduct research on the real leisure experience of orbital space travel of astronauts so that it will provide researchers with a social scientific foundation for future market research.

Market research. The existing market research in space tourism demonstrates two angles: a perspective of research method and a perspective of critical thought. In terms of research tool, the first survey for orbital tourism took place in Japan in 1993; over 3,000 people participated (Collins et al., 1994). It follows with several market studies indicating the marketing community has some interests in space tourism, such as the studies by Collins (1995) and Abitzsch (1996). NASA/STA (1998) surveyed 1,500 US families, and Futron Corporation (2002) surveyed 450 wealthy Americans. The majority of these surveyed people are either chosen from random families or state a willingness to go to space. One of the most cited and highly appreciated market research studies is mainly written by Suzette S. Beard and Janice Starzyk from Futron Corporation in 2002 (Bensoussan, 2010; Cater, 2010; Chang, 2015; Collins & Autino, 2010; Crouch et al., 2009; Depasquale et al., 2006; Gálvez & Naja-Corbin, 2008; Le Goff & Moreau, 2013; Reddy et al., 2012; Webber, 2010; Ziliotto, 2010). The Futron study mainly covers three aspects of space tourism: the size, the growth potential, and the customer features of the market. The study compares a 15-minute sub-orbital spaceflight to the fringe of space and a 2-week orbital spaceflight to an orbiting object or location. Interestingly, the article predicts a 20-year period demand in space tourism.

A perspective of critical thought is widely revealed in market research of space tourism, and these studies have inspired this research to answer the research question: when people travel to outer space, what properties of leisure experiences attached to orbital space tourism could potentially attract tourists? Recent research considers the early studies, especially those which discussed motivational perceptions in the industry of space tourism that had been conducted in Japan, Australia, and the United States, to be antiquated, so it proposes a set of elements to understand motivational perceptions of potential space tourists in a regional basis (Reddy et al., 2012). Therefore, this investigation uses the up-to-date experiences of space travel from NASA astronauts' real-time posts in Twitter. Moreover, due to the unfixed nature of fledging market, market studies could hardly reveal the surface with regard to the commercial results that exist in the future (Crouch, 2001). On the contrary, research to offer a platform for business investment in the space tourism industry is expected, so that prosperity of space travel in tourism by the end of 21st century could be possible (Laing & Crouch, 2004). For the market research, most surveys obtain straightforward yes-or-no answers from people's expectation in space tourism. However, one study, analyzing the choice-making process among kinds of space activities, criticizes the vague and open answers collected in these surveys (Crouch et al., 2009). Indeed, it is highly inadequate to ask a simple question "Would you be interested in going to outer space for leisure?" to assume a potential group of participants (Launius & Jenkins, 2006). Scholars cannot simply assume that there will be an upcoming space tourism industry by exaggerating technological, economic and political prospects (Launius & Jenkins, 2006). The ticket price $61,300 is a breakeven point for space tourism, theoretically (Peeters, 2010), while a price of $12 to $20 million

guarantees a successful company of orbital space tourism with the evaluation by net present value (Depasquale et al., 2006). However, the underlying assumption that frequent human spaceflights will drag down the cost as well as ticket price, turns out to be inadequate (Launius & Jenkins, 2006). According to the Futron Corporation study, it is highly possible that a huge cost decrease could only lead to a minor increase in participation, and revenue cannot even compensate for the substantial infrastructure investment. So it is suggested that the early market should hit 150,000 passengers per year with a ticket price of $72,000 (Penn & Lindley, 2003). Another two limitations of current market research about space tourism are the dependence on surveyed responses which cannot be solved until further growth in this industry and respondents' lack of accumulated wealth to participant in leisure space travel (Crouch, 2001). After all, "history tells us that predictions of this nature can go badly astray. As with most future events, we can be more certain they will happen than we can be about the precise timing" (Crouch, 2001, p. 219). Indeed, market research may be impossible to predict some details of the space tourism industry, but at least one thing is clear, space tourism will happen someday.

Potential space tourists. The type of potential space tourist is a common topic in market research of space tourism. Generally speaking, there are three inquires as to who should and should not be considered target markets for space tourism.

Who should not be the future participants for leisure space travel? Research shows that potential participants may be highly ineligible because of addiction to drugs or alcohol, dishonest or criminal conduct, poor medical condition, failed behavioral examination or flight training (Laing & Crouch, 2004).

Do nationalities matter? According to the demographic study of potential sub-orbital space tourists (Le Goff & Moreau, 2013), Europeans, especially Germans, pursue the elite experience, but could hesitate going due to issues as safety, self-indulgence, and environmental barriers while that cannot stop many Americans or Chinese. Adventure is a major attraction to Americans and Europeans, while Japanese mainly want to be the initial explorers. Chinese and Americans are the most passionate about sub-orbital flights. Therefore, according to Reddy et al. (2012), the nationality of potential space tourists matters in their decision-making in traveling to outer space for fun.

Should future passengers be wealthy or adventurous? Potential tourists could be either the extreme sports fans or the wealthy leisure travelers. Extreme leisure participants seek thrills, risks of riding spacecraft, perception of speedy acceleration and weightlessness. Wealthy travelers pursue the thrills and have the financial ability to pay for the experience of a space trip (National Space Society, 2009). People with abundant free time and ample money are considered the target group in space tourism; they could be upper-level managers, board members or popular stars in sports, movie, music, and art (Peeters, 2010). Another study supports this argument with its finding that a large amount of high-income people would prefer to join some types of space tourism activities (Crouch et al., 2009). However, the assumption of adventure lovers as potential space trip participants is proved to be false, but the assumption of rich participants is still highly possible (Ziliotto, 2010); thinking of the current space tourists, their ability to pay for the expensive ticket proves this statement. Indeed, rich adventurers could be the target passengers of the embryonic space tourism; people accepting moderate risk and less expensive price will be the major prospect for this industry and for the dream of public

space tourism to come true (Launius & Jenkins, 2006). After all, in a broader sense, difficulty in magnetizing private investment is the main reason of a limited development of commercial space tourism industry; and the withdrawal of the Space Shuttle decreases the possibilities of public interests since that way only the richest could afford a seat in a Russian Soyuz spaceship (Reddy et al., 2012). It may explain the reason why only seven space tourists in total have toured the orbit. However, despite this research, exactly who future potential space tourists could be still puzzles the space tourism community. Potential participants should have the willingness and financial support, yet the other attributes are unknown; future research should address characteristics of potential space tourists in nationality, age, gender, education, and personality (Reddy et al., 2012). This argument can inspire future research in exploring age and gender's influence on leisure space travel experience.

Summary. As a frontier form of tourism, space tourism is summarized by its definition and several kinds of classification. Based on the space tourism literature, this study will focus mainly on orbital space tourism with minor inclusion of sub-orbital space tourism, because orbital space tourism is believed to be the center of public interest and popular imagination, as well as a sustainable form of space tourism in the long term. Similar to the significance of market research in tourism industry in general, market studies in space tourism are also popular. This section gives an overview of space tourism research as a whole and specifically summarizes and justifies different kinds of data collection applied in these studies, points out two mainstreams in these market studies of space tourism, and explains the current development in locating qualified future leisure space visitors.

Moreover, this dissertation recognizes two gaps in academic articles. Survey questions and properties about space tourism experience are widely used in market research, but none or very few states the reasoning, the rationale, or the justification of these space experiences. There is no conclusion yet whether either the wealthy people or the adventure seekers would most desire a trip into space. Besides that, would all space tourists want the same experience? People may favor different kinds of experiences in space. Could we market certain properties of leisure experience to the targeted groups of people in order to do a better job in marketing? These gaps or questions are yet to be answered in the current space community.

Therefore, this dissertation aims at the follow purpose: to consider the authentic properties of leisure experience in space to provide a sound foundation for future market research both in academia and in practice. The current space tourism company claims to award its tourists with astronaut wings, and the social media platform Twitter has recorded many real-time experiences posted by astronauts in space; both cases highlight the significance of astronauts. So this study collects data created by astronauts who have authentic experience in space. What is more, NASA demonstrates that astronauts' life in space is not all work, they have free time to enjoy themselves, and astronauts love to have fun in space (NASA, 2014, 2015; NASA Education, 2004). Hence, the study of leisure and its experience in supporting this dissertation is essential. The rationale behind this argument is that the form of tourism and its marketing may vary dramatically, but leisure is fundamental throughout tourism activities as well as human nature.

Space Tourism from a Leisure Perspective

Leisure and its nature. In academia, leisure studies employs an interdisciplinary approach, using social science as a framework for research (Mannell et al., 2006). Leisure turns out to have a broad and variegated nature, and an ancient origin. From a biological anthropological perspective, animals play long ahead of mankind, so leisure may have an ancient origin, though the field of leisure only studies people (Chick, 2006). Leisure is also a tool to approach true selfhood. From the perspectives of Plato and Aristotle, Hunnicutt (2006) claims:

> Leisure was the freedom to move up the Chain toward human potential and authenticity … In working more than necessary … people made bad use of their freedom, choosing to become 'voluntary slaves' to their baser nature … The sign of an educated person was active leisure; playing sports and music, engaging in public debate, doing philosophy. The closer one came to one's essential self and the Truth, the more energized the soul became. (p. 64)

The founder of anthropology, Edward Tylor, detached the art of pleasure, how we give meaning to life, from the art of life, what we do for a living, in 1881 (Chick, 2006). Leisure is a phenomenon. A historic perspective of leisure means the freedom from labor, the foundation of culture, the connector of societies, the pursuit of peace, rumination and self-sufficiency, and the opposite of work (Hunnicutt, 2006), which makes leisure a "multifaceted phenomenon" (van der Poel, 2006). Here, leisure is separated from work.

Reality impacts every aspect of work and leisure. On the organizational level, leisure can convert from private to public when parks, recreation centers, and

playgrounds are sponsored, and change back to be private once again if the society lacks governmental infrastructure (Murphy, 1998). Moreover, in terms of people, there can be something in between; amateurs are those on the margin between work and leisure (Stebbins, 1981). For example, astronomer is the title of career profession, while an amateur astronomer may deal with similar tasks as a professional astronomer, but astronomy is more like a hobby than a job to these amateurs. What is more, in real life, people love to have fun. One study shows that the majority of people's discretionary income is invested in tourism and vacation (Beard & Starzyk, 2002).

Leisure is highly related to archaeology and ethnography. Because leisure studies largely depend on the archaeological evidence, for example the accounts of Olympics to understand the history of sports and games, so how our ancestors in different cultures were involved with recreation may highly relate to the study of archaeology (Chick, 2006). "Ethnography, the description of the ways in which others live, has traditionally been the foundation of cultural anthropology. Describing the ways in which different cultural groups experience leisure and manifest their expressive cultures has always been a small but important part of the ethnographic enterprise" (Chick, 2006, p. 46). Psychology is often applied to leisure studies. "Leisure behavior and experience are seem to be a function of the interplay of internal psychological dispositions (for example, perceptions, feelings, emotions, beliefs, attitudes, needs, personality) and situational influences that are part of the immediate social environment (for example, other people, group norms, human artefacts, media)" (Mannell, Kleiber, & Staempfli, 2006, p. 110). In fact, psychology has provided a powerful tool for leisure scholars to examine the interrelations among context, individual, and time; several concepts from human

cognitive processes such as motivation, expectation and satisfaction have been developed to explore the leisure experience (Stewart & Hull, 1996).

Leisure nature of space tourism. The majority of space tourism studies does not have a theoretical background. Only a few adopt the theory of travel career ladder, product life cycle, and Maslow's hierarchy of needs (Cater, 2010; Peeters, 2010). Flow theory and its relationship with edge-work and pilgrim are suggested for future research (Laing & Crouch, 2004).

Without the theoretical support, several studies still find out the drivers, expectations, motivations, desires and concerns of space tourism, but they are all concluded from surveys of potential tourists and popular imagination. In general, there are four kinds of findings: the expected experiences of space tourism have variegated forms, they are led by mixed desires, they have shown differences in terms of demographics, and they are highly related to risk.

First, the expected psychological experience in space tourism is variegated. Scholars consider the experiential nature of space tourism as danger, thrill, novelty, romance, social cachet, spiritual and personal fulfilment; and these tourists should have another name as "seeker" (Laing & Crouch, 2004). Indeed, this industry will attract high-adrenaline seekers, novelty and sensation pursuers who can undertake risks to gain personal rewards (Reddy et al., 2012). Space tourism as a form of frontier tourism is driven by emotional/psychological motivators such as intellectual curiosity, childhood influences, challenge/goal-setting, self-actualization, prestige, fun, novelty, learning, cultural influences, fantasy, the education of others, risk, escape, spirituality, environment, and adventure (Laing & Crouch, 2005). Motivation in leisure, such as

intellectual, competence-mastery, social, and stimulus-avoidance, can be contextualized into the space tourism experience (Cater, 2010). Specifically, intense training for space tourism fuels the motivation of intellectual and competence-mastery needs; space travel itself represents an elite adventure and signals a higher social status; and as committing to a somewhat stressful leisure activity that needs efforts in preparation compared to normal relaxing vacation, tourists also seek for an extreme escape after a unique experiential journey. Another attraction for space tourism can be the extensive pre-training. Training may activate tourist's motivation, especially the intellectual stimulation as learning, satisfying curiosity, and creating (Cater, 2010). Certainly, training is part of the unusual experience of space travel but determines people's decision-making process. Participants should factor the prolonged pre-training into the cost of space travel (Laing & Crouch, 2004). For example, close to half of the participants in the survey have the willingness to take two to five weeks' training for an orbital tour, while it may only take three days' training for sub-orbital travel (Reddy et al., 2012). More research is needed, because tourism psychological literatures have covered it in tourist behavior, but not yet in the space tourism experience (Laing & Crouch, 2004).

The second key finding reveals the mixed desires in space tourism. Sub-orbital space tourism is not the focus of this study, but several experiential elements are similar to orbit space tourism including seeing black sky (space) and curved earth landscape, so that the features of sub-orbital experience are considered as a reference. Attractive features of sub-orbital flight are thrill, to revive some childlike feelings, pragmatic lure of a unique experience, expectation of a sense of one's place in the universe, the immensity of the university, views of earth from space, experience of the flight itself, luxury aspect

or elite experience, ability to take photographs, to know interesting fellow passengers, rigorous training and physical screening (Le Goff & Moreau, 2013). Generally speaking, there are six expectations of future public space tourists: (1) to view the earth and space, (2) to experience zero gravity, (3) to undertake astronaut-like training, (4) to communicate with the people on earth from space, (5) to have abundant information to talk about the adventure, and (6) to obtain astronaut-like record and souvenir (Peeters, 2010). Among the motivational variables including pioneer of unusual experiences, scientific contribution, and the experience of space flight including weightlessness, sensation of acceleration, view of earth from space, the vision of earth from space is the primary motivation for tourists to go to space; the pioneering aspect follows (Reddy et al., 2012). Push and pull motives influence people's decision-making process as well. Socio-psychological factors push people to travel to space; the features of space tourism hold the pull, and other pull factors include "type of experience, health and training requirements, safety issues, type of launch and design of the spacecraft (e.g.; number of window seats), number of passengers onboard, reputation of the operation company, location of spaceports, reliability statistics, and environmental credentials" (Reddy et al., 2012, p. 6). The drivers of demand should include price, income levels, safety, risk, duration, and unique qualities (Laing & Crouch, 2004). However, the main driver is the excitement from participating in an adventure, instead of sightseeing or otherworldly activity; in other words there are a happy few and new frontier (Le Goff & Moreau, 2013). Additional drivers are needed for unique, challenging, and fun experience, the most attractive aspect would be the view of earth's curvature and the black space (Reddy et al., 2012). The space tourism motivation is also summarized as: modernity,

accomplishment, awe of experience, sightseeing the earth, weightlessness, and being the first (Smith, 2000). Some pursuits in space should be similar to earthbound activities but in a different setting; photo-taking is an example, first space tourist Dennis Tito took about 1,000 photos in space; star-gazing and romantic pursuits (sex in outer space) are other examples (Laing & Crouch, 2004). Some attractions in space ought to be like no other due to its unique nature of experience, such as, the unusual feeling of weightlessness, the taste of massive G-force, the quest to break out of the boundary of the earth and to open up new vistas, new recreation activities with different equipment and rules, spacesuit experience, and spacewalk (Cater, 2010; Laing & Crouch, 2004).

The third major finding revolves around demographics. Age, gender, and education influence the expectations of space tourism. In terms of age and education, among these who have demonstrated interest in space travel, the amount of younger generation outnumbers middle-aged people, the latter outnumbers the elders (Collins et al., 1996). Crouch et al. (2009) found similar results, the likelihood of taking orbital space tourism reduces faster as age goes up; moreover, the more educated respondents are, the less likely they would prefer to take orbital spaceflight. Some technical elements on board and during the touring process are very important to passengers, so an educational dimension of the space travel experience is also a factor (Peeters, 2010). As far as gender, many respondents emphasize the importance of safety in space tourism before considering participation (Le Goff & Moreau, 2013), women are especially sensitive to safety issue, so they are less interested (Reddy et al., 2012). However, Collins, Stockmans, and Maita (1996) provide a different explanation, men show more interest in space travel than women in every age group in American while it is not the

case in Japan; one possible reason for this is the background of participants in space program: the military background in US and the civilian background in Japan. The influence that connects people to the desire of space tourism can be traced to a broader sense than the individual self. Popular culture, science fiction, and the media are identified as external factors (Cater, 2010). Crouch et al. (2009) also supports the complexity of choice-making in space tourism that price is a particularly sensitive factor; personality, gender, age, education, and the behavior of risky actions also impact the consumer's choice.

Finally, risk is a serious topic in expected experience of space tourism. Space travel is considered as the most risky leisure activity (Reddy et al., 2012). Safety is the most important factor for the long-term progress in the commercial space tourism industry (Collins et al., 1996; Reddy et al., 2012), for example, the health risks. Physical health risks include higher possibility of cancer, dehydration during reentry, space sickness or space adaptation syndrome, serious physiological changes including loss of bone density and muscular system problems, and other diseases related to the immune system and bacterial infection (Laing & Crouch, 2004; Marsh, 2006). Though drugs and exercise are used in space to alleviate the downsides, more research is required. Most of these health risks are caused by weightlessness, accordingly, one possible solution suggests building artificial gravity in spacecraft and space hotels. It may go against the unique feature in space, but an area of weightlessness can be created (Laing & Crouch, 2004). Other risks contain paying high prices without luxury offerings and privacy issues (Laing & Crouch, 2004). Lots of time is needed to be devoted in training but future space passenger may not have enough free time (Peeters, 2010).

Critically speaking, the leisure that average people expect to experience can be very different from the leisure that real travelers undergo. In order to obtain an authentic overview of space tourism experience, these findings from market research can be used as a reference, due to the potential bias and possible false information since findings are concluded from people who have never been to space and those who may not care or even be aware of space tourism. For example, one study concludes that half of the respondents show awareness but close to 40% of the respondents express a neutral attitude compared to that only 22% believe the importance of space tourism, with a sample size of 164 British residents (Reddy et al., 2012). Space tourism is a worldwide eagerness in demand (Collins et al., 1996), therefore, a call for uncovering the properties of leisure experience from real space travelers is essential.

A quest for astronaut-like experience. If a human developed plane can be ascribed to the envy of birds, then it is safe to assume that people's desire in space travel is attributed to the envy of astronaut or astronaut-only experiences. This argument has been well indicated by academic articles, such as Reddy et al. (2012), Ziliotto (2010), Peeters (2010), Cater (2010), Bensoussan (2010), Chang (2015), and Freeland (2010).

There is direct evidence that potential tourists long for astronaut-like experience. In other words, private space explorers are motivated to experience what only astronauts have engaged with (Reddy et al., 2012). Moreover, with the help of commercialized space tourism industry, average people can really experience what astronauts have praised for years about space travel as the most exciting experience and the planet earth as both stunning and fragile (Ziliotto, 2010). Very often, customers expect astronaut-like training, suit and helmet, certificate, and memorabilia, and most important of all, the

astronaut-like experience in space. A medical check for potential passengers needs to take place during astronaut-selection screening as a reference as well (Peeters, 2010).

Space tourism studies have partially borrowed astronauts' experience to support their studies. For instance, the vision of earth from space as one important driver, is well supported by astronauts' affirmation (Reddy et al., 2012). Quote from the first space tourist is also used in these studies. For example, Dennis Tito mentions that astronauts and cosmonauts share the same experiential joy about space travel (Cater, 2010). To some degree, space tourists and astronauts may be the same. From the perspectives of innate risks in space transportation as well as the strict physical and mental preparation, it is tantamount to governmental astronauts and private space explorers (Bensoussan, 2010).

The dominant number of astronauts and the abundant data about their experience can well support the research of leisure nature in space. From the 1960s to 2000, professionally trained astronauts have been to space. From the year of 2001, the first space tourist made it to outer space (Chang, 2015), because International Space Station project temporarily allows both astronaut or cosmonaut, and spaceflight participants on board, tourists belong to the domain of spaceflight participants (Freeland, 2010). As a matter of fact, since the 1960s, space is believed to be the exclusive domain for about 500 astronauts and very few extremely wealthy individuals, but space tourism will challenge its status quo (Freeland, 2010).

Astronauts' life in space is not all work and no play. According to NASA, astronauts have up to three hours physical exercises per day (NASA Education, 2004), more hours of relaxing rather than working during the weekends (NASA, 2014); what is more, astronauts can read books, listen to music, play musical instruments, watch movies

and TV shows, enjoy drawing and photography in space, and even skype with friends and families (NASA, 2014). Moreover, some astronauts love to post their lives in space on Twitter on a daily basis; the Twitter posts are published during their free time, so social media is also part of astronauts' hobby. Therefore, obtaining the leisure experience from astronauts' Twitter posts can serve as the data for this dissertation.

Summary. A big gap exists in current space tourism publications: they seldom justify the rationale behind the properties of space tourism experience used in interview and survey, then with limited theoretical background, they collect data from non-astronauts and publish market findings about what experiential features can motivate potential participants and how big this market will be. These researches' logic is less convincing to readers. A gap filled by astronaut experience in space could ameliorate this issue. An experiential-based survey design that focuses on the leisure features of staying in outer space that amaze astronauts the most, can be applied as the foundation of a strong marketing questionnaire. Therefore, average people could get a more accurate picture of what they really would experience in space, then they may provide a more precise answer. Market research built on these responses could better map out the market potential and business model. Hence, future research design on orbital space travel is based on uncovering the leisure experience of astronauts and that is a necessary step.

Thinking of this, leisure features of staying in outer space that amaze astronaut the most can be applied as the foundation of marketing questionnaire, average people therefore could get a more accurate picture of what they really will experience in space, then they may provide a more precise answer, and market research builds on this could better map out the market potential and business model. Hence, an important step,

uncovering the leisure experience of orbital space tourism from astronauts, is about to make.

Current Trends of Space Tourism

Space tourism company. Unsatisfied with the astronaut-only experience supported by governments, entrepreneurs started to look for business opportunities to open space to the average person. Virgin Galactic is the first company to challenge the status quo and aims at serving the commercial spaceline for earth. As Virgin Galactic states the rationale of the business in the webpage:

> The astronauts have also found themselves transformed by their journeys … The experience is a profound and fundamentally personal one, but its magnitude cannot be denied … Throughout all of human history, only about 550 people have ever visited space. This means that not only have most of us never been to space, most of us have never even met someone else who can tell us about the experience … But because government space agencies are not asked to help ordinary citizens to become astronauts, most of our planet's seven billion people have had no opportunity to experience space and all of its possibilities for themselves, regardless of their passion or talents. (2017b)

Virgin Galactic plans to train its own astronauts, send them to an altitude over 50,000 feet to experience several minutes of weightlessness, then take them back for reentry, and reward them with astronaut wings (Virgin Galactic, 2017c). It is reported that 700 people from over 50 countries with an age range of 10-90 years old, have paid deposits for spaceflights offered by Virgin Galactic (Virgin Galactic, 2017b). In other

words, instead of taking these average persons to space as tourists, Virgin Galactic calls them the future astronauts or Virgin Galactic astronauts. Apparently, this type of astronaut is purely leisure-based; by making full use of the term astronaut instead of tourist, Virgin Galactic appeals to do a better job in attracting consumers, which in turn emphasizes the average person's quest for the role and experience as a real astronaut.

A service with a few minutes of outer space experience is considered as sub-orbital space tourism, and Virgin Galactic is supposed to be the first provider of commercial space travel with $250,000 as one ticket price by the end of 2018 (Bailey, 2017). It is unclear yet if Virgin Galactic will extend its business to orbital space tourism, according to scholars in space tourism discussed earlier in this chapter, orbital spaceflight is more sustainable and will replace sub-orbital space travel someday.

Compared to a few minutes' experience in outer space, SpaceX instead promises to take two tourists for a weeklong trip around the moon in 2018 (Cofield, 2017). Founded in 2002, SpaceX mainly produces rockets and spacecrafts, and has accomplished several cargo transport missions for NASA. Without publicizing much interest in space tourism, SpaceX targets at a more difficult goal, that is, to make history by colonizing other planets, especially Mars (SpaceX, 2017a).

Space experience and social media. NASA puts the icons of social media including Twitter, Facebook, Instagram, Pinterest, Google+, Tumblr, and Vine, right after the names of active astronauts in NASA's astronaut homepage (NASA, 2017a) and somehow turns astronauts into social media stars (Popular Science, 2015). NASA joined Instagram in September 2013, and has attracted 28.6 million followers as of November 2017. Astronauts' social media posts, turn out to be the main reason behind NASA's

enormous popularity, because astronauts are “the only human beings seeing the wonders of space firsthand” (Popular Science, 2015). The webpage Social Media at NASA lists 16 popular social media sites as NASA’s flagship accounts, 14 NASA centers and facilities with various social media links, 62 space-related organizations and programs with their social media sites, links for 80 missions and topics under general themes including humans exploring beyond earth, studying the sun and its effects, space science, and earth science, 10 NASA people and 35 astronauts with their official social media sites (NASA, 2017d). Twitter, is the most popular social media among all used by NASA, and each of the 35 astronauts has an official Twitter account.

Twitter works as an efficient platform in practice. While in academia, all kinds of social media, especially the Twitter posts, have gained a lot of attention in research as well. Twitter has been widely used in the research domains including applied psychology (Wang et al., 2016), political, socioeconomic, disaster monitoring, and public health studies (Macy et al., 2015), cognitive research (Yadlin-Segal, 2017), legal study (Simpson, 2017), sport history (Osmond, 2017), and tourism studies (Brandt, Bendler, & Neumann, 2017; Claster et al., 2010; Shimada et al., 2012, 2011). The features and significance of Twitter posts as research data are well recognized by scholars: “to uncover psychological states of different users, in an unobtrusive, nature setting” (Wang, Hernandez, Newman, He, & Bian, 2016, p. 357), to record real-time behaviors and to predict future directions as a social telescope (Macy et al., 2015), and to resemble daily entries of the thinking with various perspectives of the public (Osmond, 2017). So far no social media research has conducted a study of space tourism in a leisure perspective.

This dissertation uses the astronauts' Twitter posts as data to understand space travel experiences. A similar study on Twitter is conducted by Park, Ok, and Chae (2016). This study recognizes Twitter as a hot research platform in the community of tourism and hospitality; it collects Twitter data from several groups, and uses techniques including descriptive analysis and network mapping analysis, to provide marketing strategies on cruise travel (Park et al., 2016). This journal article offers valuable information about research on Twitter, such as ScraperWiki is a tool to capture Tweets with search words and hashtags, and RapidMiner can be used to count word frequency in descriptive analysis (Park et al., 2016). Moreover, their study indicates Twitter and the big data generated by Twitter are good means for collecting legitimate data. Considering NASA's popularity in social media as well as abundant real-time Tweets posted by astronauts, this study aims to research astronauts' experience through the tool of Twitter. Thus, leisure perception, utilizing the theory of multi-phase experience, will serve as theoretical background for this study.

The theory of a multi-phase experience. Two definitions of leisure adopted by this study are: "Leisure has been characterized as specific types of activity; as time free from obligations; as meaningful and satisfying experience; or as some combination of activity, time, and experience" (Kleiber, Walker, & Mannell, 2011, p. 7), and leisure "as a distinguishable context of relative freedom wherein preferred immediate experience has priority over instrumental outcomes" (Kleiber, Walker, & Mannell, 2011, p. 100).

A perspective of leisure perception, usually qualitative and interpretive, is expected to apply more in the future study of leisure, and the specific studies of individual leisure experience falls in the field of leisure psychology (Mannell et al.,

2006). In detail, the theory of a multi-phase experience is considered to support the research with respect to the properties of leisure experience attached to orbital space tourism.

The multi-phase experience theory was an early recreation theory, first defined by Clawson and Knetsch in 1966 (Kleiber et al., 2011) and by Clawson in 1963 (Hammitt, 1980). This theory states that recreational experience is multi-phasic; it has five sequential phases including anticipation, travel-to, on-site, travel-back and recollection (Clawson & Knetsch, 1966). Participants could benefit from each phase of the total leisure experience (Hammitt, 1980).

The theory of multi-phase experience was slowly developed and was paid little attention into the leisure or tourism study in the beginning, because seeing leisure as evolving and dynamic experience with its context was a challenge to the research of leisure, recreation and tourism (Steward, 1998). Later, some empirical studies examine the multi-phase nature of leisure activities and support the claims made by Clawson and Knetsch in 1966, and Clawson in 1963. For example, Borrie and Roggenbuck studied the trips in Okefenokee Wilderness in southern Georgia and concluded that "the wilderness experience is dynamic, complex, and evolving" (2001, p. 225); Arnould and Price (1993) examined multi-phasic river rafting trip in the Colorado River and described the recreation activity as extraordinary experience; similar studies were conducted in mountain-based adventure tourism (Beedie & Hudson, 2003) and in Antarctica-based extreme tourism (Maher, 2010). Clearly, the utilization of a multi-phase experience theory is usually cited in leisure and tourism experience studies, but it also has been widely applied in psychology and experiential education (Maher, 2010). Hence, the

dynamic nature of leisure experience becomes the focus of this study: when people travel to outer space, what evolving and multi-phasic leisure experiences could be extracted from astronauts' experiences and may lead to future development of private space tourism?

The theory of a multi-phase experience could benefit the intellectual understanding of human leisure involvement in several ways: It gives insights to the dynamic interactions between tourists and their environments (Steward, 1998). It is well recognized by its intuitive significance (Hammitt, 1980). It provides with a novelty process conceived from leisure engagement (Arnould & Price, 1993). It is "an evolving recreation experience by arguing that these phases occur in sequence and are each necessary for an outdoor recreation trip" (Steward, 1998, p. 391). And it is particularly good for the complicated leisure experience, because it guides through study of leisure experience by claiming its beginning and ending and clearly examining each phase in order to get a complete picture of leisure experience (Kleiber et al., 2011).

These benefits are the reasons why the theory of a multi-phasic experience is a good choice in analyzing qualitative data in this study. Space tourism is a complicated leisure activity with positive and risky experiences. And this theory has proved to be insightful in both enjoyable circumstances (Beedie & Hudson, 2003) and extreme settings (Maher, 2010). As Maher (2010) puts it: "what is needed is a conceptualization of visitor experiences to remote or extreme destinations that captures the subtleties of transition, as well as the key dimensions in the multi-phase nature of such experiences." Therefore, the theory of a multi-phase experience provides an appropriate framework for understanding the leisure experience in space.

Chapter Summary

This chapter maps out four dimensions of space tourism literature, carefully examines each part, and locates the gap in the existing literature. The dream of reaching out to outer space is possibly originated from the basic desire of flying, and people pursue the similar experience as thrill and prestige at aviation and space travel. Moreover, on an industry level, aviation serves as an important analogy to space tourism.

Spaceflight is a hard science but also is the key to future success in space tourism industry. The existing journal articles and academic publications recognize its importance, usually giving a large coverage about its history with a short imagination about the future spacecraft for space tourists. Spaceflight information provides a key foundation of space tourism discussions, but technical topics as vehicle design and legal consideration exceed the capabilities and the scope of this dissertation.

Tourism studies are an important part of space tourism, especially in marketing. There are a number of space tourism research articles dedicated to estimating market size, delineating consumers' demands, and paying attention to the price setting. Tourism marketing is essential in practice, as long as the market has been established. However, this is too soon to predict for space tourism. Before enormous investment and governmental-company collaboration put into space tourism, it is hardly possible to estimate the number of potential space tourists. Moreover, it is difficult to predict customer preference and market size before space tourism has really been fully established. However, these studies do bring a general idea about this industry, and inspire the future research in many directions. Though the primary focus of this study is on the leisure experience of orbital space, the findings of this study could be used in the

future space tourism marketing process, especially the procedures of understanding customers' expectation and promoting leisure experience in space.

Lastly, it is the leisure that carves out the nature of space tourism experience. Tourism strategies may change and adapt to markets accordingly, but the leisure nature within tourism, recreation, sports and all other pleasant and fulfilling activities remains unchanged. Leisure is a multifaceted phenomenon, it is embedded in the culture throughout time. The current studies of drives, motivations, and expectations about future space visitors fail to derive important information from astronauts, the large amount of this lucky population that have tasted space travel. Before a mature space tourism service is built, people will always aspire for astronaut-like prestige. As the ancient human was jealous of birds, modern men develop an envy of astronauts. The perception of leisure, therefore, links the past and present astronauts' experience to the future activities of space tourism. For that reason, this study positions this study as a quest for astronaut-like and astronaut-only experience to unveil leisure nature attached to orbital space tourism. In all, aviation, spaceflight, tourism and leisure form the significant historical backgrounds and early indications for the study of space tourism, and the current trends of space tourism in the business field provide significant clues to this study.

Chapter Three: Methodology

Introduction

The theory of a multi-phase experience encompasses the range of leisure experience, and in particular explains the complex and long duration leisure experience (Kleiber et al., 2011). In terms of space travel, astronauts repeatedly go through the range of the experiences from anticipation, training, departure, on-site, reentry, and recollection. Their Twitter accounts record every step of their journey. Therefore, this study uses a qualitative research method to obtain descriptions from Tweets posted by astronauts to extrapolate leisure properties future space tourists might experience. Based on the research questions, the researcher goes through the data and singles out important statements about the leisure properties of the individuals experience in outer space.

Justification of Studied Population

Critical thinking is necessary when considering astronauts' Twitter posts as data, as Bimm (2014) demonstrates:

> [Images] of astronauts and cosmonauts are used to promote investment in space exploration and are often presented as visions of the future of humanity, so the background provided here about where these representations come from, what they mean, and who they include (and exclude) is crucial (p. 871).

It is indeed likely that astronauts present the prospect of future tourism, and their Twitter posts carry representation of unique experience in space. Therefore, this study aims to use astronauts' Tweets to explore the leisure properties attached to orbital travel experiences.

In fact, not all astronauts register a Twitter account, including early astronauts that traveled to outer space long before Twitter exists, and Chinese astronauts who do not have access to Twitter due to Chinese cyber firewall. Some of these astronauts wrote books in terms of their special trips, and shared their stories in interviews and reports with the public. However, such information tends to have the natures of limited coverage about their psychological memories and widely scattered location (such as books, newspaper, confidential and public reports, videos, audios recordings and so on). This study does not deny the advantages of early astronauts' archives. In fact, these data can be used as future research to compare the findings with the study of applying social media data.

This study chooses astronauts' online archives in Twitter with several considerations. First, Twitter is the main marketing tool for NASA; most astronauts from NASA and other space agencies have Twitter accounts and post Tweets as part of their professional and private lives. Then, some astronauts who have experienced space travel before the existence of Twitter, later in their lives, still use Twitter as a platform to recall their space trips, to share and comment on current astronauts' Tweets in space, and to promote space travel to the public. Furthermore, Twitter is the real-time recorder of astronauts' activities before, during, and after space missions. It serves as an ongoing process and a continuum to observe the entire experiential phases to such an extreme destination as outer space. Moreover, Twitter, as a "digital socioscope" has been widely used to analyze social, human, environmental, accidental, and other phenomena in academia (Macy et al., 2015). In addition, most space Tweets are recorded in International Space Station (ISS). ISS has not been fully built until 2011 and is expected

to function until 2028. A number of Twitter recorded life details on ISS by astronauts could potentially bring insights into future space tourism. Lastly, space tourism is estimated to be a frontier leisure activity, with the latest test in 2018. That is to say, public space tourism will not be fully realized in a few years or decades. Therefore, using the latest data from Twitter to predict future leisure activities in space may turn out to be a better move.

Why use astronauts? Surprisingly, astronauts' authentic experience in space have not attracted as much attention as paid to other forms of data (for example, surveys of the public about their willingness to travel in space for leisure) to the study of space tourism more extensively. Why? The answer to this question is embedded in the social attitude toward astronauts. NASA considers the boarding on spacecraft to orbit the earth and beyond of the astronaut to be a career profession (NASA, 2017c). Due to astronauts' nature as work, one might not consider astronaut's space tourists. As the very nature of tourism is embedded in absence of work. However, this research makes a strong case as to the reasons astronauts are the perfect subjects to study space tourism.

First, astronauts have a dominant number among all space travelers. So far only a very limited number (less than 10) of wealthy space tourists have traveled into space for leisure. Whereas 522 astronauts in total have experienced traveling in outer space (NASA, 2017c), including 344 NASA astronauts (300 former astronauts and 44 active astronauts) (NASA, 2017c), 124 Russian and Soviet cosmonauts (Russian Federal Space Agency, 2017; Wikipedia, 2017), 18 European astronauts (European Space Agency, 2017), 14 Canadian astronauts (10 retired astronauts and 4 active astronauts) (Canadian Space Agency, 2017), 11 Japanese astronauts (4 former astronauts and 7 active

astronauts) (Japan Aerospace Exploration Agency, 2015), and 11 Chinese astronauts (China Manned Space, 2017). The much bigger population of astronauts have authentic experience of living a life and working in outer space. Their descriptions about space life are higher in reliability and feasibility than average person's opinions in a survey.

Moreover, astronauts do have free time and enjoy leisure in outer space. In each workday, an astronaut usually works from 6 a.m. to 9:30 p.m., including three meals and 2.5 hours of physical exercises (NASA Education, 2004). During Saturdays and especially Sundays, an astronaut has less hours in working and more time in relaxing and physical exercise, and private family meeting (NASA, 2014). When answering the questions "Do you watch TV? What do you do for fun?" NASA (2011) gives this answer:

> The space station crews can ask mission control to send them shows that they can watch during dinner or off-duty time. They can also watch movies on their laptops. They may bring books, music, and musical instruments with them. Some astronauts enjoy hobbies, such as drawing, photography, and HAM radio. During missions, astronauts are very busy. The few hours of free time may also be spent looking out the window at the beautiful earth below, listening to music, surfing the web, or corresponding with friends and family back home. (p. 4)

Leisure is defined as people playing, enjoying activities, and relaxing during their free time. So more evidence about astronauts' free time and leisure in space are presented here (NASA, 2015):

> Living in space is not just all work and no play…Fun is an essential ingredient to the quality of life … [Flight] planners on earth schedule time

> each day for astronauts to relax, exercise and have some fun. Station crew members even manage to have fun while working. Experiments in space sometimes involve ordinary toys and how microgravity affects them … A popular pastime while orbiting earth is simply looking out the window. Inside the International Space Station, crew members have numerous windows they can look out ... Aboard the space station, crew members have many opportunities to relax and play. Like most people who work full time, astronauts get weekends off … On any given day, crew members can watch movies, play music, read books, play cards and talk to their families. They have an exercise bike, a treadmill and various other equipment to help keep their bodies in shape. During their off time, they certainly take time out to play games and generally have a good time.

Furthermore, work may be regarded as leisure or serious leisure for some of astronauts. Leisure has a broad scope, and astronauts may consider their work as leisure. As Kleiber, Walker, and Mannell (2011) state that the mental experiences (including relaxing, free, fun, and enjoyable feelings), the psychological stage detached from obligation, the behaviors act on individuals' own willingness, and sometimes even work, are considered as leisure.

Some astronauts do express that they refuse to see their space life as work in Twitter. Essentially, the work activities of astronauts are indeed their work, but to them this work seems to be leisure sometimes. In conclusion, astronauts matter a lot to the research question of this dissertation.

Why use Twitter? Astronauts' daily activities are mostly recorded by social media, for example, a microblogging service platform Twitter. Until the second quarter of 2017, Twitter has hit 328 million monthly active users worldwide (Statista, 2017). Twitter users can share a message with up to 140 words, this short text format enables users to send a Twitter post or a Tweet by an internet connected device, these publicly available Tweets can serve as a unique opportunity to understand people's immediate thoughts on the topics of their own choices in a natural setting without influences led by a research question (Wang et al., 2016). As a result, astronauts' Tweets related to space travel experience can be used in this study to explore the experiential attributes in a real-world setting.

Why not use news media? Because news media coverage has the potential to mislead and puzzle the public about space tourism, largely due to reporters' lack of technical knowledge and critical judgement in these issues; same for reports from the economics and business magazines, journalists can easily overlook the potential commercial results (Collins, 2001). In comparison, astronauts write and post their individual Twitter posts without the concern of "lack of technical knowledge and critical judgement", and they tweet the first-hand information about their feelings, attitudes, activities, photos and videos in space.

In addition, people who speaking varying languages "do not simply see the same reality with different labels attached but literally see different realities…our perceptions of reality are only influenced rather than determined by our language, others maintain its validity in one form of another" (Chick, 2006, p. 45). Hence, written texts from Twitter

posts published by different astronauts provide multiple angles of experience in outer space.

Moreover, astronauts' Tweets are highly reliable and trustworthy. Tweets are reliable for research, because Twitter serves as a social telescope in academia and "Tweets are recorded in real time rather than retrospectively. … Relatedly, scientists can observe tweets unobtrusively" and use these "online data on human behavior and social interaction" (Golder & Macy, 2015, p. 3-5). Moreover, NASA highlights astronauts' Twitter accounts on its official website, and this study will access to these accounts via links published by NASA, in order to gather data from verified Twitter accounts. It is possible that astronauts are asked to use Twitter as part of their work because almost all of today's astronauts have individual official accounts registered in Twitter as do NASA and other space institutions. The goal of twitter accounts is to raise social awareness of space organizations and their space activities, to publicize space life, to intrigue curiosity in space and science knowledge, and to attract more funding, all by the means of astronauts and their "marketing" efforts in Twitter. As Hersch, an historian claims "[astronauts] were NASA's public face, and their words carried more weight in the public mind than those of the men who had hired them" (2012, p. 160).

Lastly, the content astronauts have posted in Twitter is not under serious control of their affiliated organizations. They usually post scattered details of training, launch and reentry, activities in International Space Station, work, spacewalk, and their opinions of news and people, their words to family, friend, fans and even strangers, their photos and videos of space life and earthbound life. To a large extent, Twitter is the record of their life, both in the earth and space. As scholars state it, "people actively construct or make

sense of the situations in which they find themselves" (Kleiber, Walker, & Mannell, 2011, p. 54). Since astronauts have some "free time" to spend on "posting Twitter activity" with a certain "state of mind" (since they choose to say something in Twitter, they must hold a positive attitude toward this action), then their behaviors of using Twitter are considered as leisure as well as a life-recording process. In conclusion, Twitter also matters to the research question of this dissertation.

Limitation. This study seeks patterns among astronauts' Tweets, but a few limitations remain. Because when personal description of journey and encounter are applied as proper accounts of naturally occurring behavior, the results may be clouded by cultural tradition, special narrative attention and individual bias (Safier, 2010).

It may be the case for using current astronauts' Tweets as data provide more contemporary observations than previous astronauts' communication, due to the fact that Twitter is relatively new and encompasses many non-official details. In the past, the historical understandings of astronauts' roles may have been shaped by the expectations of their culture in a certain way. For instance, the early involvement of military in space program successfully progressed American spaceflight to the top of the world but in the meanwhile shaped the culture of astronaut as a social icon representing good physical and mental health, the ambassador of leading technology and space science, tough manliness, disciplined military, patriotism and the prospects of mankind (Bimm, 2014).

Indeed, the books, movies, TV shows, magazines, museums, and IMAX documentaries, dominantly depict an astronaut as a white, male, military pilot. Not until in the early 1980s minorities and women were recruited by the astronaut corps (Bimm, 2014). These earlier perceptions may still exist in the current culture of space programs.

Quotes from the media can be prejudiced towards the stereotypical representation of astronauts, instead of taking richer samples from all space travelers. All views are valid, because personal explanations of their experience out of this world are highly significant to unveil the experiential aspect of space tourism (Cater, 2010). In conclusion, researcher of this dissertation is aware of these limitations.

Instrumentation

This section first reviews the existing studies in space tourism, and finds out the majority have applied a qualitative method and adopted observational study. Then observational approach is generally discussed, and connects to the netnography.

Review of methods in space tourism. Research methods that are used in space tourism studies include: qualitative (Ashford, 1997; Belij & Tadic, 2015; Bensoussan, 2010; Cater, 2010; Chang, 2015; Chang & Chern, 2013; Collins, 2001, 2006; Collins & Autino, 2010; Collins & Funatsu, 2000; Crouch, 2001; Fayos-Sola et al., 2014; Freeland, 2005, 2010; Gast, 2010; Knutson, 2007; Laing & Crouch, 2004; Launius & Jenkins, 2006; Marsh, 2006; Nagatomo, 1992; National Space Society, 2009; Peeters, 2010; Rogers, 2001; Smith, 2000; Von der Dunk, 2011; Webber, 2010), quantitative (Abitzsch & Eilingsfeld, 1992; Beard & Starzyk, 2002; Collins et al., 1994, 1996; Crouch et al., 2009; Depasquale et al., 2006; Isozaki et al., 1995; Koelle, 1999; Penn & Lindley, 2003; Ziliotto, 2010), or both (Le Goff & Moreau, 2013; Reddy et al., 2012).

Over half of these publications adopt a qualitative method, most are the summary of literature review and plain narratives. Quantitative approach is common as well, due to a large portion of market research and some technical studies.

Almost all studies conduct observational study, that is, scholars collect data and study the sample population as it is, without any explicit involvement (Carson, Gilmore, Perry, & Gronhaug, 2001). It makes sense in these tourism studies, especially those focusing on marketing. It is a necessary step because failure of meeting customers' needs could cause a disaster in business (Peeters, 2010). This study also aims to make contributions to the development of space tourism business, so an observational study is considered.

Observational method. Back in history, observation and experiment used to work together across the 18th and early 19th century that observation originated conjecture and experiment tested it; later, experiment was valued higher than observation due to the possible falsification by observers (Daston & Lunbeck, 2011). However, observational study still attracts scholars' attentions. For example, in the field of leisure perception, both experiment approach including laboratory and field experiments, and approach of naturalistic observation are widely applied to study leisure attributes (Kleiber, Walker, & Mannell, 2011).

Scientific observation has a lot of advantages, such as "an engine of discovery and a bulwark of evidence", a large amount of data that has been recorded "in proverbs, in chronicles, in diaries, in archives, in learned journals, and in computer data banks", "open to possibilities for new knowledge in the most unexpected places", and a useful tool to accumulate individual experience, to develop it into evidence, to form and polish up experience to research-based outcomes (Daston & Lunbeck, 2011, p. 7-8).

In terms of leisure experience, observation may take another form. "No psychological attribute can ever be directly observed. It can only be inferred on the basis

of what we can see of people's behavior, that is, what they say and do" (Kleiber, Walker, & Mannell, 2011, p. 55). That is, if we notice astronauts do use their free time for one particular leisure activity, for example the experience of capturing the earth by camera. Astronauts are predicted to have the tendency in choosing to perform this activity again for practical or psychological reasons, so it can be assumed that astronauts and future space tourists may typically enjoy photography in space. This process of constructing intangible leisure experience into indicators is a "hypothetical construct," and the research approach to conceptualizing and measuring leisure in this dissertation is the behavioral-observer approach (Kleiber et al., 2011). The Twitter-posting behavior and space experience of astronauts are hypothetically constructed by researcher as leisure on the foundation of the activities in which the astronauts are participated or the context or duration in which they are rooted. The specific research method used in the study of leisure perception in space is putting leisure in its natural context, or "naturalistic observation". To conduct such a naturalistic participant-observational online research is called netnography (Kozinets et al., 2014).

Netnography. Ethnography is an anthropological approach that uses observation as a tool to search for patterns and generalizations in daily life or certain events (Cottrell, 2014; Kozinets, 2012). Several types of social media including Twitter and Facebook create cyber stages where people present, share, interact with others about individual daily life or particular events (Bertilsson, 2014). Internet provides a well-recognized platform with rich and open-access information for "qualitative social scientific investigation" (Kozinets et al., 2014). Thus, ethnography is extended to a digital

ethnography, netnography, a term combined "internet" and "ethnography", in responding to such internet influence.

The term "netnography" is first developed by Robert Kozinets at the very late 20th century (Bertilsson, 2014), and it is defined as "participant-observational research … (that) uses computer-mediated communications as a source of data to arrive at the ethnographic understanding and representation of a cultural or communal phenomenon" (Kozinets, 2012, p. 2). In terms of netnography's relation to ethnography, first, netnography and ethnography share three commonalities (Kozinets, 2012): Both represented participative and observational research are capable of throwing light on new issues in social science. Both can be applied alone as well as part of combined methods in a bigger study. Both are rooted in context. The main difference is centered at netnographic data collection from online fieldwork. As Brace and Demsar (2014) put it, netnography "provides opportunities for insight through observation as online culture provides a textual terrain where conversations, information sharing and interactions occur" (p. 4).

A blended method of netnography and ethnography is proposed as a better choice (Kozinets, 2012). For example, the research would be more complete to observe astronauts' leisure activities and their behaviors in posting on Twitter, and to study their Tweets altogether. But in terms of feasibility, an ethnographic observation in space cannot take place. Moreover, netnographic field data has several benefits over ethnography including more reachable field sites, several forms of communication, possibility and easy-access to link to other fields, and auto-archiving (Kozinets et al., 2014).

A netnographic research usually has five steps (Kozinets, 2012; Kozinets et al., 2014): to prepare research topic and define research question, to select online field site or community, to observe the participants and collect data ethically, to analyze data and interpret findings in an intuitive and reliable manner, and to write and present meaningful findings and appropriate implications. And it will be applied in this study.

Validity and reliability. It is valid and reliable to use netnographic method to understand leisure experience about space travel through social media data. Netnography research in Twitter provides the opportunity and accessibility to astronauts, a special group that is not easily observed by real life interaction (Kozinets, 2012). Then, an observational netnography is adopted, it is identical to the "fly on the wall" approach which involves with no interactive intention but an absolute observation (Brace & Demsar, 2014) so that natural astronaut behavior can be traced.

Netnography is a resource-intensive and flexible method. Netnography research in Twitter can gather large numbers of data from official accounts registered by astronauts with their real names. That way, information of astronauts such as gender and age can be obtained, and anonymity in data analysis are flexible to maintain (Kozinets, 2012).

As an interpretive and qualitative approach, netnographic data analysis can code data by both hand and computer software with content analytic function, in order to compare and then ensure the validity of each coding method (Kozinets, 2012). Ethnography provides "high levels of ecological validity" (Cottrell, 2014, p. 104) and has been applied to many studies in the social science, "so too will it now extend to include netnography" (Kozinets, 2012, p. 2). Furthermore, netnography inherits adaptability and

the aim of seeking legitimacy and "the trust of its constituents by a careful attention to shared, detailed, rigorous research practices" from ethnography (Kozinets, 2012, p. 2).

Data Collection

In terms of data collection, astronauts' Tweets as archival data are collected. Archival data is referred as any information collected from the internet with no involvement of researcher in the generation of it and is used to draw the overall picture of studied community before researcher entered its environment; archival data is the type of observational data with high accessibility (Kozinets et al., 2014). Here, the Tweet texts are collected.

Enormous quantities of Twitter users have generated hundreds of millions of Tweets, these Tweet texts are accessible via several Twitter retrieval websites. For example, BirdIQ (https://birdiq.net/twitter-search) can be useful to download entire Twitter posts from astronaut official accounts into Microsoft Excel files. These collected data include Twitter texts and types, published time and devices, links, and engagement (the total number of retweets and favorites).

In terms of research sample, 35 out of 44 active astronauts (NASA, 2017c) have official Twitter accounts listed on the NASA website, so do several retired NASA astronauts and newly admitted astronaut candidates. Most retired NASA astronauts have completed space missions long before the booming era of social media, so they are excluded, except that one recent retired astronaut who have posted a large volume of Tweets in space. Moreover, NASA announced 12 astronaut candidates as 2017 NASA Astronaut Class on June 2017. Astronaut candidates mean "individuals who have been selected by NASA as candidates for the NASA astronaut corps and are currently

undergoing a candidacy training program at the Johnson Space Center" (NASA, 2017b). Candidates have started astronaut training but not qualified as active astronauts, they are not included in this study either. Therefore, a sample size of 36 NASA astronauts (35 active astronauts and one recent retired astronaut) and their Twitter accounts are considered in order to capture sufficient perspectives of the leisure nature of space tourism. These selected astronauts have been assigned to pseudonymous names.

All 36 astronauts' Twitter accounts can be accessed from NASA website (NASA, 2017c), then all corresponding Tweets can be downloaded directly by BirdIQ website into separate Excel files. One challenging issue corresponding to all Twitter-downloading websites is that the maximum number of available Tweets per account is around 3,200. After carefully checking all these astronauts' Twitter accounts, only one astronaut has published over this limit, and around 3,214 Tweets under this account can be collected. In total, 23,819 Tweets have been downloaded (updated on February 8, 2018).

In general, a Tweet has three forms: regular (directly posted by users), reply (responding posts from users), and retweets (share others' Tweets). For each Excel file, both the regular Tweets and reply Tweets are originally wrote by astronauts, they can be kept for the research. However, retweets are excluded because they are shared information, and their content may overlap with other Tweets, especially that astronauts often retweet each other's posts on Twitter. After deleting all retweets, 19,116 Tweets are left.

The popularity of a Tweet is reflected by its number of "been liked" and "been retweeted by others," and engagement score is the sum of both such numbers. The downloaded Excel files have the engagement score for each Tweet. The higher the

engagement score hits, the more the public attention has been attracted by this Tweet. It is estimated that 17,265 Tweets in total are left after selecting all the Tweets with non-zero engagement scores.

After listing Tweets from the highest engagement score to the lowest, the top 20% of each astronaut's Tweets are sorted out. Because the top Tweets represent the highest popularity of astronauts' posts attached to space travel and have attracted the hottest attention in the Twitter community and beyond. In terms of data saturation, top 20% could be a reasonable threshold to establish the quality and adequacy of data in the interpretive research and ensures the future replication of this study. However, if needed, more Tweets, for example top 30% to 40%, can be considered. With this consideration, there are left with 3,468 Tweets to delineate personal and subjective experiences about all phases of space travel.

The publishing time of all 3,468 Tweets are changed to the coordinated universal time; these 36 astronauts' launch and reentry time are also adjusted to the same time zone. The collected data focus on answering the research question. For achieving that goal, data collection takes theoretical framework as well as findings from literature review into consideration. In detail, when adopting the theory of a multi-phase experience, the Tweets related to preparation, travel to and from, and recall should be included in the research in order to delineate the whole picture of space travel experience.

Preparation phase, the first phase of a leisure experience, here refers to any kind of training or learning process that is necessary to fulfill the requirements of space travel. Furthermore, there cannot be Tweets published during the time of travel, so any recalling Tweets related to liftoff and reentry are categorized in the second and fourth phases

respectively. For all perceptions recorded by individuals on site, these posts are considered the third phase: on-site experience. And these experiential posts published after the trip are put into the recall phase, the final stage of a leisure experience.

The dividing line between phases is not strict; Tweets overlapping in more than two phases are normal. For example, an on-site post describing the rocket liftoff excitement can either go to the second or third phase, and a recall Tweet about reentry may fit in both the fourth and the fifth phase. The theory of a multi-phase experience does not aim at separating leisure experiences into clear categories. Instead, it focuses on extending the length and depth of leisure and enriching the understanding of leisure experiences.

Therefore, all Tweets that published between liftoff and reentry dates are marked as space dataset; the rest are labeled as earth dataset. In total, 1,788 Tweets fit in the space dataset that represents the astronauts' everyday activities in space. The earth dataset, including preparation (training) and recollection, contains 1,680 Tweets. Both liftoff and reentry experience Tweets may be recalled in either dataset.

Data Analysis

Based on the research question, this study adopts an inductive coding style as analytical rational that codes are directly generated from the data reading and analysis process. For example, the described object, emotional descriptions, hashtags, and other important texts emerge and are assigned as codes throughout the textual Tweets systematically. Moreover, terms directly related to leisure, such as play, selfie, free and off time, are identified as initial codes. Other terms affiliated to leisure, such as earth art, happy, and exciting, are also included.

Coding qualitative data is an ongoing and iterative process. To make the codes fit the data, codes need to be refined; the similar codes can be collapsed into a larger theme, the overall coding categories can be expanded or revised as well. The coding process finishes once the saturation has reached. In summary, codes contribute to theme identification, and themes can be sorted to patterns. This way, data can be analytically organized.

Instead of a time-consuming and heavy manual coding, a computer-assisted qualitative research software, MAXQDA, have been purchased and applied for content analyzing tool. MAXQDA can analyze vocabulary, present frequency and distribution of word combination, define and compare categories and visualize themes and patterns (MAXQDA, 2017). That way, all 3,468 Tweets are coded and analyzed by MAXQDA. MAXQDA can enhance the organizing ability of all Tweets, and explore various likelihood of Tweets analysis and interpretation. In the meanwhile, peer review is a necessary step. Two researchers not involved in this study have been invited to validate the coding process and reviewed the themes to increase the validity and strength of this study.

Chapter Summary

This chapter first justifies the reasoning behind the selection of studied population (astronauts) and the data that carries leisure experience (Twitter); their embedded limitations are also discussed. In the section of instrumentation, netnography is introduced and explained. A netnographic study is performed in data collection and data analysis to answer two research questions and possibly generate a theory about leisure experience from rich qualitative materials.

Moreover, the netnographic research procedure (Kozinets, 2012; Kozinets et al., 2014) guides the research in five steps. Leisure experience attached to orbital space tourism is set as research topic, and this study aims to answer this following research question: when people travel to outer space, what properties of leisure experiences attached to orbital space tourism could potentially attract tourists? Then, astronauts' Tweets are selected as online field site, and ethics are essential during the data collection process. A computer software MAXQDA are used to analyze data to prevent the common bias in qualitative research. Lastly, meaningful findings and appropriate implications are written in an intuitive and reliable way.

Chapter Four: Findings

Introduction

The selected 36 NASA astronauts have published over 23,819 Tweets. On average each astronaut has posted around 661 Tweets. After excluding all the retweets and the Tweets with zero-score engagement, then keeping Tweets with top 20% engagement score of each astronaut, there are left with 3,468 targeted Tweets that are coded and analyzed in this study.

These Tweets represent the most popular Twitter posts of 36 NASA astronauts. However, not all were published in space. After comparing all Tweets' publishing time with astronauts' time in space, these 3,468 Tweets can be roughly separated into two data groups: space dataset and earth dataset. Space dataset stores the 1,788 Tweets that were posted in Twitter while astronauts were in space, while the earth dataset keeps the ones that were published by astronauts on earth. Both the liftoff and the reentry Tweets can only be posted in space or on earth because of the limited travel time and the lack of access to internet or Twitter to and from space, so they can be spread out between these two data groups.

In fact, the earth dataset or the 1,680 Tweets account for 48.4% of the total targeted Tweets; that is to say, close to half of the most popular astronauts' Tweets involve with training and after-trip recall. In fact, five patterns emerging from this study are identified in terms of properties of leisure experiences attached to orbital space travel. These five patterns include training (professional anticipated preparation), liftoff (travel-to), in-space (on-site), reentry (travel-back), and memory (recollection). Only one out of five patterns directly took place in outer space. Therefore, space tourism extends beyond

the on-site experience. Space tourism, as the theory of a multi-phase experience suggests, is the total leisure experience that evolves into five sequential phases.

Training

The term "training" was one of the most frequently repeated words in the earth dataset, but few Tweets mentioned it in the space dataset. Impressions of training were diverse, but there were some consensuses on the significance, difficulty, and fun aspects of training.

Importance of training. Among the space dataset, only five out of 1,788 Tweets directly used the keyword "training" or "trained." All five Tweets identified the importance of training to space experiences. In detail, astronaut Anderson checked off training as the first task right before liftoff, and astronaut Harold thanked the training team for the "awesome ride" to space. Both astronaut Scotty and astronaut Dmitrij mentioned how training shaped their performance in space; a female astronaut, Charmayne, claimed that training made women as competent as men in terms of space travel. Indeed, not many Tweets from space dataset straightforwardly recalled the details of training, maybe the in-space experience captured the most attention away from recollecting the past. However, the whole process of liftoff, in-space, and reentry cannot be done without years' professional preparation for being competent as an astronaut.

Varieties of training programs. As to the earth dataset, the term "training" has been mentioned for 99 times, other similar terms (such as trains, trained) have repeated over 20 times. Several themes of training have been identified from the earth dataset, including spacewalk (Extra Vehicular Activity, EVA) training, pressure suit high altitude

chamber training (up to 75,000 feet), medical training, Sokol suit training, water survival training, winter survival training, zero-gravity training, flight training, eye-hand coordination and communication training, space flight readiness training, "office" training, emergency response training, language training, excursion, experiment, and maintenance training, field training, pressure suit fitting for high altitude flight training, NBL (Neutral Buoyancy Laboratory) training. These trainings mainly took place in several NASA institutions in the United States, European Astronaut Center, and Gagarin Cosmonaut Training Center. Training programs were varied, but astronauts were generally clear about the significance of training. As astronaut Samuel tweeted:

"'Chance favors the prepared mind...' Training under water today, preparing for 'game day' in space!"

Tough training. Difficulty of training was generally seen. Astronauts described EVA training as challenging, robotics training as world class level, cave training as incredible and awe, and the overall training process as great and tough. How tough and challenging the training can be? Astronaut Kana emphasized the daily amount as:

"1 jet, 2 gals, 5 flights, 5 airports, and 11 states in 12 hours on 1 Friday of great training…"

And astronaut Dale gave a better metaphor in terms of challenges of training to professional space travelers:

"Water survival training - imagine 3 friends getting changed for a wedding in the trunk of a car that is bobbing on a lake. You get the idea."

In comparison, astronaut Samuel perceived robot operation as one of the easiest training:

"A lighthearted moment during training in the 'Robot Operation Area' at @NASA_Johnson. Practicing one of the lesser-known skills required to be an astronaut. #Robotics #Space #TheRobot."

Leisure aspects of training. However, fun in these training Tweets appeared widely documented. For example, during training flights, astronaut Bora took a selfie, astronaut Martijn flew over places and took photos, both astronaut Xiaoyu and astronaut Aalok captured photographs of rainbows in the sky. Moreover, astronaut Elizabeth liked the beautiful and historical Star City during the training trip in Russia, astronaut Samuel described Gagarin Cosmonaut Training Center as "#Dance and #Space meet in silent poetry," astronaut Dale regarded emergency training glasses as "fashion accessory." Astronaut Caiqiang described final emergency training photos as "crazy pictures."

Some exploration trainings took place in caves, astronauts' excitement was most frequently mentioned. None regret or complain was seen. For instance, astronaut Bora was totally amazed by cave training and tweeted several times:

"In awe of this glorious, alien underworld."

"We felt like characters in a science fiction illustration."

"Not in my wildest dreams did I imagine such a spectacular underworld existed below the surface."

"Outstanding training … one of my most memorable life experiences."

Astronaut Dale described cave training as "exploring inner space," and gained something more than that: friendship and lifelong memories. He described the experience of cave training in detail:

"Admiring the sunshine in Tiscali Cave."

"'I gazed at the marvels of the caves in profound silence' - Jules Verne. Sounds about right! #day3 #caves2016"

"One of the coolest things I've ever done!"

"A little warm here in #Sardinia - we can't wait to get back underground tomorrow for more training!"

During training, leisure was perceived as a choice and many stated in their Tweets. For instance, party was common when the training was finished:

"Really enjoyed celebrating the @Space_Station Expedition 54/55 training team with these folks! Many countries, many great people!" (Astronaut Caiqiang)

"… 2016 training ended with success; a party with instructors." (Astronaut Elizabeth)

Training was also considered as personal and invaluable. For instance, the training team gave astronaut Elizabeth a birthday surprise:

"Thanks for all the birthday wishes. A special thanks to the @JAXA_en training team for making my birthday memorable!"

And astronaut Dale described EVA training as "great time" while astronaut Aalok expressed his gratitude:

"1st EVA training run. Thx divers, techs, engrs, conductors, directors, and awesome cameraman! #priceless."

Summary. Before people travel to space, training was perceived as a necessary step. The evidence of the importance and challenges of training was spotted from these Tweets. The properties of leisure experiences in training were identified, and the impressions of fun in training were direct and diverse.

Liftoff

When a space rocket takes off to or reentries from space, astronauts are very less likely to post anything on Twitter. Therefore, Tweets related to liftoff and return could be found from other phases such as the end of training, in-space or recollection. In other words, both liftoff and reentry Tweets are more like memories instead of in time posts. The only case for real time Twitter posts about liftoff and reentry can be found by astronauts who were not in the rocket ship but observed real time launch, docking, undocking, and landing from either space or ground control.

Few astronauts posted much information about their liftoff experiences when they were sent to space by the rocket ship, possibly due to intense preparation before the launch, and tight working schedule in space. However, astronauts who helped and observed the launch and docking processes were the most common sources of liftoff information.

Launch experience. How did professional space travelers spend the time before the launch day, and what did they feel about the launch? Astronauts' Tweets indicated that hard work was still necessary, excitement and gratitude in their opinions appeared strong.

Pre-launch hard work. At least three astronauts tweeted that they paid attention to pre-launch preparation right before their launch days: astronaut Bora put the suit on to simulate launch and reentry, astronaut Kohan spent his Thanksgiving in the vacuum chamber. As in astronaut Dmitrij's case, before working hard on the launch study, he did not forget to appreciate the beauty of life.

"This beautiful church is across the street from where I stay in Star City. I'm back for the final push to launch, time to get my study on!"

Pre-launch expressions. Few astronauts posted much technical information on Twitter at the launch day, except astronaut Charmayne; she tweeted the details of assembly in the rocket ship. In most cases, astronauts expressed their strong emotions on Twitter right before the launch. Astronaut Tianpeng implicitly explained his intense mood:

"Launch - 9 hours! The pre-launch nap time is ending shortly. In the meantime, those of us that are already awake are whispering quietly."

Others' expressions were more explicit: astronaut Michael was inspired at the moment when the shining sun glint captured his eyes; astronaut Charmayne was ready, and her team showed confident smiles in the pre-launch press conference. Some just could not hide their excitement:

"It's possible, we are a little bit excited about getting aboard this sexy rocket and heading to the space station!" (Astronaut Dmitrij)

"We the crew are up and very excited for today's launch." (Astronaut Dashqin)

"Last tweet before launch! My backup crew, soon to be prime. Goodbye Planet earth for now! Woo Hoo!" (Astronaut Meiqi)

Post-launch expressions. What did astronauts post on Twitter after their spaceship successfully docked the International Space Station? The answer may be checking their launch pictures and shared them on Twitter:

"Amazing view of our launch last week, from above" (Astronaut Harold)

"My favorite NASA pic from yesterday's launch." (Astronaut Tianpeng)

After arriving in space, astronauts were busy with tasks, but some still found time to show their gratitude to the launch team on Twitter:

"Thanks to all who made our launch possible last week! The view from here is WOW! Been busy with dragons; #science but will try to write more." (Astronaut Tianpeng)

"Huge thanks to all that made this beautiful launch possible." (Astronaut Aoyong)

Space perspective of rocket launch and docking. Compare to the limited information provided by astronauts in the rocket ship, more Tweets about liftoff were most frequently published by other astronauts. Those astronauts either helped with the docking at International Space Station in space or observed the launch at the mission control on earth. Their Tweets provided more personal and technical information.

Greetings from space. First of all, astronauts who stayed at the International Space Station showed their warm welcome to the new crew members. Right after the liftoff of rocket, astronaut Dmitrij got a launch photo from space and showed greetings:

"See you in a few hours guys!"

Once the rocket docked successfully, astronaut Aoyong tweeted:

"#Soyuz arrived! Great to welcome the rest of our #Exp46 crew aboard @space_station today!"

The view of launch from space. Some astronauts tweeted different stages of launch when they observed the process from space. The common expressions were "amazing" and "beautiful." Astronaut Michael was busy with taking photos from space:

"Fresh fruit is on the way! Here are some of the best pics taken from @Space_Station during today's launch."

Without cameras, some could still tell the rocket rails in the atmosphere:

"#Soyuz blasts through the atmosphere on its way to @Space_Station!" (Astronaut Caiqiang)

"Saw something launch into space today. Not sure what it was but the cloud it left behind was pretty amazing" (Astronaut Rafael)

When space ship docking the International Space Station took place, astronauts expressed their feelings on Twitter:

"A new guest has arrived. I saw Progress 57P out the window right before docking." (Astronaut Connor)

"Our supply ship just arrived. Precision formation flight at 17,500 mph. That still amazes me!" (Astronaut Michael)

"Here's our beautiful spaceship docked to the ISS. What a great way to arrive." (Astronaut Scotty)

"The vehicle arrived yesterday. Beautiful view from Cupola as it approached" (Astronaut Rafael)

Other launch events from space. Astronauts did not just celebrate the launch from earth, they were proud of the advanced launch from space as well. As some astronaut tweeted about the space launch events:

"Amazing how much can change in 50 years. Look at us now: launching satellites from #ISS. Pretty cool!" (Astronaut Meiqi)

"Another great example of International Cooperation today on @Space_Station -- launched 5 micro-satellites from 5 countries off the JAXA arm!" (Astronaut Dmitrij)

"Honored to participate in the legacy!" (Astronaut Tianpeng)

Ground perspective of rocket launch. Most Tweets about rocket launch were posted by a larger number of astronauts from the mission control on earth. They directly shared the real time information about the launch process, they showed best wishes to the astronauts in the rocket ship, and they expressed happiness when liftoff was safe and successful.

Observing launch from different locations. The rocket launch observation took place at several locations, and that provided different perspectives of the watching launch experience. For example, astronaut Aalok climbed high up and shared what he saw:

"Looking down from the Mobile Launcher. @NASA_SLS is a big rocket. #perspective"

At the same time, astronaut Morton at the same position described the size of Mobile Launcher:

"A view from the VAB roof of the giant Mobile Launcher for the @NASA_SLS rocket that will carry @NASA_Orion to space."

Not satisfied by simply seeing in naked eyes, astronaut Jinrui made full use of digital products:

"I was at the EFT-1 launch last week. Took a bunch of photos mostly; my favorite kind."

"Here is the launch seen in a window reflection where a TV also shows the Delta IV heavy."

Professional details of rocket launch. Human spaceflight was not a short-term project, it required months or even years' preparation. As astronaut Dale revealed the truth on Twitter:

"Though we don't launch until next year, clothing, food, and other supplies are starting the journey to the @Space_Station and will be waiting for us when we arrive."

Because rocket launch was a complicated project, some astronauts, including astronaut Dashqin, Hansen, and Samuel, shared every single progress of rocket launch with the world on Twitter. They joined pre-launch press conference, monitored weather, inspected the launch pad, updated with the launch time, provided the link to watch live launch online, and reported the status of astronauts strapped inside of the rocket. In the meanwhile, public concerns during liftoff had to be taken care, as astronaut Dashqin tweeted:

"No worries. We have plenty to study and the teams at the Cape are awesome."

After the launch was complete, astronauts continued to market NASA and space industry on Twitter:

"The crew is safe and sound aboard the #ISS! Signing off from Mission Control - Houston! I'll plan to get to more #askNASA questions soon!" (Astronaut Samuel)

"We are #OneTeam on this exciting journey! @Serious_Sellout @SpaceX and @NASA aren't competitors, we are teammates in this grand adventure! Exciting to see Launchpad 39A launching this amazing mission." (Astronaut Samuel)

"Really neat! Follow @NASAKennedy as they recreate #Apollo11 launch on twitter to celebrate #Apollo45 Anniversary." (Astronaut Hansen)

Best wishes from ground control. Astronauts gave their best wishes and warm congratulations to their colleagues who traveled from earth to space. Astronaut Samuel appraised these spacemen as "brave explorers," and astronaut Dmitrij expressed his farewell:

"Oh yeah baby! We have 3 more people in orbit! Beautiful launch - enjoy the ride to the @Space_Station!"

On Twitter, astronaut Aoyong, Bingnan, Frank, and Meiqi expressed "congratulations" to the successful launch. Furthermore, some were expected to be part of team. For example, Dale tweeted:

"I look forward to joining them next March as part of Expedition."

Inspirations. Some were aware of the encouraging side of rocket launch. For example, astronaut Samuel posted two inspirational Tweets:

"What an incredible flying machine, and what an epic mission awaited us in space! The dreams that we dare to dream..."

"Prepare well to launch your dreams; through a thousand reasons why you can't...there will be one reason why you can!"

Recall the past. Facing a rocket launch reminded several astronauts of the past. They either tweeted about their own liftoff experiences, such as:

"2 years ago today, launch of the final space shuttle mission. My friend captured it perfectly." (Astronaut Sandeep)

"Three years ago today, we set out for 6-month expedition aboard @Space_Station." (Astronaut Xiaoyu)

Or, they brought the famous space history up:

"#Soyuz is at the pad. Same pad that launched Sputnik and Yuri Gagarin." (Astronaut Dale)

Leisure aspects of liftoff. Just watching rocket launch was always worth it. Some stated on Twitter that they will never get tired of it, and it seemed fun. For example:

"Go!! Rocket launches never get old." (Astronaut Xiaoyu)

"Launchpad at sunset. Views of space portals never get old. #kennedyspacecenter" (Astronaut Bingnan)

"Wicked cool = understatement. @AstroKomrade does it again to give us sweet view of business end while they rotate Argo into launch position!" (Astronaut Dmitrij)

During rocket launch, astronauts also tweeted jokes. The best two were posted by astronaut Dale:

"5 years ago today, STS-119 launched from @NASAKennedy. @Astro_Wakata was with us. Is that guy ever on earth? :)"

"...filed under things you don't want to notice on the launch pad - wrong spacesuit!"

Summary. Excitement was highlighted when astronauts were strapped in the rocket ship and ready to explore space. However, it was also noted that other astronauts from either space or ground control also actively joined the process of rocket launch. Moreover, compare to astronauts strapped in the rocket ship, those outside expressed much more information and feelings on Twitter. It seemed that simply observing rocket launch can be memorable and fun. Once astronauts got aboard, they seemed to appreciate those who documented their liftoff journey either from earth or space. Therefore, when people travel to outer space, leisure properties included the exciting and memorable experience, the desire to document and share experience, and the fun to simply join the observation of others' liftoff.

In-Space

Over half of targeted data were originally published in space, which indicated that whatever astronauts shared from space must have attracted more public attention than Tweets about other stages of space travel on Twitter. Several themes from these popular space Tweets were identified as follows: sightseeing, impressions, greetings, and space activities.

Sightseeing from space. Astronauts repeatedly used terms as "view, see, look, watch, sight" to tweet what they saw from space. Among all the codes from space dataset, the most frequently mentioned codes in terms of sightseeing were space station, earth, sunrise and sunset, aurora, moon, cites, clouds, and coast. Overall, over 140 codes involved with the sightseeing theme. In space dataset, sightseeing was the identified theme with the most varied and the largest number of codes.

Continents and countries. Though all these 36 NASA astronauts came from the United States, but Africa ranked the top place that had been most frequently mentioned. Photos of Africa were taken and shared as well. How much did astronauts enjoy seeing Africa from space? The answer was that Africa left them with fond memories:

"The #Nile #Africa and windswept desert. I love flying over this area." (Astronaut Connor)

"Well this literally looks like an ink blot, only it's a huge ink blot in the middle of Africa; it's wicked cool looking." (Astronaut Dmitrij)

"I'm going to miss the colors of #Africa!" (Astronaut Aoyong)

Except Africa, several continents and countries were common in astronauts' space Tweets. In the order of frequency, they were: USA (America), Australia, Mexico,

Bahamas, Canada, Italy, Turkey, Europe, Japan, India, Mediterranean, Ireland, Brazil, China, Cuba, Egypt, Greece, Spain, Argentina, Madagascar, Asia, Chile, Columbia, England, Israel, and New Zealand. In most cases, the natural shape of these places captured the attention of astronauts, such as the desert in Australia and the water in Mexico:

"Hard to imagine the geologic sequence of events that created this view of the Australian desert." (Astronaut Scotty)

"Water etchings in western @Mexico sands. @Space_Station #Explore" (Astronaut Harold)

Cities and directions. A few states and cities from the United States were popular sightseeing sites from outer space, including Texas, California, Houston, Chicago, Florida, Seattle, Detroit, San Francisco, and Missouri. Sightseeing from one city to another was quick, for example:

"USA 'sea to shining sea'. Mountains of Alaska to Florida Peninsula. Only a 20-minute trip up here." (Astronaut Michael)

International cities popular from space were London, Istanbul, Dublin and Dubai. Rather than natural attractions, the artificial islands, Palm Islands in Dubai, caught the eye:

"Hello Dubai! The Palm Islands look amazing from @Space_Station." (Astronaut Rudy)

"Not something you see every day first hand. With features like this, Dubai stands out from 260 miles up." (Astronaut Rafael)

Places in earth were noticeable in the daylight, however, astronauts also enjoyed exploring the cities and countries at night. The light source at night was either from the moon or city lights. The night light was bright enough that places were observed unmistakably. For example, astronauts heaped praised on the night light of Paris:

"Stunning lights of Paris." (Astronaut Rudy)

"Last night, Paris showed us why it's called the City of Light" (Astronaut Scotty)

Furthermore, lights added extra beauty on places. For example, when comparing the city sightseeing between the day and the night, the night lights made the city stand out more:

"#London. Beautiful in the daylight, even prettier at night." (Astronaut Anderson)

"Mexico City: the brightest, largest light in view while arcing over Mexico one night last week" (Astronaut Scotty)

"Dublin, if we're lucky and it's clear, it's the first city light we see after our night Atlantic crossings!" (Astronaut Scotty)

Moonlight had the somewhat different effect on places at night. Astronaut noticed the differences as follows:

"Moonlight has a dramatic effect on pictures of the earth at night. I always loved that cool silver light." (Astronaut Tianpeng)

"Moonlit night you can see colors of earth amongst the glittering lights. This night the lights were mostly the Nile River, Cairo, and Israel." (Astronaut Franze)

In terms of directions, the codes, including "south" and "east," identified the largest number of Tweets. For example, the term south was applied to describe the rough

location of oceans, continents, and countries when astronauts did not bother to touch upon specific names of locations.

Earthart. Earthart was a common hashtag among astronauts' Tweets. Moreover, it captured colors, shadows, arrays, and patterns of the surface of planet earth and marked them as arts. But these arts may not be manmade, or even too great to be artificial. Astronaut Aoyong documented the most natural arts made by planet earth. Earthart was possible be any parts of earth surface; moreover, seeing earthart from space activated sensation:

"#EarthArt Snow-capped mountains in a blue dusk almost make me feel the cold air. Almost." (Astronaut Aoyong)

Earthart seized the beauty of continents, oceans, islands, mountains, and deserts. Observing earthart from space also recalled human wisdom back in history:

"#EarthArt Looks like earth replicated Michelangelo's famous fresco." (Astronaut Aoyong)

Why earthart was unique to space travel? Because perspectives and scales made all the differences. How unique experiences that earthart brought up with? Astronaut Aoyong gave the best answers:

"#EarthArt In 377 cumulative days in space, I've never seen this before today."

"#EarthArt Half a year, still she dazzles, colors, intrigues, excites, amuses, interests and shines." (Astronaut Aoyong)

Water. Planet earth was called a blue dot partially due to the fact of significant coverage of water on the surface. Sightseeing from space involved with all kinds of water formations, such as ocean either in the Pacific or the Atlantic, sea, gulf, lake, river, as

well as coast, island, beach, and delta. Coast was identified as the most common water sightseeing. For instance, tweet from astronaut Connor indicated the high frequency and fondness of seeing coasts from space:

"I can't help but smile every time we fly towards the #California coast."

Furthermore, tweets about coral reefs won the title of best water sightseeing:

"Coral reefs of the Bahamas and the Florida Keys … the vivid colors and patterns a work of art!" (Astronaut Michael)

"Coral reefs off the coast of #Mozambique - some of the prettiest on the planet. @Space_Station #Africa #Explore" (Astronaut Harold)

Mountains and parks. The view of the Andes, the Alps, the Himalayas, and other mountains were introduced in space tweets. How the mountains looked like from space? Sometimes, the mountains simply looked different:

"Rocky Mountains east of Seattle. Sometimes they just don't seem real from this perspective." (Astronaut Rafael)

"Oddly-shaped mountain in western South America - and massive, judging from the town next to it. @Space_Station" (Astronaut Harold)

Sometimes, the mountains triggered new angles to situations:

"5 days; a wake-up! Every #mountain top is within reach. Keep climbing." (Astronaut Aoyong)

"#Andes When you believe, you can move #mountains. Or move over them. #YearInSpace" (Astronaut Aoyong)

In some cases, the mountains fired up deep thoughts and new hopes:

"The #himalayas remind me of the bigger view we see when we conquer the #mountains we climb." (Astronaut Aoyong)

"Even the mightiest of mountains look so small against the vastness of space. Kids, focus on #STEM; help expand our place in the universe." (Astronaut Dmitrij)

In terms of parks, astronauts used a hashtag "#FindYourPark" to add more fun for the sightseeing from space. Several parks were found, including Grand Canyon, Zion National Park, Big Bend National Park, Yosemite National Park, and Killarney National Park. Even the agency of National Park Service was mentioned:

"#OTD 1916 @NatlParkService was born. Celebrate the centennial with me as I share my photos; personal story." (Astronaut Michael)

Deserts. Another attractive earth observation site was dessert. The greatest desert, Sahara, collected the most surprises of desert sightseeing from astronauts. And all desserts in astronauts Tweets were described as pretty and unbelievable:

"I never thought the desert could be so beautiful. Sand dunes in the Sahara." (Astronaut Rafael)

"Hard to imagine the geologic sequence of events that created this view of the Australian desert." (Astronaut Scotty)

Volcanos. To astronauts, volcano was an interesting target. They sent out live Tweets about erupting volcanos on Twitter and took photos as part of job in space, which indicated the significance of the volcanic observation:

"A #volcano in #Mexico oozes fresh lava and a tiny bit of steam." (Astronaut Connor)

"Copahue volcano erupting in Chile, South America." (Astronaut Michael)

"Sollipulli Volcano, Chile. One of the many earth observation sites that we are tasked to take pics of each day" (Astronaut Rafael)

Apparently, taking volcano photo did not count towards boring work. Instead, astronauts perceived this type of work as luck in their attitudes:

"By luck, I spotted this breathtaking #volcano #earthArt as we flew over #China" (Astronaut Connor)

"Not every day you get to see an active volcano, let alone 2. Vanuatu islands near the Solomons in the Pacific" (Astronaut Rafael)

Moreover, astronaut Aoyong regarded volcano as a tool for inspiration:

"Advice from a #volcano: keep your inner fire burning."

Fires. Probably the only unpleasant observation from space was fire, especially when forests or mountains were in danger. Prayers and thoughts on Twitter were given by astronauts from space, they flew over the fire but were hardly capable of changing anything. These Tweets demonstrated the personal side of astronauts and the fragility of lives:

"Our orbit took us directly over California's Rim Fire about an hour ago. Devastating. August 26." (Astronaut Xiaoyu)

"I was asked this evening if we can see the SoCal fires from space. Yes, unfortunately we can. May the Santa Ana's die down soon. #Californiawildfire" (Astronaut Franze)

"Smoke covering a vast area in @Canada. Our hearts go out to all those affected by the fires there. @Space_Station" (Astronaut Harold)

*C*yclones *and lightnings*. Not only fires were spotted from space, some atmospheric circulations were also clear to see from space, especially some massive tropical cyclones. These cyclones were commonly observed from places including Taiwan, Bahamas, Mexico, Texas, India, Madagascar, as well as areas close to the Pacific, the Indian, and the Atlantic oceans. Astronauts stated what they saw from International Space Station:

"The view out my window this morning. #Typhoon #Soudelor still looking ominous from @Space_Station." (Astronaut Aoyong)

"#SuperTyphoon #Vongfang, I've seen many from here, but none like this." (Astronaut Connor)

"Super Typhoon #Noru, amazing the size of this weather phenomenon, you can almost sense its power from 250 miles above." (Astronaut Dmitrij)

The mixed feelings of seeing cyclones from space appeared very strong. These cyclones turned out to be beautiful and scary at the same time. The massive spinning clouds formed the beauty, and the violent power of nature in awe:

"The destructive power beneath the clouds of Hurricane Harvey ruins any thought of the beauty of the cloud formations from above." (Astronaut Franze)

"Beauty. Power. Fear. #Hurricane #Marie off of #Baja" (Astronaut Connor)

"When Mother Nature gets to spinning, it can be an awesome but scary sight. Looks like super Typhoon #Noru is gaining momentum." (Astronaut Dmitrij)

Lightning was another spectacular view to see above earth. Unlike the spinning hurricane that relatively lingered on the surface of earth, it was noted that fleeting flash of

lightning was challenging to capture by either camera or eyes, which however was totally worth the effort because of its stunning scenery:

"Who knew #lightning was so fast? This blew my mind." (Astronaut Connor)

"Our chances of getting lucky and succeeding are increased by trying. Caught this lightning over the Atlantic!"

"An impressive line of storms moving through Asia July 24. The lightning was amazing!" (Astronaut Xiaoyu)

On a snowing day, lightning was observable above the atmosphere. Even astronauts admitted that it did not occur very often. But in space, unusualness was also possible. For example, as astronaut Aoyong tweeted:

"Rare #thundersnow visible from @Space_Station in #blizzard2016!"

Clouds. Compare to infrequent thundersnow, clouds turned out to be a common sightseeing for astronauts. However, it did not indicate that clouds were less interesting to professional space travelers. In fact, the hobby of cloud watching was easy to maintain from space, and the experience was similar especially when imagination was the only variable:

"Have you ever watched the clouds go by; let your imagination see different shapes? It works from space as well." (Astronaut Rafael)

"Never tire of finding shapes in the clouds! These look very botanical to me. Simply perfect … Perhaps a dandelion losing its seeds in the wind? Love clouds!" (Astronaut Xiaoyu)

Sometimes, imagination played a role in cultivating personal feelings about cloud formations. For example, some clouds reminded astronauts of their lives on earth:

"Almost looks like a painting with the clouds and red earth in the background. Had to share this one." (Astronaut Rafael)

"Day 220. A cloud over #Qatar reminds me of the pillow I miss at sleep." (Astronaut Aoyong)

Excluding the influence of human imagination, clouds may be an ordinary object to observe when living in space. However, cloud gazing above earth spotted peculiar shapes and that surprised astronauts. A few Tweets described these special moments when captured uncommon clouds:

"Oddest clouds I've ever seen … "#Hawaii blue waters and spiraling clouds. #earth still amazes me every day." (Astronaut Connor)

"Mysteriously amazing! Finally a great view of rarely seen noctilucent clouds." (Astronaut Michael)

"At sunset, the sun shines a different light on the layers of clouds and helps them come alive with color. Thank you Mr. Sun." (Astronaut Dmitrij)

It was also possible that facing same view triggered somewhat opposite thoughts and different interpretations. For example, when massive clouds cut sunlight away from the ground, one astronaut enjoyed the scene, but another was inspired by it:

"Clouds cast thousand-mile shadows into the black of #space. A favorite view of ours." (Astronaut Connor)

"Here we go! Always remember, there is blue sky above those clouds, no matter how much shadow they create beneath them." (Astronaut Tianpeng)

Aurora. How popular was aurora to astronauts? Aurora was one of the top sightseeing objects from space. A fair comparison to demonstrate the love of aurora was given by astronaut Anderson:

"Two things have given me goose bumps up here: an incredible #aurora flyover and watching the new Star Wars trailer!" (Astronaut Anderson)

How much did astronaut enjoy observing aurora? When free time finally came to these professional space travelers, one admitted that aurora was his leisure! While another did not let go of this amazing sightseeing of aurora even the break was close to an end:

"One of my favorite things to do in my free time is watch the Aurora; it's almost alive, as it slathers up the sky in awesome sauce." (Astronaut Dmitrij)

"Day 142. Weekend is fading, but #Aurora is not." (Astronaut Aoyong)

Unlike other atmospheric events, Aurora was not rare. It appeared frequently with various colors and waves, and that was why astronauts enjoyed it so much. Close to a hundred of Tweets described the wonder of aurora, astronauts repeatedly shared their experience of seeing aurora from space, let alone of the newcomers. Astronaut Franze did the best job in delineating that moment of a lifetime:

"The waves of the #Aurora are soothing and magical … Variety of colors, rhythmic movement of the auroral emissions, and spikes coming out towards us was breathtaking … My first aurora, ever! Looks like a fluorescent green cloud of cosmic smoke wafting over our planet. In a word, Fantasmal!"

Another evidence, the personification of aurora, suggested space travelers' devotion to aurora. In their opinions, aurora was decorated with personality and feeling:

"Day 199. #Aurora has danced her way out with the #sun." (Astronaut Aoyong)

"Aurora waves goodbye and lets the stars take center stage." (Astronaut Michael)

"Light from the rising moon competes with an #aurora for attention as the western US sleeps." (Astronaut Anderson)

Moreover, A flash of inspiration was drawn from aurora:

"Nothing like a little #aurora to get things started … May your electrons and protons be fully charged, so you are as bright as Aurora today." (Astronaut Aoyong)

Manmade space objects. Satellite was one of the space objects made and sent out to space from earth. Satellites were observable on the ground but may not be seen many at one time. But in space, it was a different story. As astronaut Anderson counted:

"How many satellites can you spot streaking across the stars? I count 8, 3 at 1 time!"

In most cases, satellite observation took place when they were released from International Space Station. To astronauts who was not responsible for this task, it was fun to watch the process. For example, astronaut Rafael documented this experience:

"Koichi Wakata released 3 small satellites from the Japanese Robotic Arm today. Pretty exciting to see live."

Another manmade space object was the space station. Sightseeing of space station from inside was not impossible. At least the changing colors of its surface was recorded by astronauts on Twitter:

"Our Space Station casting shadows on itself." (Astronaut Xiaoyu)

"For an instant before sunrise, the space station glows orange." (Astronaut Aoyong)

What more interesting were the smaller objects inside the space station. For example, when space station was felt like a running vehicle:

"Changed a window cover today; it's like having a new windshield, only your car is a space station going 17,500 mph. I love my new windshield." (Astronaut Dmitrij)

Not all life forms in space were human beings. Astronaut Aoyong grew, took care of, and harvest space flowers. He tweeted several times about this special life that he brought up in space:

"#SpaceFlower out in the sun for the first time!"

"Some of my space flowers are on the rebound! No longer looking sad!"

These Tweets about space flower may sound like daily routines, but the significance as well as the implications of other life forms in space were huge to deep space exploration in the future. Other than that, astronaut Aoyong believed that space flower was also an inspirational tool:

"#SpaceFlower garden proving through challenge and continuous effort comes growth."

"#SpaceFlower Where flowers bloom, so do possibilities."

The type of flower raised by astronaut Aoyong was unclear, but astronaut Rafael joined the journey and tweeted his observation:

"New life on ISS. A sunflower sprout is now 2 days old. Another few days at this growth rate; it will need a new home."

Sightseeing from orbit. Whatever earth beauty was seen from space, astronauts were actually staying at space station which was continuously rotating the earth orbit. What have discussed above were Tweets about details such as city lights, coastlines, or

sand patterns. While the sightseeing Tweets about orbit were more like outlines of sightseeing of planet earth. As astronaut Dmitrij illustrated the difference of being on the ground and in orbit:

"It's always fun to make sandcastles at the beach. From orbit, you get to see the cool stuff Mother Nature makes on the beach."

After all, space station moved all over the orbit in a short period of time. How quick did the space station move and how unique the experience was? Some Tweets offered answers:

"Day 304. That's 4,864 orbits a'round' our beautiful planet #earth." (Astronaut Aoyong)

"From southernmost point of orbit over the South Pacific, all clouds seemed to be leading to the South Pole." (Astronaut Xiaoyu)

"You see all seasons from orbit. Saw this colorful lake and thought, part frozen, part not, but all awesome!" (Astronaut Dmitrij)

Though the speed of space station ran quickly in orbit, it did not mean that places were not seen distinctly, or earth objects were not observed the same as from the ground. Astronauts Franze gave two examples:

"The holy city of Mecca, where the Kaaba is clearly visible even from orbit."

"From the ground or from orbit, the Grand Canyon in Arizona is an amazingly unique feature on our planet."

Another distinctive experience from orbit was the unique sightseeing of sun lights. Depending on different routes of orbit, sun lights changed in various ways. Some astronauts reported their experience on Twitter:

"Our orbit over the past few days on @Space_Station has us in daylight all day long!" (Astronaut Harold)

"Continuous Twilight. When our orbit follows the day-night shadow, the sun never sets." (Astronaut Jinrui)

Travelling in orbit was not just felt, the trace was recorded, and the trail was also predicted by digital equipment. Astronaut Scotty shared a map of his orbital travel history:

"We've been flying a 'high-beta' orbit: pic shows our line of travel skimming beside dusk (or dawn). Lots more sun!"

Sun. The last sightseeing objects were not in earth or near orbit, but they were frequently observed as well, such as moon, sun, planet, star, constellation, and galaxy. Over 220 Tweets mentioned the sun which ranked the top one among all Tweets about sightseeing of planets and stars. It made sense, because of the massive power of sun and its influence on human life. Solar phenomenon including sunrise, sunset, sunshine, and sun glint was common but also fun to astronauts. As astronaut Aoyong described the experience as follows:

"Five thousand #sunrises during my #YearInSpace. Wish I could have seen them all!"

"Funny how #sunrise resembles a light saber. #TheForceAwakens #GoodMorning from @space_station!"

See the funny side, astronaut Dmitrij got the same joke between Star Wars and the sun, and also shared a different one:

"If you squint a little & turn head sideways, a sunset; solar array look a lot like a light saber, just saying. #MayThe4thBeWithYou"

"In space, when you can't find your sunglasses, you can just use a solar array to block the Sun. Good morning, everybody!"

Several Tweets about the sun also emphasized the visible colors. How did they explain the scenes of incredible vividness? Astronauts tweeted the answers:

"First hint of sunrise is blue. Then red creeps in." (Astronaut Xiaoyu)

"Early sunrise soaring out of a magical moonlit night, the brilliant blue ribbon of our atmosphere on the horizon." (Astronaut Scotty)

"It's amazing to watch how sun glint changes my view of water so quickly as we fly by (at 17,500 mph), brings a lake to life." (Astronaut Dmitrij)

Sun was used as a standard for time. At the same time, astronauts did not seem to get tired of it. As astronaut Harold explained:

"Another 16 sunsets, so it's time for bed. #Goodnight from @Space_Station."

"The #sunset never gets old here @Goodnight from #ISS."

Moon. Though Tweets of the sun easily doubled the posts about the satellite of earth, the moon was also a popular theme. Like the sun, moon had different forms, such as moonrise, moonset and moonlight, to attract astronauts' attentions. How the moon gazing experience was different in orbit? It seriously depended on perspectives and on who tweeted the post on Twitter:

"Look! It's the moon! By my toe!" (Astronaut Aoyong)

"I still chuckle at how tiny our #moon looks from up here." (Astronaut Connor)

“Lady Luna sure is pretty from up here, but she’s difficult to take a picture of. I'll keep trying. Goodnight moon!” (Astronaut Dmitrij)

Similar to the jokes that linked sun to Star Wars, astronaut Dmitrij played the moon on words as well:

“Now that's what I call a full moon! Although it does resemble the Death Star. #earthShapes, oops, nope. I guess it’s #moonShapes.”

The sightseeing of earth’s closet neighbor was still spectacular. It turned out that silver moonlight did not devalue the beauty of the moon. Instead, astronauts were amazed by its natural magic:

“Moonlight has a dramatic effect on pictures of the earth at night. I always loved that cool silver light.” (Astronaut Tianpeng)

“Look at this! Absolutely Stunning! @Thom_astro captured the super moon!” (Astronaut Charmayne)

“Gorgeous moon rise! Such great detail when seen from space. Next full moon marks #Eclipse2017. We'll be watching from @Space_Station.” (Astronaut Franze)

Similar to the function of sun, moon was capable of pointing out time as well:

“After a hard day of work, the #moon sets, and so do I. Good night from @space_station.” (Astronaut Aoyong)

Moon was also an inspirational space object. Astronauts shared their motivation moments when touched by the moon:

“Sometimes all you have to do is shine a new light on it, to see things in an entirely different way, like the ocean by moonlight.” (Astronaut Dmitrij)

"Beautiful moonrise to get you motivated for the #supermoon tonight. We have a front row seat from @Space_Station, not a chance of cloud cover to get in our way." (Astronaut Franze)

The universe. Sometimes astronaut stretched out their attention to the deeper universe. From the orbit, Venus was spotted; however, Venus was viewed as a supporting actor compare to the moon. For instance, astronaut Aoyong wrote Venus's byplay like these:

"#Venus chases the #moon over South East Asia."

"#Venus photobombed the #moon tonight."

In terms of constellation, astronaut Xiaoyu mentioned one as follows:

"Seven Sisters overlooking Reunion; Mauritius Islands in a moonlit Indian Ocean."

The major sightseeing of the universe was our galactic home, the milky way. Astronauts observed it, described it, and put it in comparison with time. How did the observation go? The key words were beautiful and awesome:

"The #MilkyWay steals the show from #Sahara sands that make the #earth glow orange … Nothing like a view of the #MilkyWay first thing on Sunday morning. Beautiful." (Astronaut Connor)

"Can you see stars from up here? Oh yeah baby! Check out the Milky Way as it spins; paints the heavens in a thick coat of awesome-sauce!" (Astronaut Dmitrij)

How did astronauts explain the milky way that was seen from the orbit? The answers were beauty and harmony:

"On the number of stars in our #MilkyWay galaxy, mind blown … #MilkyWay. You're old, dusty, gassy and warped. But beautiful." (Astronaut Aoyong)

"#ISS #earth #MilkyWay all flying in perfect harmony." (Astronaut Connor)

It was noted that astronaut Aoyong measured his time by space objects. This time, his tool was the milky way:

"Day 256. #MilkyWay births 7 new stars a year, so 2 star births to go."

Impressions. In-space impressions were astronauts' feelings and attitudes towards life in space. The overall impression was assumed to be mixed with positive, neutral, or negative aspects. However, in the space dataset, the frequency of the term "good" was 169, the numbers to "beautiful" and "great" were 79 and 78 respectively. These three words were the top three feelings about living in space. Other major impressions in order included new, amazing, color blue, cool, happy, awesome, love, spectacular, big, pretty, safe, fun, best, beauty, hope, bright, incredible, gorgeous, nice, stunning, wow, better, early, favorite. In conclusion, all major impressions turned out to be positive and promising.

Neutral and plain descriptions about astronauts' experience in space were common among all Tweets from the space dataset. In most cases, they worked for the illustrations of what astronauts observed. These descriptions either provided objective impressions about space experience or let the attached photos or videos to do the talk. The main significance of neutral impressions was to outline the picture of space travel experience, to encourage explanation, and to inspire imagination. For example, several Tweets from the theme of sightseeing fit into the neutral side.

Negative perspective contained the terms as old, busy, hard, bad, sad, and scary. Though these terms may represent opposite meanings in different contexts, here they did not straightforwardly leave a pleasant or fun impression as what leisure was supposed to be. However, negative impressions offered insights into space tourism.

For example, the impression of "busy" was illustrated in two ways. On the one side, astronauts in space had tight schedules, challenging and risky tasks, and new working locations. The term "busy" was applied to indicate the nature of their job as astronauts, and sometimes the emergencies at the International Space Station. For instance, astronaut Scotty had an urgent experience at work:

"Suddenly very busy! Ammonia leak on the outside of station means that Cassidy and I will be doing a spacewalk tomorrow to try and repair it."

In astronaut Scotty's case, spacewalk may involve with preparation on that day, but it did not occupy Scotty's time all day. Furthermore, Scotty tweeted this post which indicated that he had some free time to log on Twitter at least. That is to say, posting a Tweet that saying "busy" may actually mean "not that busy;" this vagueness can be found in others' Tweets as well, and this is the other side of the impression of "busy":

"Gorgeous #sunrise I just snuck a peak at on a crazy busy day onboard #ISS" (Astronaut Connor)

"Enjoying every minute up here in low-earth orbit! Very busy, but doing well. Great #teamwork!" (Astronaut Frank)

"Was a busy day on #ISS yesterday, but my thoughts were with you, India. Happy Independence Day! Snapped these for you." (Astronaut Meiqi)

In conclusion, impressions of space travel seemed to be mixed with positive, neutral, and negative aspects. However, positive impression of in-space life turned out to be dominant; that is to say, astronauts tended to have pleasant experiences about in-space life.

Greetings. Greeting was generally seen from Tweets posted by astronauts from space. Tweets of greetings were expressions of goodwill, welcome, and salutation. In detail, greeting Tweets had several themes. Goodnight was mentioned in about 276 Tweets; the following was the post of good morning which involved with over 120 Tweets. All kinds of happy holidays were written on Twitter as well. Other greeting posts related to the themes of general salutation, goodbye, congratulation, and welcome.

Who were the recipients of these Tweets? On the one hand, greeting Tweets were expressed to inanimate objects like planets and spacecrafts, and to countries and agencies. On the other hand, astronauts wrote these Tweets mainly to build, maintain, and strengthen human relationships with crewmates, families and friends, teams and agencies, as well as the public.

Over 210 goodnight Tweets from seven astronauts were directly worded with "good night (goodnight) from @space_station" with vague indication that they suggested to the general public. The action of expressing good wishes before sleep from the International Space Station appeared prevailing. The rest posts either added no other information or sent goodnight to the moon and earth. For example, astronaut Dmitrij sent his night wish to the moon:

"My 1st real moon pic … Goodnight moon!"

Tweets about good morning were similar, the majority was morning greeting from space station. Others were sent to friends, cities, countries, and even sunrise. For example, astronaut Aoyong tweeted:

"#GoodMorning sunshine! Be with me for the next 45 minutes."

Compare to previous themes, Tweets about happy holidays were more diverse. All kinds of holidays were mentioned, including Christmas, New Year and Chinese New Year, Thanksgiving, Easter, Halloween, Valentines' Day, the 4th of July, Veterans Day, St. Patrick's Day, World Photography Day, National Coffee Day, World Ocean Day, earth Day, and other anniversaries.

Sometimes, even Friday, Saturday, and Sunday were celebrated as holidays maybe because they indicated free time after work days; none Monday, Tuesday, Wednesday, or Thursday were worded with the term "happy." For example, there were 15 Tweets that contained "Monday." However, over half of them dropped a hint that motivation was needed on Mondays; in particular, one Tweet directly described Monday as gloomy:

"A little #sunrise to brighten your #BlueMonday!" (Astronaut Aoyong)

In general, departures may be as depressing as Mondays. However, for all ten goodbye Tweets, none showed explicit sadness. Instead, astronaut Xiaoyu wrote a departure wish to three specific crewmates. While another five goodbye Tweets said farewells to undocking spacecrafts; for example, astronaut Dmitrij pretended that vehicle Dragon was a living person:

"And there goes #Dragon. Goodbye to our 1st return visitor since Atlantis in 2011. Come on back anytime, we'll leave the lights on for you!"

Among seven birthday Tweets, three were expressed to the USA and another was to the United States Marine Corps. It made sense because all chosen NASA astronauts were U.S. citizens, and some had military backgrounds. Moreover, astronaut Aoyong commemorated the birthday of Sally Ride, the first American woman astronaut, on Twitter. The rest two Tweets were more personal:

"Sorry to miss your birthday for the same reason again my little Princess, I wish you the Happiest of Birthdays, Papa will be home real soon." (Astronaut Franze)

"Thanks to all my friends for making this an epic birthday." (Astronaut Harold)

Other greetings Tweets were more general, they were identified by codes including hello, greetings, and salute. These Tweets were mostly expressed to either friends on earth or places when astronauts flew above.

Finally, in terms of people among all Tweets in the space dataset, team, crewmate, friend, and family were most frequently tweeted. It was interesting to note that the nature of team and crewmate seemed to be more work-related, while friend and family were more relaxing subjects.

Space activities. Except sightseeing, impression-changing, and greetings-sending, what else did people do for activities in space? Astronauts shared some of their work and leisure activities that may potentially attract future space tourists.

Spacewalk. Among all activities, Spacewalk was demonstrated in particular as an exciting, unique, and recommended activity, and it was the kind of work that was accomplished outside of the International Space Station. Some Tweets did not hide its challenging nature or astronauts' reaction to spacewalk:

"Did you know we use our hands to maneuver around @Space_Station during our #spacewalks? @Astro_Wheels calls it a 'fingertip ballet'!" (Astronaut Franze)

"I think I'll go on a little #spacewalk tomorrow. Feeling all emotions right now." (Astronaut Connor)

However, demanding spacewalk did not contrast with leisure opportunities sought by astronauts. For example, spacewalk was considered a game, and the preparation of spacewalk was compared to an action of being a super hero; more interestingly, astronauts were able to find some free time during spacewalk to enjoy sightseeing:

"Day 212 Getting my game face on for #spacewalk." (Astronaut Aoyong)

"Preparing my space suit tool belt for tomorrow's #spacewalk. I wonder if Batman goes through this process?" (Astronaut Anderson)

"Sometimes on a #spacewalk, you just have to take a moment to enjoy the beauty of our planet earth." (Astronaut Franze)

Was it a different experience from the outside of the International Space Station? Several astronauts agreed and claimed that it was even much better. For example, astronaut Dmitrij expressed his excitement by just receiving the task of going out for the second time:

"What's more awesome than being on @Space_Station? Getting a call from mission control for another spacewalk! Dancing with the cosmos tomorrow!" (Astronaut Dmitrij)

It was not true that the very rareness of having the chance to work outside of a spacecraft made spacewalk special. Instead, a lot of men and women had taken the lead, and many more joined the journey:

"My spacewalking crewmate is now 221st Human to have ventured into the void of space in his own personal spacecraft! #Spacewalk" (Astronaut Franze)

Three reasons may explain how unique spacewalk could be. First, spacewalk provided the change to enjoy sightseeing outside of a spacecraft, and the view was more breathtaking than simply observing through the windows of space station:

"The view was reasonably INSANE during the #spacewalk" (Astronaut Connor)

"A spacewalk is like taking off the blinders to the enormous beauty of our world." (Astronaut Dmitrij)

Moreover, spacewalk was the activity that brought up with new feelings which was impossible to simulate or compare in other occasions. These new feelings left astronauts with unforgettable memories in space:

"Exciting time during my 1st #spacewalk. I won't forget the sudden spacious feeling when the hatch opened and bright white light flooded in." (Astronaut Tianpeng)

"On a #spacewalk, the earth never lets you forget you are 250 miles/400 km high." (Astronaut Franze)

Third, being authentically in space without the shield of spacecrafts broadened the outlook on some aspects:

"Unique perspective of an #ISS solar array from today's #spacewalk" (Astronaut Connor)

"While #spacewalking I realized something: I used to think I was scared of heights but now I know I was just scared of gravity." (Astronaut Connor)

In summary, spacewalk attracted astronauts' interest and attention because of its unique sightseeing, memorable feeling, and new perspective. Therefore, it was not

surprising that both astronaut Franze and astronaut Tianpeng endorsed spacewalk and suggested for more such chances if possible:

"Amazing views during our #spacewalk. What a phenomenal way to experience our world, I highly recommend it if you have the chance!" (Astronaut Franze)

"I will never forget views like this during my 1st #spacewalk, it's hard to soak it all in. I look forward to more opportunities tomorrow." (Astronaut Tianpeng)

Photographing. One of the less dangerous activities in space may be taking photos. Photograph was considered to be common during space trips. It may be one of a few activities that people loved doing through training, liftoff, in-space, reentry, and recollection. In-space photographs documented astronauts' work, beauty of earth, life at space station, and lots of minor aspects about space experiences.

In fact, space was more than a reasonable place to take pictures from. According to astronauts, the orbiting space station and micro-gravity provided possibilities to all kinds of photograph ideas:

"Happy #WorldPhotographyDay! Traveling our world 250 mi above earth at 17,500 mph is a visionary dream." (Astronaut Aoyong)

"Here's what happens when space-folk take some pictures to show their USA-Pride, micro-gravity allows for some cool poses!" (Astronaut Charmayne)

Photographing was neither a solely sneaky leisure activity nor a military serious task. It combined both elements: astronauts admitted that it was part of their work in space, but they had fun as well, otherwise they were not able to share pictures on Twitter. For example, astronaut Rafael tweeted one of the required photo sites:

"Sollipulli Volcano, Chile. One of the many earth observation sites that we are tasked to take pics of each day."

It seemed that sometimes photographing became a captivating activity to astronauts in space. Tweets from several astronauts indicated that even those professional space travelers with busy schedules can be tempted to dwell upon recording and sharing the views they saw from space:

"Sorry another northern lights photo, but they just keep getting better!" (Astronaut Rafael)

"Just can't stop photographing the Andes while they're clear, from the Argentine pampas to the coast." (Astronaut Scotty)

"Every time we fly over the Bahamas I am blown away by the color of the water so I have to take more pictures." (Astronaut Rafael)

If astronauts enjoyed spending time and effort on photographs, the number of pictures taken from space was possible to be large. How many were these photos? Two astronauts gave their answers:

"Wow. Did I really tweet 1,000 photos? Guess I've been here a while." (Astronaut Aoyong)

"1 millionth ISS photo. Part of time lapse series. Not sure who took it, Dan Burbank or myself. We can't remember." (Astronaut Jinrui)

This hit on an idea that space could be an ideal site for photographers. For this case, astronauts already showed their agreement, and even gave some thoughts about photographing options:

"#Italy is the most photogenic of countries, day or night." (Astronaut Connor)

"#SpaceZoom slide show featuring giant clouds. In space the horizon provides endless options for photography." (Astronaut Michael)

Except the scheduled photograph tasks, did astronauts take pictures for entertainment during free time? The answer was positive. Astronaut Dmitrij ranked photo-taking as his favored leisure activity:

"My favorite pastime in space? Looking out the windows (of course); taking pictures!"

Furthermore, astronauts took photos of each other and shared them on Twitter. This way the public was easily able to access real time space experience through Twitter. Moreover, astronauts used these Tweets with photos to interact with crew members as well as to document their own life in space:

"A closer look at infinity in my visor reflection - the Yin & Yang of earth & Space. Big thanks to @Astro_Sabot for this #spacewalk photo." (Astronaut Franze)

"My 2nd #spacewalk is complete for Expedition 53! Can you find the two people working outside in this picture?" (Astronaut Tianpeng)

"Here's a shot of me controlling the robotic arm, carrying @astro_luca, during yesterday's spacewalk." (Astronaut Xiaoyu)

Photograph was also a tool to link people from space to the ground for educational purpose. Through Twitter, astronaut Michael revealed the mystery of photo-taking skill in weightlessness space:

"Let me show you this Cupola view, the window on the world! Plus how we take pictures up here."

Selfie. A more fun activity may be taking selfie in space. The most popular selfie theme was spacewalk selfie. However, first of all, it was necessary to acknowledge that selfie in space was not an easy task:

"A #spacewalk selfie is harder than you'd think. Put on some oven mitts and try finding the shutter button!" (Astronaut Franze)

Challenging selfie during spacewalk did not scare astronauts away though. Moreover, these selfies conveyed a clear message about how much astronauts loved spacewalk and their enjoyment of work and life in space:

"#SpaceWalkSelfie Back on the grid! Great first spacewalk yesterday. Now on to the next one next week. #YearInSpace" (Astronaut Aoyong)

"#SpaceSelfie - sorry about reflections, but you can see moon next to my helmet; you might notice the size of my smile - spacewalks are AWESOME!" (Astronaut Dmitrij)

"#Spacewalk selfie on this #SelfieSunday. A day at the office doesn't get any better than this!" (Astronaut Franze)

The fun of selfie was not limited to human being. Astronaut Aoyong extended the scope of selfie subjects to heads of lettuce:

"Tomorrow we'll eat the anticipated veggie harvest on @space_station! But first, lettuce take a #selfie."

Teams took selfies as well. It was unclear if floating camera in space was not able to take team photos, but it seemed that selfie was a more common way to photograph several people together:

"Great work by the whole team yesterday and a brief moment to take a #selfie!" (Astronaut Aoyong)

"#Selfie from last week with the whole crew. What a great group to work with!" (Astronaut Connor)

Probably the best selfie Tweet was posted by astronaut Connor. While he was in space, through internet he participated a live TV show with all performers and audiences on earth, and Bill Clinton was one of the honored guests as well. At the end of the TV show, astronaut Connor took a selfie with Bill Clinton while they were geographically miles away. It was a great example to show that some wishes were able to be realized in space:

"I can now cross '#selfie with @BillClinton' off my #SpaceBucketList" (Astronaut Connor)

Video. Camera was not simply applied to photographs. Videos were recorded and made for the purposes of documenting work and life in space. Compare to pictures, videos did a better job in illustrating more complicated subjects to the non-professionals:

"#Fitness is critical in space! Watch this #SpeedyTime video as I transform the multi-modal ARED machine during my workout." (Astronaut Charmayne)

"We do so many interesting tasks up here I thought I would float around and record some video. This 'What You Doing' clip shows @Astro_Sabot removing air from a water bag using centripetal force." (Astronaut Frank)

Video was capable of attracting more attention to real time event. For instance, astronaut Michael publicized the launch of a spaceflight on Twitter:

"That Soyuz flight to @Space_Station last week was exciting! Watch this video and come along for the ride." (Astronaut Michael)

Other than working aspects, videos offered direct evidence about what astronauts enjoyed of sightseeing. Astronaut Franze recorded some views of earth from the orbit and tried to interact with the people from these areas by such a Tweet:

"Beautiful coastal lights from Seattle down to Baja - if you live on the west coast of North America you are probably in this video! Make a wish on the shooting star, seen in the upper right at about 30 seconds." (Astronaut Franze)

In terms of human interaction, video provided a better way to maintain relationship than a Tweet message. For instance, astronaut Charmayne had some family moments through video:

"Did you know I get to video-conference with my family while aboard the @Space_Station?"

Exercise. Physical fitness was more of a necessity than a choice to astronauts in space. That way, exercise was a regular activity and was able to be done by treadmill or some physical working tasks. For example, astronaut Dmitrij offered two short stories about exercise in space:

"Bungee cords hold us down on the treadmill in space so we don't float away while running."

"Wrestling the vacuum cord can be a pain for sure, but on orbit, it's a lot worse. @AstroPeggy found me after I wrestled the vacuum and lost."

Except being in the weightlessness, exercise was also fun when counting the geographical miles that passed. Astronaut Rafael gave his daily number of running performance by the measure of earth miles per orbit, and astronaut Aoyong provided the

total number of his orbiting experience, readers can calculate if astronaut Aoyong ran treadmill one orbit each day, and how many miles did he run for an entire year:

"Ran for ~1 orbit today. 12 miles on the treadmill while the station travelled more than 25,000 miles. I've now run around the world." (Astronaut Rafael)

"Today I began the 2nd half of my #YearInSpace! Having circled the globe 2,736 times." (Astronaut Aoyong)

Experiment and research. Some astronauts' job in space was conducting experiment and research. These science projects were shipped to the International Space Station and installed by astronauts. Why did they have to be tested in space? Astronaut Dmitrij used a relaxing tone to indicate that the answer was special conditions of outer space, for example, micro-gravity:

"Tropical punch attack! Not having gravity means a mess if you spill your drink ... but also makes the station a great place for @ISS_Research." (Astronaut Dmitrij)

The transportation and installation of experiment and research went through astronauts' efforts as well. It was noted that science projects and living resources were shipped to the space station, astronaut did not mind to share all details of procedures:

"We finally caught a #Dragon by the tail and we're not letting go! It has a ton of great @ISS_Research aboard (; maybe a little ice cream)." (Astronaut Dmitrij)

"You can see the airlock behind me and the rails that the table slides out on so that we can install a new experiment or launcher." (Astronaut Charmayne)

Science projects partially explained the busy schedule that astronauts had in space, but some astronauts managed to have a good time and tweeted their contributions:

"Taking pix while wearing hardware for a cardiovascular experiment, always busy on the #ISS!" (Astronaut Scotty)

"Great day of science on board ISS. I performed an experiment with spheres simulated fuel tank." (Astronaut Rafael)

Some astronauts really enjoyed working on research. Some Tweets highlighted these moments when positive emotions were implied:

"I love being on @Space_Station, and the science work is my favorite. Biochemistry, genetics, you name it! @ISS_Research has it all." (Astronaut Charmayne)

"Honor to meet @Dev_Still71; proud to be small part of the team working on @ISS_Research to end things like Cancer!" (Astronaut Dmitrij)

Fun was part of research and experiment as well. For example, Astronaut Dmitrij ate his experimented food, and astronaut Charmayne received recognition from the president of the United States:

"Disco lights + cabbage + space = salad tomorrow! VEGGIE experiment is finding new ways to stimulate plant growth for us in space & on earth." (Astronaut Dmitrij)

"Thank you, Mr. President, for the great opportunity to highlight the research we are doing up here aboard the @Space_Station and beyond!" (Astronaut Charmayne)

Except the fun element, some experiments, either formal or informal, tended to be personal. These two Tweets showed the private side of scientific tasks in space:

"How wicked cool that I got to work on an experiment from my old high school! Future is bright with smart young folks like this engaged in STEM!" (Astronaut Dmitrij)

"Why do I have a fidget spinner in space? My kids told me to bring one! Watch the reaction from these students when it spins to the camera." (Astronaut Franze)

Super Bowl. To sports fans, space was not an impossible place to continue watching and supporting favorite teams and sports. In terms of Super Bowl, there were two ways to see the game from space. The first one was to watch the game in person, but it might only be an instant moment:

"Even off the planet folks were watching the #SuperBowl! Chicago to Minneapolis in one grand view from @Space_Station!" (Astronaut Tianpeng)

"Got to see the #SuperBowl in person after all! But at 17,500 MPH, it didn't last long." (Astronaut Aoyong)

The second way was to see through internet. It seemed that on the game day, astronauts were allowed to join the game-watching crowd, even though not many showed up:

"The big screen is up on the @Space_Station, and we are ready for the Big Game. Good luck to the @Patriots and @Eagles. #SuperBowl." (Astronaut Frank)

"Hosted #SuperBowl party on @space_station, but no one showed up. I would have served nachos!" (Astronaut Aoyong)

Music. Compare to watch Super Bowl, listening to music was more of a regular activity in space. Not many Tweets mentioned specific pieces of music or songs, nor did any state how different music was in space. However, astronauts' journey was accompanied by music, and it was impossible to live without it:

"Music is a huge part of life in space." (Astronaut Aoyong)

"Be amazed by the stunning beauty of our home planet and mesmerized by music that accompanies it so well." (Astronaut Franze)

Movie. The movie-watching experience in space were different in three aspects. First, in terms of simulating authenticity, science fiction movies were best played in a spacecraft. Star Wars and Serenity were two good examples:

"I can't think of a better movie theater to watch Star Wars than on the @Space_Station!" (Astronaut Frank)

"Just watched the movie #Serenity with the crew on @Space_Station - pretty surreal to watch a space science fiction movie on a spaceship." (Astronaut Harold)

Furthermore, the nature of weightlessness gave movie-watching a new experience, movie quality and projecting technology did not compromise in space:

"#Movie night in micro #Gravity aboard #ISS on our new HD projector which we use for conferences, tech software, etc." (Astronaut Aoyong)

Finally, astronauts claimed that a movie theatre like the space station was surprisingly comfortable, especially after a busy week at work:

"Movie night in the most comfortable theater in the solar system. Suspended in zero-G, just bungees to keep from floating into your buddy." (Astronaut Franze)

"After a long week of rocking science, sometimes we curl up; watch a movie; bungee chairs are shockingly comfy! Have a great weekend y'all!" (Astronaut Dmitrij)

Food and beverage. So far, science did not stop food floating in space, but astronauts still ate pizza, Gelatin and cheese tacos. Snacks in space were tasty as well, but the best food in space was claimed to be the space-grown vegetable:

"Friday's harvest of mixed crop went well. Nothing beats fresh, homegrown food." (Astronaut Frank)

In astronaut Dmitrij's case, lesson learned on earth may not work in space, especially in terms of food:

"Mom said not to play with my food, but when it's this fun, I just can't help it. Happiness = Coffee Balls in the morning!! #CoffeeBallsRock" (Astronaut Dmitrij)

Others instead played with liquid water in space. Water fun in space turned out to be a favorite leisure activity:

"One of the coolest games in space: playing with water; the phenomenon of refraction." (Astronaut Xiaoyu)

"#SpaceVine - Turns out a sphere of floating water makes the ultimate fisheye lens … Floating water is so much fun to play with." (Astronaut Connor)

However, some tricks of playing food or water were only performed in space, and the performers mastered the skills before getting up to space. Eating and drinking in space seemed to be fun and challenging at the same time. Even astronaut Dmitrij tweeted the warning:

"Don't try this at home folks, these are highly-trained, floaty-food professionals!"

Summary. When people stayed in outer space, plenty of leisure activities were able to participate in orbit. A wide variety of leisure experiences were demonstrated by sightseeing that ranged from mountains on earth to stars in other galaxies, greetings that sent from space to people on earth, and diverse space activities including spacewalk, selfie, exercise, and movies. The overall impression of in-space experiences was mixed but it tended to be positive and enjoyable.

Reentry

Similar to the stage of liftoff, Tweets about reentry also involved with three perspectives: astronauts who were strapped in the rocket ship and ready to sail back to earth, astronauts who observed and helped with undocking from space, and astronauts who waited around the landing site.

Pre-reentry impressions. Feelings of ending the space journey were mixed. There was no evidence that astronauts had a bad time in space; however, some reported that it may be emotionally difficult to accept the fact of leaving the space soon. For example, two astronauts seemed to linger over their limited time left in space:

"Checked out our Sokul suits today in preparation for returning to earth next Monday. Can't believe it's almost time!" (Astronaut Rafael)

"Am going to miss sunsets like these when we return to earth next week." (Astronaut Scotty)

The pre-reentry impression resembled a summary of astronauts' life in space. Astronaut Harold summarized it as "an incredible adventure;" astronaut Franze outlined his journey in space on Twitter:

"On July 28 we launched to this outpost orbiting the earth. After countless scientific & medical experiments, maintenance & spacewalk activities, cargo & housekeeping operations, it's time to return."

Moreover, some were fully ready to fly back home without hard feelings. Astronaut Aoyong implied that space was just another office, and astronaut Dmitrij publicized his landing time and invited the public on Twitter to watch his reentry:

"Shutting down my #space office today." (Astronaut Aoyong)

"#Countdown We're down to a wakeup. #earth. I'm coming for you tomorrow! #GoodNight from @space_station!" (Astronaut Aoyong)

"That's all folks! Expedition 52 came to a close today as @AstroKomrade took over. Watch our journey home tomorrow, landing at 9:22 p.m. EDT." (Astronaut Dmitrij)

Furthermore, hope in Tweets appeared common. Astronauts' hope can range from a safe trip back to mankind's future exploration, such as:

"Dear God, please bless our crew. Help us in our mission and to return safely home. Please help me not to mess anything up." (Astronaut Dashqin)

"We return to earth tomorrow. I can only hope that through the eyes of this spaceman, you have felt a part of the journey." (Astronaut Franze)

"#Countdown 2 days; a wake-up! Getting closer to earth, hope Mars too." (Astronaut Aoyong)

Post-landing recall. After landing was a success, how did astronaut recall the experience of reentry? Some astronauts posted a neutral Tweet to explain the reentry route, for example:

"Our #Soyuz capsule after burning through the atmosphere and landing in #Kazakhstan." (Astronaut Harold)

However, emotionless Tweets was less common in terms of reentry experience. Because the title "astronaut" can only be officially entitled after a complete trip to space, and most astronauts thought gravity pull was awesome:

"Never dreamed I'd return as #astronaut with Peg up above again!" (Astronaut Bora)

"Just landed on the Space Shuttle. Awesome landing." (Astronaut Dashqin)

"@AntonAstrey and I returned home in our Soyuz after half a year aboard @Space_Station during Exp 29/30. What a ride!" (Astronaut Morton)

Some described the reentry in more details. For example, astronaut Dale pictured himself in a falling comet, and the touchdown was a "comet landing." Astronaut Samuel did a better job in summarizing the entire feelings of reentry, he tweeted:

"The 'return ride' back to earth? It's a feast for the senses ... loud, violent ... punishing heat, vibration, g-forces."

Even though the previous Tweet delineated a scary picture of being on a reentry rocket, some astronauts still appreciated the experience as a memorable life event:

"Unforgettable return to earth. Am feeling good and very happy to be back with the family." (Astronaut Scotty)

"Journey of a lifetime complete. Reentry was wild, fun, crazy. Still a bit shaky but doing incredibly well. Home. Cheers." (Astronaut Connor)

Space perspective of rocket reentry. Not all reentries involved with taking human back to earth. Astronauts often observed the undocking of supply rocket ships, for example Dragon operated by SpaceX. Astronaut Connor spotted clear aurora when undocking Dragon. Meanwhile, astronaut Dmitrij treated Dragon as a living object and posted a rather personal Tweet:

"And there goes #Dragon. Goodbye to our 1st return visitor since Atlantis in 2011. Come on back anytime, we'll leave the lights on for you!"

In terms of reentry of human spaceflight, best wishes were given from crew remaining at the International Space Station. Landing was hoped to be soft, safe, and quick. Some astronaut tweeted such hopes to their reentry colleges:

"Half of our complement of crew @Space_Station departed today. Godspeed Argo and your crew, may you have a soft landing!" (Astronaut Franze)

"Fair winds and following seas my friends! Safe landing" (Astronaut Aoyong)

"2 brave souls closing the hatch; taking their space-sports car for a quick ride home! Soft landings my friends." (Astronaut Dmitrij)

Moreover, the difference between liftoff and reentry was best stated by astronaut Aoyong when he expressed farewell to returning crew, and that emphasized the impact of such incredible space travel experience on people:

"They arrived in space like baby birds barely able to fly; now they soar home as eagles. Great job!"

Ground perspective of rocket landing. Over half of Tweets about landing from ground perspective were technical explanations. For example, astronaut Kohan answered how to protect life from a hard landing. Furthermore, astronaut Samuel tweeted technical details during rocket launch. Likewise, he introduced the procedures of a real time landing, including landing time and date, separation of modules, altitude report, landing zone situation, landing support teams, de-orbit burn, separation burn, landing trajectory, parachute deploy, and the touchdown moment. In fact, astronaut Samuel represented NASA to interact with readers on Twitter by clear their uncertainties, in the end he tweeted:

"Thank you for your great questions at #askNASA!"

Others skipped the technical details, and rather directly welcomed their colleagues safely back from space. They may not get close to the landed rocket part as soon as possible, so they expressed warm greetings on Twitter:

"Touchdown!!! We have a landing! Welcome back to earth" (Astronaut Aalok)

"View at #41S Soyuz landing site. Welcome home from @Space_Station" (Astronaut Hansen)

Summary. When travelling from outer space, key themes of leisure properties emerged from the reentry data. In detail, reentry seemed like violent, loud and dangerous, that explained why astronauts expressed their hopes for safe returns. However, reentry was also exciting and unforgettable; landed crew were warmly welcomed by ground support teams and families, and they were officially entitled as astronauts. After all, a journey to space was never complete without a safe and sound landing.

Memory

When reentry and landing were safe and successful, space travel seemed to come to an end. Indeed, the substantial moments of liftoff or reentry, weightlessness or spacewalk flowed away. However, evidence showed that the trip continued in three forms as follows: re-experiencing earth life, recalling space memories, influencing oneself and others.

New life on earth. After spending some time in space, physical and mental adjustments were necessary for re-experiencing life on earth again. Some aspects of life which used to take granted for were not the same. Gravity, for example, was the first challenge. It seemed that astronaut Connor underestimated the power of gravity:

"Been home a week. Bottoms of feet a little sore but otherwise the body has adapted incredibly quick. Gravity seems stronger than I remember."

Another new perspective was the food on earth. Sometimes the food did not seem that tasty without the separation by distance and time. In this case, a Tweet by astronaut

Scotty demonstrated how he experienced earth food differently right after he came back from outer space:

"First day home. Cold milk. Fresh orange. Wow. I like earth."

First times. In terms of appreciating the earth life, astronaut Aoyong tweeted every single activity that he experienced on earth after spending hundreds of days in the orbit. It seemed that the space trip brought up with new eyes to life.

First, similar to previous Tweet posted by astronaut Scotty, astronaut Aoyong also recorded the food he had for the first times, including steak, salad and pie. Astronaut Aoyong appreciated the change of taste, and admitted his longing for earth food in space:

"My first #dinner at a table on #earth! More than food, I missed the dining experience while away on my #YearInSpace."

Surprisingly, daily routines, such as pets, holidays, and even dental appointment, were worth sharing on Twitter when astronaut Aoyong finally got back on them. Sometimes, new perspective of such aspects was triggered by the lack of memories:

"Saw my 1st #dog on #earth yesterday! Funny the things you forget about when you leave the planet for a #YearInSpace."

Moreover, nature surprised astronaut Aoyong about earth life, even the first flower he encountered was posted on Twitter. Astronaut Aoyong realized how much he missed about planet earth:

"My first #rain on #earth! Great end to a full day of post-flight tests @NASA_Johnson. I missed weather. #YearInSpace"

Visit sites seen from space. Evidence from the stage of in-space experience indicated that space travelers sightsaw the whole world on earth. When space trip

finished, astronauts traveled to the places which were used to be their observation sites from space. Some astronauts simply updated status when visiting such sites, while astronaut Aoyong gave better explanation about how he felt them differently. Such examples about places including countries and cities were as follows:

"Good morning, #AbuDhabi! You were impressive from 250 mi up on my #YearInSpace. Great to be visiting you today!"

"Good morning from #California! I recall your beauty from my #YearInSpace. Now I'm experiencing your awesome weather!"

"Great time in #NYC last night! I recall how bright you were at night from #space. Thanks for keeping your lights on!"

Space memories. When astronaut Michael were in space, he tweeted:

"Ending the day with reflection and appreciation."

Even each busy day at the International Space Station involved with thoughts and expressions, then after completing the trip from space, it was reasonable that astronaut recalled the space trips very often. Evidence supported this assumption. However, what moments were unforgettable and worth recollection? The possible answer turned out to be photograph, earthart, spacewalk, intense feelings, and best memories.

Photograph. It was common to see astronauts tweet old pictures taken from space trips. For example, photo and video were great sources to support the celebration of relevant holiday, to recall precious moment, and to give better explanation:

"A heart from my #YearInSpace. Wishing everyone a Happy #ValentinesDay!" (Astronaut Aoyong)

"1st earth view I sent from space year ago today. Remember thinking, how could I ever capture more beautiful picture?" (Astronaut Xiaoyu)

"This is the light show out the window of the #Soyuz capsule during re-entry into earth's atmosphere. This video will help explain some of the things you may see or hear, as you follow these space travelers' journey home to earth." (Astronaut Samuel)

Earthart. Earthart was described as amazing and breathtaking from space. It was still a popular them in space recollections. Old photos, videos, or descriptions of earthart were brought up and used to illustrate statement, to show favorites, and to remind the sightseeing from space. Examples were as follows:

"Our blue planet lives and breathes in color, art, poetry, and song ... in slow and steady rhythm ... #earthArt" (Astronaut Samuel)

"#EarthArt, two perspectives, from my collection of favorites I took from ISS in 2013." (Astronaut Xiaoyu)

"I am quickly forgetting how beautiful the view was. #earthArt - #SanFrancisco from #space" (Astronaut Connor)

Spacewalk. Through the process of answering public questions about space travel, astronaut Samuel recalled details of spacewalk on Twitter, including preparation, technical fact, and mental challenges.

Diaper or pre-spacewalk snacks were rarely mentioned from the in-space stage. However, astronaut Samuel revealed these information of spacewalk preparation by recalling such memories on Twitter:

"The spacewalkers wear a diaper inside of their spacesuit ... that's a secret though, so don't tell."

"Before a spacewalk, we eat relatively 'light', usually a protein bar, granola, and some fruit."

Likewise, few Tweets introduced basic environment of spacewalk. Interestingly, astronaut Samuel liked to share them after the trip was finished:

"We're orbiting so fast that we have a sunrise/sunset every 45 minutes. Half of the spacewalk will be in darkness."

"The crew will use lights on their helmets."

Probably the most intense memories of spacewalk were involved with emotions. For the first time, astronaut Samuel uncovered the biggest challenge of spacewalk. That was the mental management, especially when towards the end of a spacewalk with distracting beauty below. However, the challenge was able to be coped with by practices. In detail, astronaut Samuel explained as follows:

"Yes! Danger engulfs you on a spacewalk. It's an exercise of the realization of danger and the management of fear."

"By far, the most dangerous time is at the end of a spacewalk. You're exhausted, hungry, cold and prone to complacency."

"It's easy to get distracted on a spacewalk. earth is raging with life, color, and light – 'below' you! Very distracting!"

The most interesting evidence was about the work of spacewalk. "Fingertip ballet" was a metaphor used to demonstrate the difficulty of handling tools during spacewalk. One astronaut mentioned in one of the in-space Tweets, and astronaut Samuel recalled the exact same metaphor in this post:

"Yes, definitely more mental effort in space. It takes very little force to move; a spacewalk is like a 'fingertip ballet.'"

Feelings. After landing was complete, astronauts tended to have diverse feelings. One the one extreme, they started missing the special experience in space. For another extreme, they embraced home and claimed that home was the best. As to other cases, astronauts happily struggled between these two extremes.

To begin with, a Tweet from astronaut Samuel indicated how regretful he became only if he had explored more stuff in space:

"If I could turn back time ... I'd tell this younger and flatter version of me to hold on tight for space adventures beyond imagination!"

On the contrary, some astronauts were satisfied and ready to go back home. To them, children, friendship, or even the term "home" became the gravity of their hearts. In this sense, home was unbeatable:

"Home sweet home. Can't wait to hug my kids. What an amazing journey it has been!" (Astronaut Connor)

"So nice to go home; spend time with friends talking about space in one of the prettiest places on or off this world - Cape Cod!" (Astronaut Morton)

"Great to be back on #earth. There's no place like #home!" (Astronaut Aoyong)

Sometimes, mixed feelings were developed by strong attractions both from home and space. Quick shift of environment and vivid sightseeing from space may partially explained this mental struggle:

"About 48 hrs ago I was in space, now I'm in Houston with my family. Great to be home but I do miss the ISS." (Astronaut Rafael)

"This was my view last October during my #YearInSpace. Like being on earth but miss the view." (Astronaut Aoyong)

"I missed the color #green most during my #YearInSpace. Great to see it again on #earth! #StPatricksDay" (Astronaut Aoyong)

After all, travel trips were temporary, but life moved on regardless. Astronaut Dmitrij recognized it and enjoyed cozy moment at home, while astronaut Samuel put a step further and expected more in the future:

"One thing I didn't have on the @Space_Station, my furry little best friend Bandit. We're back to chillin' in my chair..." (Astronaut Dmitrij)

"Now a fading memory ... I'm grateful to have felt the spirit of flight on this rocket; excited for the wonders to come!" (Astronaut Samuel)

Favorite memory. What were the best memories astronauts recalled from space travel? Interactions with crewmates, work moments, and fun activities were mentioned. In detail, people were key parts of good memories, which again indicated the significance and enjoyment of teamwork during space trips:

"Favorite memory of #ISS: On top of the world w/@foreman_mike; help from @astro_box; @astro_g_dogg." (Astronaut Hansen)

"Reliving space flight memories with 2 former crewmates in Star City! I'm in the wrong suit!" (Astronaut Samuel)

In some occasions, work became a source of unforgettable memory. It made sense when considering the uniqueness of space jobs. Two examples showed as follows:

"Many great moments during #15YearsOnStation. First handshake with @AstroRobonaut in space." (Astronaut Morton)

"My favorite #spacewalk was on Nov 3, 2007 when we repaired a damaged solar array." (Astronaut Samuel)

Leisure activities were reported as great memories too. For example, astronaut Dale enjoyed sightseeing from space and particularly loved aurora:

"Yes, many fond memories of Auroras on orbit ... but I meant to say 'mesmerizing' (thanks iPad!) :)"

Furthermore, astronauts were interested in others' favorite memories as well. Astronaut Samuel even wrote a Tweet to encourage the writing of space experiences:

"Sharing amazing memories of space through the art of storytelling; moments of awe; wonder; moments of fear & isolation. we are all fragile stories written on tattered pages stories longing to be told from a heart longing to be known #Storytelling. Share your story..."

Influences. Space travel undoubtedly impacted on astronauts, in terms of perspectives and relationships. Moreover, astronauts' trips to space served broader and higher purposes as well. Probably the best recollections of space trips were remembered by the changes made to oneself as well as to others.

In terms of perspective change, astronaut Aoyong admitted that in-space experience gave him fresh eyes to see nature and earth:

"A #YearInSpace gave me a fresh perspective of #earth; a new appreciation for #nature. Enjoying our planet today."

As to the relationships built from space trips, they were maintained back on earth as well. The relationship was originally established by face at the International Space Station, as well as by internet. Both cases worked on earth:

"Mr. President, appreciated your support on my #YearInSpace. Miss our space tweets & chats. Happy Birthday, @BarackObama! #ObamaDay" (Astronaut Aoyong)

"Reunion today with my friend: Soyuz Commander! Reminiscing about yesteryear and our time together in space." (Astronaut Samuel)

People who went through space travel also had impact on a broader audience. Based new life and perspective gained from space, astronauts applied Twitter as a platform to promote virtues and inspire others. Astronaut Aoyong offered some of the best inspirational quotes:

"#MondayMotivation from my last #sunrise on my #YearInSpace: The best view comes after the hardest climb!"

"#Endurance is to reach the end of a long and challenging mission with the same energy; focus at the start."

A higher mission was benefited from these space explorers. For example, astronaut Aoyong spent over a year in space and therefore his physical data was used to study long space duration's influence on human health. A sense of devotion was found from his post:

"A trip to #Mars will challenge bones. Scans to study my bone health after a #YearInSpace to help solve the problem."

Furthermore, several astronauts made full use of Twitter account as well as their influence to publicize, illustrate, and support space activities on Twitter. Though their tasks of space travel were ended in either short or long terms, astronauts spent time and efforts to answer questions raised by anyone on Twitter. It was a hashtag "#AskNASA" that linked astronauts to the public. About 110 Tweets in earth dataset were under this

theme. For example, astronaut Samuel explained to an audience about his lonely status in space:

"Not 'anxiety', but it's common to feel fear, loneliness, and isolation. @Kingxtra You see your home planet, and you're not on it. #askNASA."

Summary. When people complete travel from space, the journey continued in different ways. Spending days under weightlessness caused physical and mental challenges for performing activities on earth. And space trips taught astronauts a lesson about the appreciation of minor aspects of life. Either missing home or space more, astronauts held mixed viewpoints; however, both experiences on and off earth seemed important to astronauts. Because space travel had made changes in those who went through, and these people seemed to broadcast space activities and use their stories to make more contributions. This way, space travel went beyond the limited duration from training to landing and proceeded to be the ride of a lifetime.

Chapter Summary

This chapter answered the research question that when people participate a trip to space, onboard experience is amazingly attractive, but it does not represent the whole story. In fact, instead of being a mathematical sum of specific activities, the experience of space travel is multi-phasic by nature.

In detail, training, liftoff, in-space, reentry, and recollection are five stages of a trip to space. Time may separate one stage from another, but the experiential nature of each stage can be overlapped with each other. For example, in terms of time, both training and in-space stages have finite durations, liftoff and reentry are supposed to be set at certain hours. However, the learning process of training may extend to in-space

stage when astronauts gradually master the skills practiced on the ground or face new problems that are never stimulated before. What is more, recollection does not simply happen after the end of space travel; actually, in any other stages, recalling memories are common. For instance, expectation of reentry may be compared to liftoff experience when reentry is ready to take place.

Generally speaking, whatever stage astronauts are at, as long as they use free time to post something or interact with others on Twitter, the action itself contains a leisure element. Furthermore, findings in this chapter fully explain the fun activities and leisure experiences of space travel in each stage. In this case, the boundary between work and leisure is blurred: space work can be enjoyable and fun, leisure activity can relieve stress from work and inspire ideas.

Chapter Five: Discussions

Compare to other tourism destinations, space may represent the ideal location in terms of adventure, beauty, and novelty. Most earthbound travel trips may involve the elements of anticipation, transportation, and recollection. However, no other tourism can contain such a multi-phasic experience with unique features at all five stages.

Findings from this study highlight the trip to space as a dynamic experience with its context. Specifically, the identified key patterns including training, liftoff, in-space, reentry, and memory, are formed into five stages of orbital space travel. Evidence from these five stages have been widely documented in astronauts' Tweets. The selected 36 NASA astronauts have recorded their detailed working thoughts and enjoyable moments on and off earth on Twitter. Their Tweets imply that though the purpose of astronaut's trip to space is work-related by nature, it is undeniable that their journey is spectacular, exciting, and most importantly, fun.

It is suggested that the period in space appears to be the most entertaining part; however, in terms of duration and variety of leisure properties, in-space stage cannot outshine the entire experience that contains professional preparation, rocket launch and landing, as well as personal recollection. In other words, training, liftoff, and landing are necessary steps in order to maintain a safe and sound period in space; moreover, different leisure experiences can be explored at each stage. For example, at the in-space stage, leisure attributes include breathtaking sightseeing, meaningful human interactions, evolving impressions, and enjoyable space activities. After all, except the fun details at each stage, space travel is an extremely unique experience by itself, since only less than 600 human beings have had the chance of riding spacecrafts to outer space in history.

The findings of this study provide solid descriptions of leisure space travel and may fill the gap in space tourism research. That way, properties of leisure experience in space from this study can be applied to market research and development of space tourism. In the near future, people do not have to be fully competent as professional astronauts to desire space travel. Instead, a space tourist as amateur astronaut can expect her space trip with multi-phasic leisure experiences as the ride of a lifetime. As to marketing of space tourism, the exploration of specific desired features at each stage would be a significant tool to attract amateur astronauts.

Aviation and leisure space travel

Even though air travel is different with space travel in many ways (Collins, 2001; Peeters, 2010), the first phase of spaceflight takes aviation training into action. For example, astronauts have tweeted pressure suit high altitude chamber training, flight training, and pressure suit fitting for high altitude flight training. This is the first connection between aviation and leisure space travel that the training of aviation provides a necessary step for the preparation of space tourism. For companies that deal with space tourism business, it can be a good idea to provide the service of certain aviation training for the purpose of the professional preparation as well as the fulfillment of learning motivation. Also, astronaut-like training can be an attractive feature at phase one of space tourism.

Several literatures consider aviation industry as a comparable case to private spaceflight industry (Cater, 2010; Collins, 2001, 2006; Collins & Funatsu, 2000; Laing & Crouch, 2004; Lyles, 2000; Maryniak, 2000; National Space Society, 2009; Reddy et al., 2012). It may make sense because the aviation-related issues including medical

instructions and risk management have also been reflected in the experiences of space travelers. This is the second connection: future space tourism can learn some meaningful lessons from the industry of air travel in terms of commercialization and risk management.

Probably the most significant connection is the similar psychological need in both air and space travel. The desire for excitement, prestige, and pride in flying (Gibbs-Smith, 2003), also motivates travelers to explore a higher and harder destination. In Twitter, astronauts have expressed their strong exhilaration about liftoff and space view, and their sincere appreciation of such a precise opportunity of space travel. Therefore, space tourism may examine the early motivations of air travel and then use them in the marketing endeavors.

Spaceflight and leisure space travel

This study may not directly indicate what Gurtuna (2013) proposes that space tourism can turn to a massive market if the space industry aims at serving the general public for a leisure travel purpose; however, the in-space experiences described by astronauts turn out to be astonishingly unique, stunning, and memorable. It is safe to assume that a much bigger population of space travelers can help promote the popularity and then the development of private space trips. That is to say, if the market price for a space ride can be controlled at a lower price, a massive number of passengers can be attracted and then promote the prosperity of space tourism industry.

Moreover, those astronauts studied in this dissertation are government workers, and they represent the public face of NASA (Hersch, 2012). By publishing Tweets, and posting pictures and videos in Twitter, these astronauts share and update their lives from

NASA and space to the public. In turn, social media users read, like, reply, and share these Tweets; sometimes these users interact with astronauts in Twitter. In a sense, astronauts and their space trips have won some public attentions. Therefore, the current data of this study reveals an opposite position compare to the statement made by Collins (2001) that it is impossible that the governments are willing to guide public interest to space tourism. In fact, several astronauts have expressed their hopes in Twitter that more people, with or without being an astronaut, could experience what they see and feel in outer space. As to private space travel business, this study suggests that the collaboration between private and public sides is worth trying.

Besides governmental institutions as NASA, it may be correct that the space tourism business has been left to the private sector so far. Since 700 riders have paid deposits for sub-orbital flights offered by Virgin Galactic in the late 2018 (Bailey, 2017; Virgin Galactic, 2017b), and two upcoming moon travelers have been announced by SpaceX (SpaceX, 2017b). These space tourism activities have not taken place yet, but the findings of this study support the statement made by Webber (2010) that some private companies have collaborated with NASA and offer service as cargo transportation. Indeed, several Tweets have described astronauts' experiences about SpaceX ships docking at and undocking from the International Space Station. It seems that private companies, especially SpaceX, have worked on space trips on a cargo-delivering level, and the tourists service can be expected in the near future.

It is interesting to notice that few legal or regulation content has been mentioned in the popular Tweets posted by astronauts, regardless of some discussions about legal issues in several academic publications. The findings of this study may not be able to

indicate any straightforward suggestions in terms of the development of law and regulation in space tourism, but findings of this study can infer a similar viewpoint that the legal consideration appears to be an important aspect.

Moreover, several in-space Tweets expressed the dangerous and brutal nature of outer space, which goes with the statement that insurance is essential for a high risk circumstance like space business (Elgart et al., 2016). Especially when considering the Challenger and Columbia accidents, future industry as space tourism should identify risks and minimize losses; Or, as Ziliotto (2010) puts it, any such disaster in space tourism can delay its prospects for dozens of years. Therefore, as to the statement that the commercial success of space tourism needs a multinational collaboration (Collins et al., 1996), this study can infer it from the current data. In fact, astronauts staying at the International Space Station come from different countries and their Tweets show international cooperation and friendship; it is the hope of this study that space tourism business can achieve the same level of international partnership.

Tourism and leisure space travel

The amount of academic publications about space travel from a tourism perspective turn out to be limited. As to these countable studies, they either choose a narrative about space travel, or conduct surveys from the public, or deal with technical issues. Interestingly, the findings of this study indicate that the general Twitter users favor astronauts' Tweets in terms of the vivid descriptions of space experience, the meaningful interactions with the public, and the plain explanations about rocket science. It may show that the public has an expectation about unique experience like space travel, an

interaction with people from different locations, and a desire of learning, which can be potential motivators in the marketing process of space tourism business.

Moreover, some scholars cover broad topics about space tourism and these topics are also the key themes from the data in this study. For example, the themes including the awareness of space travel, motivational exploration, training, and environmental concern (Reddy et al., 2012) can also be easily identified in astronauts' Twitter. Furthermore, astronauts' Tweets reveal even more interesting themes which actually could attract the public interests. In other words, unlike some market studies that apply assumed questions to explore the public desire in space tourism, this study aims at contributing to the justification of the leisure properties of space travel based on authentic experiences from astronauts. In this way, future marketing practices can take the previous academic assumptions as well as the findings of this study as important references.

Astronauts' Tweets from this study indicate some elements of the nature of tourism. For example, according to the five perspectives of tourism (Goeldner et al., 2000a; Wearing et al., 2010), first, space travelers, even astronauts, are possible to enjoy themselves during their free time. Second, both NASA and SpaceX deliver supplies to astronauts; for future space travel business, there can be commercial or public organizations to provide service and goods for passengers. Third, governments and nations may take space tourism as one economic factor and give sufficient supports when this business achieves some levels of economic scale. Fourth, space tourism industry could increase job opportunities; as Colbert (2004) describes, possible employment may involve with transportation, food and beverage, marketing, health care, photography, film, education, and translation. In fact, astronauts take responsible of various roles in

NASA; these roles can be converted to several specific job opportunities to the broader public if space tourism industry develops and expands and hence increase employment. At last, official NASA spaceflights have impacted on economy, society and culture throughout the world; as an emerging phenomenon, space tourism has great potential to bring huge influences on the world as well.

From another perspective, tourism requires financial investment and free time in terms of tourists (Launius & Jenkins, 2006); space tourists should prepare for both. Taking astronauts as an example, they are chosen to take spaceflights as job responsibilities, they have no need in paying expenses; however, to future space tourists, financial preparation for a ride to space is a necessity. In terms of time allocation, space tourists may have more free time to enjoy themselves than astronauts if both parties are scheduled the same duration in space. Because the former is not assigned to work; if space tourists choose to deal with work, it could be their free choice to do so during free time.

Who would be potential space tourists? The research findings reveals an opposite view toward the statement made by Launius and Jenkins (2006) that a group of people can be assumed to be space tourists by simply asking their willingness of space travel in the survey. Except the desire to participate, future space tourists may also need financial investment and free time. Furthermore, both Americans and Europeans are assumed to be adventure takers, while being pioneers motivate Japanese to participate space trips (Le Goff & Moreau, 2013). The findings of this study indicate that the authentic space experiences are both adventurous and unique. People from these places may be the marketing target for space tourism business. Or, as Reddy et al. (2012) put it, the

nationality of potential space tourists does matter. Lastly, being adventurous or being wealthy, which is more importance in deciding potential customers for space tourism companies? Scholars voice different opinions and most think highly of financial factor. However, the research findings indicate that both are significant but being adventurous may be more important. For example, astronauts are not chosen by wealth, but by their personal traits and professional behaviors. Tweets published by astronauts demonstrate how brave, curious, selfless, and responsible people they are. Literature review reveals that the public wants an astronaut-like experience (Bensoussan, 2010; Cater, 2010; Chang, 2015; Freeland, 2010; Peeters, 2010; Reddy et al., 2012; Ziliotto, 2010), so space tourism business may take the procedures of astronaut selection as a reference when the financial requirement is no problem for potential participants.

Why would people travel to outer space for fun? It is a question of tourism motivation. Early study introduces with four fundamental elements about travel motivation which contains physical, cultural, interpersonal, and prestige motivators (McIntosh, 1977). The findings of this study indicate that in one sense astronauts are motivated by similar factors. Astronauts rest and relax from work, and exercise daily in space to keep health, this is the physical motivation. NASA astronauts spend time with other professionals from other countries at the International Space Station, and explore earth views about different cultures from space, this is their cultural motivation. Astronauts posting content, picture, and video in Twitter, and interacting with earthbound people, indicates their interpersonal motivation. Lastly, several astronauts express their strong gratitude and good luck for experiencing personal growth during training, and for undergoing such a unique career opportunity to travel to outer space; and this is the

prestige motivation. Therefore, marketing of space tourism could emphasize on such motivators for attracting tourists.

In terms of adventure tourism, some scholars claim that risk and danger are important components (Giddy & Webb, 2016). However, research data from astronauts shows a conflicting result, because astronauts seldom mention the themes as "risk" and "danger," instead they are fully aware of the cruel environment in space and do their best to avoid technical malfunction and person mistakes. In such a case, risk or danger is a possible component of the circumstances of space travel. Specifically, tourists may not feel danger mentally or physical when spaceship smoothly orbiting the earth, both weightlessness and spectacular views of earth from spaceships may occupy their minds. During liftoffs and reentries, people may think of risks without desiring real danger to happen, in this sense, risk may not be joyful for most people, at least not at all for any astronauts. Therefore, space travel may not bring with the same type of thrill as other earthbound adventure tourism when risky situation is the source of happiness. Rather, the main motivations, as this study suggests, are the beauty, the excitement, the uniqueness, and the novelty of space travel experience. Space tourism business should take safety as a responsibility instead of marketing it as a key part of the experience; and the marketing team should concentrate on introducing features of beauty, uniqueness and novelty to potential tourists.

Astronauts' Tweets show a wide variety of unique experiences during five stages of a space trip. Pine and Gilmore (2014) consider travel as a product of experience. It may be the case for space travel. Similar to other types of tourism (Beard & Starzyk, 2002; Collins & Funatsu, 2000; Ziliotto, 2010), orbital space tourism also proves to be a

more extensive experience. Inspired by Dann's research (1996), the marketing of orbital space tourism can apply features identified by this study to explore key motivations for different potential tourists.

Some astronauts spot national parks and polluted areas from space and post them on Twitter to raise awareness of environment protection and sustainability, which corresponds with the research by Runte (1998) that travel helps visitors be aware of the significance of the preservation of natural beauty on planet earth. Space travel experience also has educational influence on participants (della Dora, 2010; Riley, 1996), the five stages of space travel provide visitors with sited knowledge on different levels, and fulfill professional curiosity. Therefore, space tourism experience can apply environmental and educational components for part of its marketing plans.

Leisure and space travel

Can space experiences posted by astronauts on Twitter be considered as leisure? According to Hunnicutt (2006), astronauts' space experiences turn out to be active leisure. Because they can do sports, listen to and play music in space, they can join public discussion, and work on self-reflection and philosophy based on this space journey. Moreover, space travel phenomena contain space activities free from labor (e.g., sightseeing and movie-watching events), culture-related influence on astronauts' leisure behaviors (e.g., celebrations about Thanksgiving and Christmas), the connector of societies (e.g., participating TV shows from space), the pursuit of peace (e.g., multinational friendship at the International Space Station), and rumination (e.g., personal time in space). This indicates the multifaceted nature of astronauts' experience, which connects to the statement concluded by van der Poel (2006) that leisure has such a

phenomenon as well. Therefore, space tourism business should make full use of previous astronauts' experience as a great opportunity to explore authentic leisure activities for future space tourists, and apply the findings of this study to the understandings of priorities and preferences from potential customers.

Furthermore, the research findings show that space travel experience is an interaction between personal psychological dispositions and situational influences. This corresponds with the research conducted by Mannell, Kleiber, and Staempfli (2006). For example in Twitter, astronauts express individual feelings about the space trip (which are mostly "good, beautiful, and great"), different scenarios of each stage of space travel offer astronauts with fresh and situated experiences (such as the multiple gravity pull during liftoff, and zero gravity in space), they share fun stories about how they interact with peer astronauts and how their perceptions about the world have been changed by space trips. Therefore, future marketing team of space tourism company should focus on developing three dimensions of leisure experience at each stage: individual dimension, situational dimension, and the dimension of interplay between these two. For instance, at the training phase, space tourism companies should consider providing potential tourists with clear individual gains including mental strength and physical improvement, the unique situated experiences including cave exploration and high-altitude flight, and the development of group norm and community recognition.

Furthermore, toward the end of each stage, space tourism companies can organize ceremony or rite of passage to reward successful completion of each stage. The practice of rite of passage may possibly add extra value into participants' overall perceptions about the trip. Evidence from research data can be easily spotted when NASA organizes

parties at the end of astronaut training, and awards astronaut wings for people who achieve a successful mission to space. For astronauts, these rituals also define the uniqueness of space travel and the special occasions in their lives.

Moreover, experiences of orbital space travel cover sub-orbital features. The attractive features of sub-orbital flight listed by Le Goff and Moreau (2013), such as views of earth from space, ability to take photographs, to know interesting fellow passengers, rigorous training and physical screening, are themes with high frequency from the data in this study. What is more, research findings demonstrate that orbital spaceflight involves with mixed desires, and it can provide variegated forms of leisure. In other words, the current data of this study reveals an identical view with the statements in terms of leisure nature of space tourism made by Smith (2000), Laing and Crouch (2004), Cater (2010), Peeters (2010), and Reddy et al. (2012). However, expected features of orbital space tourism from these studies are not complete; this study fills the current research gap and delineates a broader map of authentic experiences on different phases of space travel from several astronauts.

The business of space travel should be aware that average people may expect different, incomplete, or unrealistic orbital journey compared to the real leisure experiences. It is highly beneficial for space tourism companies to take this study as a reference, to develop leisure activities based on astronauts' trips, to convey correct information, and to inspire strong motivations. Therefore, based on astronauts' journey of both work and fun, this study suggests that space travel is a multi-phasic experience with variegated forms, and the business of space tourism should market future space tourists as

amateur astronauts because participants will undergo stressful and unique experiences in their lifetime.

Astronaut' trip to space: integrated work and play. The research data shows that astronauts' space trip is a mixture of work and play. In fact, the leisure component has been shown frequently from astronauts' descriptions in Twitter. Hersch explains that NASA astronauts' words "carried more weight in the public mind than those of the men who had hired them" (2012, p. 160). This historian is right about the significance of astronauts to space agencies and the public. Astronauts act as the performers, the reporters, and the salesmen of space travel. And Twitter is a popular social media that astronauts use to update status and share thoughts. This study collects 23,819 Tweets, nearly all posts from 36 NASA astronauts on Twitter. Then, 3,468 Tweets in total are selected and represent the top 20% popular Tweets from each astronaut's account. That is to say, these data indicate the most intense public interest and attention about these astronauts on Twitter. In fact, only 51.6% of these target data are in-space Twitter posts, while the rest 48.4% involves with themes like training and memory. It indicates that the public has near-equal strong desire in acquiring both in-orbit and on-earth information. In terms of contents of all target Tweets, both professional illustrations and personal stories are mentioned. Even at each stage of space travel, activities and thoughts at both work and free time are recorded within these public favorite Tweets. Therefore, astronauts' expressions of enjoyment in terms of space travel turn out to be authentic and extensive, and these happy moments involve with play as well as work. The development of space tourism business can start to market such astronaut-like experiences, and then develop more forms of play for space tourists since tourists do not pay for work in space.

To investigate astronauts' work in space is also necessary to the business development of space tourism. The work-related Tweets that attract the most public interests have spread all over five stages of space travel. Work Tweets at the first stage explain the importance and varieties of training programs, as well as the tough process of being prepared for space trips. At the liftoff stage, pre-launch preparation is still necessary; moreover, astronauts who observe the liftoff share a lot of professional details about rocket launch. In-space stage shows tasks including specific sites observations, satellites launches, experiment and research, and spacewalk. As to reentry, this stage contains technical undocking descriptions as well as landing details from the perspective of ground control. At the final stage, some favorite memories are spacewalk, teamwork, and work moments. To future space business, these work Tweets can be developed as learning and knowledge components of space tourism. People with strong curiosity and learning desires may be attracted by such space-specific knowledge.

Likewise, a lot of fun moments through all stages of a space trip are shared by these target Tweets. In fact, various astronauts appreciate leisure at each phase differently. To begin with, there are some interesting stories of at the training stage, including selfies and photos, training flight sightseeing, training equipment jokes, caves exploration, birthday surprise, and parties. To space travel business, these are valuable sources for developing marketing strategies for phase one of space tourism.

At the second stage, excitement is the major feeling before launch takes place; after astronauts get aboard on the International Space Station, they share photos of liftoff and express gratitude to teams. Some astronauts stay at the ground control and watch rocket launch from several places, they admit that rocket liftoff is fun to see, and they

never get tired of it. These astronauts at ground control tweet their best wishes to those inside of rocket. Inspirational posts are also sent out by them during liftoff; sometimes the observation reminds them of the past when they were strapped in the spaceship. For astronauts who watch the docking process from space, they show greetings and tweet about their new crewmates' launch photos. At this stage, commercial space travel organizations should put liftoff observation, interaction and blessing among passengers, and photograph opportunity about rocket launch as important components of its marketing plan.

In-space stage has the best leisure experiences. The most attractive leisure activity may be sightseeing. When astronauts stay in orbit, they can view all kinds of wonders. The category of sightseeing contains continents, countries, cities, directions, earthart, water, mountains, parks, deserts, volcanos, fires, cyclones, lightnings, clouds, aurora, manmade space objects, space station, orbit, sun, moon, and the universe. During the time in space, astronauts have fun by sending greetings to people on earth, such as good night, good morning, happy holidays, general salutation, goodbye, congratulation, and welcome. Free time is spent well by photographing, filming, sharing selfies, exercising, watching Super Bowl and movies, enjoying music, playing with floating food and beverages. The overall impression of in-space stage is mixed with positive, neutral, and somewhat negative feelings. However, the dominant impression is positive, because the top ten feelings about space travel in orbit are good, beautiful, great, new, amazing, cool, happy, awesome, love, and spectacular. This stage is the key of space travel experience, space tourism company should develop the most potential activities on this phase and put it as the focus of its marketing strategy.

Maybe the in-space experience is too unique and memorable that astronauts start cherishing time and express unwillingness to leave as their pre-reentry impressions. However, after going through undocking, reentry, and landing, these astronauts appreciate the growing strong gravity-pull experience and think it is awesome. At the same time, those who help undocking give their best wishes on Twitter and hope their leaving crewmates have a soft, safe, and quick landing. Furthermore, astronauts joining the ground support team send their warmly welcome to these brave travelers through Tweets. Except guaranteeing potential space tourists with the safety of reentry, space travel business can take astronauts' positive perceptions at this stage as marketing plans to put daunting passengers at ease.

Once astronaut finish space trip and get home, they consider each activity on earth as first times, due to short-term physical and mental adjustment. This way, they gain new perspectives about life differences between earth and space. New relationships that built from face-to-face or through internet in space can be maintained and strengthened on earth too. In fact, at the memory stage, some astronauts go visit sites seen from space, and meet friends made from orbit. Moreover, whenever they recall space memories, photos taken from orbit are attached along the Tweets. These Tweets tell how astronauts miss seeing the earthart from space the most. Other favorite space memories include interactions with crewmates and fun activities in space. A few days after coming back to earth, astronauts' impressions cannot be easily concluded if the feeling of glad to be home is stronger, or the missing space part is more intense. The final stage seems to matter to individuals only. However, space tourism business can work on collecting feedback, encouraging expression of trip memory, and inspiring suggestions from successful

participants. Moreover, setting up a club or building a social community for these amateur astronauts is beneficial for the sustainability for its business.

In summary, through digital socioscope of Twitter, it is noted that astronauts' space trip is less like the process of balancing professional and personal life, but more as the integration of work and play. The public pays near-equal attention to both sides of space experience reported by astronauts in social media. Moreover, if the business strategy of future space tourism considers the taste of space work as an entertaining and educational activity, then astronauts' posts on Twitter and corresponding public reactions can add direct value on the development of commercial space tourism.

Leisure of space travel: a multi-phasic experience. Almost none previous studies see space tourism as a dynamic and evolving experience, except some studies have highlighted the necessity of training (Cater, 2010; Laing & Crouch, 2004; Reddy et al., 2012). Each phase of leisure space travel, including training, liftoff, in-space, reentry, and recollection, have its unforgettable experiences and unique leisure attributes. That may explain a statement made by early researchers that space tourism appears to be global enthusiasm in demand (Collins et al., 1996). Space tourism is definitely worth the worldwide eagerness, as astronaut Franze shares his excitement on Twitter:

"Amazing views during our #spacewalk. What a phenomenal way to experience our world, I highly recommend it if you have the chance!"

Space travel attracts public attention and popular interests internationally for several reasons. Research data of this study shows identical results with the statements of tourism purposes made by other tourism studies. For instance, the #AskNASA activity at the memory stage indicates that astronauts often explain and share their expertise and

sited knowledge to whoever have questions in terms of space trips; future space tourists may have the desire to pass on their stories as well. And that corresponds well with the educational nature of tourism (della Dora, 2010; Riley, 1996). Furthermore, at the third stage, the scientific and research projects at the International Space State benefit the creation of new knowledge and prepare for future deep space exploration. Space tourism can broaden the chances for research and promote the development of science. In this case, it can fulfill the scientific purpose of space tourism (Reddy et al., 2012; Runte, 1998).

What is more, the sightseeing of breathing and living earth through the third phase of space tourism make tourists to reflect upon their previous and future actions, which can consequentially provide insights to the dynamic interactions between people and their surroundings (Steward, 1998). Several times when astronauts look through the window of the space station and stare firmly at the breathtaking blue planet in the black void, they cannot help but tweet their awareness of protecting our fragile and precise mother earth. Space tourism can bring more people to go through the similar spiritual journey, and raise greater worldwide attentions about sustainability. It turns out to be the environmental purpose of tourism explained by Runte (1998).

Research findings also reveals the psychological motivators of fulfilling personal desire to travel high and far to outer space. To begin with, tourism can be driven by a cultural motivator that drives tourist to learn new cultures (McIntosh, 1977). In fact, staying at the in-space stage of space tourism can check out the world all over from orbit. For example, astronaut Dmitrij appreciates the precise opportunity to explore other cultures:

"Got the chance to see some of the rich Indian culture today, beautiful temples in Bhubaneswar!" (Astronaut Dmitrij)

It may be possible that someday astronaut Dmitrij will walk into these amazing temples in India. Because after the trip finishes, at the recollection stage of leisure space travel, a lot of astronauts go visit the places they have observed from outer space. After all, the view of earth's curvature with the background of black emptiness is unique and breathtaking, and sightseeing from orbit probably is one of the most attractive aspects of leisure space travel, which is also indicated by previous studies including Reddy el al. (2012), Ziliotto (2010), Peeters (2010), and Le Goff and Moreau (2013).

In summary, when people travel to outer space, a multi-phasic leisure experience is identified from astronauts' Tweets. It claims the space journey from the beginning to the ending and delineates a complete picture of leisure space travel, which may lead to future development of commercial space tourism. Moreover, instead of marketing in-space part only, the multi-phasic nature of space tourism has bigger chance to develop more unique activities and then attract a broader range of potential customers.

Future space tourist: amateur astronaut. Space tourism studies highlight potential space tourists as risk and danger seekers (Giddy & Webb, 2016; Laing & Crouch, 2005, 2004; Le Goff & Moreau, 2013). The current data of this study reveals a conflicting result that astronauts do not search for risks; instead, they work hard and carefully to avoid mistakes and to fix problems in order to minimize terrible consequences of any potential risks or dangers. However, research data infers that adventurous tourists may be the major consideration of future space tourists.

Among the entire dataset with 3,468 target Tweets, only eight Tweets directly mention the terms like "risk" or "danger". The focus of these terms accounts for 0.23% of the total Tweets. It may not directly indicate that astronauts are non-risk takers; instead, it is suggested that the users on Twitter who retweet and like these astronauts' Tweets do not have a clear tendency in favoring a Tweet that may express fondness of risky and dangerous situations. Hence, to companies of space tourism, danger should not serve as a key feature of space travel; it is the responsibility of such companies to inform customers about potential risks, and to try their best to enhance the level of safety.

Furthermore, astronauts hold cautious and respectful viewpoints about danger and risk. In fact, they are never trained to pursue anything that may put the entire space station in danger. However, accidents happen, even at the training stage. For example, astronaut Aalok posts a message of condolence that shows the respect to his friend and the self-awareness of the tragedy:

"Flight test is a dangerous business. Lost a friend yesterday. Prayers for the family."

In terms of in-space phase, astronaut Dale is fully aware of the danger. His Tweets convey clear messages to the public about the limits of space adventures. As a performer of all tasks in space, astronaut Dale is also serious about sacrificing personal life to save the big picture; if it is possible, then he will be ready:

"Though today we may make it look easy, it remains one of the most dangerous & exhilarating things we do in space."

"'We are in a risky business and we hope that if anything happens to us, it will not delay the program. Gus Grissom #Apollo1."

In astronaut Dale's case, the biggest difference between him and adventurous tourists is the responsibility of oneself and others. Space travelers do not priority personal desires of thrill and surprise at the cost of others; in particular, space travel is a complicated system with countless efforts and time devoted by people, agencies, countries, and even international alliances. Astronaut Samuel and astronaut Aalok are right about the reasonable attitude, that cautiousness can be practiced, fear is manageable, and leadership can make a difference:

"Danger engulfs you on a spacewalk. It's an exercise of the realization of danger and the management of fear." (Astronaut Samuel)

"Exploration is inherently risky and sometimes tragic, but great leadership can turn setbacks into triumph. Learn how Apollo Leaders changed the culture and the program after the that terrible fire." (Astronaut Aalok)

Space travel is an adventure, several astronauts have claimed that. However, instead of being risk seekers, space travelers should be risk detectors and danger solvers. Rather than being fearless or pursuing thrill, space travelers should be courageous and curious but also be wise about limitations and consequences. Therefore, future space tourists may be the moderate risk takers (Launius & Jenkins, 2006).

Then, what would be a better name for space tourist if adventure seeker is not the case? A study by Peeters (2010) offers a clue, that future space tourists expect to obtain astronaut-like record and souvenir. It goes back to the literature review that the desire of space tourism is a quest for astronaut-like experience. Several studies support this statement. For example, private space tourists are driven to experience what only astronauts have involved with (Reddy et al., 2012); moreover, previous self-paid space

tourist Dennis Tito claims that cosmonauts, astronauts, and himself share the same experiential joy in terms of space travel (Cater, 2010). In a sense, space tourists seem to be similar to professional astronauts. Space tourism companies should emphasize the astronaut-like elements to attract more potential space tourists, for example, rite of passage for successful completion of each stage in space travel may be an attractive service of space business.

At the practical side, Virgin Galactic will soon take several customers up to the sub-orbital level, and plan to award its riders the title of Virgin Galactic astronauts. In other words, tourists pursue the experience as well as the title of astronauts, but they are not necessarily affiliated to NASA or other space agencies. And that gives space tourists a new name: amateur astronauts. Amateur astronaut can be a unique service offered by space tourism business. Space tourists may be strongly attracted by the prestige of being awarded the title of amateur astronaut for successful space journey.

Here, an amateur astronaut is different to a professional astronaut in several ways. First, amateur astronauts do not take space trips as working tasks, nor do they consider the title as a career profession. While professional astronauts like NASA astronauts are affiliated to space agencies, they visit space and apply learned skills to space activities by following schedules and orders. Second, amateur astronauts may pay for their own trips or find sponsorship to pay off the fee. While professional astronauts get paid by taking space journey.

Third, amateur astronauts may not be competent as a NASA astronaut due to loose selection and limited training; but a retired professional astronaut can turn to be amateur astronaut, if she desires another chance to outer space, or she wants to enjoy pure

fun instead of being busy with tasks. Fourth, professional astronauts may stay longer time in space than amateur astronauts, unless the latter pays for more trips to outer space. Finally, professional astronauts have an integrated life between work and play in space, while amateur astronauts simply focus on recreation purposes.

Amateur and professional astronauts also have several similarities. First, they are both astronauts and are awarded the title by travelling to outer space. Second, training, liftoff, in-space, reentry, and recollection are five stages that both will go through. Third, they both can watch others' launch and reentry as observers. Fourth, both physical and mental preparation are necessary, even though professional astronauts may undergo a tougher training. Fifth, sightseeing from orbit may not be differentiated much.

Taking references of definitions of space tourism from Freeland (2010) and astronaut from NASA (2017c), amateur astronaut is thought to come up with a definition as well. That is, the term amateur astronaut, or space tourist, is a hobbyist title that symbolizes the private participants taking spacecraft to the orbit and beyond for pleasure and/or recreation.

Future research

Space tourism as a type of frontier leisure, still needs more academic and practical attention and investment. The leisure space travel contains five stages and that indicates the complexity of business development.

Future research can begin with improving the multi-phasic experience of space travel by collecting astronauts' data from other social media, such as Facebook, Snapchat, and Instagram, to see if there is any difference or supplement. Furthermore, findings from

this study can also be compared to other data sources including astronauts' books, news reports, documentaries, and interview videos.

If re-using data from Twitter, it may be interesting to examine if astronauts' gender, age, and duration in space may have an impact in leisure perception. In other words, do astronaut experience each stage of leisure space travel differently when controlling factors like gender and age? This implies a need for future research to emphasize the textual analysis of Tweets.

Moreover, it is also an interesting angle if the term "amateur astronaut" may bring more potential customers to the market of space tourism. And the findings from this study can be applied as questionnaire and interview questions in order to develop market strategies for space travel business.

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IRB APPROVAL

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

IRBN007 – EXEMPTION DETERMINATION NOTICE

Monday, May 21, 2018

Investigator(s): Jingning Ao; Helen "Joey" Gray
Investigator(s') Email(s): ja4y@mtmail.mtsu.edu; joey.gray@mtsu.edu
Department: Human Performance

Study Title: Ride of a lifetime: A netnographic research to unveil the leisure experience attached to orbial space tourism
Protocol ID: **18-1271**

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category *(2) Educational Tests* A summary of the IRB action and other particulars in regard to this protocol application is tabulated as shown below:

IRB Action	EXEMPT from furhter IRB review***	
Date of expiration	**NOT APPLICABLE**	
Participant Size	36 (Thirty Six)	
Participant Pool	**Adults 18+**	
Mandatory Restrictions	1. Participants must be age 18+; therefore only Twitter feed of adults particpants may be observed	
Additional Restrictions	**1. Data use limited to existing de-identified observation of public use Twitter feed.** **2. The protocol does not allow contacting or interacting with human participants beyond observation of public Tweets.**	
Comments	None at this time	
Amendments	**Date**	**Post-Approval Amendments** None at this time

***This exemption determination only allows above defined protocol from further IRB review such as continuing review. However, the following post-approval requirements still apply:

- Addition/removal of subject population should not be implemented without IRB approval
- Change in investigators must be notified and approved
- Modifications to procedures must be clearly articulated in an addendum request and the proposed changes must not be incorporated without an approval
- Be advised that the proposed change must comply within the requirements for exemption
- Changes to the research location must be approved – appropriate permission letter(s) from external institutions must accompany the addendum request form

- Changes to funding source must be notified via email (irb_submissions@mtsu.edu)
- The exemption does not expire as long as the protocol is in good standing
- Project completion must be reported via email (irb_submissions@mtsu.edu)
- Research-related injuries to the participants and other events must be reported within 48 hours of such events to compliance@mtsu.edu

The current MTSU IRB policies allow the investigators to make the following types of changes to this protocol without the need to report to the Office of Compliance, as long as the proposed changes do not result in the cancellation of the protocols eligibility for exemption:

- Editorial and minor administrative revisions to the consent form or other study documents
- Increasing/decreasing the participant size

The investigator(s) indicated in this notification should read and abide by all applicable post-approval conditions imposed with this approval. Refer to the post-approval guidelines posted in the MTSU IRB's website. Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 within 48 hours of the incident.

All of the research-related records, which include signed consent forms, current & past investigator information, training certificates, survey instruments and other documents related to the study, must be retained by the PI or the faculty advisor (if the PI is a student) at the sacure location mentioned in the protocol application. The data storage must be maintained for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:

Click here for a detailed list of the post-approval responsibilities.
More information on exmpt procedures can be found here.