ASTRONOMY TOURISM: EXPLORING AN EMERGING MARKET

Group Culture, Individual Experience, and Industry Future

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This research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council (NHMRC) *National Statement on Ethics Conduct in Human Research*, 2007. The proposed research study received human research ethics approval from the James Cook University Human Research Ethics Committee:

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____________________________ __________________________

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# ABSTRACT

Astronomy tourism, a novel research topic and the basis for an emerging market, is the central concern of this thesis. Astronomy, or the simple contemplation of starry skies, has always been of profound interest to humans and world civilizations. Travelling for astronomy-related purposes as a significant tourist phenomenon, though a rising trend, has not been studied in the tourism literature. The principal aim of this thesis was to explore the group culture of astronomy tourists, their individual travel experience and the prospects for the future development of the industry. To tackle these new issues concerning astronomy tourism, this thesis attempts to address three key questions:

1. *Who are astronomy tourists and what is astronomy tourism?*
2. *What travel experiences do they have and why do they travel?*
3. *What are the industry stakeholders' perspectives towards the future development of astronomy tourism?*

To answer these questions, the first chapter of the thesis started by reviewing the research context. The details about astronomy tourism, the neglected assets of dark skies, and the knowledge gaps were observed. Historical cases of interest and contemporary activity underlined the significance of the research. Multiple perspectives from three areas, built the foundation literature. Three pillars - emerging tourism markets, special interest tourism and tourism future studies – were developed as the basis for research attention.

The second chapter designed the research at two levels. At the theoretical level, the conceptual schemes for the research were specified by four components: The neo-

tribe theory, the phase-based multidimensional model of tourist experience, the leisure involvement theory, and the travel career pattern (TCP) approach concerning tourist motivation, were reviewed and integrated as the theoretical bases for the research. At the methodological level, the paradigms and researcher positions were considered before reviewing three research methods. Netnography, a questionnaire-based survey and the key informant interviews were selected, in turn, as primary approaches to conduct the studies of group culture, individual experience and views of the future by industry future.

Chapter 3 described the study of the group culture of the astronomy tourists' neo-tribes. It delivered qualitative findings based on 244 travel blogs and 14 interviews. By employing a data mining technique, the market of astronomy tourism was outlined and the profile of astronomy tourists was documented. The elements of group culture were revealed by portraying symbolic and behavioural characteristics of astronomy tourists' neo-tribes. Preliminary considerations of tourist motivation and the tracking of the astronomy travel career provided guidelines for further similar concerns in the subsequent questionnaire development.

Chapter 4 gazed into the individual travel experience of astronomy tourists through a questionnaire-based study which involved a quantitative analysis of 866 respondents from a world-wide sample. An array of findings were reported by assessing tourists' general travel experience, determinants in decision making, tourist motivation, leisure involvement, on-site activity participation, tourist satisfaction, recollection behaviour and learning outcomes. A key conclusion was drawn that travel career patterns vary significantly with rising levels of serious leisure involvement in the astronomy tourism context.

Chapter 5, concerning the industry future of astronomy tourism, encompassed two focus groups and 28 in-depth, semi-structured interviews which were conducted by the key informant technique. This qualitative study assessed the industry stakeholders' perceptions of the current status of astronomy tourism and their attitudes towards future development. Using the IPA (importance and expected-performance analysis) approach, three key solutions were proposed and which addressed the sustainable development issues for the future of astronomy tourism.

Chapter 6 highlighted a synthesis of the overall researching findings. The connection between Pearce's (2005b, 2011a, 2011b) TCP model and Stebbins' (1982, 2014) leisure involvement theory was established as the major conceptual contribution of the thesis. In the context of special interest tourism, this link suggested a clear variation of tourist motivation patterns among the casual leisure, project-based leisure and serious leisure pursuers. A growth in leisure involvement is significantly reflected in higher-level motivations pertaining to self-actualization or self-development needs.

In the practical field, the thesis outlined several implications for the stakeholders of astronomy tourism industry at a managerial level. The empirical findings with a large sample and primary data constitute a substantial reference resource for developing desirable astronomy tourism products to meet the multiple needs of customers in the future. Additionally and to complete the work, the limitations of the research and the directions for further studies were indicated.

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"It is clear to everyone that astronomy at all events compels the soul to look upwards, and draws it from the things of this world to the other."

--- Plato

CHAPTER OUTLINE

1.1 A Panorama: Context and Overview of the Research

> *"The desire to find and lose ourselves in the stars is ancient. Like so many other inhabitants of this planet over the eons, we use the stars to navigate far away and to find our way back home."*
>
> ***(International Dark-sky Association, IDA)***

Astronomy tourism is the central topic of this thesis. Before giving a context or a precise definition, astronomy tourism can be provisionally regarded as "travelling for the purpose related to astronomy or doing astronomy-related activities during travels" (Bahmba, the SPACE Group, 2016)[1]. With the further specification of this research, the definition will be discussed and clarified in a later stage of this chapter. Prior to this, it is worthwhile tracing some clues from history.

1.1.1 Research Context: Historical Parallels

Astronomy and its related travels have a major historical presence. As one of the oldest sciences, astronomy has been one of the crucial driving forces for global travel. Navigation by the stars has been pivotal for human travels. Famous historical links can be sought in the 'Age of Sail', also known as the 'Age of Discovery' (Stavrianos, 1995). Magellan, the first person to circumnavigate the Earth in 1522, was driven by the desire to verify the astronomical theory of a 'Spherical Earth'. Prior to him, the prominent 'discoverer' of the American continent, Christopher Columbus, was another staunch supporter of the 'Spherical Earth' theory. His voyage across the

[1] https://astrotourism.wordpress.com/

Atlantic Ocean in 1492 was essentially to demonstrate the Earth is a sphere. Another remarkable seafarer, James Cook, was commissioned by the Royal Society of London to undertake the 'Endeavour' voyage from the United Kingdom to Tahiti in 1769, in an attempt to observe an episodic and peculiar astronomical phenomenon, 'The Transit of Venus' (See Figure 1.1). One and a half centuries later, a crew of sailors guided by Arthur Stanley Eddington in 1919, carried out a long journey to Principe Island in West Africa, and captured photos of the total solar eclipse in order to ascertain Einstein's famous astrophysical theory of 'General Relativity'.

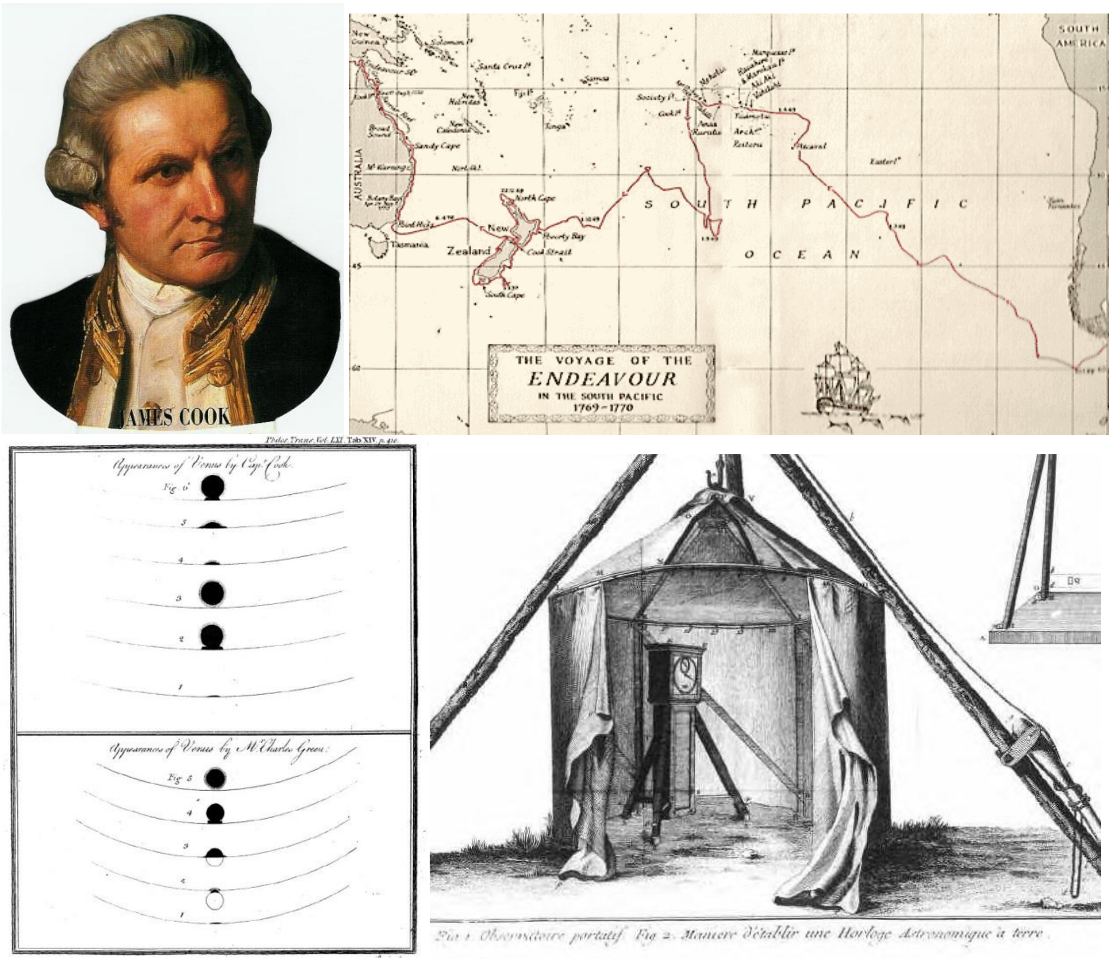


Figure 1.1 Cook's 'Transit of Venus' voyage route, sketching and portable observatory

Humankind has always observed the night sky either to interpret it or to understand the physical laws that govern the universe. The previous four well-known voyages about extraordinary discoveries are certainly not the only examples demonstrating how astronomical forces stimulated travel. Astronomy tourism, the topic of this thesis, arguably began with the travels of observers to the locations where physical settings were optimal for specific astronomical phenomena, such as solar eclipses and the movements of the planets (Crouch, 2001). In previous centuries, the upper class and science explorers, such as astrologers and astronomers, have travelled across national boundaries for observing astronomical events, such as aurora borealis, solar eclipses, lunar eclipses, comets and meteor showers. Eventually, many constellation diagrams and nautical charts were drawn and became available to the public, and in turn, they have become roadmaps for new adventurers to pursue worldwide expeditions.

1.1.2 A Contemporary Phenomenon: Rise of the Market

Nowadays, there is evidence that celestial objectives such as stars, nebulas, eclipses, meteor showers, auroras and comets have fostered a growing branch of travel activity provisionally named astronomy tourism or astronomical tourism (Berman, 2013; Kate, 2007; Najafabadi, 2012). A growing number of amateur and professional astronomers participate in group tours and cruise ships to capture solar eclipses or other celestial spectacles (Crouch, 2001). Chasing astronomical wonders is no longer an exclusive or individual province for celebrities or notable explorers. Arguably, it is gradually becoming an amateur hobby as well as a leisure lifestyle for the middle class in contemporary society. Today, the popularity of astronomy interest and hobby underlies the foundation of the market of ‘astronomy tourism’. Due to the improving quality of life and rapid development of world transportation, a growing cadre of astronomical enthusiasts with an observational or photographic focus travel regularly to far-flung places, seeking a dark sky without light pollutions (NASA Night Sky

Network, 2008). Nevertheless, more remains to be explored about this emerging market. Though there is yet no cumulative data on the exact scale of the astronomy tourism market, some descriptive statistics suggest that the phenomenon is growing (Cater, 2010; Rodrigues, Rodrigues, & Peroff, 2015; Weaver, 2011). According to the world's largest and oldest astronomy education society, ASP (Astronomical Society of the Pacific), there are presently no less than five million enthusiasts in amateur astronomy world-wide. One third of them travel at least once a year due to an astronomical interest or purpose (ASP, 2009). As an example, the total solar eclipse which occurred in Cairns, Australia, 2012, attracted over 60,000 tourists from more than 20 countries. They gathered along the beaches of North Queensland, to observe this fascinating astronomic festival. Similarly, in 2009, over 100,000 visitors from all over the world assembled on a mountaintop resort in Eastern China as this region experienced the longest total eclipse of the sun in the past five decades (International Astronomical Union, IAU, 2009). The most recent solar eclipse occurred on 9th March 2016, and more than 10,000 foreign visitors and 100,000 domestic tourists were alleged to have flooded into Indonesia's west island of Sumatra to see the sun totally eclipsed by the moon. Events such as culture festivals and dragon boat races were organized around the time of the eclipse. Hotels in the best viewing spots filled up weeks before and in one city officials had to find extra space for tourists on boats [1] (The Guardian, 2016).

Besides solar eclipse tours, visiting observatories is another representative activity of astronomy tourism. According to Wikipedia, an inventory, which is acknowledged as incomplete in 2016, alleged that there are approximately 500 public terrestrial-based observatories in 53 countries worldwide (nearly half of them are in the United States).

[1] https://www.theguardian.com/science/2016/mar/07/thousands-flock-to-indonesia-for-total-solar-eclipse

Three million tourists per year visit the observatories. Many observatories are marketed and function as tourist attractions (see Figure 1.2), while a few of them are only accessible for scientific or educational use.

Viewing aurora borealis / australis is also one of the key forms of astronomy tourism (Weaver, 2011). In recent years there has been a significant increase in the number of tourists visiting Arctic aurora destinations such as Alaska, Finland, Iceland, Sweden, and Norway. Over the past decade, the Northwest Territories (NWT) of Canada has been successful in expanding the Aurora viewing market with 6.8% annual growth. In 2015, 15,000 aurora visitors, who spent approximately $11.5 million, comprised the largest portion of overseas visitors to the NWT. The majority of them were from Japan, China and South Korea, and 67% of them were female tourists (GNWT, 2015).

Figure 1.2 Representative forms of astronomy tourism

1. Aurora hunting in Yellowknife, Northwest Territories of Canada
2. Observatory visits accompanied with astronomy educational program
3. Meteor seeking enthusiasts with a meteorite found by them
4. Stargazing with a guide on an astronomy-theme cruise ship ‘Princess’
5. Chasing a total solar eclipse on an air charter.

The significance of viewing aurora borealis is indicated by the growing number of tourists and travel companies serving the market. Travel to significant astronomy tourism sites is typically a mix of independent, self-organized trip, and group or package tour offerings. Some astronomy tourism enterprises have already emerged and now cater to this niche market, operating unique tours and providing large varieties of astronomy-related products for customers (Cater, 2010). These products generally include but are not limited to aurora displays in Arctic or Antarctic regions, solar eclipses on cruise ships or other package tours, watching space shuttle launches at Kennedy Space Centre (KSC) in Cape Canaveral, meteorites seeking in sparsely populated areas, and stargazing excursions in national parks or dark-sky reserves. Some organizers even charter planes for the high-end market to chase a total eclipse of the sun for some additional time (Chaudhary, 2012). In the United States, companies offer celebrities astronomy-themed cruises in Michigan and Huron Lakes, as well as international voyage across the Pacific Ocean (e.g. Eye on the Sky® Astro-Cruises astronomy programs, see Figure 1. 2 above).

The opportunities for researching these multiple factors of astronomy tourism are rich. A further consideration of the ways in which the resources have been utilised is needed before articulating specific research directions.

1.1.3 An Overlooked Tourism Asset: The Missing Dark Skies

Although the market is emerging and its size is growing, astronomy tourism has been underestimated by tourism stakeholders for decades. It has remained an overlooked submarket in which dark skies are the dominating tourism resources and observation of nocturnal 'mega-skies' is the most prevalent form of tourist activity (Rodrigues *et al.*, 2015; Weaver, 2011). "It is surprising that tourism, increasingly sophisticated as it is, has limited itself in almost all cases to utilizing its natural and cultural resources only during daylight hours" (UNWTO, 2007). Unlike other general tourist activities that often take place in daylight, in contrast, astronomy tourism's most valuable asset possibly lies in the existence of dark skies at nighttime (except solar eclipse, Transit of Venus, Transit of Mercury and other episodic diurnal events). For some destinations which have already encountered a decline or stagnation phase in their lifecycle, astronomy tourism is able to provide a possible pathway to extend the length of tourists' stay and to diversify their nighttime activities by developing an ignored and unexploited tourism resource – night skies.

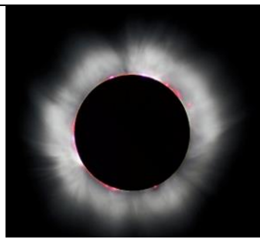
Table 1.1 Natural celestial resources of astronomy tourism

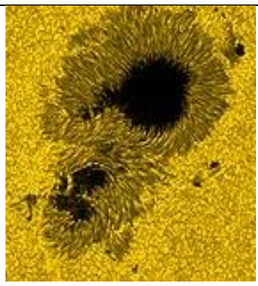
Time of Day	Nocturnal	Diurnal	Crepuscular
Celestial Objects	Stars, star cluster * Planets Moon Satellites Meteors Deep-sky objects (e.g. galaxies, nebulas*, clusters, etc.)	Sun dogs* (parhelia) Sunspots *(macula) Rainbows Clouds	Comets
Astronomical Phenomena	Aurora* borealis/australis Lunar eclipse Opposition of planets Occultation*	Solar eclipse* Transit of Venus*	Sunrise Sunset Midnight sun

Source: adapted by author from Weaver (2011). * refer to Table 1.2 for the illustration of glossary.

This classification follows Weaver (2008) who referred to the options as components of 'megacaela'. The natural resources of astronomy tourism can be divided into three categories by time of day – nocturnal, diurnal and crepuscular (see Table 1.1 above). Nighttime resources are the primary natural assets and the dominant attractions of astronomy tourism. Some nocturnal human activities or cultural resources are omitted in this approach, such as night visits to observatories, participation in star parties and star excursions. These activities can also be considered as other forms of astronomy tourism. Table 1.2 repent the definitions of typical resources of astronomy tourism.

Table 1.2 Glossary of celestial objects and astronomical phenomena

Term	Definition	Image
Nebulas	A nebula is an interstellar cloud of dust, hydrogen, helium and other ionized gases. Originally, nebula was a name for any diffuse astronomical object, including galaxies beyond the Milky Way.	
Aurora	Aurora is a kind of natural light display in the sky particularly in the high latitude regions (known as borealis in Arctic and australis in Antarctic). It is caused by the collision of energetic charged particles with atoms in the high altitude atmosphere.	
Star Cluster	Star clusters are groups of stars. Two types of star clusters can be distinguished: globular clusters are tight groups of hundreds of thousands of very old stars which are gravitationally bound, while open clusters, more loosely clustered groups of stars, generally contain fewer than a few hundred members, and are often very young.	
Solar Eclipse	As seen from the Earth, a solar eclipse occurs when the Moon passes between the Sun and Earth, and the Moon fully or partially blocks the Sun. It happens only at new moon, when the Sun and the Moon are in conjunction as seen from Earth in an alignment referred to as syzygy.	
Lunar Eclipse	A lunar eclipse occurs when the Moon passes directly behind the Earth into its umbra (shadow). This can occur only when the Sun, Earth, and Moon are aligned (in "syzygy") exactly, or very closely so, with the Earth in the middle. Hence, a lunar eclipse can only occur the night of a full moon.	
Transit of Venus	A transit of Venus across the Sun takes place when the planet Venus passes directly between the Sun and Earth, becoming visible against (and hence obscuring a small portion of) the solar disk. During a transit, Venus can be seen from Earth as a small black disk moving across the face of the Sun	
Occultation	An occultation is an event that occurs when one object is hidden by another object that passes between it and the observer. It can also refer to any situation wherein an object in the foreground blocks from view (occults) an object in the background.	

Macula (Sunspot)	Sunspots are temporary phenomena on the photosphere of the Sun that appear visibly as dark spots compared to surrounding regions. They are caused by intense magnetic activity, which inhibits convection by an effect comparable to the eddy current brake, forming areas of reduced surface temperature.	
Parhelia (Sundog)	A sundog, scientific name parhelia from Greek, also called a mock sun or a phantom sun, is an atmospheric phenomenon that creates bright spots of light in the sky, often on a halo or luminous ring on either side of the sun. Sundogs may appear as a colored patch of light to the left or right of the sun, 22° distant and at the same distance above the horizon as the sun.	

Aside from Weaver's typology, UNESCO (United Nation Educational, Scientific and Cultural Organization) launched an 'Astronomy and World Heritage' project[1] in 2003 and subsequently defined 'tangible astronomical heritage' as a conference based 'Kazan Resolution' in 2009. Tangible astronomical heritage, according to UNESCO's definition, is "the material evidence relating to astronomy and representation of astronomy". Within this framework, the boundary of astronomy tourism and its resources have been broadened from heavenly bodies to terrestrial attractions, such as facilities related to space exploration; historical sites, monuments, cultural landscapes related to the history of astronomy. The approach also includes architecture and urban infrastructure related to the applied astronomy and the results of astronomical observations and contextual understandings. Other than the tangible astronomical heritage initiated by UNESCO, the international community has also raised the awareness of the fact that dark skies can be utilized as an astronomy tourism asset and should be preserved for current and future generations. This common recognition can be seen in the 2007 La Palma Declaration (a.k.a. 'Starlight Declaration', full name

[1] http://whc.unesco.org/en/astronomy

refers to 'Declaration in Defence of the Night Sky and the Right to Starlight'), in the 9^{th} resolution[1] where tourism is highlighted below as an effective tactic to protect dark skies:

"Among others, tourism can become a major instrument for a new alliance in defence of the quality of the nocturnal skyscape. Responsible tourism can and should take on board the night sky as a resource to protect and value in all destinations. Generating new tourist products based on the observation of the firmament and the phenomena of the night, opens up unsuspected possibilities for cooperation among tourism stakeholders, local communities, and scientific institutions."

(La Palma Declaration, 2007)

In reality, bright starlight is disappearing with the ongoing global urbanization and the loss of dark skies on our planet (Rodrigues *et al.*, 2015). Stars and the Milky Way are both less visible for many urban children, and the starry nightscape is increasingly scarce in rural areas (Falchi, Cinzano, Duriscoe, Kyba, Elvidge, Baugh, Portnov, Rybnikova, & Furgoni, 2016). "A large part of the present generation is the first in history that have grown up without a direct contact with the beauty of a starry sky, in an environment where these cultural references are falling into the oblivion."[2] If the ignorance of starlight reduction continues, this overlooked underlying tourism asset is likely to be over-polluted or even destroyed before it has been fully used (Collison & Poe, 2013). Once the value has been recognized and the utility has been realized, dark skies can be preserved and counted as sustainable assets for the developing astronomy tourism industry and used profitably for an emerging tourist market.

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[1] http://www.starlight2007.net/pdf/StarlightDeclarationEN.pdf

[2] The Starlight Reserve Concept (2009), initiated by UNESCO-WHC (Initiative Astronomy and World Heritage)

1.1.4 An Unstudied Domain: Astronomy Tourism

The situation that astronomy tourism is a neglected frontier not only emerges in the industrial field, but also exists in the tourism research domain with limited academic concerns and sparse commercial investigation. In commencing this research program in 2013, and searching with the key word 'tourism' followed by at least one of the following words 'celestial' 'astro' 'astronomy' 'astronomical' 'astro-tourism' in the title of academic articles, there were only five results in Google Scholar. The results contained articles from business news reports and one conference paper with an astronomy focus. Only three academic journal articles stood out and two of them were from a tourism research perspective, but different in the nomenclature of 'astronomy tourism'. Weaver (2008, 2011), Cater (2010), Collison and Poe (2013) labelled the astronomy tourism as the 'celestial ecotourism', 'terrestrial space tourism' and 'astronomical tourism' respectively. Apart from these contributions, a series of non-scholarly short articles printed in French and Chinese-language journals in the early 2000s also represented the scanty exploring this interest. Research and interest in the topic can also be found amongst some groups and individuals in the world of astronomy. Some astronomy education professionals indicated that amateur astronomers could be as effective as professional astronomers in providing astronomical tourism outreach programs (Gibbs & Berendsen, 2007), and the more knowledgeable they are, the more likely they are to be doing tourism outreach, especially if affiliated to an astronomy club (Berendsen, 2005). However, such previous analysis is from an astronomy education perspective instead of a tourism research view. In summary, astronomy tourism is a less-studied segment of tourism literature.

(1) Debate on definitional boundaries

The definition of 'astronomy tourism' and its distinction compared to 'space tourism' are somewhat ambiguous for newcomers. Although no consensus has been achieved on defining the boundaries, the definitional debate requires some explicit clarification (see Table 1.3 below).

Table 1.3 Definitional debate on astronomy tourism by key scholars

Nomenclature	Year	Researchers	Definition	Boundaries
Terrestrial Space Tourism	2001, 2009	Crouch, G.	Earth-based simulations, tours and entertainment experiences related to space tourism. An early form of 'Space Tourism' with existence for a number of years as an established tourism product	Confined by the spatial interface of tourist activities: a segment of 'space tourism' which occurs in the outer space of the Earth
Celestial Ecotourism	2008, 2011	Weaver, D.	Ecotourism where the interest of visitors is focused on the observation and appreciation of naturally occurring celestial phenomena.	Limit to ecotourism products and natural tourism resources; excluded constructed and cultural elements
Astrotourism	2010	Cater, C.	Adopted from Crouch, refers to a space tourism segment which occurs beyond/in the earth orbit (outer space).	Consistent with the classification of 'space tourism' and used as a broader industry sector
Astronomical Tourism	2013	Collison, F. & Poe, K.	Travelling to a particular location to enjoy the beauty of the night sky or an astronomy-related historical site	Limited to astronomy amateurs and normal tourists. Experts travel for professional observing is excluded

Source: integrated by author

Astronomy tourism was initially defined as 'terrestrial space tourism' and equivocally classified as one form of the 'space tourism' by Crouch (2001), who was probably the earliest pioneer with a tourism background to consider this emerging market. In his early contributions, he classified space tourism into three submarkets in terms of the height of the interface of space tourists' activities: orbital space tourism, high-altitude or suborbital space tourism, and terrestrial space tourism. Thereafter, his research team built a tourists' decision making model to identify space tourism potential customers' choice behaviour (Crouch, Devinney, Louviere, & Islam, 2009).

Using the term 'celestial ecotourism', Weaver (2008) described an overview of some of the topics of tourism interest. He insisted that observatories were the single largest component in terms of visitation, while aurora tourism was the most developed as a specialized commercial tourism industry in the high latitudes of Europe and North America. However, due to his ecotourism perspective, only natural attractions and resources were embraced within the boundary of 'celestial ecotourism', and hence many astronomy-related cultural and constructed attractions which created decontextualized settings were excluded from astronomy tourism, such as visiting planetariums, watching space shuttle launches on site, participating in star parties or astronomy conventions, sightseeing at astronomy-related heritage sites and so forth.

The boundary of Weaver's 'celestial ecotourism' was argued and broadened by Collison and Poe (2013). In an empirical study, they renamed the phenomenon as 'astronomical tourism' (Collison & Poe, 2013) and suggested that astronomy tourism should generally contain five segments and specific tourism products: 1. Visits to astronomy observatories; 2. Regions with aurora viewing; 3. National or local parks offering astronomy programs with dark skies; 4. Amateur astronomy institutions that offer tours and public programs; 5. Other providers of astronomical travelling sites/facilities including bed & breakfasts (B&B's) and private/organizational observatories with resources and services for solar observing or observation of the night sky. Based on the background of ecotourism and sustainable tourism, their research provided a descriptive analysis of astronomy and night sky darkness programs at Bryce Canyon National Park in the United States. Akin to this, a recent case study on an IDA (International Dark-sky Association) dark sky reserve and its corresponding tourism program in Portugal was commenced by a group of dark sky preservation pioneers (Rodrigues *et al.*, 2015). They concluded that astronomy tourism indeed offered a sustainable tourism approach for improving local community development and long-term starlight preservation.

Cater (2010) and Rodrigues et al. (2015) followed Crouch's definition and the typology of 'terrestrial space tourism'. Nevertheless, Cater adapted the notion of 'orbital space tourism' into a broad industrial concept 'astrotourism', which is possibly confusing with the 'astronomy tourism' used throughout our research. To avoid this complication, it is essential to offer a succinct comparison amidst all the competing and adjacent definitions of 'astronomy tourism' (see Table 1.3). For this study, orbital space tourism and suborbital space tourism are beyond the sphere of interest of the work.

(2) Defining the phenomenon within this study

In this study, the investigator initiated the term 'astronomy tourism' to conceptualize the phenomenon and classify a new tourist market. According to Cooper et al. (2006) and Novelli (2005), five characteristics are generally used to define emerging or niche tourism market: (1) geographical origin (e.g. Chinese tourism, Asian Tourism); (2) geographical destination (e.g. Antarctic tourism); (3) type of attraction (e.g. gastronomy tourism); (4) type of accommodation (e.g. resort tourism, Airbnb tourism) and (5) type of transport (e.g. drive tourism, RV tourism). Usually a new form of tourism and tourist groupings involve some mixture of transport, demographic factors, geographic location, travelling style distinctions, product and activity classification and features of tourist attraction, and whereby tourist behaviour can be themed (Pearce, 2005b, 2011a). In these ways a niche tourism form can be defined (Robinson & Novelli, 2005). Using such approaches, a primary definition of astronomy tourism can be proposed for the present thesis, and the synopses of this phenomenon is summarised in Table 1.4 below.

Table 1.4 Synopses of 'astronomy tourism' phenomenon in this study

<table>
<tr><th>Aspects</th><th colspan="4">Synopses</th></tr>
<tr><td>Provisional Definition</td><td colspan="4">Travel to a particular destination where the environment is suitable for observing and/or photographing celestial bodies or periodic astronomic phenomena/events in either the nocturnal or diurnal sky. Additionally, visitation to astronomy-related historical sites or observatories, and tours with participation of astronomical activities are also generally included in astronomy tourism.</td></tr>
<tr><td>Premise</td><td colspan="4">Travel from one place to another, must be away from tourists' domiciles (home-based astronomy hobbyists' activities are excluded from the study)</td></tr>
<tr><td>Boundary</td><td colspan="4">Undertaken on the terrestrial surface-- Space tourism (both orbital and suborbital) which occurs in outer space or atmospheric space is beyond the scope of this study</td></tr>
<tr><td rowspan="8">Forms of Activities</td><td>Type</td><td>Objective</td><td>Time of Day</td><td>Examples</td></tr>
<tr><td rowspan="3">Observing or Photographing</td><td rowspan="2">Celestial objects</td><td>Nocturnal</td><td>moon, stars, planets, nebulas*, comets, galaxies, meteors, aurora*, satellites and artificial satellites</td></tr>
<tr><td>Diurnal</td><td>solar and sunspot* viewing, clouds, parhelia(sundog)*, rainbows</td></tr>
<tr><td>Astronomical Phenomena</td><td>Periodic, non-specific time</td><td>solar/lunar eclipse*, The Transit of Venus *, Planet Opposition, occultation*</td></tr>
<tr><td rowspan="2">Visitation</td><td>Observatories Planetariums</td><td>Nocturnal & Diurnal</td><td>Kitt Peak National Observatory</td></tr>
<tr><td>Astronomy-related historical sites</td><td>Aperiodic, usually diurnal</td><td>Stonehenge in UK, Chichen Itza in Mexico, Pyramids Giza in Egypt</td></tr>
<tr><td>Astronomy – related activity participation</td><td>Astronomy-related experiences</td><td>Aperiodic, both diurnal and nocturnal</td><td>Astronomy-theme cruises, meteorites seeking, star parties, astronomical education workshops or conventions, viewing space shuttle launch on site, etc.</td></tr>
</table>

Source: integrated from Crouch (2001), Weaver (2008, 2011), Cater (2010), and Rodrigues et al. (2015)
Note: * Please refer to Table 1.2 for the glossary explanation.

As presented in the table, 'astronomy tourism' is thereby defined using the third criterion – attraction type, as astronomy or its related representations is the paramount purpose of this particular type of travelling. Astronomy tourism can be either a small part of travel or the central purpose of a trip. Multiple customer segments exist ranging from individuals to corporates, families to groups; in brief, whoever travels for the main purpose of astronomy or doing astronomy while they are travelling can be included in the study of the topic.

Other comparative definitions are eliminated based on following reasons. The notion of 'terrestrial space tourism' is not employed as the theme of this study because 'astronomy tourism' is less ambiguous, while the former is a derivation from space tourism, which is another distinct study topic. Additionally, astronomy tourism involves the movement of solid numbers of astronomical observers to different locations and has been in existence for a number of years (Crouch, 2001). By way of contrast, space tourism to date has emerged only recently and has only brought a few tourists to the sub-orbital or outer space (Laing & Crouch, 2004; Prideaux & Singer, 2005). In essence, space tourism can be considered as a submarket and as well as a specific evolution outcome of astronomy tourism. In this study it will not be discussed and studied as a form of astronomy tourism because our major endeavour will be to focus on those activities which occur in the terrestrial environment.

As for celestial ecotourism, as discussed before, it is replaced by 'astronomy tourism' because the latter definition embraces a more general concept for a larger variety of astronomy-related cultural tourism activities, such as travelling for star parties or astronomy conventions. Regarding the term 'astro-tourism' suggested by Cater (2011), it was originally created to academically define a segment of space tourism that happens beyond or inside the earth's orbit at an outer or atmospheric space. By way of contrast 'astronomy tourism' often takes place on the earth's surface. Moreover, based on some online investigations, the words 'astro-tourism' and 'astronomy tourism' have been widely adopted for a long time by many astronomy tourism business operators (such as AstroTourism® in India[1] and Astronomical Tourism® in Chile[2]). They mainly describe the 'terrestrial space tourism' products. As a result, this study abandons this existing term and initiates the new label 'astronomy tourism' for the thesis title. The approach arguably establish as an explicit realm of interest as against the research domain of space tourism.

1.1.5 Overview and Significance of the Research

Astronomy tourism is a complex issue, but it is not as mysterious as astronomy itself. It is a less-studied realm in tourism literature, literally a business frontier lying under a 'dark sky'. A reality of the contemporary tourism industry is its dynamic character, and astronomy tourism creates an emerging market where tourism is arguably useful in exploiting the underlying nocturnal skyscape resources.

The present thesis is centrally focused on portraying a panoramic picture of the rising topic of astronomy tourism from a global viewpoint through three aspects – interpreting the group culture of astronomy tourists, elaborating their individual travel experience, and looking forward to the industry future from the perspective of astronomy tourism's stakeholders. The work in this thesis separates at a middle, micro and macro level respectively.

For the first aspect, this research traverses the cross-discipline area between tourism and sociology studies. Group culture is a notion originally derived from sociology and

[1] https://astrotourism.wordpress.com/
[2] http://www.astronomictourism.com/

is newly adapted in tourist groupings and tourist culture studies. It describes how groups tend to develop their shared culture over time, based on knowledge, beliefs, practices and behaviours their members hold in common. In this thesis, it will be employed to indicate astronomy tourists' subcultural group identities, to decode their mutual interest, to explore relationship between group members, to understand their general patterns of astronomy-related travel experience and to crystallize their common tourist behaviour modes.

Based on the exploratory attempt to their group culture, the second study area will see a further elaboration about astronomy tourists' individual travel experience. Studies on tourist behaviour and travel experience have been key topics in the tourism literature since the discipline established in 1980s (Pearce, 1987, 2005b, 2011a; Ryan, 1995). A number of fresh issues have emerged with the synchronic development of new tourists, and astronomy tourist is one part of this new wave. In this study, the work will stand 'on the shoulder of giants' to build the foundation of a conceptual scheme; that is, it will follow existing theories and approaches in tourist experience studies to build a framework for revealing astronomy tourist's travel experience, including studies on their travel motivation, decision making, satisfaction and leisure involvement. As a consequence, this study, compared with existing literature in this field, will be likely to initiate some new perspectives that may contribute to tourism academia.

The focus of the third study lies in assessing astronomy tourism stakeholders' views towards the future development of this sector. Assessing market potentials and forecasting future tendency are prevalent measures to detect the value of an emerging and niche market. Tourism future studies are emerging at present but the efforts are unevenly distributed among different topics. In this section, the researcher develops the idea of study in the future of astronomy tourism using an emic approach. The endeavour will try to summarize key implications for the tourism government sector, tourism firms or corporates, tourist destinations and local communities. It is intended to assist them to develop new products, to seize niche market opportunities and to acquire future benefits from the astronomy tourism industry through better tourism planning and administration.

Overall, in comparison with existing astronomy tourism literature, this thesis, which consists of three sub-topics, can be significant in several distinct attributes below.

- Firstly, it is an exploratory study. New trends, new consumers and new products in an emerging and niche tourism market are studied with an exploratory approach. This allows the study, with few precedents existing, to build new definitions, fresh concepts and potentially original insights.
- Secondly, a post positivist research paradigm is applied and three empirical studies are implemented in the thesis. In particular, this study will initially look at the travel experience and the group culture of astronomy tourists through quantitative analysis, which has not been applied by previous researchers in this interest area.
- Thirdly, a global perspective is adopted. In phenomenon sampling methods, this study addresses research questions with a worldwide viewpoint. Major astronomy tourist origin countries are considered in the sample frame to ensure the generality of research conclusions.
- Further, this study builds on the research in tourist behaviour, instead of merely describing the general phenomenon as in previous astronomy tourism studies. This is the first time that a systematic approach about astronomy tourists' individual behaviour and group culture fields has been attempted.

- The fifth distinctive quality of this study is its future-oriented and forward-looking perspective. This feature is present in the future studies of astronomy tourism. Unlike dominant studies on emerging tourism or astronomy tourism that are often backward-looking at existing or past facts, this study offers future prospects of applied significance.
- Last but not least, it is a multi-disciplinary research, which is consistent with the multifaceted quality of tourism. Perspectives and methodology from sociology, anthropology and semantics are integrated to complete this study. Specifically, this study employs subculture and neo-tribe theory, the Travel Career Patterns (TCP) approach, Serious Leisure Perspective (SLP) from leisure involvement theory, and Importance expected-Performance Analysis (IPA) approach as guiding frameworks.

In summary, the overall research target is focusing on unveiling the global group culture and individual experience of astronomy tourism customers. In a previous section, the tourism literature relevant to astronomy tourism has been reviewed and contextualized. Next, related literature in emerging tourism markets, special interest tourism and tourism future studies will be taken into consideration to build the research plan. Based on the following systematic review of foundation literature, knowledge gaps will be indicated and research opportunities will be specified.

1.2 Introduction to the Foundation Literature

Back in 2013, when this study was initially conceptualized, limited studies emerged from the area where tourists' group culture and individual experience in astronomy tourism were investigated. The questions were how we should start looking at the issue and from which angle we should tackle the core topics in astronomy tourism?

To answer this question, the readily available academic materials to the relevant topic were constructed into two foundational pillars.

Firstly, the research phenomenon was considered to establish a comprehensive background for unfolding the puzzle box of astronomy tourism. This embraced a review of the foundation literature in the following three fields:

- Previous studies in emerging tourism markets
- Recent studies in special interest tourism
- Newly emerged literature in tourism future studies

Secondly, more specific and focused theoretical concepts linked to each study of the thesis were reviewed and conceptualized into a framework to support the work: group culture, individual experience of astronomy tourists, and the future of the industry. More specifically, they included a review of the literature in these areas:

- Group culture and subculture studies
- Neo-tribe theory and its application in tourism studies
- Tourist experience studies, the TCP approach on tourist motivation in particular
- Leisure involvement theory and the Serious Leisure Perspective (SLP)

The former two perspectives arise from the group culture theme and will be employed in Chapter 3, while the last two aspects will be used in Chapter 4 to address the topic of astronomy tourists' travel experience.

In summary, the central purpose for reviewing foundation literature in this thesis is to contextualize the topic of astronomy tourism. Therefore, both the foundational pillars focus only on those perspectives that directly contribute to the development of a knowledge base for the research key issues to be tackled in the present study. In the next section, the topic of astronomy tourism will be underpinned by the ideas about emerging tourism markets and work on special interest tourism.

1.3 RESEARCH IN EMERGING TOURISM MARKETS

1.3.1 Understanding Emerging Tourism Markets as Business Frontiers

Tourism as a phenomenon and the world's largest industry has been continuously affecting more individuals worldwide since its emergence (Yeoman, 2012). Akin to other burgeoning industries, tourism is also evolving and altering its shape with megatrends of new customers, new products and new markets. (Han, Meng, & Kim, 2017; Sezgin, 2016; Williams, 2014) In terms of definition, a new and emerging tourism market is defined in opposition to the established 'mass tourism' market (Hall & Allan, 2008; Williams & Shaw, 2011). Most emerging markets are characterised by distinctiveness and innovation. There is an implication that the new tourism form has a sophisticated set of practices that help distinguish and differentiate participating tourists (Mahrous & Hassan, 2016; Novelli, 2005). In essence, an emerging market may represent a change to the mechanism of production and consumption, and it can be realised by the transformation of technology, culture and society (Claveria, 2016). Specifically, with the recent emergence and rapid development of new information and communication technologies (ICTs), rising levels of wealth and life quality, extended leisure time and changes in values and lifestyles accounting for a new consciousness regarding one's own needs as well as regarding social responsibilities, tourism has now encountered a new flow of customers in the 'digital tourist era' (Amaro, Duarte, & Henriques, 2016; Pearce, 2011a; Wu & Pearce, 2014a). These new consumers of tourism products are more informed, more independent, more involved and more individualistic (Li, 2016; Pearce, 2011a; Pearce & Wu, 2016; Poon, 1993; Ryan, 2002a).

Using a special classification approach, an emerging tourism market can be identified by nomenclature as a new category of tourism market, involving specific criteria used to clarify its definitions (Claveria, 2016; Li, 2016; Swarbrooke, 2003). Such criteria include: 1) Geographical origin or destination (e.g. Indian tourism, Chinese tourism) (Jiang, Scott, & Ding, 2015; Sharda & Pearce, 2006); 2) Type of attraction (e.g. gastronomic tourism, cultural-heritage tourism); 3) Accommodation category (e.g. B&Bs tourism) and, 4) means of transportation (e.g. drive tourism). Defining an emerging or niche tourism market is usually dependent on a combination of these characteristics of the suppliers, customers or destinations (Burns & Novelli, 2008; Claveria, 2016; Han *et al.*, 2017).

Some researchers have also explored emerging tourism markets from the perspective of ‘niche tourism’ (Burns & Novelli, 2006; Cooper, 2005; Cooper & Wahab, 2005; Macleod, 2006; Novelli, 2005). By definition, a niche market is the subset of the market on which a specific product is focused (Burns & Novelli, 2008; Prideaux & Carson, 2011; Robinson & Novelli, 2005). As an example, Chinese self-drive tourists in western countries are a rising market in the drive tourism space (Wu & Pearce, 2013). The market niche is defined by the product features aimed at satisfying specific market needs and by the price range. The production quality and the demographics that are intended to support such niches are often small market, highly specialized, and seek to survive among the competition from other offerings (Mahrous & Hassan, 2016; Novelli, 2005; Tretheway & Mak, 2006).

1.3.2 Why New and Emerging Tourism Markets?

It is predicted by UNWTO that the magnitude of international tourists will reach 1.6 million by 2020 with an average growth of more than 4 percent annually. To take advantage of this expansion with enormous transformation both on the demand and supply sides, government sectors, academic members and industrial stakeholders all need to develop a timely consideration of new trends and issues that are shaping the future of tourism (Williams, 2014; Yeoman, 2012).

The significance of emerging tourism markets relates closely to the origins of research on this topic, which highlight the importance of sustainability and innovation for both present and future tourism (Chand, 2016; Williams, 2014). New product development and innovation in tourism is paramount for sustainable competitive advantage (Molina, Ochoa, & Alcaraz, 2017; Tyler & Dinan, 2001). Effectively, these processes depend upon the accurate and timely identification of new markets. However, in the tourism sector the process of new market identification has tended to be reactive, and only in recent years has the sector taken a professional and disciplined approach (Mahrous & Hassan, 2016; Tolkach, Chon, & Xiao, 2016).

For destination administrators and planners who are attempting to employ tourism as a mechanism for economic development, the niche tourism approach appears to provide greater opportunities and a form of tourism that is more sustainable, less negative in influencing others, and importantly, more likely to deliver high-spending tourists (Robinson & Novelli, 2005). And for tourists, emerging and niche tourism implies that they will be offered a more creative set of experiences in the knowledge that their desires and demands are being met (Novelli, 2005; Yeoman & McMahon-Beatte, 2016). Therefore, the study of new and emerging markets can be a critical issue for tourists, tourism companies, destinations and other related sectors involved in tourism activities and industry (Narduzzo & Volo, 2016; Tarlow, 2007).

New phenomenon and fresh topics are always attractive. Every time a new tourism subsector emerged, it was often accompanied with a flourish in the literature. Scholars have paid concerted attention to tourism business frontiers and emerging market since the 1990s. (Buhalis & Costa, 2006; Molina *et al.*, 2017) However, only in recent years have emerging tourism markets been systematically considered (Claveria, 2016). This effort has helped subsequent studies seeking to solve similar puzzles. The founders commonly took the credit for updating new areas of knowledge, and by evoking fresh interest they also propelled a new wave of studies to stand at the academic frontier of the present era.

1.3.3 Main Issues in Emerging Tourism Market

New tourism markets have been characterized by expansion coupled with continuous diversification. As a result, exploratory studies on new customers, product innovation and industry development in emerging tourism markets have appeared in last two decades.

(1) A 'niche tourism' perspective

Studies on emerging tourism market are theoretically underpinned by the concept of 'niche tourism'. Lew (2008) examined how, for the past two decades, tourism researchers had been debating tourism in the context of globalisation and rapid technological change. He stated how this 'new tourism' can be seen in the context of 'the emergence of niche marketing tourism'. Huh and Singh (2007) also discuss how the maturity of the tourism marketplace, coupled with fierce competition and, a more engaged consumer, has led to this desire to seek out new tourism markets or niches.

Although previous work has been conducted investigating the growth of special interest tourism, and specific niche markets in tourism, 'niche tourism' as a disparate concept and theory was not examined in full until the new millennium. In 2002 the Crichton Tourism Research Centre at the University of Glasgow held a conference with the theme '*Niche Tourism in Question: Interdisciplinary Perspectives on Problems and Possibilities.*' One of the outcomes of the conference was a set of published proceedings which attempted to draw together for the first time academics from different tourism related disciplines to debate this 'new tourism' (Macleod, 2003). This work provided some of the first collective thinking on 'niche tourism' and its multiple aspects.

Macleod and Novelli initially defined and elaborated on the concept of niche tourism. Macleod (2003) suggested that the term 'niche tourism' was largely borrowed from the term 'niche marketing' which referred to how a specific product can be tailored to meet the needs of a particular audience or market segment. This was then extended into the idea of 'niche tourism products' and 'niche tourism markets' (Macleod, 2003). Subsequently, Novelli (2005) further described how at one level niche tourism can be defined as breaking down tourism into still relatively large homogeneous market sectors – 'macro niches' (i.e. cultural tourism and event tourism – each then capable of further segmentation – 'micro niches' (i.e. wine tourism and sport tourism). In addition to the focus on tourist activities and what tourists engage with at a destination, there are further spatial and psycho-demographic profiles with which locations can establish specific niche products, and position themselves as niche destinations.

According to Novelli (2005), in niche tourism, tourists as independent travellers choose specialized activities to engage with social life and to become more cosmopolitan. Niche tourism is increasingly regarded as a way to create identities via social encounters in authentic rather than staged settings (Novelli, 2005; Stainton, 2016; Trunfio, Petruzzellis, & Nigro, 2006). That is, choosing a holiday type and destination can reflect one's identity or identity search (Macleod, 2003; Novelli, 2005; Kaufmann, *et al.,* 2009). This underlines the point that niche tourism is an innovative response to deeply rooted needs, reflecting the desires of a clientele and characterized by enthusiasm and sensitivity. The continuous application of the identity concept in marketing is concisely summarized by Kaufmann (2011). As tourism can be seen in the wider context of consumption, the influence of social identity is crucial (Kitios & Kaufmann, 2009). In this context, niche tourism is a means of search for meaning, social bonds and status (Hall, 1999; Novelli, 2005). Along with the increasing identity related experiences and more authentic cross-cultural relationships, niche tourism has a higher transformative power compared to traditional mass tourism.

Novelli's (2005) seminal text on this subject progresses the work of Macleod (2003) as she attempts to provide the rationale for niche tourism production and consumption. Through a series of theoretically underpinned case studies, Macleod introduces the two extremes (macro and micro) of niche tourism by referring to the following characteristics:

(1) The term 'niche tourism' has its roots in the concept of 'niche marketing';

(2) It is a counterpart to the undifferentiated mass tourism product;

(3) It refers to specific tourism products focused on meeting the needs of particular market segments or niches;

(4) There exists a niche tourism continuum with macro niches on one end occupying relatively large market shares (e.g. ecotourism) and further segmented micro niches at the other end of the continuum (e.g. whale watching tourism).

Overall, niche tourism can be seen as a response to an increasing number of more sophisticated tourists demanding specialist tourism products (Macleod, 2003). It is a means by which destinations can focus their offerings to differentiate their tourism products and compete in a fiercely competitive and cluttered tourism environment (Ali-Knight, 2010). This critical appraisal presents an exploration of various forms of niche and emerging tourism, such as wine, student, festivals and events, and health tourism. The studies of these segments will be reviewed in the following paragraphs.

(2) Segmentation of emerging tourism markets

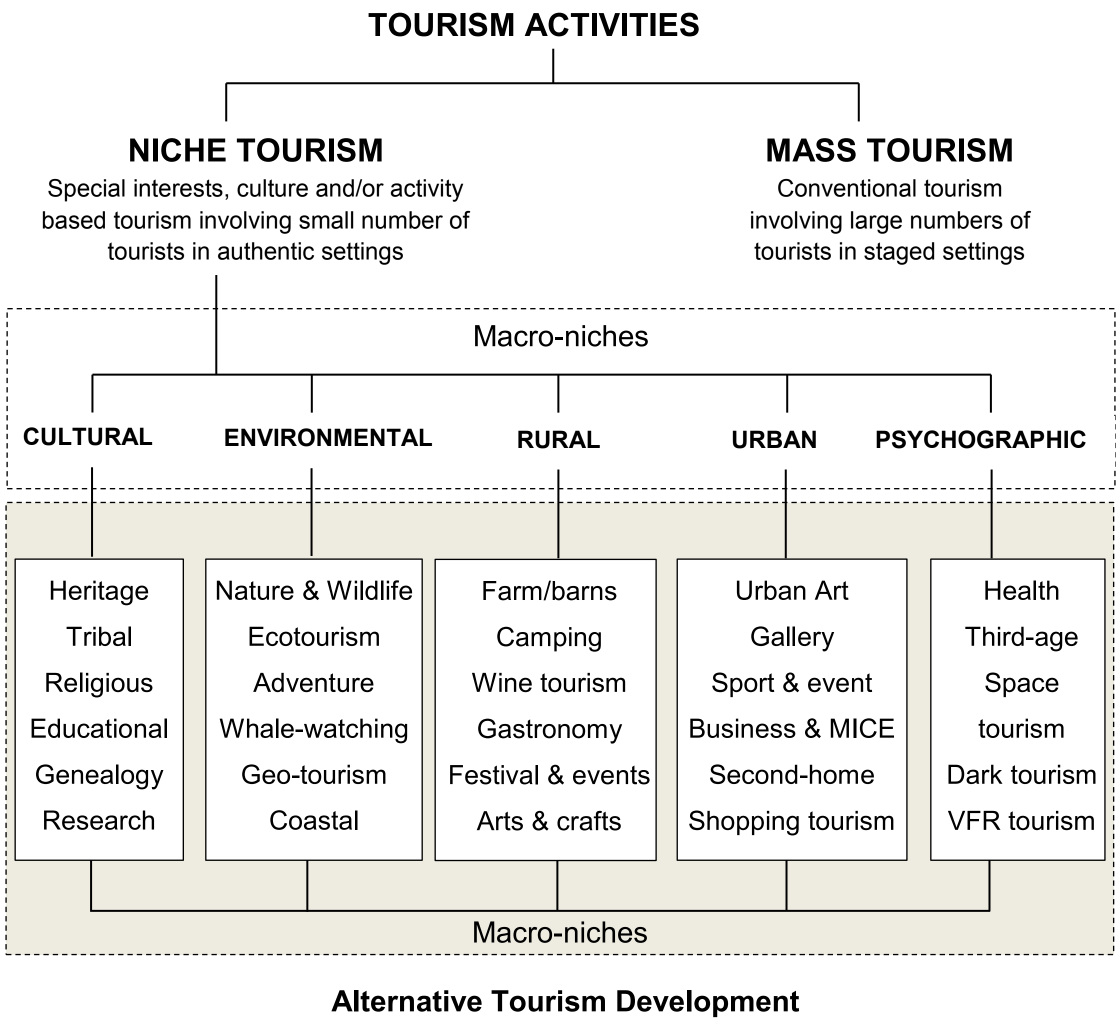
Based on Novelli's (2005) work, a map depicting research themes for various segments of niche tourism can be drawn (Figure 1.3). This framework captures the two streams of niche tourism development and showcases some specific examples of micro-niches.

Drawn on this diagram, different branches of emerging tourism market studies can be sought out and reviewed. According to Novelli (2005) and Macleod (2003), these subsectors of divided micro-niches can be further identified through the locations of destinations and tourists' special interest. The three approaches noted by Cooper (2006), as below, can be used to refine the scheme presented in Figure 1.3:

(1) Geographical and demographic approach: urban, rural, or coastal environment.

(2) Product-related approach, the presence of activities, attractions, settlements food and other amenities are emphasized.

(3) Customer-related approach – mainly looks at the specialty activities that tourists are seeking in order to meet their requirements and expectations which based on their special interest, lifestyle, values, and attitudes are the focus of niche tourism.



Source: Adapted from Macleod (2003) and Novelli (2005)

Figure 1.3 Niche tourism components and market segment

Followed such an approach, new forms of tourism such as third-age tourism in Australia (Benckendorff, Moscardo, & Pendergast, 2010), youth and adventure tourism in Europe (Richards & Wilson, 2006), domestic and visiting friends and relatives (VFR) tourism in western countries (Pearce & Moscardo, 2006), MICE market and business tourism in England (Ladkin & Spiller, 2000) and so forth, are all possible from a customer-related perspective and have become popular issues (see Table 1.5).

Similarly, tourism product-related approaches applied in identifying submarkets including urbanization and second-home tourism (Pedro, 1998, 2006; Jaakson, 1986), sport and event tourism (Knop, 2004), whale-watching tourism (Orams, 2000, 2001), shopping tourism (Reisinger, 2006, 2008), health tourism (Goodrich, 1993; Gustavo, 2010), gastronomy, food and wine tourism (Hall, 2003; Hall & Mitchell, 2007), and space tourism (Crouch, 2001; Lappas, 2006; Van Pelt, 2005) have all attracted the attention of academia as well.

Table 1.5 Synthesis of main segments in emerging tourism market

Segments	Representatives	Research summaries	Approaches
Third-age Tourism	Benckendorff, Moscardo, & Pendergast (2010)	Empirical case study on great barrier reef(GBR)'s senior tourists, evidence about various features of senior travel, including motivations, special products, market segment and so on	Positivist study by quantitative analysis with secondary survey data
Youth & Adventure	Richards & Wilson (2006)	Long-distance youth travellers are primarily experience seekers, collecting unique experiences that will serve to build their self-identity narratives.	Descriptive study by interpretive method, with a global perspective
VFR Tourism	Pearce & Moscardo (2006); Pearce (2012)	Portrayed the VFR market size and distribution, classification of VFR travellers and differences in the market. Future directions for research and market were given.	Interpretive study with descriptive cases
MICE Tourism	Ladkin and Spiller (2000)	Initiated the term 'MICE', described the market scale and future trend from a global perspective, discussed venue selection and satisfaction of it; Concluded complexity of the industry	Empirical study with in-directed data and descriptive cases

Table 1.5 (Continued)

Segments	Representatives	Research summaries	Approaches
Second-home Tourism	Pedro (1998, 2006); Jaakson (1986)	Defined the phenomenon, analysed the foundation characters of second-home tourism and key stakeholders, implications for future products	Interpretive and descriptive study with secondary data
Sport & event Tourism	Knop (1992, 1999, 2004)	Conceptualized sport tourism's typology and its basic model, discussed the importance of sport tourism, impact of sport on tourism and the prospects for the future	Empirical studies with comparative cases. Surveys are used for collecting quantitative data
Whale-watching Tourism	Orams (2000, 2001)	Described the phenomenon and explored the basic activities, discovered factors that affect whale-watchers' enjoyment	Questionnaire-based empirical study
Shopping Tourism	Reisinger (2006, 2008)	Defined the market and tourist motivation, discussed global values that impact the future of shopping tourism	Both descriptive and analytical methods on secondary data
Health Tourism	Gustavo (2010) Smith and Puczkó (2008)	Systematically described market's scope, definition, history, product and customer behaviours, proposed its managing issues, implicate the industry future and challenges	Case comparisons and empirical studies by questionnaire-based survey
Gastronomy Tourism	Hall (2003), Hall & Mitchell (2007)	Initiated the definition from a Special Interest Tourism perspective, explained the market evolvement and changing consumption pattern	Interpretive study with conceptualized models and patterns
Space Tourism	Crouch (2001) Cater (2005) Van Pelt (2005)	Defined space tourism and its market segment, assessed and market size and choice modelling of potential tourists. Prospected the industry future and management strategies.	Interview studies in descriptive approach and quantitative modelling approach

Source: Sorted by the author

Due to the shift of customers and products, some change in the entire industry is inevitable and has become a focus for scholars. The megatrends in intermediaries such as travel agencies and tour operators (Buhalis & Ujma, 2006), conversion in tourism transport and transit (Graham, 2006), sharing in the hospitality industry

(Jones, 2008) and new strategies towards destination management (Manente & Menghetti, 2000) have already been discussed as tourism frontier issues. The further specification of markets, products and tourism issues in the sharing economy and the digital age supplement these studies (Sigala & Chalkiti, 2012; Sigala, Christou, & Gretzel, 2012).

1.3.4 Knowledge Implications

In general, emerging tourism market studies are also emerging, and scholars have addressed multiple topics and diverse market segments (see Table 1.4). Based on reviewing key literature, several commonalities can be crystalized into implications for embarking on an astronomy tourism research design. These hints include:

- Initiating a comprehensive definition of a specific emerging or niche market is a requirement at the first stage for investigating the new market and phenomenon.
- Reviewing a new market's historical evolution, which is normally divided by different phrases with remarkable milestones, is essential for understanding the context and variation of an emerging market, especially through a longitudinal perspective (e.g. Jaakson, 1986).
- Depicting the geographical distribution of the market is frequently applied at the beginning of emerging tourism market studies. By adopting a spatial analysis, the market demand and supply elements can be clearly illustrated across the globe (e.g. Smith & Puczkó, 2008).
- Considering the product/activity classification and market segmentation presented by new market research pioneers, as such studies are very helpful to identify the issues and primary factors that keep shaping the emerging tourism market.

- Developing consumer behaviour studies after the preliminary exploration of the new phenomenon. The majority of these studies follow conceptual schemes derived from mature theories, which help these empirical studies identify tourists' behaviours, in particular, motivation and satisfaction.
- Identifying future directions and tendencies are usually required for emerging tourism market studies, either through a descriptive approach or a quantitative modelling method.
- Employing mixed methodologies, notably initial descriptive approaches with qualitative analysis to portray a new market, such as interviews and focus groups. However, empirical approaches with quantitative data analysis are also seen in some studies, notably those focused on tourist behaviour.
- Observing that new lifestyle and special interest needs which can embody and shape a specific group of tourists in an emerging market (Novelli, 2005). Also, special interest tourism plays an indispensable role in constructing the appearance and content of the emerging or niche tourism. Therefore, special interest tourism will be reviewed as one aspect of the foundation literature in the next section, and its relationship to niche tourism will also be clarified.

In summary, based on the inspiration from previous studies, astronomy tourism can be regarded as one segment of niche tourism or emerging tourism markets. In particular, issues such as the phenomenon definition and the historical evolution of astronomy tourism, its market segmentation and distribution, product and activity classification, its tourists' experience and behaviour, as well as its industry future, all remain to be addressed. Whilst the academic domain has swiftly responded to the alternation and variation in new-born tourism markets hereto, there is still a "space" left for the neglected topic of astronomy tourism to be explored and occupied.

1.4 RESEARCH IN SPECIAL INTEREST TOURISM

Astronomy tourism can be probed through the scope of special interest tourism (abbreviated as SIT below), which is also positioned as a counter-point to what is recognized as 'general interest tourism'. The tourism patterns highlighted in the previous section have led to the rise of what is commonly referred to as SIT, where the focus is on a new form of tourism that has the potential to meet the special needs of tourists and hosts (Trauer, 2006).

1.4.1 What is 'Special Interest Tourism'?

Special interest tourism is growing rapidly, due to the increasing scale of discerning and heterogeneous tourist markets and tourists' demand for more focused activities and interest-based travel experiences. SIT was, at first, defined as "travel to a particular destination for a specific reason and with a distinct motivation, often using tourism businesses that provide customized tourism experiences" (Weiler & Hall, 1992, p. 5). Later, Swarbrook and Horner (1999, p. 38) extended this definition by stating that two types of motivation drove the SIT: either indulging in an existing interest or developing a new interest in a novel or familiar location. Subsequently, Douglas and Derrett (2001) regarded SIT as "the provision of customized leisure and recreational experiences driven by the specific expressed interests of individuals and groups". It has also been argued that tourism with physical exertion such as in sport or adventure should be considered as SIT from the tourist's perspective (Hall, 1992; Morpeth, 2001; Trauer, Ryan & Lockyer, 2003). In terms of motivation, the demand for new locations and authentic products comprises one aspect of the motivation for visiting a particular place. The past and present of places are part of the unique experience sought by the tourist (Robinson & Novelli, 2005). From this point of view, SIT can also be defined as "a form of tourism which involves consumers whose holiday choice is inspired by specific motivations and whose level of satisfaction is determined by the experience they pursue" (Novelli, 2005).

1.4.2 Mainstreams of Special Interest Tourism Studies

Apart from the varying definitions, academic efforts have also addressed extensive areas of the SIT studies. Both theoretical and empirical work converges into two mainstreams of the SIT studies. The theoretical school primarily conceptualized the analysis framework for SIT and has mainly focused on the tourist motivation and satisfaction while empirical work has measured variables defining specific segments and sub-segments of the SIT market (see Table 1.6 and Table 1.7).

Table 1.6 Selected theoretical studies in SIT areas

Study Theme	Representatives	Main ideas or contribution
Definition or conceptualized framework of SIT	Weiler & Hall (1992)	Proposed the primary definition of SIT, provided an overall framework for studying SIT, systematically introduced SIT market and its segments
	Swarbrook and Horner (1999)	Argued the definition by Hall and Weiler and suggested that SIT is different from activity tourism as it involved little physical exertion.
	Trauer (1999, 2006)	Argued and refined the definition of SIT, proposed frameworks for analysis, such as tourism interest cycle, SIT trip cycle, the SIT experience model
	Douglas & Derrett (2001)	Renewed the definition of SIT, described it as an alternative to mass tourism, provided a comprehensive survey of SIT: strategies, policies, and initiatives introduced in Australia and overseas
	Novelli (2005)	Reviewed different definitions and perspectives about SIT, integrated SIT into the concept of 'Niche Tourism'

Table 1.6 (Continued)

Study Theme	Representatives	Main ideas or contribution
Tourist motivation in SIT	Brotherton & Himmetoglu (1997)	Presented 'Tourism Interest Continuum' to distinguish general interest, mixed interest and special interest tourism, indicated four categories based on motivational nature of SIT customers
	Ryan (2002b); Mohsin (2003)	Presented a multi-motivational model to explain backpackers' decision making
	Trauer (1999, 2006)	Conceptualized a motivation model for SIT by studying the case of adventure tourism in Australia
	Mckercher and Chan (2005)	Empirically surveyed if activities are a valid proxy for motives to SIT trip purpose and existence of a direct correlation between actions and motivations
Tourist satisfaction in SIT	Williams and Soutar (2009)	Tourist's value is conceptualized as a multidimensional construct and indeed three value dimensions had strong, positive influences on customer satisfaction and behavioural intentions in an adventure tourism setting.

Source: integrated by the author

From the theoretical side, Hall and Weiler (1992) initially provided a comprehensive framework for studying SIT. They provided a systematic overview of the SIT market and its segments. Further they revealed the motivation and attributes of SIT tourists. Brotherton and Himmetoglu (1997) conceptualized a framework of a "Tourism Interest Continuum" and added a "Tourism Interest Cycle" (TIC) which consists of General Interest Tourism (Trauer & Ryan, 2005), Mix Interest Tourism (MIT) and Special Interest Tourism. This model of a cycle was later processed into the "SIT Cycle" by Prosser (2001), and also by Schofield (2001) and Trauer (2006), who attempted to divide SIT into an extension of TIC. It was named the "Leisure-Tourism Interest Cycle" with a latent cyclic feedback loop between leisure and tourism. Meanwhile, discussion was also started by Trauer (2006) about the SIT phenomenon within a triangular relationship of supply, demand and media. He conceptualized SIT by proposing the "SIT trip cycle". Trauer (2006) also created a four-dimension framework called "SIT Experience" for analysing tourist behaviour at a micro-level. This was built on the basic sequence of tourist movement originally outlined by Clawson and Knetsch (1966), Hamilton-Smith (1987), Leiper (1990), Dimanche and Samdahl (1994). In addition, Trauer (2006) also observed how the growth of the SIT sector reflects the diversity of interests of contemporary society – increasing concerns for the conservation of the environment; the desire for self-improvement; personal fulfilment and new experiences and the thirst for knowledge (Wearing, 2002; Urry, 1990).

Table 1.7 Selected empirical studies in SIT segments

Segments of SIT		Sub-segments	Main Representatives
Special interest (activity/setting) segments	Cultural tourism	Ancestry tourism, Safari tourism, Military tourism	Craik, 1991 ; Zeppel, 2006; Harron & Deadon, 1994; Trotter, 2006
	Sport tourism	Golf, tennis, cycling, soccer, etc.	Hall, 1992; Tabata, 1992; Bull & Weed, 2010
	Adventure tourism	Backpacking, scuba diving, sailing, etc.	Hall, 1992; Johnston, 1992; Morpeth, 2001; Douglas & Derrett 2001; Taylor, et al, 2013
	Health tourism	Wellness & spa, Spiritual tourism	Goodrich, 1987; Hall, 1992; Goodrich, 1993; Douglas *et al*, 2001
	Gastronomy tourism	Food tourism, Wine tourism	Hall & Johnson, 1997, 1998; Mitchell & Hall, 2001; Cambourne et al, 2012
	Environmental tourism	Ecotourism, Wildlife tourism	Valentine (1992); Weiler & Davis (1993); Dowling (2008)
	Educational tourism		Wood (1992, 2001); Kalinowski (1992)
Accommodation, transport & event segments:	Cruise tourism	Lighthouse tourism	Wood (2000); Johnson (2002); Dowling (2006); Kester (2003);
	Resort tourism		Agarwal (2002); Prideaux (2000)
	Wedding tourism		Bertella (2015); Johnston (2006)
	Festival and event tourism		Dimmock & Tiyce (2001); Derrett (2004); Getz (1991) ;Quinn (2009)

Table 1.7 (Continued)

Segments of SIT		Sub-segments	Main Representatives
Affinity group segments	Sex tourism	Gay tourism	Ryan (2000); Ryan & Hall (2001)
	Senior tourism	Nostalgia tourism	Benckendorff *et al.* (2010);
Geographical location segments	Rural tourism	Agri-tourism, Property tourism	Sharpley (2002); Roberts and Hall (2001); Getz and Carlsen (2000)
	Urban tourism	Gambling tourism Museum tourism	Nickerson (1995); Page (1995); Jansen-Verbeke and Van Rekom (1996); Law (1993)
	Space tourism	Sub-orbital space tourism, terrestrial space tourism	Crouch (2001); Cater (2005); Weaver (2008, 2011); Collison & Poe (2013)

Source: integrated by the author

Since the conceptualized framework was established by the early 2000s, theoretical studies have stagnated somewhat since that time. By way of contrast, ever-growing empirical studies have prospered with a main focus on studying the nature of the SIT market segments (see Table 1.6). The core of the SIT market normally can be captured but not confined to four conditions (Brotherton & Himmetoglu, 1997): (1) special interest segment based on tourist activities or attraction settings, (2) accommodation, transport & event segments, (3) geographical location segments, and (4) affinity group segments. Each of them can be further divided into specific segment such as sport tourism, environmental tourism and gastronomy tourism, and some of these segments consist of several sub-segments. For example, environmental tourism embraces sub-streams including ecotourism, birding tourism (AKA bird watching tourism), wildlife tourism and nature-based tourism. Each of the branches has been explored with some empirical studies. It is clear that some subsectors of SIT overlap with those in emerging tourism markets stated before, such as travel for health, food and wine, sport and events. This implies that the study of astronomy tourism arguably lies at the intersection of both SIT and emerging tourism fields.

1.4.3 Implications from Literature

By reviewing the knowledge from relevant literature, four implications concerning the current state of thought on SIT studies can be indicated as follows.

Firstly, special interest tourism is the root underlying niche or emerging tourism. According to Read (1980) in Hall and Weiler (1992), the conceptualization of the term 'Special Interest Tourism' emerged during the 1980s and can be seen as the predecessor of 'Niche Tourism'. Early discussion of SIT set the context for the development of emerging tourism markets, and was seen to be a prime force associated with the expansion of tourism and the motivation around which tourist activity was particularly planned and advanced. It marked the move from tourism as a commodified mainstream offering to one that was more specialised and unique. Thus, there is a clear overlap between some segments of SIT and those of emerging tourism markets. Namely, some sub-markets have attributes both fall into the characteristics of SIT and niche tourism: quite specifically, the overlap occurs when they are emerging markets with new consumers and new products in new destinations. Further, these kinds of markets have tourists who are more discerning and heterogeneous and who demand more specialized activities and specific interest-based travel experiences. Expressed succinctly, this implies that studying astronomy tourism can fall into the overlap between the studies on SIT and emerging tourism market.

Secondly, SIT is connected to the ideas specified in Stebbins' (1982) Serious Leisure Perspective. To be specific, initially SIT products were seen to focus on relatively homogeneous groups of consumers such as eco or cultural tourists and were compared to Stebbins' (1982) specialised, serious leisure consumers. However, what began to emerge in the academic debate was that there existed another softer end of the spectrum often linked to individual operators' expertise within that special interest field and their desire to tap the latent consumer demand for that niche market. This 'casual' end of the spectrum, as Stebbins (1982, 2007) points out, is still often a majority. Such consumers are seen as pursuing a 'relatively short-lived pleasurable activity requiring little or no special training to enjoy it'. The group was identified the group as 'dabblers' (Stebbins, 1982, in Bartram, 2001, p.5). Such connections suggest that studying SIT based on the leisure involvement theory is likely to be insightful as there are multiple groups of special interest tourists defined by their different stages of leisure involvement. Further from an individual perspective connecting to the casual and serious leisure perspective may facilitate researching any individual's trajectory or career in a specific SIT activity.

Thirdly, in accordance with Ryan's (2003) multi-motivational travel decision-making model and Trauer's (2006) 'SIT Cycle' perspective, special interest is not always pursued throughout the entire travel experience. Instead, a condition is maintained within the given theoretical framework for 'special interest tourists' to be free to select other forms of tourism holidays (GIT, MIT) according to their needs and desires over time. This suggested flexibility implies that special interest is arguably playing different roles (primary, secondary, subsidiary or marginal) in driving people to pursue a specific type of tourism or to participate in a particular interest activity (Hall & Sharples, 2003). Therefore, it is important and necessary to take other influential factors rather than special interest into consideration in studying a specific segment of special interest tourism – say astronomy interest for example. That is, different tourists with divided layers of interest or at distinct stages of their travel career in a particular setting of tourism activity may have varied travel motives and experiences.

Further, a deficiency which can be identified from the previous literature is the scarcity of future oriented studies in SIT. A contrast can be drawn here with emerging tourism market research. The imbalance between retrospective studies and future oriented studies may partly be because we have fewer tools to think about the future (Tonn, Hemrick & Conrad, 2006). Wall and Mathieson (2006) make the point that much of the tourism literature is only concerned with and examines the results and outcomes of tourism. It can be proposed that more needs to be done to evaluate the phenomenon that has caused the changes and drives the future. Additionally, destination administrators, corporate managers and tourism policy-makers show increasing preference in forward-looking research (Yeoman, McMahon-Beattie, Meethan, Fields, & Albrecht, 2015), as future studies inspire them to step from passive reactions to the prior actions of an anticipated future. This becomes the foundation underlying their planning and practice. In a word, future studies such as predictions of challenges or likely impacts, are significant for practice and deserve particular academic concern in SIT areas. This theme is developed in the following section.

1.5 Research in Tourism Future Studies

In this section, the literature concerning future studies in select tourism area will be reviewed and the state of knowledge appraised to assist the present research. In particular, methodological topics and their application in tourism future studies will be highlighted.

1.5.1 Future Studies in Tourism Research

As one old Chinese proverb says "Through the mirror of history, one can foresee ups and downs." Namely, today's strategy is underlying tomorrow's success. Tourism researchers have started looking ahead since the 1980s, when one of the earliest studies about tourism planning and policy making based on forecasting was conducted by Van Doorn (1982). Then in the following two decades there was some interest in studying tourism's future. Moscardo, Laws, and Faulkner (2001)'s book 'Tourism in the 21st century: reflections on experience', Dwyer, Edwards, Mistilis Roman and Scott's (2009) work on future of destination and enterprise management, Pearce, D. and Butler (1999; 2010) future tourism research vision towards 2020 represent some of the examples where researchers have considered tourism's future.

By reviewing a large amount of literature in tourism future studies, five groups of studies can be sorted by research topics: (1) tourist, (2) tourism product suppliers, (3) tourism local community, (4) governmental sectors related to tourism industry and, (5) future changes of information technology in tourism (see Table 1.8).

Table 1.8 Selected futures studies from tourism literature

Objects	**Representatives**	**Approaches / Methodologies**
Tourists' behaviour	Getz, *et al*.(1999)	Quantitative analysis by surveying
	Yeoman, *et al.* (2007)	Interpretive approach with macro statistical data
	Song & Li (2008)	Computer modelling
	Gretzel, Fesenmaier, and O'Leary (2006)	Theoretical study with descriptive interpretation
	Weiermair & Mathies (2004)	Integrated work with interpretive approach and economic models
	Crouch, *et al.* (2009)	Consumer choice modelling

Tourism product suppliers and destinations	Pearce, D. & Butler (2010)	Integrated work with forecasting model, Delphi technique, etc.
	Gretzel, *et al*. (2006)	A mixture of focus groups and expert panel study
	Cater, (2010)	Key informant Interviews
Tourism communities	Wu & Pearce, P. (2013, 2014b, 2014d)	Focus groups, photo-elicitation, scenario planning
	Moscardo (2008)	Theoretical study by initiating model for community capacity
Related governmental sectors	Van Doorn (1982)	Theoretical study by modelling and speculative forecasting techniques
	Yeoman (2012)	Empirical study by secondary data
Future changes & technologies	Buhalis & Law, (2008)	Literature-overviewing study
	Gretzel, *et al.* (2004)	3525 survey by random sampling
	Sigala, *et al.* (2012)	Theoretical studies associated with applied cases
	Mahmood, Ricci & Ventutini (2009)	Recommendation methodology based on machine learning techniques

Source: integrated by the author

The first category is mainly focused on forecasting tourist future demand and foreseeing future consumers' choices based on tourist behaviour studies. In general, these studies often apply quantitative methods such as economic models and time-series models using computer modelling. However, qualitative approaches and interpretive methods are also employed.

The second type of future studies targets those tourism suppliers as its main informants, investigating their attitudes towards the prospects of the industry or an emerging tourism market. Tourism marketing strategies and product research and design tactics are normally drawn from these studies by interviews and Delphi approaches.

The third group has emerged recently and has a close relationship with responsible tourism and sustainable tourism. Such work addresses tourism communities and public views of tourism. Focus groups, scenario planning, questionnaire survey are often used in assessing a community's perception and attitude towards future tourism development.

The fourth category is similar to the second one. Researchers concentrate efforts on exploring the prospects from governmental officials as key stakeholders within the tourism sector. Using the key informant approach in interviews, directions for future tourism planning, crisis management, and policy making are pointed out. The last category derives from studying on-going technology changes as well as noting ICT applications and impacts in tourism. ICT techniques are adopted in this area and surveys are conducted to investigate new technology users' reaction and attitudes (c.f. Gretzel, et al., 2004).

1.5.2 Frequent-used Methods in Future Studies

The methodologies employed in tourism future studies are diverse. Multi-disciplinary techniques are growing both in number and variety in recent years. Three types of approaches can be summarised from tourism future work: (1) Quantitative forecasting or modelling, (2) key informant technique, and (3) scenario planning. Other prevalent methods include the use of the Delphi technique, simulation and gaming, focus groups, photo-elicitation and group brainstorming. The table below outlines a succinct summary of these three major techniques with relevant authors and literatures. The material assists in considering the application of these methods in the present thesis (see Table 1.9 below).

Table 1.9 Major methodologies in tourism future studies

Methods	Outlines	Initiators/Examples
Quantitative Forecasting	Hypothesis: future can be extrapolated form the past Area of use: tourist demand forecasting Users: For organizational decision makers Technique: computer modelling based on tourism economics models or time-series models	Martin and Witt (1989); Kulendran and Wong (2009); Lim and McAleer (2002); Song and Li (2008); Lim and McAleer (2002); Crouch, *et al*., (2009)
Key Informant Technique	Origin: an ethnographic method from anthropology Attribute: experts' source of information Protocol: individuals from a range of academic, representative and managerial bodies are selected at a national, regional and local level to be invited by letters and followed by phone interviews	Marshall (1996); Yau, McKercher, and Packer (2004); Tosun (2006); Fallon and Kriwoken (2003); Simpson (2009); Cater (2010);
Scenario Planning	Origin: developed by Royal Dutch/Shell in 1970s, later applied in global issues such as climate change, economic development, transportation and mobility, technology innovation, etc. Area of use: long-term forecasting in an uncertain environment, especially tourism community future Aim: identify existing trends and key uncertainties which are embodied into pictures of the future	Moriarty (2012); Haywood (1988); Gössling and Hall (2006); Gössling and Scott (2012); Wu and Pearce (2014d)

Source: sorted by the author

In addition to these three major methodologies applied in tourism future studies, the Delphi technique is also frequently used. It requires a pool of experts who are usually asked to separately complete questionnaire-based surveys without any contact with each other. Subsequently, the views are shared and respondents are asked to reconsider their position. As a result, a consensus among different viewpoints will be reached by assessing their repeated responses. However, it is normally necessary to obtain a relatively reasonable-size pool of experts for conducting the survey at least twice for each individual informant to ensure the test-retest reliability. Thus, it is possibly more time-consuming than the key informant technique which follows protocols but without the need to employ a retest.

1.5.3 Implications from Literature

Studying the future of tourism is challenging but significant and interesting. Though very limited literature has emerged with a particular concentration in tourism future studies (Dwyer, et al., 2009), it is clear that a growing number of tourism scholars have shown increasing interest in this area. Future studies are commonly linked to the topic of emerging tourism markets. Tourism futurists' topics vary from global issues concerning challenges and opportunities for the overall industry, to insights about tourists' behaviours and the application of new technology. Also, researchers' interests have expanded into special interest tourism and the future development of a specific SIT segment, such as space tourism (Cater, 2005; Crouch, et al., 2009), food and wine tourism (Getz & Dowling, 1999; Hall & Sharples, 2003), and cruise tourism (Dowling, 2006). The majority of the studies have proposed panoramic scenarios about the tourism future images, but have not yet moved into specific topics. Clearly, the methods applied in tourism future studies are feasible and yet to be employed in astronomy tourism studies.

1.6 A SYNTHESIS: INTEGRATING RESEARCH FOUNDATIONS

Based on the substantial and multi-dimensional review of the foundation literature, it is clear that the present research interests are rooted in emerging tourism studies, special interest tourism studies and tourism future studies. In this chapter, there has been a central concern to consider contexts: from which aspect or scope should we look at and explore a novel and broad topic, that of astronomy tourism? In the next section, the shape of the research will be developed by a key consideration of the identified knowledge gaps and possible methods of inquiry.

1.6.1 Knowledge Gaps and Research Opportunities

The main knowledge gaps from the previous key literature and associated research opportunities can be identified in four aspects as highlighted below.

(1) The overlap between SIT and niche tourism

Although the issues of SIT and niche tourism have been extensively studied since 1980s, astronomy tourism as a completely newly-emerging area and less-studied topic is yet to be explored. In accordance with the literal definitions stated before (refer to section 1.1.4), astronomy tourism falls into the mutual study area that belongs to both SIT and emerging tourism market. However, neither of the two domains has yet paid sufficient academic attention to astronomy tourism as one of their particular segments. The phenomenon definition, market segmentation, product/activity classification, spatial distribution and longitudinal evolution of the market still remain unclear (Weaver, 2011). Any exploratory attempts to reveal these new areas will be significant for resolving the puzzle.

(2) Paucity in tourist experience and group culture studies for niche tourism

As claimed in section 1.3.4, studying a specific emerging tourism market through the perspective of tourists' group culture or individual travel experience deserves solid consideration. While the much of the previous literature in niche tourism studies has explored emerging markets at a general level, mostly through a marketing, industrial or economic perspective, research from the perspective of group culture is original or at least distractive and fresh. From this point of view, a cluster of tourists with special interest pursuit are regarded as a subculture or a cultural tribe. It is potentially possible to offer a new approach for depicting the group behavioural and cultural pattern of new customers in an emerging tourist market. Furthermore, limited research is done on tourist's individual travel experience, motivation and satisfaction studies for the niche tourism, while less work appears about tourists' on-site activity, return travel or recollection phrases of the overall travel experience. In this present thesis, the researcher will attempt to fill these gaps.

(3) The lack of multiple methods to explore a niche tourism and SIT market

By assessing the methods applied in previous studies, it is evident that the dominant style of work has employed standard methods to collect research data, whether quantitative or qualitative. The most frequently used approaches are questionnaire surveys based on theoretical models and secondary statistical data analysis (refer to section 1.3 & 1.4). Some newer methodologies in the digital era which are based on the Internet data base such as 'Netnography' and date mining techniques have hardly appeared in the exploration of SIT and niche tourism. A mixed application of combining conventional methods (e.g. questionnaire, interview and secondary data) and new means (e.g. Netnography approach and data mining technique) is missing in the existing literature. Thus, by using multiple and comprehensive methodologies to appraise the astronomy tourism market and address its multi-layered questions, it is anticipated that an extensive panorama of this novel topic will be depicted.

(4) Few tourism future studies fall into the specific area of astronomy tourism

Literature concerning astronomy tourism is emerging but very limited. Due to this account, no future studies can be found in the astronomy tourism area. Though some researchers have begun paying attention to the prospects for this industry, their studies are mainly backward-looking oriented with a minor focus on foreseeing the future of astronomy tourism from stakeholders' views. Even though Cater (2010) and Crouch (2009) respectively presented forward-looking studies towards the space tourism industry and its potential, astronomy tourism was merely considered as a subsidiary segment of space tourism (they named 'terrestrial space tourism'). This thesis will present a specific study chapter illustrating the future outline of astronomy tourism as seen by key stakeholders.

In general, there are many reasons for launching this research project and many research opportunities to be seized. The key ones can be summarized by the following points: Firstly, there is a lack of concern about the group culture and individual travel experience of the worldwide and growing number of astronomy tourists. Secondly, there is little work on the magnitude and underlying impacts of both current and future astronomy tourists. A study on what indeed astronomy tourism is, who astronomy tourists are, why they travel, which activities they usually enjoy, and what the industry future will look like may be a globally significant issue, not merely a matter for regional tourism or market development.

Accordingly, this research with its forward-looking attribute and multi-layer view of a global niche tourism product in the SIT context has the potential to explore a new area and build theoretical concepts/models in tourists' group culture and travel experience studies. To be vivid and specific, the literature gaps, research opportunities and study focus for the present thesis are represented in the following figure (Figure 1.4).

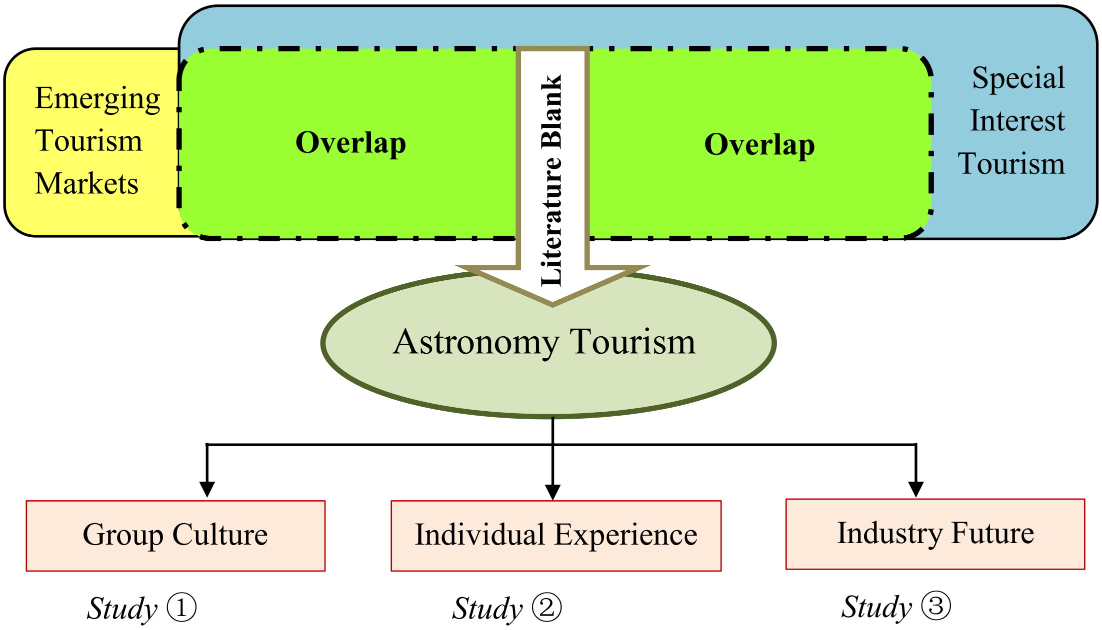


Figure 1.4 Literature gap, research opportunities and study focus

1.6.2 Preliminary Aims and Overall Research Questions

Drawing on the above integrated literature review and specified research opportunities, the present thesis is anticipated to primarily address the following basic questions, which embody the preliminary aims of the research:

(1) ***Who are astronomy tourists and what is astronomy tourism?***

(2) ***What travel experience do they have and why do they travel?***

(3) ***What are industry stakeholders' perspectives towards the future development of astronomy tourism?***

These three arrays of primary questions compose the central topic of each study respectively. The questions and associated study aims require the establishment of a sound research design, a systematic theoretical framework and an appropriate methodological scheme. The next chapter presents the approaches and methodologies to tackle the thesis questions and aims.

Chapter 2

Methodological Foundations and Research Design

"Humankind has always observed the night sky either to interpret it or to understand the physical laws that govern the universe. The interest in astronomy has had profound implication for science, philosophy, religion, culture and our general conception of the universe."

The Starlight Declaration, 2007

Chapter Outline

2.1 INTRODUCTION

Drawing on the research context and the foundation literature review in the previous chapter, a draft of the approach to exploring astronomy tourism was outlined. This develops solutions to tackle the core question remains in Chapter 1: which methods and concepts should be employed to precisely address the research aims?

Research designs and methods typically need to be tailored to the topic and context. Design links the research aims addressing the literature gaps, directs methodological tactics and also determines the subsequent data analysis and interpretation (Creswell & Clark, 2007). To meet this design challenge, this study is going to seek and select well-developed theories and concepts from an extensive range of social sciences rather than use approaches confined to tourism studies. As a result, four areas of conceptual work are reviewed and integrated into a theoretical framework. Subsequently, three methods are appraised and selected to conduct three empirical studies respectively: blog studies, questionnaire studies and interview studies. Their use in tourism studies is introduced, and then their basic protocols and specific techniques are presented. Importantly, how these approaches will be applied in this thesis to serve the conceptual schemes will be highlighted.

At the end of this chapter, more detailed research aims for the three empirical studies will be presented together with the thesis outline and a structural framework of the overall research.

2.2 THE CONCEPTUAL SCHEME

Four pillars for building three empirical studies are constructed as the theoretical framework of this research. More specifically, the first pillar is neo-tribe theory which will be used in the study of astronomy tourists' group culture; the remaining three pillars describe firstly the phases of the overall tourist experience, then the serious leisure perspective (SLP), and finally the travel career pattern (TCP) approach to motivation. The three approaches will be incorporated together into a framework to direct the second empirical study on astronomy tourists' travel experience. In the present chapter, the main ideas of each approach, their application in tourism studies, and their implications for the current thesis will be specified.

2.2.1 Tourist Group Culture: Neo-Tribe Theory

What is tourist 'group culture'? A cross-disciplinary perspective is helpful to explore this topic. Approaches can be traced from the sociological literature. Specifically, there is work on subculture theory and neo-tribe theory. The question of which one is more feasible for portraying the concept of 'group culture' in tourism study context remains unknown. By clarifying and comparing these two theories, the following section attempts to answer this question.

(1) Group culture and subculture studies

A group, by definition in sociology, is a number of persons who come together as a collective social unit bound together by common values, norms, identities and affiliation. It follows that group culture is a representation which reflects the mutual interests, language, rituals, beliefs, lifestyle, social standards and conventions which all group members share. Derived from this broad theme, the notion of subculture has become a long-lasting subject in sociology, politics and cultural studies since the 1930s. The reputable U.S. sociologist David Popenoe (1983; 2000) defined subculture in his authoritative textbook "Sociology" as follows:

> *"Broadly speaking, the subculture is usually defined as a sub-group of the broader culture. This group forms a lifestyle which not only includes certain characteristics of sub-culture, but also includes some cultural elements that other groups do not include."*

(Popenoe, 1983)

Aside from Popenoe, solid definitions have varied over decades. The Oxford English Dictionary defines subculture as "a cultural group within a larger culture, often having beliefs or interests at variance with those of the larger culture." As early as the 1950s, Riesman distinguished between majorities, "which passively accepted commercially provided styles and meanings, and a 'subculture' which actively sought a minority style...and interpreted it in accordance with subversive values". In the book "Subculture: The Meaning of Style", Hebdige (1979) argued that a subculture is a subversion of normalcy. He proclaimed that subcultures can be perceived as negative due to their criticism of the dominant societal standard. He also emphasised that subcultures bring together like-minded individuals who feel neglected by societal standards and allow them to develop a sense of identity. Additionally, the sociologists Fine and Kleinman (1979) argued that a subculture is a group that serves to motivate a potential member to adopt the artefacts, behaviours, norms, and values characteristic of the group.

In 1995, Thornton, drawing on Bourdieu's theory of cultural production, described "subcultural capital" as the cultural knowledge and commodities acquired by members of a subculture, raising their status and differentiating them from members of other groups. Australian subculture expert Gelder (2007; 1997) distinguished subcultures from countercultures based on the level of immersion in society. He described subculture as a group of individuals in a non-normative state or marginal state for certain areas due to their unique interests and habits.. This argument stressed that subcultures have an identity, often strengthened by being excluded from mainstream society. That is, a group which forms a lifestyle where its cultural identity is distinctive and different from the dominant culture and can be considered as subculture. Gelder (2007) further proposed six key ways in which subcultures can be identified:

1) Often negative relations to work (as ‘idle’, ‘parasitic’, at play or at leisure, etc.);

2) negative or ambivalent relation to class (since subcultures are not ‘class-conscious’ and don't conform to traditional class definitions);

3) Association with territory (the 'street', the ‘hood’, the club, etc.), rather than property;

4) Movement out of the home and into non-domestic forms of belonging (i.e. social groups other than the family);

5) Stylistic ties to excess and exaggeration (with some exceptions);

6) Refusal of the banalities of ordinary life and mass culture.

From reviewing relevant literature, subculture theories and studies consist of three mainstream directions:

(1) Subcultures and deviance. The earliest subculture studies came from the “Chicago School”, who interpreted such groups as forms of deviance and delinquency. Starting with what they called Social Disorganization Theory, they claimed that subcultures emerged on one hand because of some sectors’ lack of socialisation with the mainstream culture and, on the other, because of their adoption of alternative axiological and normative models. As Park, Burgess, McKenzie and Wirth (1925) suggested, by means of selection and segregation processes, natural areas or moral regions where deviant models concentrate and are re-enforced appear in society. Subcultures, however, are not only the result of alternative action strategies but also of labelling processes on the part of the mainstream society which defines them as outsiders. As Cohen (1971) suggests, every subculture's style, consisting of image, demeanour and language becomes a trait for recognition.

(2) Subcultures and resistance. In the work of Clarke, Hall, Jefferson and Roberts (1975) from the Birmingham CCCS (Centre for Contemporary Cultural Studies), subcultures are interpreted as forms of resistance. In this British context, society is seen as being divided into two large fundamental classes, the working class and the middle class, each with its own class culture. Middle-class culture is conceived as being dominant. Particularly in the working class, subcultures grow out of the presence of specific interests and affiliations. Cultural models evolve which are in conflict with both the parent culture and mainstream culture. Identity and resistance are expressed through the development of a distinctive style which, by a re-signification and 'bricolage' operation, uses cultural industry goods to communicate and express individuals' conflicts. Facing a weakening of class identity, subculture is a new forms of collective identification representing what Cohen (1971) called symbolic resistance against the mainstream culture and developing possible solutions for structural problems.

(3) Subcultures and distinction. More recent interpretations see subcultures as forms of distinction. In an attempt to overcome the idea of subcultures as forms of deviance or resistance, sociologists describe subcultures as collectivities which, on a cultural level, are sufficiently homogeneous internally and heterogeneous with respect to the outside world to be capable of developing, consistent distinctiveness, commitment, identity and autonomy (Hodkinson, 2002). Defined by Thornton (1995) as taste cultures, subcultures are endowed with elastic, porous borders, and are inserted into relationships of interaction and mingling, rather than independence and conflict, with the cultural industry and mass media (Muggleton, 2000; Redhead & Henry, 1997). The very idea of a unique, internally homogeneous, dominant culture is explicitly criticized. Thus forms of individual involvement in subcultures are fluid and gradual, differentiated according to each actor's investment. Clear dichotomies may not exist and membership may vary from partial to full involvement.

The study of subcultures, even though academic schools differ in their emphases, often consists of the study of symbolism attached to language, demeanour, clothing, music, image and other visible traces. The ways in which these same symbols are interpreted by members of the dominant culture is a topic of interest. Members of a subculture often signal their membership through a distinctive and symbolic use of style, which can includes fashion, mannerisms and argot (Hebdige, 2003, 2012). These ideas and theories of subculture have been applied to tourism studies since the 1990s. It is notable that in studies of tourist groups, travellers are divided into sub-groups or subcultures with specific identities due to their different tastes, preferences, behaviour, culture and lifestyle. For example, Loker-Murphy and Pearce (1995) proposed a contemporary social definition of "backpackers" based on the youth subculture concept. Green and Chalip (1998) carried out a case study on women's flag football and emphasized this format of sports tourism as the celebration of a subculture (Nash, 1999). Sporting subcultures are also discussed by Gyimothy (2009) who explored three groups of festival visitors as "casual observers, connoisseurs and experimentalists" from the perspective of leisure sociology. In addition, festival tourist subculture studies were also identified in recent research by Spracklen (2014) who argued that the commodification of music festivals gradually led a loss of the Goth subcultural authenticity. Similarly, Garcia (2016) profiled music-minded voyagers who return repeatedly to Berlin in order to participate in local electronic dance music scenes as ‘techno-tourists’. Within a subcultural scene, she discussed the motivations, attitudes and patterns of travel, and pointed out the impact of tourism are reflected in local community’s ambivalence towards tourist identities.

By reviewing the above literature concerning group culture and subculture studies, an underlying conceptual framework from subculture theories can be utilized to help find a pathway to characterise the group culture of astronomy tourists. The approach necessitates analysing and interpreting their symbolised cultural elements which can indicate their group identities and social representations. This is both feasible and measurable as demonstrated by Robards and Bennett (2011), who revealed that online identity expression through social media and networks can be interpreted as exhibiting subcultural qualities. However, they argued it is more in line with neotribalism than with what is often classified as subculture. Neotribalism and its theory has already been employed by tourism researchers (Hardy, Gretzel, & Hanson, 2013; Hardy, Hanson, & Gretzel, 2012; Hardy & Robards, 2015) in studying recreational vehicle travelling neo-tribes. This approach is further explained in the following section.

(2) Neo-tribe theory in tourism studies

Neotribalism (a.k.a. Neo-Tribalism or modern tribalism) is a sociological concept which postulates that human beings have evolved to live in tribal society, as opposed to mass society, and thus will naturally form social networks constituting new tribes named ‘neo-tribes’ (Bennett, 1999, 2011; Maffesoli & Smith, 1996).

French sociologist Michel Maffesoli (1996) was perhaps the first pioneer to use the expression ‘neotribalism’ and ‘neo-tribe’ in a scholarly context, when he saw a rise of small, ephemeral groups supplanting individualism (Spencer & Walby, 2013). By coining the term ‘urban tribe’ in 1985, Maffesoli described a micro-group of people who shared common interests in urban areas. He stated that members of these relatively small groups tend to have similar worldviews, dress styles and behavioural patterns. Their social interactions are largely informal and emotionally laden, different from late capitalism's corporate-bourgeoisie cultures which are based on dispassionate logic. He suggested that punks were a typical example of a neo-tribe. Maffesoli also predicted that as the culture and institutions of modernism declined, societies would embrace nostalgia and look to the organizational principles of the distant past for guidance, and therefore, that the post-modern era would be the era of neotribalism.

The term neo-tribe was initially derived from and subsequently moved beyond the subculture concept. Its theoretical model was empirically employed as an alternative method for youth culture studies when the post-modern era saw traditional subculture theories had been broadly criticised by many post-subcultural theorists (Bennett, 1999, 2000; Blackman, 1996, 2010; Muggleton, 2000; Robards & Bennett, 2011).

Maffesoli’s metaphor of the neo-tribe is applicable for analysing the emotions and spatial dynamics of group culture and life. According to Maffesoli (1996), neo-tribes “refer more to a certain ambience, a state of mind, and are preferably to be expressed through lifestyles that favour appearance and form”. While subcultural theories advocate that individuals from different walks of life are bundled or forced together in subcultural groups by social class, race, kinship, community or gender, the neo-tribal theory, on the contrary, emphasises the effect of common taste, lifestyle, aesthetics and affectivity as underlying drivers for crystallizing persons into groups with collective identities and affiliations (Bennett, 2011). The neo-tribe concept allows its members a more fluid, dynamic, provisional grouping than subculture, focusing on a state of mind and a lifestyle rather than a solid and long-term membership. Such a grouping is more likely organised around commercial goods and brand names, often with temporary identities instead of rigid and formal modes of organization (Bennett, 1999; Hardy & Robards, 2015; Maffesoli & Smith, 1996). Another notable and similar term 'group' can also be regarded as having no necessary permanent or tangible attributes, but allows members flexibility to live out a selected, temporal role or identity as ephemeral gatherings (Bennett, 2011; O'Reilly, 2012). Therefore, the term 'group' as it is referred to here, is closer to the concept of 'tribe' than 'subculture'. Consequently, the rationale for attempting to explore the group culture of astronomy tourists fits best with the conceptual scheme of neo-tribal theory throughout this thesis.

Drawing on the work of applying neo-tribal theory, scholars such as Hetherington (1998), Heath (2012), Cova, Kozinets and Shankar (2007), Goulding and Shankar (2011) suggest that there are multiple attributes available for grouping people into tribes. A coherent sense of '*communitas*' (Turner, 1974), shared taste, mutual emotions, alike lifestyles and consumption patterns are all integrating forces. By studying RV users in Canada as traveling neo-tribes, Hardy and her colleagues (2013; 2015) distilled these attributes into two categories which shaped individuals into neo-tribes: symbolic elements and behavioural element (See Table 2.1).

Table 2.1 Symbolic and behavioural elements of neo-tribes

Element	Attributes	Description	Components
Symbolic	Internal and Invisible	Collective affectivity or sentiment, and emotional bonds amidst neo-tribal members with akin lifestyle	Fellowship Shared interests Sense of community
Behavioural	External and Visible	Group representation and activities, expression of collective identities, physical sharing spaces	Rituals/Etiquette Signifiers Scenes

(Source: Integrated by the author)

Following this dichotomy, Hardy and her colleagues argue that neo-tribal theory has great potential for understanding needs, culture, lifestyle and behaviours of tourist groups, (Hardy & Robards, 2015). In the context of tourism studies, evidence can also be found in Goulding and Shankar's empirical work (2011) on youth tourists' clubbing culture and ritualised behaviour in the United Kingdom. He suggests that neo-tribal experiences such as clubbing and its ritualised processes provide a parallel or source for interpreting a large variety of tourists' behaviour and their group culture. Exploring the characteristics of astronomy tourists' group culture will draw upon the neo-tribal theoretical scheme. This approach will become the focal issue and key aim of the empirical study of astronomy tourists' group culture (Chapter 3).

2.2.2 Tourist Experience: A Multidimensional Model

As stated before, the second empirical study will explore the individual travel experience of astronomy tourists. Nevertheless, the topic of tourist experience is a labyrinth of ideas and research directions. To investigate this maze, it is rational to start with reviewing the key literature in recent tourist experience study areas and then to isolate the components and directions of most relevance for this set of studies.

(1) Development and Dimensions of the tourist experience studies

The tourist experience is a complicated and much discussed topic in tourism academia. Giving it a concise or precise definition is a challenging task as the tourist experience can embrace a multidimensional matrix of elements. In terms of historic milestones, it initially grew from a spin-off issue to a research frontier in 1960s (Uriely, 2005) and became a prevalent topic in social science studies by the 1970s (Quan & Wang, 2004). Cohen (1979) and MacCannell (1973) were the first two tourism scholars to link it to authenticity and studied tourist experience within a phenomenological framework. Subsequently Pearce and Moscardo (1985) developed empirical studies from the perspective of social psychology. Mannell and Iso-Ahola (1987) proposed three dominating methods in assessing leisure and tourism experience: the definitional approach; the post-hoc satisfaction approach; and the immediate approach. They emphases: 1) identifying elements and dimensions of the tourist experience, 2) exploring tourists' psychological outcomes by studying motivations and satisfactions, and 3) portraying the nature of on-site experiences and real-time activities. This threefold classification provided a dimensional model to frame the subsequent tourist experience research. Additionally, another group of studies carried out from a business or attraction management approach must also be incorporated into a full understanding of the scope of the term (Cutler & Carmichael, 2010).

Drawing on this foundational framework, a number of pioneering scholars started to produce literature outcomes from a wide range of research areas (Cutler & Carmichael, 2010). Inductively, they can be grouped into three dimensions, which are conceptualized from the phases of the tourist experience, the influences on the experience, or from important results or outcomes the experience. This typology is represented in the table below with some indicative examples of academic work (see Table 2.2 below).

Table 2.2 Dimensions of the tourist experience studies and selected examples

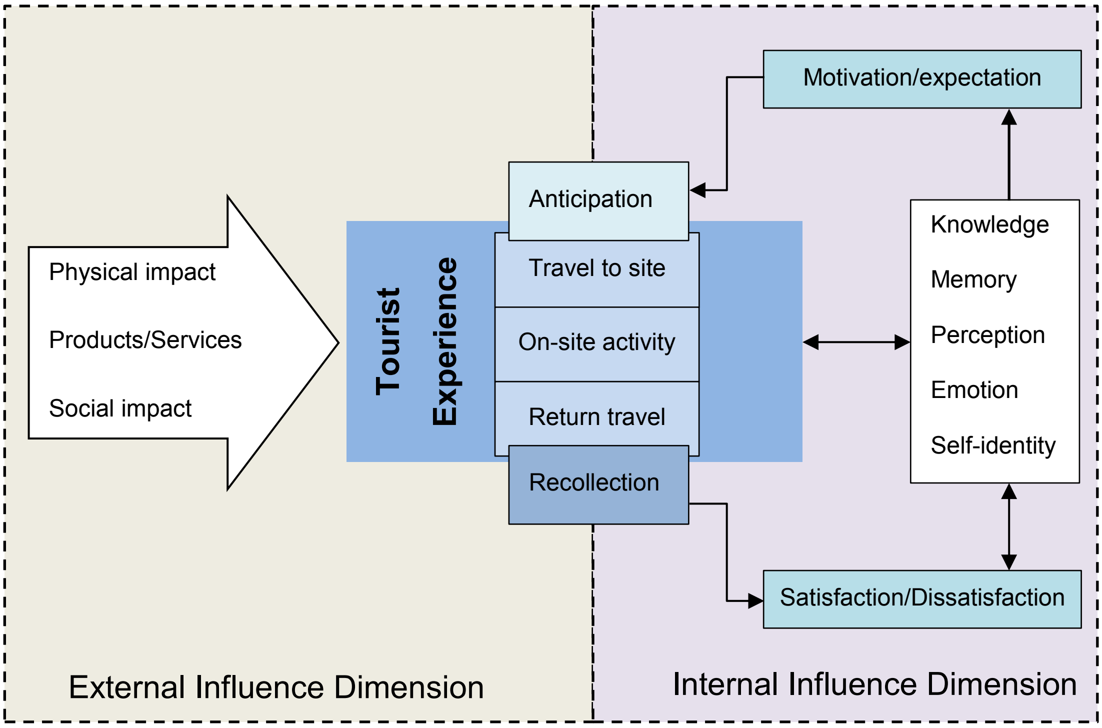
Dimension		Definitional Focus	Representatives
A Phase-based Approach		Phases of experience	Clawson & Knetsch (1966); Cohen (1979); Fridgen (1984); Botterill & Crompton (1996); Graburn (2001);
		Modes of experience	Cohen (2004; 1979); Mannell & Iso-Ahola (1987); O'Dell (2007)
Influential Dimension	Internal influence realm (Within individuals)	Motivation & expectation	Crompton (1979); Rayan (1998, 2002); Pearce (1983, 2003, 2005b); Wu & Pearce (2014c, 2016b)
		Satisfaction/Dissatisfaction	Otto & Ritchie (1996); De Rojoas & Camarero (2008); Wang (1999); Pearce (2005b); Ryan (2003);
		Knowledge	Smith & Jenner (1997); McIntosh & Prentice (1999); Li (2000); Ritchie (2003); Pearce (2005b);
		Perception	Larsen (2007); Selstad (2007);
		Emotion	Noy (2007), Chang (2008); Arnould & Price (1993); Trauer & Ryan (2003)
		Self-identity	Vogt (1976); Desforges (2000); Palmer (2005); White & White (2004); Selstad (2007); Noy (2004)

Dimension		Definitional Focus	Representatives
	External Influence realm (Outside individuals)	Physical factors	Hayllar & Griffin (2005); McCabe & Stokoe (2004); Mossberg (2007)
		Social factors	Andereck, *et al.*(2006); Prentice, *et al.* (1998); Li (2000); Pearce (2005a)
		Products/activities & Services	Stamboulis & Skayannis (2003); Nickerson (2006); Pearce (2005b)
Consequential Dimension (Outcomes of the tourist experience)		Cognitive development	Wilson (1998); Pearce & Foster (2007); Cary (2004)
		Affective development	Gmelch (1997); Arnould & Price (1993); Trauer & Ryan (2005)
		Psychomotor development	Pearce & Foster (2007); Moscardo (2008); Arnould & Price (1993)
		Personal development	Gmelch (1997); Hunt (2000); Pearce & Foster (2007)

Source: Integrated from Cutler & Carmichael (2010) and Hsu &Huang (2008)

(2) Conceptualizing a multidimensional model applied in this research

The preceding discussion reveals the multi-phased, multi-influential and multi-consequential nature of the tourist experience. Nevertheless, viewing the tourist experience separately through each single dimension is not the intention of the current research. Instead, the multidimensional attributes of the tourist experience studies are conceptualized and presented in the following figure by encompassing all three aspects (see Figure 2.1). This representation offers a combined overview of the tourist experience, making it possible to navigate the direction for the study of the individual travel experience of astronomy tourists.



Source: adapted from Cutler & Carmichael (2010)

Figure 2.1 A multidimensional model conceptualizing the tourist experience

The questionnaire-based survey for examining astronomy tourist's travel experience in study II will be designed using this underlying conceptual model. Particularly, the seven phases (highlighted in blue colours) derived from Clawson and Knetsch's five-phase model will be a focus of attention. Also, other dimensions and elements such as those from the influential and personal realm will be considered into research design and data interpretation. Such detail will be elaborated in the specific methodology section of Chapter 4.

2.2.3 Tourist Involvement: The Serious Leisure Perspective (SLP)

(1) Definition and theory schema

The 'involvement' construct has been a consistent theme in consumer and leisure studies over time. It has also been widely employed in tourism literature in recent years. Tourists' involvement in tourism activities varies in their travel careers or during different stages within a single journey. From this point, it is necessary to look at astronomy tourists' travel experience from the serious leisure perspective (SLP), which was initiated by Stebbins (1982). Expressed succinctly, his theoretical framework stressed three conceptualized patterns of one's leisure involvement, displaying their similarities, distinctive characteristics, and interrelationships (Stebbins, 2007). In accordance with the work of Stebbins (1982, 1996a, 2007) and Bartram (2001), the three forms of leisure – serious, casual, and project-based leisure – can be briefly defined as follows:

Serious Leisure: Systematic pursuit of an amateur, hobbyist, or volunteer activity sufficiently substantial, interesting, and fulfilling for the participant to find a (leisure) career there acquiring and expressing a combination of its special skills, knowledge, and experience

Casual Leisure: immediately, intrinsically rewarding, relatively short-lived pleasurable activity, requiring little or no special training to enjoy it.

Project-based Leisure: short-term, reasonably complicated, one-shot or occasional, though infrequent, creative undertaking carried out in free time, or time free of disagreeable obligation.

It has been extensively argued that serious leisure embraces three forms of involvement: amateurism, volunteering and hobbies (Stebbins, 2009). Serious leisure requires “high investment” with sustained commitment to the development of knowledge and skills (Kelly & Godbey, 1992, p. 350). Leisure involvement has been commonly used as key evidence to separate serious from casual and project-based leisure (Trauer, 2006). Unlike the casual leisure and project-based leisure participants with situational involvement, those who pursue serious leisure often possess “enduring involvement” (Cater, 2000; Trauer, 2006). Such involvement contains four facets: importance of product category, enjoyment derived from it, self-expression through product category and centrality to lifestyle (McIntyre, 1989, 1998, p.42; Gahwiler, 1995; McKercher & du Cros, 2002). One notable conclusion drawn by Stebbins (1997) is that participants pursing serious leisure are actually in the minority compared to those involved in casual leisure, and often they were initially involved in the advanced stage of casual leisure and situational involvement. This notion is supported by several scholars in the field of SIT, including ecotourism (Eagles, 1996) and cultural tourism with the researchers (Craik & Trotter, 1997; Stebbins, 1996a), demonstrating that there is a flow and evolution of leisure involvement. In recent years Stebbins (2014, 2015a, 2015b, 2015c) developed and amended his theories of SLP constantly, building links to positive psychology. His new contribution is incorporated and adapted into the schema of the SLP, which is illustrated in Figure 2.2.

In the inductive review of SLP, it is evident that measuring leisure involvement is an essential task for developing and refining the theory. Through several empirical studies, six distinguishing qualities of serious leisure have been identified and can be used to measure involvement (Gould, Moore, McGuire, & Stebbins, 2008; Stebbins, 2007). They are specified as below.

(1) Perseverance. The situational need to persevere through adversity distinguishes serious leisure from casual or project-base pursuit.

(2) Leisure career. A personal course or passage in a leisure role, molded by its own special contingencies, turning points and phases of achievement or involvement.

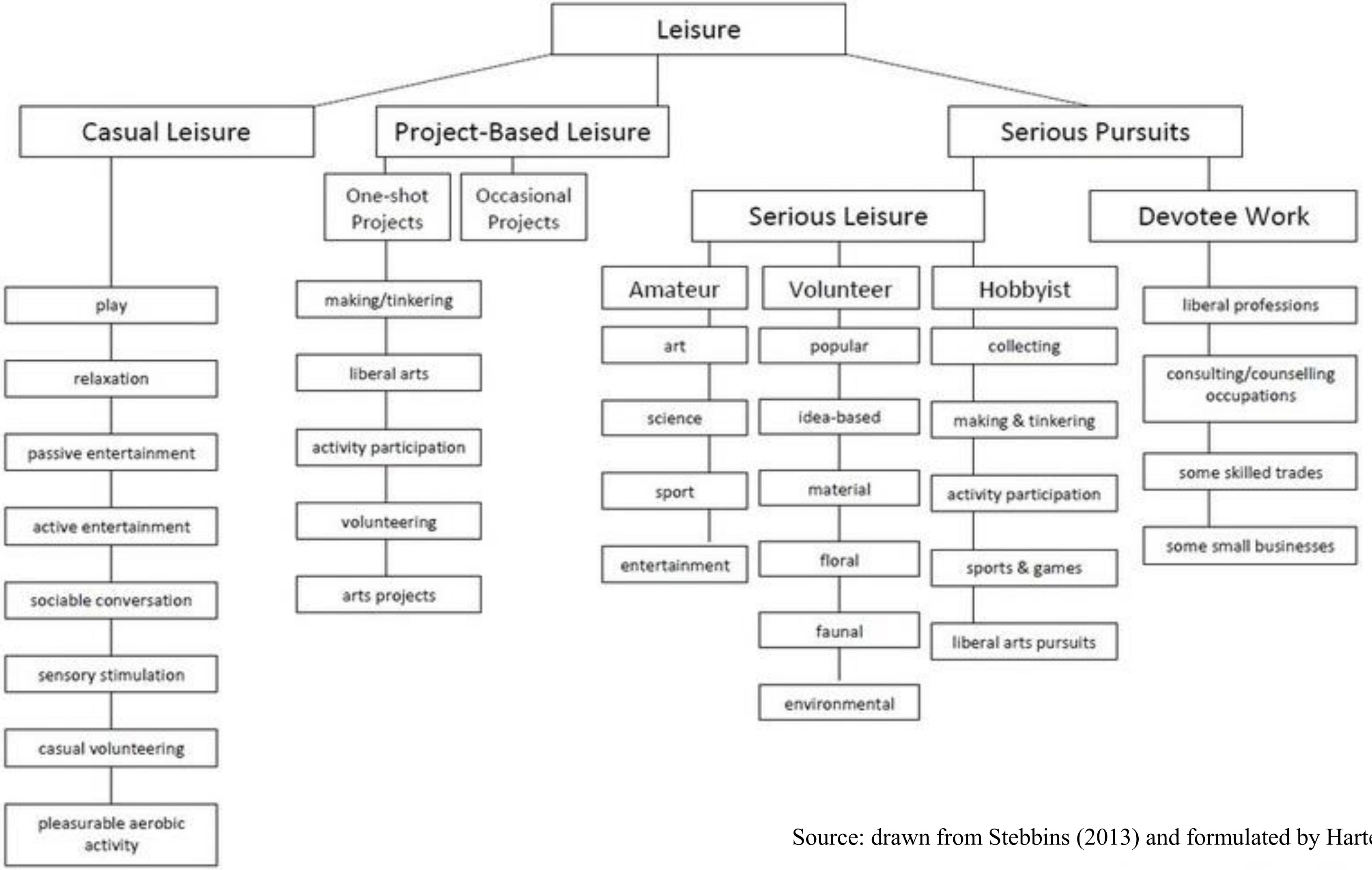
(3) Significant effort. It pertains to the exertion of significant personal effort to obtain and develop special knowledge, skills, techniques or abilities. The leisure career is shaped by the effort and energies devoted to the pursuit.

(4) Durable outcomes, both from the individual and group realms, are generated from explorations of the costs and rewards associated with serious leisure lifestyle. The individual outcomes contain several elements, including personal enrichment, self-image, self-gratification and re-creation of one's self, while group outcomes pertain to the social reward of group attraction by participating or involving in the social world of serious leisure activities.

(5) Unique ethos. This quality implies the existence of diverse ideas, values, emotion, or guiding beliefs that are shared by members of a serous leisure social group.

(6) Identification with pursuit. The strong identity recognition among participants with a chosen and collective pursuit.

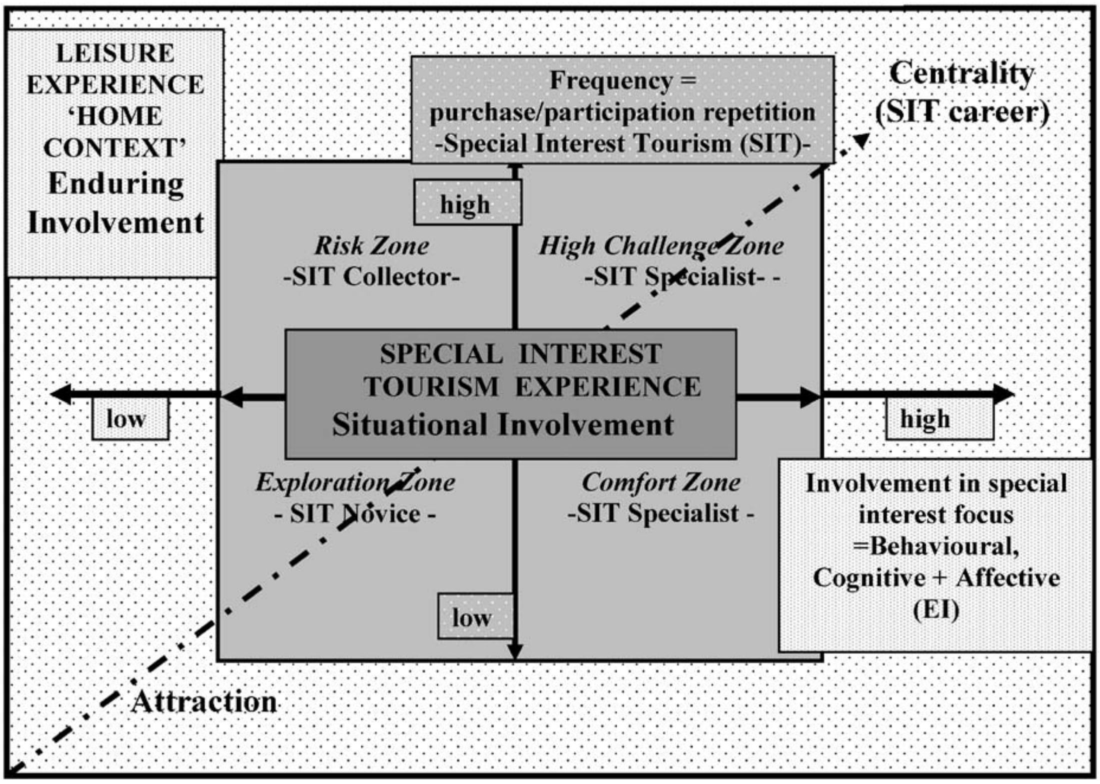
Within the framework underpinned by the aforementioned six qualities, the degree of leisure involvement can be indicated and divided into different levels.



Source: drawn from Stebbins (2013) and formulated by Hartel

Figure 2.2 Conceptualized diagram of the Serious Leisure Perspective (SLP)

Drawing on the work by Brotherton and Himmetoglu (1997), who developed and applied Stebbins's SLP theory in an empirical study on UK outbound special interest tourism consumers, a continuum of 'dabbler', 'enthusiast', 'expert' and 'fanatics' was developed to classify special interest tourists by their different leisure involvement levels. Its significant contribution to both SLP and SIT studies lies in the fundamental conceptualization of SIT underpinned by the multi-dimensional and cyclic concept of involvement, taking into consideration the influence of possible enduring involvement in a leisure (home-based) context and situational involvement within the tourism context (see Figure 2.3). An arguable 'leisure career' path in SIT is underlying this finding and needs further discussion and examination.



Source: adapted by Trauer (2006) from Brotherton and Himmetoglu (1997)

Figure 2.3 The SIT experience model based on SLP theory

(2) Application in this research

In the current research, the serious leisure perspective can provide an affective, cognitive and behavioral overview from its theoretical framework and be helpful in exploring the issue of astronomy tourism at both an individual and micro level. With reference to the work by Brotherton and Himmetoglu (1997), Trauer (2006) and Stebbins (2008), this study will also provide a new empirical example and potentially demonstrate the existence of Stebbins' SLP career path or involvement trajectory. The attempt will be made to trace the dynamic transition processes among casual leisure, project-based leisure and serious leisure. That is, the attempt to make a contribution to the theory of SLP is a goal of this effort. In this present thesis, SLP approach will be mainly employed in the second empirical study portraying the astronomy tourist experience. Specifically, it will be conceptualized into a framework and used in designing the questionnaire by framing the scales and items which assess the extent of leisure involvement. Varied groups of astronomy tourists will be considered according to their involvement or interest level. It is proposed that such an approach will be helpful in interpreting tourists' travel involvement history and career. These studies will be presented in Chapter 4 and Chapter 5.

In both the leisure and tourism motivation studies, individuals choose to participate in recreational activities in order to reach multiple needs (Ryan, 2003). The concern of motivation studies need to be added to the array of ideas to explore astronomy tourists' experience. Tourist motivation will be reviewed as a distinct topic in the following section.

2.2.4 Tourist Motivation: The Travel Career Pattern (TCP) Approach

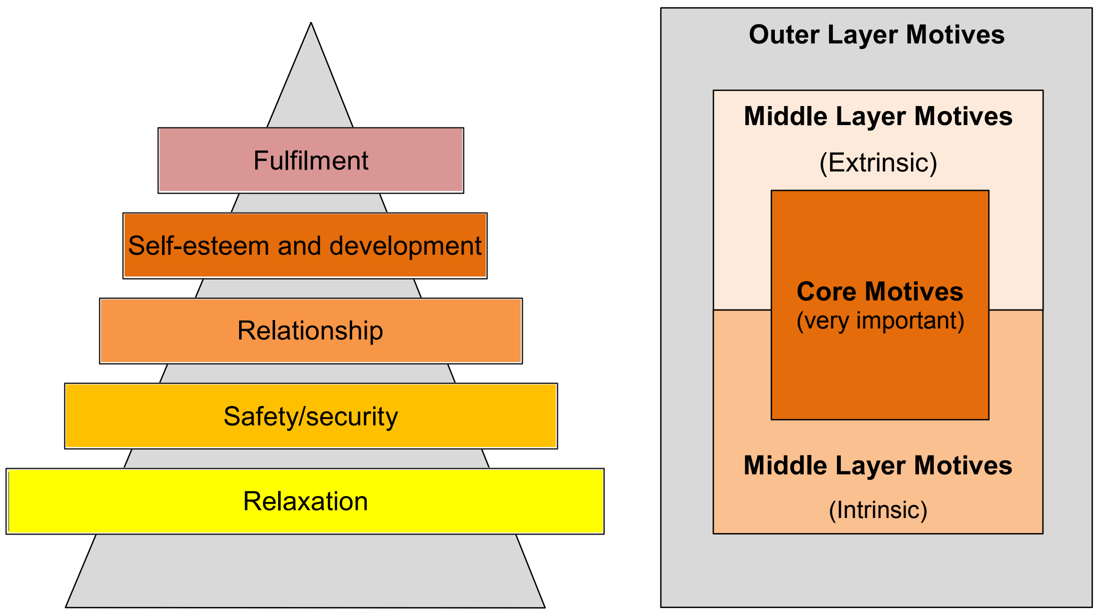
(1) Definition and development of the TCP approach

Two conceptual frameworks for interpreting tourist motivation – the travel career ladder (TCL) and travel career patterns (TCP) – are must-read materials in this field. The original thoughts behind the TCL model (Pearce and Caltabiano 1983; Moscardo and Pearce, 1986; Pearce, 1988) possible can look backward to Pearce's pioneering articles on tourist behaviour (Pearce, 1982). By dealing with coded data from both positive and negative travel experiences, Pearce (1982) concluded that older tourists recalled more incidents involving positive relationships (love and belongingness needs) and self-actualization needs than did younger tourists, who gave proportionally greater emphasis to physiological needs. In addition, those who travelled more frequently were more likely to emphasize self-actualization, love and belongingness needs.

In essence, the TCL model drew on Maslow's hierarchy of needs and the conceptualization of psychological maturation towards a goal of self-actualization (Ryan, 1998). The basic idea underlying this conceptual framework is that an individual's travel motivation varies with one's travel experience. Generally speaking, the TCL approach proposed that experiences transform tourists so they become more motivated to seek fulfilment of the higher-order needs. The TCL is cited frequently in the tourism literature as the model's applications have moved beyond the pages of academic journals to the reports of commercial consulting organizations (Ryan, 1998). Nevertheless, a case study by Ryan (1998) indicates that little evidence was available to support Pearce's ideas. He argued that, based on past visits to a destination, tourists hardly show growths in the intellectual motivation for travel. Comparing experiences of holiday types alike, the results report a significant reduction in the importance of intellectual needs as a motivation.

Refined from the TCL model – the Travel Career Patterns (TCP) – was subsequently presented by Pearce and his colleagues (Lee and Pearce, 2002; Pearce, 2005; Pearce and Lee, 2005). Though they call TCP a modified work of TCL, the new model is in effect very different. The core commonality consists of retaining the idea that travel experiences affect motivation patterns. Lee and Pearce (2002, 2003) appraised the TCP framework empirically by carrying out surveys in both Western (Australia, the United Kingdom and other Western countries) and Eastern (Korea) cultural environments. Their studies found very similar cross-national motivation factors. Namely, fourteen motivational factors were drawn from 74 motivational items from both studies, with slightly different importance mean ranking orders. In the Korean context, when ranked by mean value, the motivation factors are: (1) novelty, (2) escape/relax, (3) self-actualization, (4) nature, (5) kinship, (6) self-enhancement, (7) romance, (8) kinship-belonging, (9) autonomy, (10) self-development (host-site involvement), (11) nostalgia, (12) stimulation, (13) isolation and (14) recognition. By comparing motivational factor scores among various travel career (experience) groups, highly convergent results appeared. Conclusions show that within the 14 factors, informants at higher travel career levels put more emphasis to external-oriented motivation factors, such as host-site involvement and seeking nature. In contrast, respondents with less travel experience concentrate on internal-oriented motivation factors, such as self-enhancement, romance, kinship and autonomy. None the less, based on their importance, these factors can be divided into three clusters. One cluster includes the most important and common motivation factors to all travellers, namely novelty, escape/relax and kinship or relationship, while a second cluster includes motivation factors that were less important to all respondents, such as nostalgia, stimulation, isolation and social status. A third middle cluster is important in reflecting the differentiation and motivational needs of experienced tourists.

Pearce and Lee (2005; Pearce, 2005b) propose that the 'TCP approach' can be depicted conceptually as three layers of travel motivation, where each layer consists of different travel motives. The most important motives are embedded in the core layer. The next layer, surrounding the core, includes the moderately important travel motives, which embrace both inner-oriented travel motives to externally oriented motives. The outer layer consists of common, relatively stable and less important travel motives (see Figure 2.4). Pearce and Lee (2005) further explain that pleasure travellers at all levels of the travel career pattern are influenced by the most important and central travel motives, as well as by less important motives. Nevertheless, as their travel career level develops, travellers' moderately important travel motives show an orientation towards involvement with the host-site, environment and self-development.



Source: adapted from Moscardo & Pearce (1986) and Pearce (2005b)

Figure 2.4 The TCL and TCP models

Reformulated from the TCL, the TCP model reveals explicit information and systematic explanations concerning tourist motivation. As an approach for analysing motivations, the TCP model is extensively employed in recent tourism studies, especially in those pertain to new customers and emerging markets, such as backpackers (Paris & Teye, 2010) and Chinese backpackers (Chen, Bao, & Huang, 2014).

However, the TCP approach is still developing following further discussion. For example, Filep and Greenacre (2007) evaluate and extend the TCP model by examining study-abroad university students in an educational tourism context. Panchal and Pearce (2011) encompass the health factor as a motive into the TCP. Studies conducted by Pearce and colleagues (Lee & Pearce, 2002; Pearce, 2005b; Pearce & Lee, 2005) confirm that travel motivation is a multidimensional concept that has been proposed in many motivation studies but has shifting patterns over time (Pyo et al., 1989; Jamrozy & Uysal, 1994; Baloglu & Uysal, 1996; Kim & Lee, 2002; Ryan, 2003).

Another point for the current research is the link between the TCP and the 'leisure involvement' construct as described by Getz and Andersson (2010). Their study empirically suggest that the event-tourists' travel career 'trajectory' pertains to interrelationships between motivation, travel and events. Namely, tourist motivation should shift with increasing involvement. Based on the career trajectory and the TCP model, it has been ascertained that a growth in involvement is significantly reflected in higher-level motivations pertaining to self-actualization or self-development needs. These findings provide a broad-based framework to link the leisure involvement and tourist motivation components together underlying the conceptual scheme of the current research.

(2) Application in this research

In this research, the TCP approach will be adopted to tackle the exploratory work on astronomy tourists' motivation in two areas. Firstly, in the group culture study, the TCP approach will be employed to frame the exploratory work on collecting neo-tribal facts and representational information concerning astronomy tourists' motives. The descriptive and qualitative data distilled from travel blogs will be coded in accordance with the TCP approach. Secondly and more importantly, the following empirical study on the tourist experience will examine those motives from the first study, by conducting a quantitative survey based on the TCP approach. Items and questions will be designed and refined in reference to the most recent TCP's empirical appraisals. Furthermore, linkages will be constructed in the second study, bridging the TCP model and the SLP theory by analysing different motivation patterns among groups with distinct involvement levels in astronomy tourism activities.

2.3 METHODS REVIEW

The main purpose of this section is to review travel blog studies, questionnaire-based surveys and interviews as three primary methodologies for this present research. Succinct good practice principles will be summarized and the application of these approaches will be considered in the current thesis. Broad application points will be stated here and full details will be highlighted in relevant the chapters.

2.3.1 Paradigmatic Concerns and Researcher's Position

There are multiple stances and paradigms with which a researcher can commence an investigation. Research paradigms define the nature of the world (Liburd, 2012). They provide a basic belief system or worldview that construct any individuals' observation and reasoning (Heimtun & Morgan, 2012). Four major research paradigms are usually adopted by many scholars: positivism, post-positivism, interpretivism and criticalism (Heimtun & Morgan, 2012; Xin, Tribe, & Chambers, 2013).

Throughout the present research, the post-positivism paradigm is mainly adopted. Post-positivism (also known as post-empiricism) is a meta-theoretical stance that critiques and amends the positivism paradigm (Botterill & Platenkamp, 2012; Henderson, 2011). While positivists believe that the researcher and the researched person are independent of each other, post-positivists accept that theories, background, knowledge and values of the researcher can influence what is observed (Henderson, 2011).

In terms of epistemology, post-positivists believe that human knowledge is based not on unchallengeable, rock-solid foundations, but upon human conjectures (Henderson, 2011). As human knowledge is thus unavoidably conjectural, the assertion of these conjectures are warranted, or more specifically, justified by a set of warrants, which can be modified or withdrawn in the light of further investigation. However, post-positivism is not a form of relativism, and generally retains the idea of objective truth. Concerning the ontology, post-positivists believe that a reality exists, like positivists do, though they emphasize that it can be known only imperfectly and probabilistically (Hsieh & Shannon, 2005).

The theoretical framework and conceptual scheme considered in the previous section cannot directly shape the behaviour and position of the researcher in terms of how to approach the community of astronomy tourists. It thus suggests that the researcher's position needs to be considered. It is important to emphasize that, before commencing the current study of astronomy tourism, for a long period the author has been an active member of several amateur astronomer clubs (both national and international) with over sixteen-years of astronomy-related travel experiences. Further, the author has a research background in sociology and tourism. This researcher's stance readily ensures the accessibility to approach the study personnel - astronomy tourists. Such accessibility can be provided from three facets: **1)** With the shared astronomy interests, the researcher is familiar with the languages, words and terms that are used by the special interest group 'astronomy tourists'; **2)** It enables the researcher to share the same knowledge base of astronomy with the target audiences, helping him act as an "insider" and a "group member" of the researched tourists; **3)** As a tourism scholar as well as an experienced astronomy tourist, the researcher has a solid background of literature and theories to address the research topic through a tourism perspective. It also enables the researcher to interpret the insights of the phenomenon based on his own astronomy-related travel experiences.

Using the above post-positivism paradigm and the concept of a researcher's position, an integration of the emic and etic approach (Pearce & Packer, 2013) is applied in the research at the methodological level. This integration acts as the glue or link for separate studies in the present thesis because they can be considered as mutually complementary (Wu & Pearce, 2013). More specially, the emic approach was mainly adopted in travel blog studies – the author positioned himself as a member of astronomy tourists, to comprehend the ideas, thoughts and perceptions of the informants. The etic approach was subsequently employed to implement the questionnaire-based survey and the key informant interviews – the researcher was isolated independently from the researched objects. The details of these research methods applied in the current thesis are to be reviewed in the following section.

2.3.2 Travel Blog Studies

(1) Blog studies in tourism research

Blog studies, as a new exploratory approach have emerged within the past decade (Kozinets, 2010). Blogs, as a popular tool and platform of communication based on the Internet website, refer to an act of maintaining online journals as a space to publish an individual's thoughts. The author of a blog is named 'blogger', that is, the individual who is source of the views reflecting one's personal lives and experiences.

As the internet and digital era rapidly seeps into every corner of the contemporary world and daily life, blogs are increasingly used by tourists, and accordingly, blog studies have been widely adopted by a growing number of tourism researchers and operators (Thevenot, 2007; Kozinets, 2010). Travel blogs are not only an essential mechanism for exchanging information among tourists, but are also a helpful tool for both tourism destinations and businesses to learn about the motivation and the behavioral patterns of their customers. The narrative or storytelling components in blogs are important to understanding the tourist experience because key events of tourism activities and facts of tourists' stories and can be effectively extracted from travel blogs (Pearce, 2010; Wu & Pearce, 2014a). A growing number of travel stories written online by bloggers attempt to the global appeal of the medium as a way to report travel experiences (Pearce & Butler, 2010). As a result, the tourism discipline has witnessed a sharp increase in the number of travel blog studies in recent years (Mkono & Markwell, 2014). Examples can be traced on multiple themes including studying tourists' perception of poverty in South Africa (Pearce, 2012). The approach assists in exploring patterns and typologies of the tourist experience through systematically coding of the reported behaviors and assessing tourists' attitudes and identities (cf. Wu, Pearce, Huang & Fan, 2015; Woodside, Cruickshank & Dehuang, 2007).

(2) Techniques and methods in blog studies

There are two representative techniques pertaining to the research methods of blog studies: netnography and blogosphere. Pan, MacLaurin & Crotts (2007) is one of the pioneers applying the blogosphere technique in tourism studies. The study emphasises the utility of extracting qualitative data from travel blogs. The 'blogosphere' is an automated mechanism and procedure for monitoring travel blogs, employing a real-time tourist feedback system and quality control tool for destination marketing (Pan, et al, 2007). Their study raises the question of whether to code the content of blogs manually or by computer software tools.

The blogosphere work subsequently evolved into another widely-applied technique named 'netnography' which was initiated by Kozinets (1997) and subsequently developed as a research tool (Kozinets, 2010). As a qualitative and interpretive approach, 'netnography' is an adapted concept from the anthropological expression, 'ethnography' and incorporates the word 'internet'. Compared with the blogosphere as a marketing toolkit, netnography is mainly adopted in tourist behaviour studies (Wu & Pearce, 2014a). According to Kozinets (2010), six steps pertain to the procedure for conducting a netnographic study: Entrée, data collection, data analysis, consider research ethics, member check and data interpretation. They are applied in empirical studies such as Chinese RV travellers in Australia and then enhanced with more detailed tactics (Mkono, 2012; Wu & Pearce, 2014a) which are crystallized as below:

- **Entrée:** Define research questions, social sites and topics to investigate. Consider all the relevant virtual communities and select the most specific, relevant and non-commercial ones with high traffic.
- **Data collection:** Identify a suitable online community as a channel to collect data. Focus on the voices from the 'devotees' and 'insiders', rather than 'lurkers' and 'minglers'. Both textual and visual information relevant to the research questions should be collected. Once the informants' online demographic profiles are assessed, there can be researcher-led interactions and requests for information if some data are missing.
- **Data analysis:** Both quotes and insightful images can be analysed and content analysis can be carried out manually so the researchers retain a close familiarity with the original postings. Reliability checks can be employed to enhance the confidence in the codes and build the overall credibility of the study.
- **Research ethics concerns**: Considering all the blogs are publically accessible, the researchers do not necessarily have to disclose their identities. When interaction is necessary to identify missing information, the researchers can approach the blog posters revealing and explaining the identities as social scientists. Non-disclosure helps ensure the material being considered is unaffected by the researcher's own online involvement if they have chosen to be a participant in the communications of the group. Whenever the original images (either with people or without people) and direct quotes are used, permission from the informants can be obtained. When interaction is necessary to identify missing information, the researchers can approach the blog posters explaining the purpose of the work.
- **Member check**: A member check can be adopted with the key informants, especially those whose travel information is discussed in the study.

- **Data interpretation**: Comparison with other data sources are used to build contrasts and highlight study insights. Original quotes and images (if necessary) from the insiders are widely used to effectively communicate the information.

(3) Adoption in this research

Astronomy tourism as an entirely new area as a niche market needs to be explored. An exploratory approach with both quantitative and qualitative data collected is a preferred pathway when there is little or no substantial empirical analysis about an emerging phenomenon (Stebbins, 2001). As an effective exploratory approach, blog studies are feasible and potentially valuable to tackle this new phenomenon. That is, the researcher will primarily employ netnography as a tool to characterize astronomy tourists. Following the six steps emphasized by Kozinets (2010), this research will start with exploring the group representation by astronomy-related travellers' blogs, online forums and social network sites (SNS, such as Facebook, Twitter and Weibo). Through a global scope, the degree of the astronomy tourist's leisure involvement can be measured in world-wide blog articles, online discussions, self-expression and performance on SNS. Worldwide travel blogs and astronomy-related internet forums will be collected and tracked. Meanwhile, based on neo-tribal theory, astronomy tourists' cultural representation will be coded, identified, analysed and displayed by interpreting travel blogs' qualitative and quantitative data.

2.3.3 Questionnaire-based Survey

The questionnaire-based survey is still widely employed in tourism research as a conventional technique. They are usually used in studying the tourist experience (Dolnicar & Grün, 2013). The remarkable variation of the technique lies in its development in the digital era – self-administrated surveys personally delivered and printed questionnaires mailed to the respondent are no longer prevalent, while online and electronic versions and telephone surveys are taking over the role (Bryman, 2011). However, the onsite self-administrated questionnaire is still valuable to ensure reasonably high respondent rate, and to assist in clarifying items (Veal, 2006). The online questionnaire and onsite approach will both be considered and adopted in this thesis. In questionnaire-based surveys, Likert scales are often used to collect quantitative data and examine scale variables (Dwyer, Gill & Seetaram, 2012). In particular, they are frequently used in tourist motivation and involvement studies. It is challenging and meaningless to develop a new questionnaire and its items based on little theoretical framework, and therefore, following a well-developed scale with reasonable adaptation is a usual method (McLean, 2006). In addition, for exploratory work using blog studies followed by questionnaire surveys, it is helpful in enriching the questions (Mkono, Ruhanen, & Markwell, 2015).

In this research, the questionnaire-based survey in the second study is underpinned by the prior blog studies on the astronomy tourists' group culture. In particular, the items concerning astronomy travel motives will be extracted from the blog study by netnography and will be employed in the questionnaire design to shape the survey in conjunction with the TCP approach. Additionally, the items pertaining to leisure involvement will also be distilled from travel blog contents and subsequently used in grouping astro-tourists by involvement levels. For the sampling procedure, astronomy club members and onsite astronomy-related activity participants will both be selected as respondents. Both an online questionnaire-base survey and an onsite version will be used.

Cases will be compared between cities in China and Australia where the astronomy tourism market is booming. Four sites in total will be compared. The differences between temporary events and enduring activities will also be studied. Based on a pilot survey and preliminary interviews, over 800 worldwide questionnaires are expected. The phenomenon sampling method will both cover two target audiences: astronomy tourists (with serious leisure involvement) and potential astronomy tourists (with casual or project-based leisure involvement). Additionally, questionnaire data will be processed and analysed by statistics toolkit SPSS 20.0.

2.3.4 Interviews by the Key Informant Technique

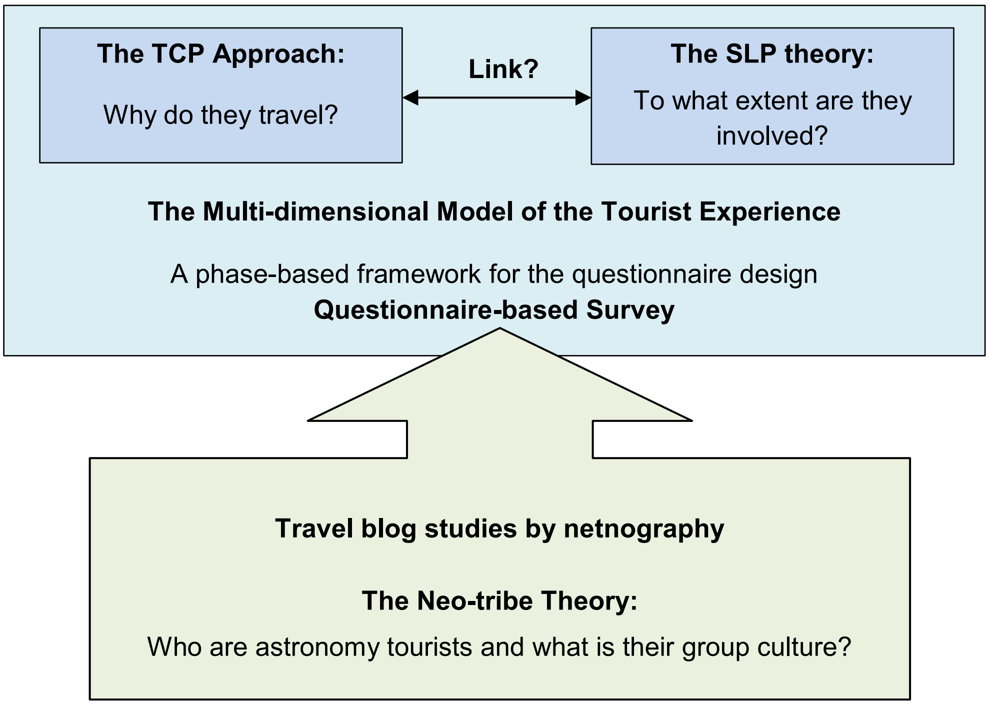
The interview is another important method extensively applied in tourism study areas. It is often associated with qualitative research (Bryman, 2004; 2006). Jennings (2010) describes three categories of interviews: the structured, the semi-structured and the unstructured ones. Veal (2006) compares two types of interviews frequently used among tourism scholars: in-depth interviews and group interviews (also known as focus groups). Dwyer *et al.* (2012) classifies three types of interview according to the interface between researchers and interviewees: face-to-face, internet –based (video-based) and telephone interviews. In terms of sample selection criteria, key-informant interviews (interviews conducted by key informant technique) are often applied in tourism studies, particularly where there is a focus on the community's attitude to tourism and the views of tourism stakeholders are required (Cater, 2010; Simpson, 2009). There is considerable value in gaining qualitative information from key individuals within communities and from assessing the role of different stakeholders in a given initiative (Simpson, 2009).

By definition, key informants are those people who "for their history, knowledge and inclusion within a community are able to provide valid and credible information on phenomena on which they are informed" (Montanari & Staniscia, 2009, p. 1468). Key informants are viewed as appropriate respondents if appropriate selection procedures are used (John & Reve, 1982). Tremblay (1957) initiated the key informant technique and elaborated on the procedure as well as providing examples of its application in social science studies. Marshall (1996) followed the work of Tremblay and developed the technique with some adaptation. Sarantakos (1998) states that key informant interviews "involves elites, that is, well-known personalities, prominent and influential people, as respondents. Therefore, it aims to collect information that is exclusive and unique to these informants". Sarantakos (2001) contends that the key informant technique by elite interviewing is a very useful tool for data collection, as such important groups of respondents are likely to provide insights from a number of perspectives.

Consistent with these views, the current research will obey the principles and procedures of key informant interviews to assess the perception and attitude of market or industry stakeholders towards the present situation and future state of astronomy tourism. It is anticipated that 30 in-depth semi-structured interviews will be conducted, either personally or by video/internet calls. In addition, those 'devotees' and 'insiders' who are highly involved in astronomy tourism activities and travel blog posting will be selected as key informants to be interviewed by telephone calls and face-to-face conversations. The phone interviews by the key informant technique will also be a supplementary approach to obtain further information about their travel group culture and individual travel experiences.

2.3.5 Linking Research Methods to the Conceptual Scheme

The research methodologies discussed in the previous section can be integrated and underpinned by the conceptual scheme of the research, thus providing a systematic framework to embark each study. An illustration is presented in Figure 2.5 for better understanding the linkages.



Source: drawn by the author

Figure 2.5 Linkage between methodologies and the conceptual scheme

2.4 RESEARCH FRAMEWORK AND THESIS OUTLINE

2.4.1 Detailed Research Aims

To be more explicit in embodying the detailed goals of the three empirical studies, it is useful to review and repeat the preliminary aims stated in Chapter 1 as below:

(1) ***Who are astronomy tourists and what is astronomy tourism?***

(2) ***What travel experiences do they have and why do they travel?***

(3) ***What are industry stakeholders' perspectives towards the future development of astronomy tourism?***

These three central questions will be addressed in Chapter 3, 4 and 5, by travel blog studies, questionnaire-based surveys, and key informant interviews respectively.

More specifically, **Chapter 3 will tackle the following detailed aims:**

1) Investigate key characteristics of astronomy tourism as a phenomenon as well as an emerging astronomy tourist market, and thereby present a global market panorama from four aspects: market evolution, market segments, market and resource distribution, and the classification of products and activities.
2) Profile astronomy tourist's overall group identity, and classify subgroups by different attraction foci and distinct activity involvement levels.
3) Interpret the overall online representations of astronomy tourists by describing detailed symbolic and behavioral characteristics they share which shape the astronomy tourist neo-tribes.
4) Discover the push and pull factors of astronomy tourists' travel motivation, and thus obtain variables for the subsequent questionnaire design in Chapter 4.
5) Portray different trajectories of astronomy tourists' leisure involvement based on a longitudinal blog study.
6) Summarize and integrate the definition of astronomy tourism and astronomy tourists based on the netnographic study results.
7) Guide the framework of the questionnaire-based surveys in Chapter 4.

Chapter 4 concerning the travel experiences of astronomy tourists aims to:

1) Differentiate general interest tourists, mixed interest tourist and special interest tourist in an astronomy tourism context. Interpret the general travel experience of astronomy tourists.

2) Explore the influential factors of astronomy tourists' decision making and highlight the key determinants.
3) Assess the degree of leisure involvement of astronomy tourists. Classify them into groups by different involvement levels.
4) Dissect the motivation factors of astronomy tourists through the TCP approach. Examine if the motivation patterns are transformed with rising involvement levels of astronomy tourists.
5) Portray the on-site activities in which astronomy tourists usually participate.
6) Reveal astronomy tourists' recollection experience and learning outcomes.
7) Measure the satisfaction of astronomy tourists.
8) Compare demographic differences in the astronomy tourists' travel experience.

Chapter 5 regarding the industry future of astronomy tourism aims to:

1) Assess industry stakeholders' attitudes towards the present situation and future development of astronomy tourism.
2) Compare key informants' perception towards astronomy tourism's present and future across different kinds of industry stakeholders
3) Indicate the key measures to sustainably develop astronomy tourism products and markets, as well as solutions to preserve the astronomy tourism resources.

Finally, the goal for Chapter 6 is to present a synthesis of the overall exploratory work on astronomy tourism, and to review further possibilities and research directions for future studies. Additionally, it is anticipated that possible refinements to the TCP model and SLP theory may be achieved. Empirical evidence from this niche tourism context may help build a link between these two constructs.

2.4.2 Research Structure and Thesis Outline

To reach the series of aims above, the present thesis consists of six chapters. Figure 2.6 below displays the structure of the research and provides an outline of the thesis.

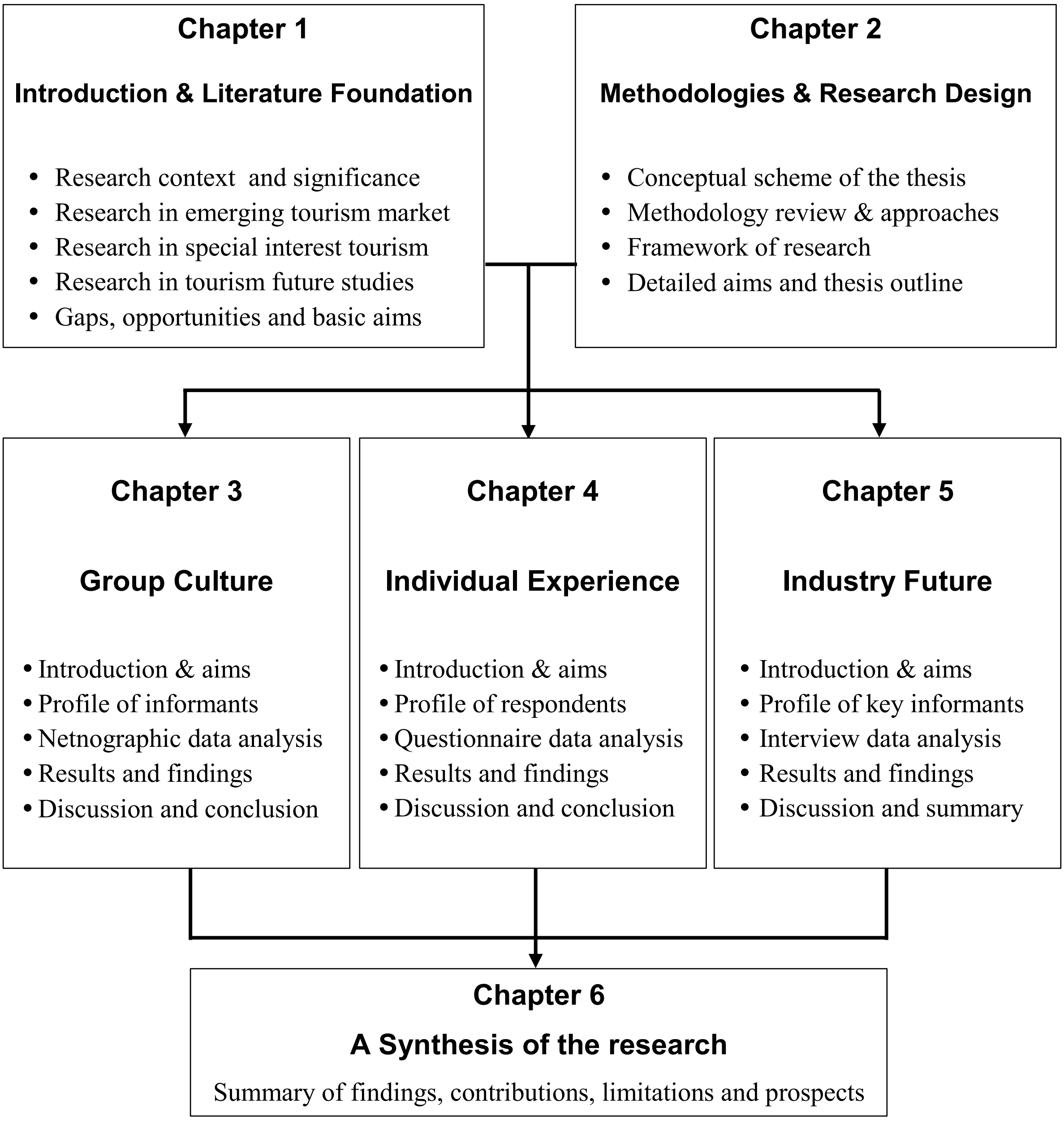


Figure 2.6 Chapter structure and thesis outline

Chapter 3

Understanding the Group Culture of Astronomy Tourists: A Netnographic Study

"The history of astronomy is a history of receding horizons."

Edwin Powell Hubble

January, 1936

Chapter Outline

3.1 INTRODUCTION

As proposed in the summary of Chapter 2, in this section the first empirical study concerning the emerging astronomy tourism market will be presented. The work will focus on two key questions - “what is astronomy tourism?” and “who are astronomy tourists?” To address these two questions, this empirical study aims to explore the astronomy tourism puzzle box by addressing two topics: 1) Understanding the general characteristics of the global astronomy tourism market and industry; 2) Portraying several facets of astronomy tourists’ group culture, including their group identities, online representations, culture change, and the trajectory of their travel career.

Three research methods were mainly employed in this empirical study: netnography, data mining and phone interviews. The foundation work started with a data mining method. An archival approach was conducted in data mining software by retrieving over 5,500 websites and 1,200 online archives in the years of 2014, 2015 and 2016. These archives were studied by content analysis and further interpreted in descriptive statistics. Findings presented several attributes and basic characteristics of the global astronomy tourism market, including market evolution and segmentation, product classification, resource and market distribution, consumers’ profiles and preferences, popular tourist attractions and activities.

Next, a netnographic study considering both textual and pictorial contents from 244 travel blogs posted worldwide was conducted. The study examined indicators that the group of astronomy tourists can be seen as a “neo-tribe”. Using blog poster’s contact information and networking traces, ten phone interviews to clarify informants’ travel motives and career trajectory were also designed and conducted as a supplementary method. This netnographic study associated with phone interviews presented a basic understanding of astronomy tourists' group culture from the neo-tribal perspective. Additionally, tourist motivation, the common topics discussed, and general facets of individual travel experience were tentatively revealed. These findings will help assist the construction of the subsequent questionnaire-based research in Chapter 4.

3.2 Research Aims

This chapter presents a foundation and exploratory work to guide further studies of astronomy tourism. It attempts to tackle the following detailed aims and sub-aims:

1) Understand the key characters of astronomy tourism as a phenomenon as well as an emerging astronomy tourist market, and hereby present a global market panorama from the following four aspects:
    - Describing the market evolution
    - Mapping the market and resource distribution
    - Identifying the classification of products and activities
    - Presenting market segments
2) Profile astronomy tourist's overall group identity, and classify subgroups by different attraction focuses and distinct activity involvement levels.
3) Interpret the overall online representations of astronomy tourists by describing detailed symbolic and behavioral characteristics in common which shape the astronomy tourist neo-tribes.
4) Discover the push and pull factors of astronomy tourists' travel motivation, and thus obtain variables for the subsequent questionnaire design in Chapter 4.
5) Portray different trajectories of astronomy tourists' leisure involvement based on a longitude blog study.

6) Summarize and integrate the definition of astronomy tourism and astronomy tourist based on the netnography study results.
7) Guide the framework of questionnaire-based surveys in Chapter 4.

3.3 METHODOLOGY

3.3.1 Overview

In this study, a qualitative research method was mainly used to conduct an exploratory investigation of the astronomy tourism market and astronomy tourists' group culture. The research work was conducted by the content analysis based on three methods: archival approach, netnographic approach and phone interviews as a complementary approach.

3.3.2 Research Methods

(1) A Content Analysis Approach: Netnography

In recent years, social networking websites have quickly become a well-used form of communication. They serve to distribute information and news. They offer a way for people with similar backgrounds, interest, lifestyles, professions or hobbies to connect. The validity of an online based ethnographic approach (a.k.a. netnography) has been established for studying neo-tribal culture or group culture (Cova *et al.*, 2007). Websites can be regarded as public manifestations of group culture, such as young tourists' clubbing culture (Goulding & Shankar, 2011) and RV travellers' online representations (Hardy *et al.*, 2012). Additionally, contemporary tourists rely heavily on the internet and are particularly active in social networking via social media use (Bilgihan, Barreda, Okumus, & Nusair, 2016; Lyu, 2016).

As stated in Chapter 2, netnography is the main approach applied in this exploratory study. Netnography has been employed as a viable qualitative research methodology in many exploratory tourism studies (Mkono & Markwell, 2014; Mkono *et al.*, 2015; Wu & Pearce, 2014a). This research adopted the six-step procedure proposed by Kozinets (1997; 2010) to conduct the netnography study: 1) Entrée, 2) data collection, 2) data analysis, 3) consideration of research ethics, 4) member check and, 5) data interpretation. In the current study, the qualitative content analysis by netnography was undertaken to code and analyse the qualitative data from astronomy tourists' group culture through their online representations. In particular, the text about astronomy tourists' travel experience (e.g., tourist's feeling, perception, belief, stories, thoughts, interpretations and impression about every aspect of their tourist experience), group cultural facts (e.g., fellowship, language, scenes, rituals signifiers and other element from neo-tribal culture) posted in the tourists' travel blogs, online forums, social medias, and pictorial information captured by astronomy tourists, were all collected and coded into several themes and topics.

(2) An Archival Approach: Data Mining Technique

Aside from netnography, this study adopted several qualitative approaches, applying the methods which offer statistical appraisals. Archival approach was one of the methods used. As one of the oldest and most utilized sources of data known to researchers, archival research generally entails the use of secondary data which the investigators "deal with people's product rather than with the people themselves" (Dane, 2010). Archives are sources of existing data that can be assessed by several analytical and interpretive methods (Timothy, 2011). There are multiple data sources and units of analysis applied in archival research, including newspapers, books, journals, letters and other written sources (Dane, 2011). Especially in the digital era, electronic archives and modern technology offer another channel to review a large amount of data. To select which information to use and how to analyse it becomes a challenge for contemporary researchers (Narduzzo & Volo, 2016). A data mining method is helpful in this situation because it can deal with large data sets. Data mining is a computational process of discovering patterns and key information from a huge database. It involves methods at the intersection of artificial intelligence, machine learning, statistics, and database system (Han, Pei, & Kamber, 2011). The basic principles of data mining is to analyse the data from different angle, categorize it and finally to summarize it, and the toolkit WEKA (Waikato Environment for Knowledge Analysis) has been widely used in exploring new areas knowledge databases (Singhal & Jena, 2013).

In this study, with the assistance of widely-used content analysis software Nvivo 10.0 and data mining toolkit WEKA, the contents of worldwide travel blogs and online archives were retrieved, coded and analysed. The sources of these electronic archives were mainly from astronomy-related websites, online libraries, observatories, museums, tourism organizations and astronomy associations. Descriptive textual and image contents were saved and filed. Frequencies and mean analyses which described the astronomy tourist market were calculated. Astronomy tourists' group profiles, individual preferences, and popular tourist attractions were also investigated.

(3) An Auxiliary Method: Phone Interviews

Although accessing archival data via netnography from online virtual communities is inexpensive, efficient and focused, there are still some limitations in this process. For example, researchers cannot direct the content of informants' text or validate the authenticity of the respondents' claims in the written materials (Mkono, 2012; Mkono & Markwell, 2014; Wu & Pearce, 2014a). Hence, as a supplement to netnography-based studies, in-depth and semi-structure interviews were conducted to investigate focused issues and collect comprehensive data to support the research. Following the contact information left on the blogs and social media, informants were selected and invited via emails to participate in phone interviews upon their willingness. These participants were chosen from different countries and continents respectively to ensure a global perspective of the study and a reasonable extensive phenomenon sampling process. Two subjects of questions were asked to the willing participants: (1) motivation to take astronomy- related travels and, (2) involvement milestones in their astronomy tourism travel career.

3.3.3 Sampling and Selection of Blogs

In terms of Kozinets' typical netnographic analysis procedure, this study began by identifying appropriate social media channels and online virtual communities where the informants are actively involved in posting their astronomy tour experiences. Blog users who only browse and comment, and corporate websites on which the astronomy tour commodities are merely advertised, were not the targets of this study. Therefore, three categories of virtual community channels were selected as cross-national sample sources of the netnographic data: (1) astronomy travellers' blogs worldwide, (2) international, national and regional astronomy club's or society's online forums, and (3) social media (Facebook, Twitter, Instagram and Weibo) where participants posted detailed text and image style descriptions about their astronomy travel scenarios.

According to Kozinets (1999, 2010) and other tourism research pioneers who are interested in appraising and adopting netnography (Wu & Pearce, 2014a; Wenger, 2008; Mkono, 2012), the data collection procedure offers a focus on voices from the '*devotees*' and '*insiders*' instead of '*lurkers*' and '*minglers*'. Thus, astro-tourists' detailed travel stories from personal blogs or public forums, Facebook posters, Twits and other social media articles written in French, English, Spanish, Japanese, Korean and Chinese about their astronomy tour experiences from the 1990s to the 2010s all comprised the data for the study.

With the assistance of non-English speaking specialists, the content of the texts written in other languages were translated into English. Meanwhile, the blogs were screened out from the further recognition if: (1) they simply introduce astronomical knowledge about celestial phenomenon or events, (2) they only posted questions or inquiries about astro-tours or campaigns, (3) they simply announced astronomy-related news, forecasts or club event affairs, (4) they only had photos and other images in the content but insufficient text, or (5) informants did not pay a visit to a particular place which was away from their residence but only participated in the astronomical activities near their homes. In a word, only rich informed travelogues and abundant descriptive postings were selected. Finally, 244 were accessed to meet the requirement of this study with a sample of 188 from personal blogs and online forums, and 56 postings from social media. Individual profiles for each informant, and demographic data, both textual and visual information relevant to travellers' motivation attributes were also extracted and coded for these 244 units.

The abundant textual and pictorial data extracted from 188 blogs and 56 social media posters in the six languages (Chinese, English, Korean, Japanese, French and Spanish) enabled the investigator to build a panoramic global map of foundation information of astronomy tourists' demographic profiles (see Table 3.1). It suggests that the majority of astronomy tourists who posted their travel stories online were relatively young (41%

of them are under or in their 30s). Seniors (above 60) were the second largest age group (25%) of astronomy travel blog writers. There was a rapid growth in the number of posted astronomy tourist's stories in the past three decades as a dramatic increase was discovered in blogs and social media posters (3 in 1980s, 11 in 1990s, 106 in 2000s and 124 in the first half decade of 2010s). For astronomy tourists, enthusiasts from astronomy clubs or association peers were the first choice of travel companions, and an overwhelming number of them had official membership with astronomy societies or clubs. The explanation may lie in the travel grouping patterns, as the study revealed that 39.8% of the astronomy tourists were travelling in groups which were organized by astronomy clubs. In addition, most of them were travelling with their own astronomy apparatus such as telescopes, binoculars or digital cameras (69.3%). Some were even equipped with multiple professional devices (23%), with which they can observe and take photos of the starry skies simultaneously.

Based on the netnographic data, this study also revealed that informants stay for 4.2 days on average for a single visit. People who stay for 2-3 days make up the highest proportion (22.1%). Most astronomy tourists travelled inside their own nations while 33.2% had ever travelled overseas to chase the astronomical wonders. Asia and North American were the two largest tourist regions for tourist origins (27.9% and 22.9% respectively), whilst the proportion of astronomy tourists from Europe (21.3%) and Oceania (13.6%) were also notable. By looking at the primary attractions of the astronomy tours, pursuing solar eclipse and aurora experience were the dominant reasons for travel. The study also revealed that besides astro clubs or societies, astronomy group tours were advertised and organized by the tourism commodity suppliers, including travel agencies and destination sectors. Self-organized group tours with families and friends were popular as well.

Table 3.1 Demographic Profiles of 244 Astronomy Tourists' Online Ethnographies

Factors	Items		Counts	Proportion (%)
Gender	Male		139	57.0
	Female		105	43.0
Age group	Unspecified		25	10.2
	Under 30s		54	22.1
	30s		46	18.9
	40s		28	11.5
	50s		30	12.3
	60s and above		61	25.0
Year of travelling	1980s		3	1.2
	1990s		11	4.5
	2000s		106	43.4
	2010s		124	50.8
Travel companion	Travel alone		28	11.5
	Travel with friends		42	17.2
	Travel with family		14	5.7
	Travel with partner		23	9.4
	Travel with astronomy club members		157	64.3
	Unspecified		3	1.2
Membership	Astro-club members		169	69.3
	Non-members		53	21.7
	Unspecified		22	9.0
Equipment	Telescope(s) or binocular(s)		98	40.2
	Camera(s) only		71	29.1
	other equipment		56	23.0
	Without astronomical rigs		13	5.3
	Unspecified		6	2.4
Length of Stay	No more than 1 night		37	15.2
	2-3 nights		54	22.1
	4-5 nights		45	18.4
	5-6 nights		38	15.6
	No less than 7 nights		49	20.1
	Unclarified		21	8.6
Destination	Domestic		163	66.8
	International		81	33.2
Tourists' Origins	North America		56	22.9
	Latin America		24	9.8
	Asia		68	27.9
	Europe		52	21.3
	Africa		11	4.5
	Oceania		33	13.6
Travel Organizers	Group Travel	Travel agencies	39	16.0
		Self-organized	64	26.2
		Organized by associations/clubs	97	39.8
		Organized by tourist destinations	16	6.5
	Independent Travel		28	11.5

Additionally, the researcher also initiated interactions with 14 international bloggers as well as social media article posters who can be regarded as online ‘devotees’ and ‘insiders’ (Kozinets, 2002). Both semi-structured and structured interview procedures were implemented via emails and interviews through telephone as recorded live conversations. With the further communication, their identities were confirmed and the authenticity of the respondents’ viewpoints was verified. Additionally, they were screened from other blog posters by two key criterions: (1) they had rich information and experience in their astronomy-related travelling stories and, (2) more importantly, they had kept posting their travel blogs constantly for a long period of time. These criteria ensured that they can provide trackable scenarios and content for investigating travel motives and tracing their travel involvement history through a longitudinal approach. This part of the interview data was also coded and analysed through Nvivo.

3.3.4 Data Coding and Analysis: Manual Methods and Toolkits

This research mainly applied a qualitative empirical approach with the assistance of textual analytic software Nvivo 10.0 and Leximancer 4.0 in coding and analysing netnographic data. Supplementary manual coding and content analysis were used as well. Nvivo has been utilized to code and analyse qualitative data in social science empirical studies for many years (Dwyer, Gill, & Seetaram, 2012). It allows analysts to work with content in documentary memo, datasets and web content, as well as audio and video materials. For this study, the researcher manually established 244 profiles derived from blogs and posters and then input them all into Nvivo to run coding queries and analyse demographic statistics, thus profiling the identities of astronomy tourists.

Translating descriptive texts into quantitative data and coding qualitative data are always difficult and time consuming. For this reason, a codebook (appendix VII) was manually compiled in a pilot study to subsequently assist and help classify astronomy tourists' travel blogs' text and photographs. A qualitative data analytic procedure based on manual coding approach was adopted to establish the codebook. Specifically, within Nvivo, quotes from blog users were identified and extracted, and then codes were analytically generated and inductively added to the data. These codes were associated with clear content. Next, the codes were transformed into categorical labels or themes, and were subsequently classified. Later on, similar patterns, phrases, relationships, commonalities or disparities were identified to examine the sorted materials and then isolate meaningful patterns and process. Finally, the grouped themes were considered in the light of previous research theories and a summary developed.

To code descriptive and textual blog contents into qualitative data, Leximancer (the 4.0 edition) was also utilized in the study. Leximancer is a word-based software tool and a new technical toolkit for translating lexical co-occurrence information from natural words into semantic patterns. It helps researchers to analyse the text from words to meanings to insightful thoughts (Angus, Rintel & Wiles, 2013). It assists researchers to determine the main topics within the text by generating a concept map which indicates how topics build linkages to each other. In recent years, this toolkit has been increasingly used by tourism researchers in exploring tourists' experience through online blogs (Mkono *et al.*, 2015).

Leximancer, in netnographic analysis can illustrate the relationship among words, concepts and themes in the concept map, thus helping provide comprehension and insights about the natural language the astronomy tourists have used online. This study adopted the general analytical process of using Leximancer, which followed three main steps: (1) identify key themes and concepts by searching semantic information from blog texts; (2) illustrate and group branches of data into a graphical format called the 'concept map'; (3) explore the concepts through examining the text for deeper contextual relevance (Cretchley, Gallois, Chenery, & Smith, 2010).

As a result, forty-eight concepts in total were extracted from the qualitative data by the Leximancer program at the initial stage. By drawing upon the concept map, the overall online representation of the astronomy tourist group culture was interpreted. Next, textual materials were subsequently sorted into different groups according to the tourist's interests, and then loaded into the Leximancer program for further analysis. This step explored how astronomy tourists with different activity interests described their astronomy tourism experience.

3.4 RESULTS AND FINDINGS

3.4.1 Understanding the Market: a Global Perspective

(1) Describing Market Evolution: Timeline and Milestones

As stated in Chapter 1, astronomy-related travel, as a part of human activities and individual phenomena, originated long ago and has existed for centuries. However, for a long period it only attracted travellers from particular professional groups such as astronomers, astrophysicists, adventurers and explorers. Initially, a limited number of observatories were open to the public. They provided limited facilities exclusively to scientists for astronomical research purposes. The actual "astronomy tourism" market was born after World War II, when it grew from individual phenomena into a commercialized industry. By integrating data and knowledge mining results sorted by WEKA from related websites and online archives, Figure 3.1 below outlines the timeline of astronomy tourists market's evolution.

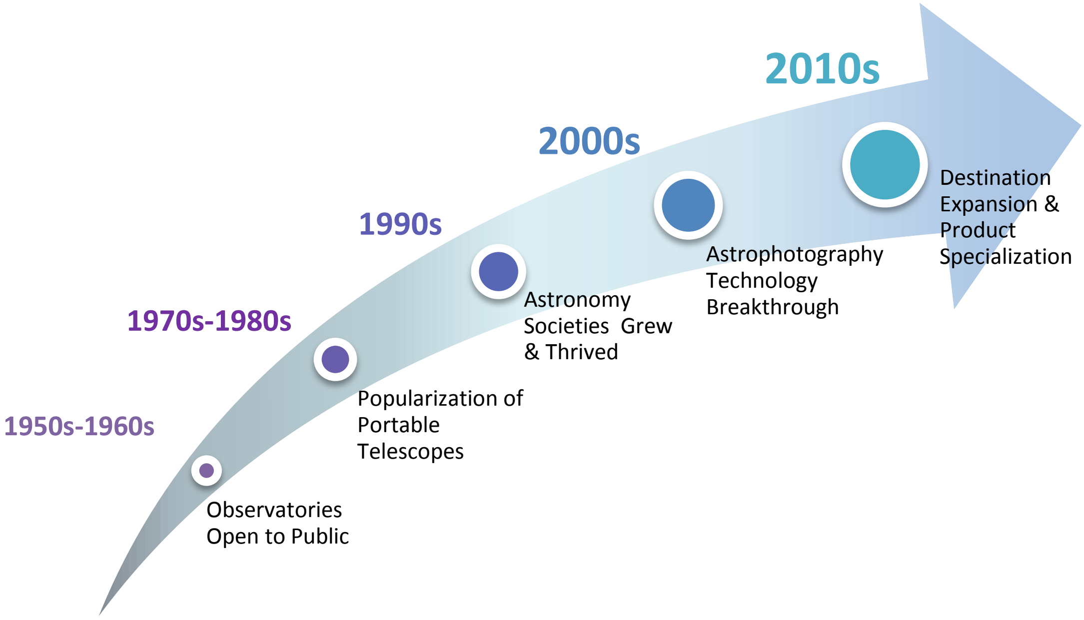


Figure 3.1 Milestones of astronomy tourism market evolution

Specifically, according to the data mining results, the post-war era between 1950s and 1960s saw an increasing number of newly established observatories (mostly in Europe and the United States). The domes were opened and the telescopes became available, showing ordinary citizens fascinating deep sky objects through the eyepieces (see Figure 3.2). Meanwhile, planetariums in Europe and America started showing imitation galaxies through planetarium projectors. The first group of visitors were in Vienna, Rome, Moscow, Milan, Hamburg, Chicago and Los Angeles. The Griffith Observatory[1] and the Adler Planetarium[2] represented two of the oldest public institutions as marketable astronomy tourist attractions. The number of visitors

[1] http://www.griffithobservatory.org/about/griffithobservatory.html
[2] https://en.wikipedia.org/wiki/Timeline_of_planetariums

gradually grew into thousands per year. As a consequence, visitors to observatories and planetariums became the first wave of regular astronomy tourists, and it was in Europe and America that the market started booming.

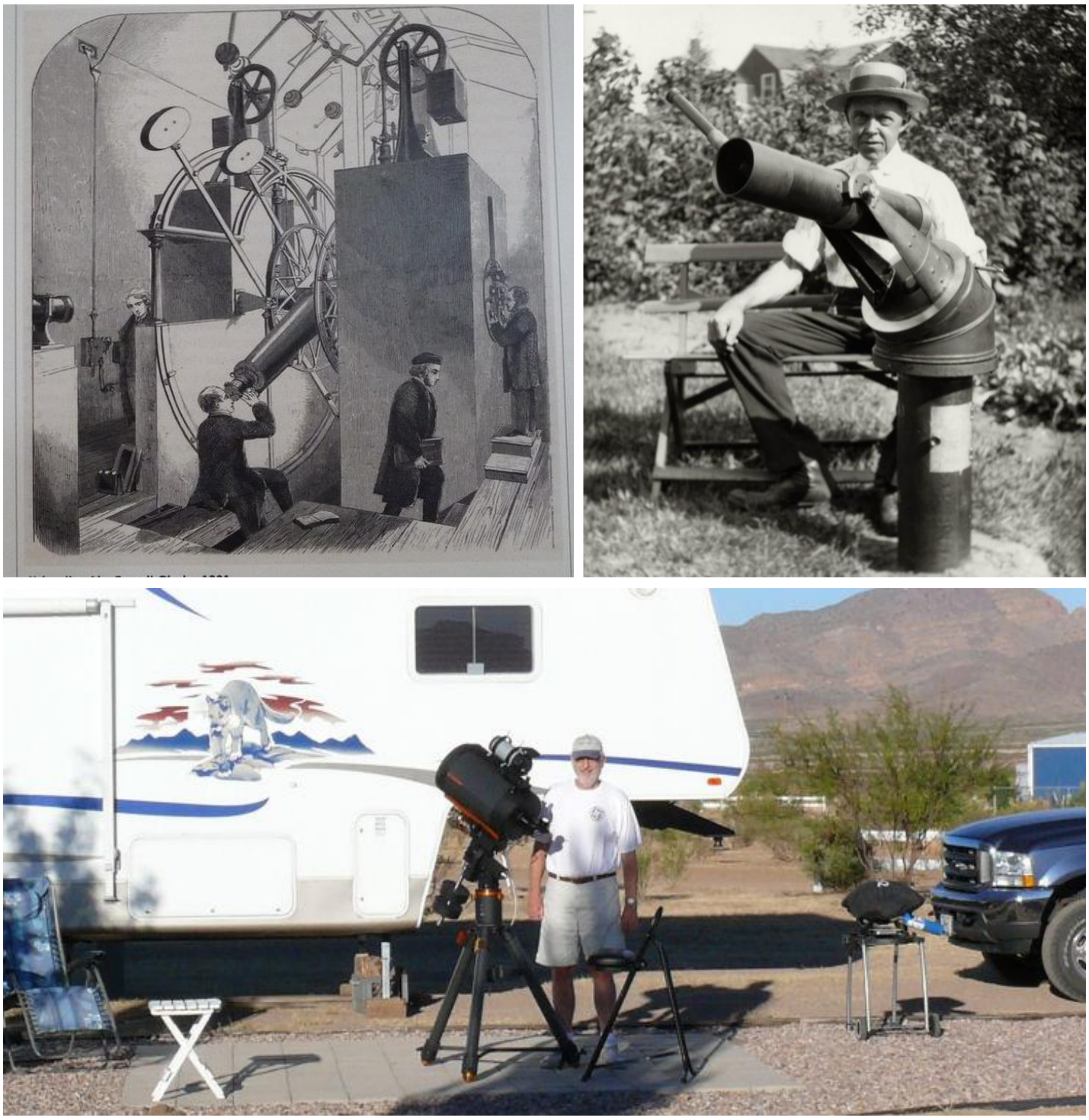


Figure 3.2 The evolution of telescopes and the mobility of astronomy travel

In the 1970s and 80s a revolution in the observational equipment occurred. Boosted by the growing needs for mobile stargazing, more portable and cheaper telescopes were invented by enterprises such as Meade[1] from USA and Takahashi from Japan[2]. As a result, former observatory visitors were able to carry and set up their 'mobile observational stations' anytime during their trip wherever they arrived (see Figure 3.2). They no longer had to adhere to the limited opening hours and stationary venue of official observatories. This revolution expanded the geographical range of tourist destinations and the physical territory of astronomy-related activities. The changes also reshaped the travel patterns of astronomy tourists. In particular, the declining cost of astronomical telescopes, to some extent, enabled widespread purchasing of portable observational appliances, which brought citizens closer to the stars and inspired the public's interest in amateur astronomy and travel.

The number of amateur astronomers grew during the 1990s. People with the same interests organized themselves into clubs and regional organizations, variously called astronomy clubs, groups, societies or associations. Members periodically travelled for stargazing and shared astronomy knowledge and practical stargazing experiences. According to online data mining and statistical results, 56% (1246/2225) of the total number of astronomy-related civil organizations in the word were registered and founded within this decade; including 425 in Asia (253), Latin America (78), Oceania (57) and Africa (37). In the birth places of the astronomy tourism market, the numbers were Europe, 469, and North America, 352. Simultaneously, the decreasing international transport and accommodation costs allowed tourists to travel across nations and continents to chase peculiar astronomic spectacles, such as solar eclipses and auroras in Northern Europe and Alaska. Hence, some pioneers from astronomy clubs began to travel in groups globally as eclipse chasers or international aurora followers. Travel agencies and tourist destinations subsequently noticed the emerging

[1] http://www.meade.com/company/
[2] http://www.takahashi-europe.com/en/takahashieurope.about.php

niche market and started to develop tour packages particularly for total solar eclipses, the midnight sun and auroras, particularly in Norway, Finland, Sweden, Alaska and Northern Canada.

In the first decade of the twenty-first century the market moved into an accelerating period both because of these commercial developments and the digital photography revolution. Increasingly affordable and tech-advanced digital cameras transformed traditional astronomical 'observers' into 'photographers'. Apart from gazing the stars, tourists with digital cameras were more likely to take pictures of what they saw through telescopes – as they called it 'astrophotography'. Compared with film, digital photographic equipment allowed astronomy tourists without professional skills and experience to create better outcomes. Such tools assisted primary astronomy dabblers to become mobile astro-photographers. In order to capture higher quality photographs for posting online or joining photo contests, many individuals were motivated to travel for better weather conditions, less light pollution and prettier landscapes in different locations. The destinations with better visibility ('dark-sky') were obviously target destinations for taking better photos. It is these factors that have driven amateur astro-photographers and astronomy group members to travel more frequently. Specific places are well-known as regular-astronomy destinations, and some of them are assigned as dark-sky reserves or parks by the International Dark-sky Association (IDA).

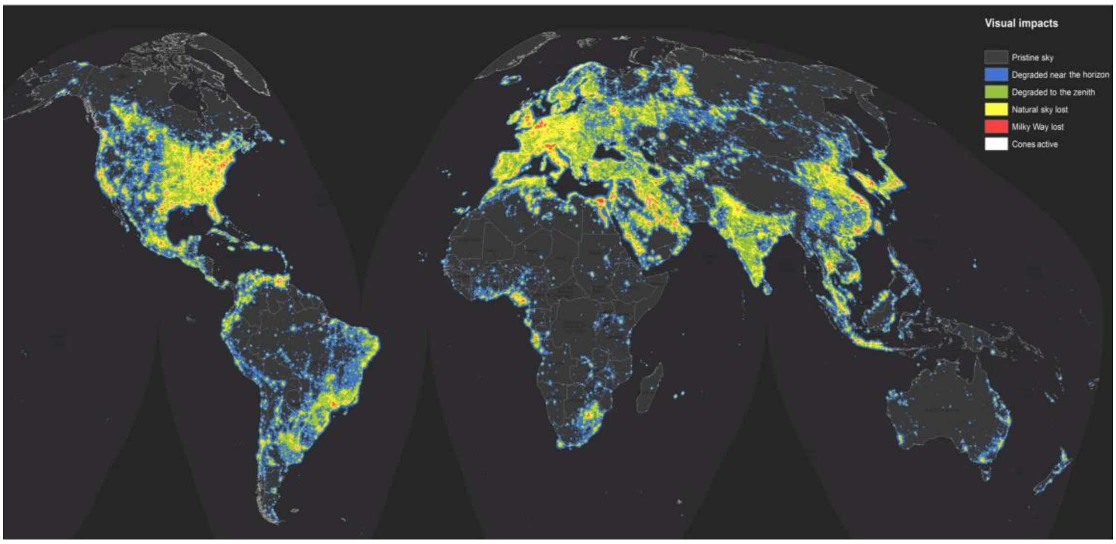
In the second decade of the 21st century, the astronomy tourism market became more mature due to the process of product specialization and the expansion of tourist destinations. Online virtual communities had experienced a substantial development as social media and social networks reshaped contemporary tourist behaviours and the entire tourism industry (Chua, Servillo, Marcheggiani, & Moere, 2016; Lyu, 2016;

Mariani, Di Felice, & Mura, 2016). Astronomy tourism was a part of this change. With the effect of social media, a growing number of astronomy tourist destinations and related activities were promoted to mass audiences, and increasing travel opportunities were organized by astronomy clubs with diversified themes and targets in new places. New markets emerged and thrived in Eastern Asia, Africa and Latin America in particular. Besides the accumulating travel experience, astronomy tourists had divided their interests and reinforced their specialities. Accordingly, travel agencies and local tourist destinations reacted to the market demands and developed specialized tours. Such development will be discussed in the next section as product classification and market segmentation.

(2) Mapping the Market and Resource Distribution

Before describing the world astronomy market distribution on an atlas, it is necessary to understand the power source which drives astronomy enthusiasts to travel - dark skies. Except for solar eclipses which never take place in nocturnal skies, or diurnal visits to observatories or planetariums, dark skies are overwhelmingly the major astronomy tourism resource (Weaver, 2011). The existence of dark skies shapes the travel of astronomy tourists, especially for stargazing, aurora watching and meteor shower seeking. The uneven geographical distribution of dark skies and demand from populated markets lead to the spatial separation between the origins and destinations of astronomy tourists. This gap shapes the traveller flows from bright urban areas to less light-polluted rural places with purely dark skies. The markets with the strongest demand are from those regions with the world's brightest night-skies.

In Figure 3.3 the atlas reveals that more than 80% of the world and more than 99% of the U.S. and European populations live under light-polluted skies. The Milky Way is hidden from more than one-third of humanity, including 60% of Europeans and nearly 80% of North Americans. Moreover, 23% of the Earth's surfaces between 75°N and 60°S, 88% of Europe, and almost half of the United States experience light polluted nights. It is significant to see that the regions with the most light-polluted dark skies, to a large extent, are normally the markets with the highest astronomy travel demand. This fact explains why European and American markets have become the dominating origins of astronomy tourists as they have the brightest night sky without the starry Milky Way. The same effect also occurs in East and South Asia, Eastern Oceania and Latin America.



Source: The new world atlas of artificial night sky brightness, by Falchi et al. (2016).

Figure 3.3 Map of light pollution's visual impact and dark-sky resources

Table 3.2 provides data profiling that Europe and North America are overwhelmingly strong markets. They have more than half of the world's total number of astronomical organizations (such as astronomy clubs, societies and associations which are homes for the dominating population of astronomy tourists). More than 55% of public observatories and planetariums, and more than 92% of the IDA (International Dark-sky Association) certified places as the most-visited stargazing destinations are also located in Europe and North America, making them the world leading astronomy tourist destinations. These two continents also possess the largest number (60%) of diversified tourism products from 61% of the world's professional astronomy tourism corporations.

Table 3.2 Industrial statistics for global astronomy tourism market distribution 2016

Categories & Quantities		Europe	North America	South America	Asia	Oceania	Africa	Total
Astronomical organizations (societies/clubs/associations)		652	484	221	577	231	60	**2225**
Virtual communities (social network groups/ forums)		551	743	354	812	369	191	**3020**
Public observatories & Planetariums		249	205	81	186	79	21	**821**
IDA places (reserves/parks/ sanctuaries/communities)		19	45	1	1	2	1	**69**
Astronomy tourism commercial product providers		55	72	18	49	11	2	**207**
Typical Products	Stargazing tours	42	91	12	26	33	7	**211**
	Aurora package tours/cruises	35	11	1	2	2	0	**51**
	Solar eclipse tours/cruises	18	11	2	4	5	3	**43**
	Astronomy-related educational tours	18	37	9	20	14	6	**104**
	Astronomy theme parks/holidays	6	15	3	1	4	0	**29**
	Astronomy B&Bs hotels or Inns	27	58	8	36	21	3	**153**

Note: integrated from WEKA data mining results based on retrieving over 5,500 websites and 1,200 online archives in 2016. Oceanian data are limited to Australian and New Zealand only.

Though these two markets have been developed since the 1950s, they both originally designed similar products such as aurora/solar eclipse cruise tours, astronomy theme parks / holiday parks, and astronomy-themed accommodations. Select distinctions in their specialized products in different regions do exist. For instance, Northern European countries like Norway, Iceland, Finland and Sweden are mostly well-known as astronomy tourism destinations for their aurora hunting, as is Alaska in the United States, while dark-sky parks in United Kingdom and Colorado regions greet visitors for stargazing and capturing astro-photographs.

Markets are now rapidly developing in Asia, Latin America and Oceania. In terms of virtual astronomy communities in the world, including groups from social media and social networks, online forum and internet BBS (Bulletin Board System), Asia has a substantial proportion (27%). This region has the biggest potential for new consumers. They appear to be relatively enthusiastic and active in discussing astronomy topics online with many emerging possibilities to undertake astronomy-related travels. Japan, Korea and Greater China constitute the major markets in Asia, where stargazing and astronomy educational programs for students bring most tourists. In South America, Australia and New Zealand, markets started developing earlier than Asia. Chile and Brazil are the dominant markets in Latin America and are world-famous for their high-altitude observatories, while Australia and New Zealand have abundant starry dark-skies which attract world-wide stargazers to view unique constellations which can only be seen in the Southern Hemisphere. By way of contrast, though Africa also possesses the world's darkest night-skies, it is limited in market size and industry development in nearly every aspect according to statistical data.

(3) Identifying Product and Activity Classification

Astronomy tourism products and activities can be grouped into four categories in terms of suppliers. The detailed classification can be viewed in Table 3.3 below.

Table 3.3 Astronomy tourism product classified by source of suppliers

Suppliers	Categories	Attractants: Product/Activities	Counts
Astronomical Organizations or Interest Groups (N=244)	Peculiar Astronomical Phenomena (N=138)	Solar Eclipse	49
		Aurora	30
		Meteor Shower	22
		Lunar Eclipse	11
		Transit of Venus	10
		Comet	6
		Transit of Mercury	5
		Occultation	3
		Opposition or Conjunction of a celestial body	2
	Regular Astronomy-related Activities (N=106)	General Stargazing or Astro-photographing	39
		Travel for Star Parties	28
		Observatory Visitation	11
		Astronomy-themed Holiday / Vacation	7
		Astronomy Conference/Forum/Convention	5
		Planetarium Visitation	4
		Astronomy-related Competition	3
		Full-moon excursion/hiking	3
		Meteorites Seeking	2
		Visit Astronomy-related historical Sites	2
		Witness Onsite Rocket Launch	2
Tourist Destinations	Stargazing Tours / Excursions / Packages		211
	Observatory / Planetarium Visits or Guide Tours		821
	IDA Park/Reserve Visitation or Accommodation		69
Travel Agencies	Aurora Tours or Cruises		51
	Solar Eclipse Tours / Cruises		43
	Astronomy-themed Recreational Parks / Holiday Packages		29
Local Communities	Astronomy Conventions / Educational Programs		104
	Astronomy B&Bs or Astronomy Inns		153
	IDA Certified Communities' visits and other services		11

Source: sorted and integrated by analysing WEKA data mining results and netnographic statistics.

The astronomy tourism market mainly consists of four types of products supplied by four different organizers respectively. They can be identified as: (1) the 'club-type', which is organized by official astronomy-related organizations (e.g. registered clubs, societies and associations) or unofficial groups with shared astronomical interests; (2) the ‘destination-type’, which is supplied by particular tourist destinations, such as observatories, planetariums, stargazing tours in IDA certified parks/reserves or other dark-sky areas; (3) the ‘travel agency-type’, which is offered by corporations specialized in operating three kinds of astronomical tours – chartered cruises or planes for aurora hunting, eclipse chasing, and holiday packages with an astronomy theme, mostly in holiday parks or RV camps; (4) the ‘community-type’ goods, this includes astronomy-themed B&Bs, inns or hotels, educational programs or conventions hold by local communities, and some private or self-organized chargeable guide tours open to tourists and served by local individual amateurs or astronomy interest groups. In addition, the ‘club-type’ activities are not actually commercial goods, unlike the other three types which are supplied as profitable tourist products. Club activities are normally self-organized and involve spontaneous travels. During such trips these independent or group tourists use transportation, accommodation, buy entry tickets, food and have other experiences. Amongst all the four types, it is notable that the destination-type and the local community-type are relatively consistent sources for tourist destinations, while the other two types are mobile since physical venues change due to visual conditions, aperiodic occurrence, or uncertain location of the attractants, especially solar eclipses and auroras.

By using a content analysis approach through Nvivo 10.0, key words and concepts regarding astronomy tourism products and activities were distilled, analysed and calculated. Frequencies, supplemented by manually screening every sentence in the content of blogs and posters provided data. Results of the content analysis are presented for the club-type product section in Table 3.3. Using Nvivo, club-organized or self-organized travels were studied from 244 online ethnographies. There were two categories of astronomy-related attractions: either to witness nine sorts of peculiar phenomena or experience eleven types of regular astronomy-related activities. In terms of popularity, travelling for solar eclipses, auroras and meteor showers were the top-three attractions among astronomical phenomena, while stargazing and astro-photography, star parties and observatory visiting were revealed to be three of the most attractive activities that motivate travelling. Further data based assessment of these points will be considered through questionnaire-based surveys and quantitative data analysis in Chapter 4.

(4) Describing Market Segmentation

The segmentation of the global astronomy tourist market can be described with the support of the netnographic data. Seven branches can be drawn from the market panorama, and they constitute seven major market segments or submarkets: (1) stargazers; (2) eclipse chasers; (3) aurora hunters; (4) observatory visitors; (5) meteor seekers; (6) star party travellers; and (7) other interest followers, including tourists who have particular enthusiasm in seeing rocket launches or the midnight sun, experiencing full-moon hiking and starry night excursions. The scale of each submarket is not able to be measured or evaluated by the qualitative netnographic data. However, descriptive analysis can be conducted to present different interest groups' neo-tribal culture, and they can be characterised as 'subtribes' in terms of divided tourists' predilections, identification and lifestyle. This approach is presented in the following sections 3.4.2 and 3.4.3.

3.4.2 Group Identities: Profiling the Astronomy Tourist Neo-tribe

This part of the results aims to determine the extent to which astronomy tourists can be identified as members of a neo-tribe. The section seeks to interpret the symbolic and behavioural characteristics of astronomy tourists. Although astronomy tourists have distinctive interests in diverse astronomical wonders, and hence are subdivided into different customer submarkets and subtribes, in general, some common indicative characters of their neo-tribal culture still distinguish them from general-interest tourists. These characteristics can be regarded as identifiers of the astronomy tourist neo-tribe and will be specified as symbolic and behavioural characteristics in the following paragraphs.

(1) Symbolic characteristics of the astronomy tourist neo-tribe

- ***Collective sentiment***

According to Bennett (1999), collective sentiment or affectivity is one of the essential links for bonding members together into a neo-tribe. In the case of astronomy tourists, two types of sentiment are found in their travel stories: (1) shared interest in astronomy, and (2) strong feelings of fellowship during travels.

Among astronomy tourists, a collective symbolic sentiment described by many informants in the content of the travel blogs is the mutual interest in astronomy knowledge, observational practice, or astro-photography. Such interests are shared by members despite their diverse demographic markers such as class, age, nation, income and ethnic background. It is the abandonment of their more standard social identity symbols that brings members a sense of belongings to the neo-tribe. This explanation has synergies with the notion of what sociologist called '*communitas*' (Turner, 1974) and neo-tribalism (Bennett, 2011) – in particular, the definition of 'neo-tribe' by Maffesoli (1996). That is, there is a clear view that people come from different walks of life. This finding also suggests a consistency with Hardy's study of RV traveller neo-tribes (Hardy *et al.*, 2013).

By considering the netnographic data, it is notable that the shared interest is underpinned by the strong enthusiasm which emerges from astronomy tourists who are eager to explore natural novelty and pursue really rare astronomical phenomena. The feeling of fulfilling one's lifetime dream was frequently described by informants in their travel blogs. Indeed, it is the rareness and peculiarity of some spectacular phenomena that propel astronomy enthusiasts. Even the people with little knowledge or interest about being in a tourist crowd, travel for a long distance to witness the wonders that could only occur once in one's lifetime, such as the Transit of Venus, Halley's Comet and some solar eclipses.

Beside the shared interest, the concept of fellowship, which supports members with the sensation and perception of belonging to a group, is also an indispensable aspect of sentiment that ties astronomy tourists into a neo-tribe. According to textual contents from the travel blogs, the emergence of close fellowship mostly came from the experience of astronomical observation activities and associated travels with other members. A significant advantage of being a member of the "tribe" was often identified. In particular, if members were linked to an official astronomy-related organization (e.g. astronomy club, astronomy society), rather than from a transient self-organized travel group, they were more likely to obtain support, assistance and protection from other group fellows. It can be argued that it is the fellowship that makes them feel safer and more supportive. Similar conclusions were drawn by Hardy *et al.* (2013) in the context of assessing road travellers.

Additionally, the feelings of freedom from routines and escaping from the urban crowd are also valued by astronomy tourists as two important aspects of shared symbolic sentiment. The flexibility and spontaneity of astronomy-related travels allow neo-tribal fellows to relish a sense of freedom and, whether registered astronomy club members or not, to enjoy natural scenery and peace away from modernized urban areas and daily life.

- ***Lifestyle***

Lifestyle, as a concept advanced by neo-tribal theory, is one of the most distinctive symbols for understanding how the neo-tribe's identities are constructed and lived out (Bennett, 1999, 2000). In this study, underpinning the concept of astronomy tourists' lifestyle is the diverse motivations to experience different astronomy phenomena or to participate in various astronomy-related activities. The occurrence of flows between different identities under different lifestyle is evident in tourists' online ethnographies. There is fluidity among "sub-tribes" in membership and lifestyle.

Specifically, the majority of astronomy travellers are 'part-timers' who are 'dabblers' and 'enthusiasts' in terms of their lifestyle involvement. In particular, they are eclipse chasers, aurora hunters, meteor seekers or observatory visitors, who often travel to experience aperiodic or unpredictable events due to changing weather conditions and varying visibilities. They return to daily normalities soon after the travel ends. In contrast, 'full-time' lifestyle travellers are normally from stargazers and star party followers. They often travel on the road every single day as long as visibility or time allows, searching for good weather, capturing great pictures and sharing a 'fulltime stargazing life' with other travel companions. They are usually astro-photographers who are a distinctive group of astronomy travellers with a unique and fluid lifestyle. They may possess multiple interests in different astronomy events or attractions. However, the lifestyle of different interest groups is evidently not fixed but fluid according to their focus of interest and degree of involvement. A part-time solar eclipse chaser can possibly be identified as a fulltime stargazer as well as an astro-photographer. Over time, a part-time stargazer initially regarded as a dabbler can also step into a lifestyle with all their spare time travelling every day to capture astro-photos.

(2) Behavioural characteristics of the astronomy tourist neo-tribe

- ***Signifiers***

The overriding signifier by which all groups of astronomy tourists can be identified and characterised is astronomy-related equipment, in particular, telescopes, binoculars and astro-photographic cameras. One can still enjoy stargazing through the naked eye, yet a tourist with the specialized equipment for astronomy purposes are potentially and most likely to be labelled as an astronomy traveller by others. The statistical data also demonstrates that more than 90% of the informants are equipped with either a telescope or binoculars. By the grade or brand of telescope and cameras, one can also be classified as a professional astro-photographer or an amateur.

Apart from telescopes which differentiate members from other special interest tourists, another key signifier existing in the astronomy tourist neo-tribal culture is the private vehicles that the members use. This enables neo-tribal members to be seen as distinct from other home-based astronomy hobby pursuers and hence to be named astronomy 'travellers'. The possession and using of a private vehicle not only allows tourists flexibility in time and destinations while travelling, but also offer them possibility to carry astronomical equipment and travel independently or in groups.

In addition, members of astronomy tourism neo-tribes are also labelled by signifiers in the form of language. Either in the virtual communities online or the physical scenes offline, they share common jargon or terms which are incomprehensible to outsiders and necessary for interaction within the tribes. Some frequently-used language are summarised and interpreted by the research. From the language usage in term of frequency and users' identity, we can conclude that: (1) the more experienced the members are, the more frequently they use special terms; and (2) the majority of professional terms are used in describing three topics – astronomical equipment, astrophotography (including the pictures and their capture procedure), and the particular astronomical phenomenon they seek to view. Language performs as a clear signifier to differentiate new acquaintances from insiders, quickly identifying the individual as a novice or as an experienced member of the neo-tribe.

- ***Scenes***

With the usage of signifiers, the conceptualized 'scene' emerges as a stage where neo-tribe members gather and present their collective identities and enact their lifestyles (Bennett, 2000, 2011; Cova *et al.*, 2007). In this study, the scenes of astronomy tourist tribes consist of multiple places and vary with the tourists' activities. Taking stargazers for example, IDA certified parks and reserves are the ideal scenes, but in reality, many pay visits to dark sites as regular destinations which are not far from their homes yet away from urban lights. In this case, typical scenes which can evidently represent and identify their tribal culture is the presence of a group of people with telescopes and photographic equipment standing under a starry night sky, talking about constellations and with each holding a red-beam torch (see Figure 3.4).

Figure 3.4 Typical Scenes of Astronomy Tourist Neo-tribes

For eclipse chasers, the scene is totally different. They never have fixed locations for observing the spectacle due to the variability in the places where the phenomenon occurs. Instead they travel widely to view and capture the astonishing but transient darkness at daytime. They may still have telescopes yet the images are different from stargazers; in this case they must wear a filter or put one on top of a telescope to protect eyes. Such tourists often prefer places with a high altitude and unobstructed horizons. Weather is always a paramount but challenging restrictive condition which becomes the central topic while they are waiting for the event of interest.

The online virtual community is another form of the astronomy tourist neo-tribal scene. Astronomy tourists have begun using the internet-based forums on club's websites since the 1990s. Social media such as Facebook groups are the primary virtual communities where the group communications, knowledge exchanging and experience sharing among members take place. Compared to tangible scenes which are relatively closed to tribe members, they are open as a platform whereby their neo-tribal culture is presented publically and can be readily accessed by other tribes or communities.

- ***Rituals***

Rituals as key behaviours of astronomy tourist neo-tribes can be found in their travel stories. Two typical rituals exist in their tribal culture: star parties and astronomy conventions (see Figure. 3.5).

Star parties are mentioned and described as a form of popular ritual which is usually offered by clubs or societies. They are for new members to make friends, to share astronomy knowledge and practical observation skills, and to observe or capture the night skies with other comrades. Such parties often take place at night-time at a dark site where activities are similar to the stargazing scenes. During the ritual, cults or etiquette such as welcome introduction, group-photo taking, constellation pointing and storytelling, are normally passed among club members. In contrast, astronomy conventions as tribal rituals are organized by official astronomy institutes or associations at a more formal level with a scientific educational goal. An astronomy expert is often invited to give a seminar or a lecture during this ritual, and participants share more theoretical astronomy knowledge at the convention than at star parties. In addition, telescope producers or retailers are sometimes invited to the convention, which is effectively an equipment trade market.

Figure 3.5 Star party and astronomy convention as two forms of neo-tribal rituals

3.4.3 Interpreting Online Representations of Astronomy Tourists

This section addresses the third aim of the study. It seeks to interpret the overall online representations of astronomy tourists as a neo-tribe by answering questions such as:

- *What activities do they describe that they have participated in onsite?*
- *Which astronomy-related attraction(s) do mostly anticipate and pursue?*
- *What tourism settings do they discuss and concern about?*
- *What kind of pictures do they take?*

- *What do they learn from travel?*

To address these issues, two sets of methods are employed. Firstly, a preliminary study using Leximancer software was conducted to explore and determine the main topics and themes of astronomy tourists' online travel stories. Secondly, within the conceptual framework of the tourist experience of the five-phase model initiated by Clawson and Knetsch (1966), a further netnographic approach using manual coding was employed to present a panorama of their overall astronomy travelling experiences.

(1) Results from Leximancer Analysis

By running the Leximancer 4.0 program, forty-eight concepts were identified at the first stage. Not all of them are presented in the subsequent results as it is important to adjust the original concept list. The concept map (Figure 3.6) was generated to reveal the most general themes and notions found in the astronomy tourists' online text contents, as well as the frequency of their occurrences and co-occurrences. The figure illustrates concepts (small grey nodes) which are clustered into themes (larger bubbles in several colours). Specifically, the themes of "visibility", "solar eclipse", "equipment", "tour", "transportation" and "celestial bodies" are identified as six prominent topics representing the overall travelling experience of astronomy tourists. The connectivity rates for these six themes are 100%, 83%, 44%, 17%, 14% and 6% respectively, and these connectivity percentages in Leximancer indicate the relative importance of the themes (100% presents the most importance). These scores are calculated by applying the connectedness of concepts within that theme to assess the importance of a theme within the whole date set (Leximancer, 2011).

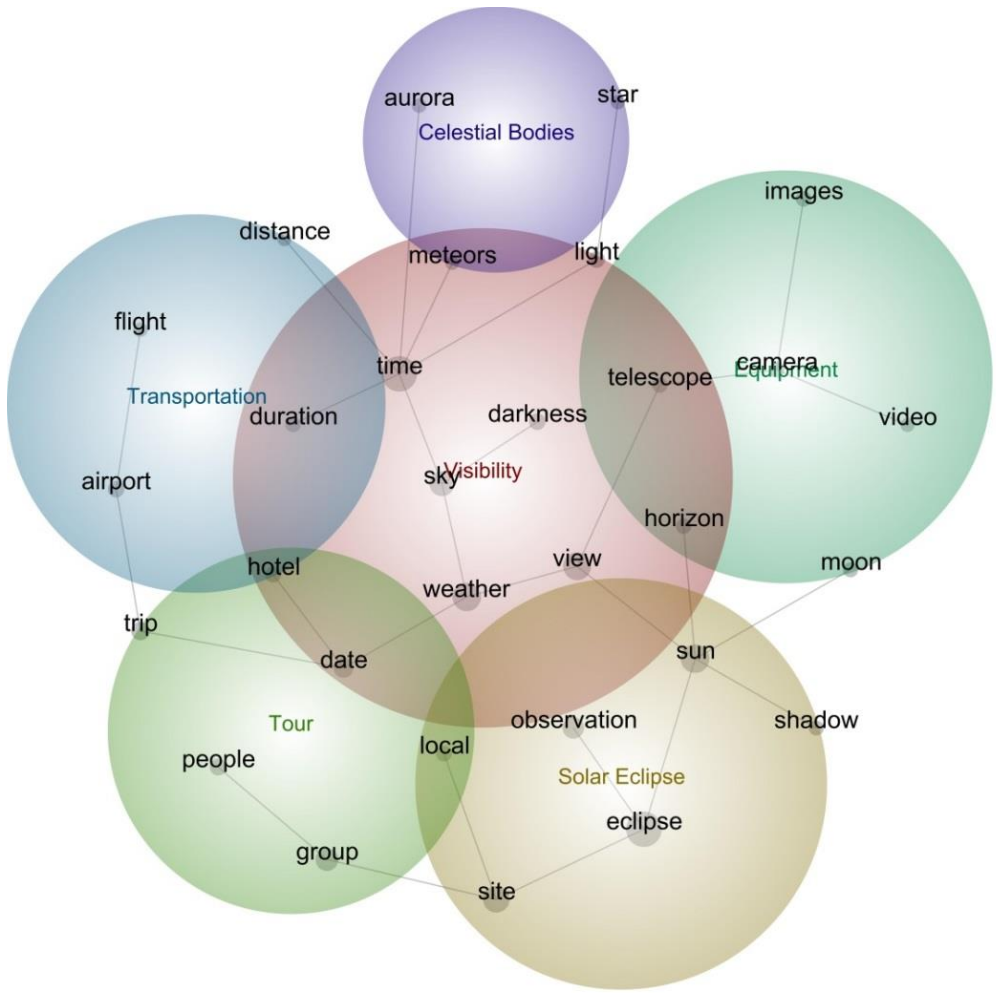


Figure 3.6 Main topics and themes of the astronomy tourists' travel blog contents

The theme of "visibility" appears as the first priority topic discussed in astronomy tourists' travelling stories. This theme consists of tourists' concerns about the time and duration of the astronomical phenomena taking place, and is also associated with their attention to the local weather condition, atmosphere stability, observational viewpoint (horizon is unobstructed and flat) and darkness of the sky (less light pollution means better visibility). It can be readily understood why visibility becomes the centre of the other five connected themes. It is because this factor is indispensable as a basis for an astronomy tourist. It is also a hot topic to talk about during the trip since visibility varies over time. In other words, good visibility is always the main reason and first concern for astronomy tourists.

Closely connected to “visibility” is the concept “Celestial bodies” which astronomy tourists have seen. The top three astronomical objects they have noted are aurora, meteors and stars, which become the most popular astronomical attractions among astronomy tourists. “Solar eclipse” appears separately from other celestial bodies as the second strongest theme. It is closely connected to the issue of “visibility”. There are 49 out of total 244 blogs indicating “solar eclipse” as the first reason or major stimulate that drives tourists to undertake astronomy-related travel. The word ‘solar eclipse’ itself has been mentioned 188 times by these 49 blog posters, so it is clear that ‘solar eclipse’ is a rich theme with a large information base. Astronomy tourists describe the principle of this spectacular event, in several ways such as the “shadow” of the “sun” projects to a specific “site” on the earth.

The next theme which emerges in astronomy tourists’ experience is “equipment”. The concept refers to the materials used during observing or astro-photographing. The items “camera” “telescope” and “video” all represent the typical equipment and methods they possess and utilize to capture astronomy objects during the trip.

“Tour” is also an important themed issue among astronomy tourists in general. Merged with “trip” “travel” and “journey”, this concept was counted 232 times in the 244 blogs. It is necessary to be aware that the term “tour” mentioned here could be a self-organized independent travel, a group tour arranged by astronomy associations, or a commercial tour product supplied by travel enterprise with special marketing focus on astronomy tourism. Within the theme of “tour”, tourists most likely have an interest in reviewing the “hotel”, showing the “date” and time in itinerary, commenting on other "people" as travel companions in the same "group" or "local" residents and other tourism settings.

The last theme is the identification of the "transportation" astronomy tourists have experienced. The majority of them have the history of undertaking a "flight" for astronomy travel, hence, it is fairly reasonable for them to mention the "airport" they are at and the "distance" they are going to travel.

The findings clarify that the traveling experience of astronomy tourists centres on observing and photographing celestial bodies and astronomical spectacles especially solar eclipses. Visibility is the core concern and one of the driving factors for them to undertake an astronomy travel. Equipment such as telescopes and cameras are usually necessary for them to satisfy their special interest and enjoy the trip. Those with whom one travels are also important and influence the astronomy travel experience.

(2) Results from Directed Content Analysis

A directed content analysis approach was employed to review and code the travel blogs. Compared to other two types - conventional and summative approaches, the directed content analysis defines codes derived from existing theories or relevant research findings, rather than from data itself (Hsieh & Shannon, 2005). More specifically, the coding and content analysis tactics adopted in this study follows the Clawson and Knetsch's (1966) five-phase tourist experience conceptual model. Based on the definition approaches to the tourist experience reviewed in the literature, motivation and satisfaction are added as two stages to the start and end of the five phases. In summary this produces for seven topics: Motivation, anticipation, travel to site, on-site activities, return travel, recollection and satisfaction. Consequently, after having carefully read and manually coded 244 travel logs, 24 dominant topics were derived from 116 codes and sorted into seven phases (see Table 3.4).

Table 3.4 Twenty-four topics sorted from 244 astronomy travel logs

Phases(counts)	Topics (counts)	Detailed Codes	Counts
Motivation (702)	Internal purpose for traveling (516)	Escape	55
		Nature	62
		Novelty	82
		Special Interest in astronomy	45
		Self-actualization/development	26
		Nostalgia	12
		Relationship	84
		Recognition	39
		Relax	87
		Romance	24
	External drivers for traveling (186)	Visibility factors	61
		Geographic location	58
		Type of the attraction	51
		Rareness of the event	16
Anticipation (954)	Expected Astronomical phenomenon (436)	Solar Eclipse	241
		Aurora	94
		Meteor Shower	38
		Lunar Eclipse	22
		Transit of Venus	34
		Comet	2
		Transit of Mercury	1
		Occultation	3
		Opposition or Conjunction of a celestial body	1
	Proposed Astronomy-related activities (177)	General Stargazing	68
		Astro-photography	51
		Travel for Star Parties	14
		Astronomy-themed Cruise/Holiday/Vacation	5
		Observatory Visitation	16
		Astronomy Conference/Forum/Convention	12
		Planetarium Visitation	4
		Astronomy-related Educational Program/Competition	2
		Full-moon excursion/hiking	1
		Meteorites Seeking	1
		Visit Astronomy-related historical Sites	2
		Witness Onsite Rocket Launch	1

Phases(counts)	Topics (counts)	Detailed Codes	Counts
	Itineraries (341)	Travel route	182
		Travel timeline	159
Travel to site (1053)	Transportation they use (313)	Airplane	95
		Railway	53
		Private car	101
		RV	23
		Rental car	5
		Ship/Boat/Ferry/Cruise	14
		Helicopter	3
		Bus/Coach	17
		Bicycle	2
	Accommodation (294)	Premium hotel	14
		Budget hotel	64
		Resort	3
		Motel	2
		Hostel	48
		Camping	106
		RV- ing	23
		B&Bs/Guest house	10
		Friends' or relatives' dwelling	22
		Others	2
	Food & drinks (178)	Dining experience during travel	178
	Social communication (268)	With Local people	95
		With travel companions	43
		With travel guide/leader	46
		Anecdotes	84
On-site activities (2383)	Equipment/rig (408)	Telescope	141
		Binoculars	89
		Cameras	155
		Other astronomical devices	23
	Astronomy-related activities (980)	Naked-eye Observing	166
		Observing through equipment	224
		Astro-photographing	364
		Networking with others	152
		Star-parties/conventions	69
		Educational program	5
	Other activities (217)	Sightseeing nearby	141
		Bird watching	20
		Fishing	6
		BBQ	8
		Hiking/excursion	13
		Swimming	3
		Cycling	1

Phases(counts)	Topics (counts)	Detailed Codes	Counts
		Surfing	1
		Visiting friends or relatives	24
	Astronomical objects / celestial bodies (212)	Specific term or language used to describe celestial objects	212
	Physical Scenes (366)	Weather	156
		Light pollution	103
		Vegetation	38
		Wild life	25
		Terrain	44
	Perception of the activities (56)	Belongingness to a group	12
		Self-development	15
		Feeling of fulfilment	6
		Authenticity of the nature	23
	Affection during the activities (144)	Relaxation	34
		humility	11
		Reverence/respect to the universe	10
		Excitement	65
		Enjoyment	24
Return travel (132)	Social Networking (44)	Social Media interactions	16
		Physical interactions	28
	Shopping (17)	Shopping behaviour	17
	Transportation (66)	Transportation facts on way back	66
	Post-travel stories (5)	Other facts on the way back home	5
Recollection (211)	Travel history/career (23)	Stimulants for involvement	3
		Regular destination of traveling	2
		Travel distance	11
		When did they start the career	4
		Length of stay	3
	Learning outcomes (172)	Astronomical knowledge	72
		Observation or photography skills	49
		Personal travelling skills	51
	Blog posting (16)	The fact of posting blogs online	16
Satisfaction (184)	Satisfaction or dissatisfaction of the travelling experience (184)	The overall experiences	12
		Travel safety	58
		Service of the destination	18
		Facilities of the destination	27
		Convenience of the travel	39
		Comfort of the travel	16
		Accessibility to the destination	14

While reviewing 244 travel logs, there was a predictable repetition of themes and topics in the content of different blogs. Essentially, once these overlapping principal themes or guiding ideas were established, there would be little value for reading more stories due to the redundancy in the accounts. In this case, the frequencies in Table 3.4 were calculated from the times the relative sub-topic had been mentioned by every single informant, and hence the 'counts' were computed by the summation of all bloggers.

As revealed in Table 3.4, the topics describing astronomy tourists' travelling experience ranged from the beginning stage of travel to the end of recollection phrase. It is clear that astronomy tourists wrote most of their travel experience about the astronomy-related activities. They also used their blogs to describe the on-site activity phase, while the 'travel to site' phase received the second most attraction. The solar eclipse was the most frequently discussed as a travel expectation topic, and this is consistent with the analytical results conducted through Leximancer.

Based on the above content analysis, a framework for the questionnaire-based survey study can be constructed. The study in Chapter 4 will adapt and apply these topics to further explore individual astronomy tourist's travel experiences.

3.4.4 Exploring the Motivation of Astronomy tourists

Based on the descriptive data from the phone-interview and the manual-coding based content analysis, the 'push-pull' factor model initiated by Dann (1977, 1981) is applied to generally discuss why tourists choose to travel for astronomical attractions. Figure 3.6 reveals the key push-pull factors that encourage tourists to undertake astronomy travels either domestically or internationally. There are no hierarchical differences or importance ratings among these factors, but it can be proposed that they vary among tourists who are at a different stage of astronomy leisure involvement and astronomy travelling experience.

(1) Push Factors

As illustrated in Figure 3.6, the push factors are internally based and the key motives are considerably stable over an individual's travel career as well as closely comparable for different nationality groups (Pearce, 2011). The push factors extracted from the data of 244 online blogs by the netnography approach, as well as the data from 14 phone interviews with content analysis identified escape, romance, relax, relationship, pursuit of novelty, nostalgia, and recognition, appreciation of nature, self-actualization and "special interest in astronomy". Most of these motives are consistent with the elements presented in Pearce and Lee (2005) and Pearce's (2011) travel career patterns (TCP), although the patterns of importance of each motivation may vary for astronomy tourists. However, other than a core motive pattern of escape, relaxation, novelty, developing relationships and middle layer motive pattern of nature, self-actualization, which are revealed in other general tourist motivation studies, the distinctive push factors for astronomy tourists do appear as recognition, romance, and nostalgia. These findings suggest that astronomy tourists' motivation pattern is a hybrid and complex system, in which the special interest in astronomy is an intrinsic motive at a different level separated from the TCP model. It can be considered as a composite of the major factors of importance listed in the push factors. The motivation patterns may vary among tourists with different levels of astronomy interests. This will be further explored and discussed in Chapter 4.

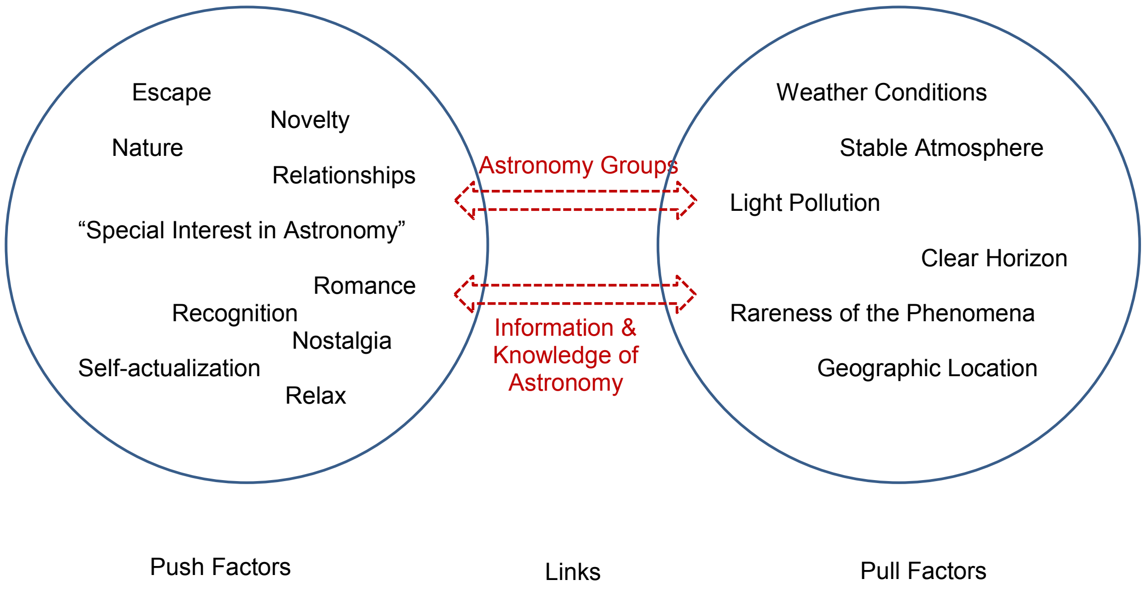


Figure 3.7 Push-pull factor analysis on astronomy tourist’s motivation

(2) Pull Factors

By contrast, pull factors are externally based and reflect the underlying stimuli from the particular qualities of destinations. The represent the appeal of diverse settings of social, cultural or physical contexts, and they are useful in marketing new products and emerging market (Wu & Pearce, 2014c). In this section, descriptive data from astronomy tourists’ emic voices are interpreted and employed to detect the reason why astronomy-related travels occur. Content analyses from both netnography and the phone interviews were conducted and five dominant pull factors are outlined.

- ***Visibility of the astronomical phenomenon***

Is the phenomenon or celestial object visible? This is the most frequently asked question as well as a necessary factor an astronomy tourist takes into consideration before making a choice to travel. The visibility is indeed a paramount condition which restricts the destination and time to go. It consists of four key elements: weather, light pollution, atmosphere and skyline (horizon), which all affect visibility. Figure 3.6 presents all of these elements.

Weather, as all 14 interviewees emphasized and illustrated in the concept map (Figure 3.5), is critical for determining the specific location and time to travel, especially for stargazers, aurora hunters and eclipse chasers. Astronomy tourists always keep an eye on the weather forecast from professional institutions and are likely to "shift immediately from one initial destination to another merely because cloudy weather arrives" (quote from interviewee 4).

Light pollution, directly related to the resource of dark-skies, is another indispensable element suggested by eleven respondents. In particular, it is a key driving force for stargazers, astro-photographers and meteor seekers. "The area with the darker skies, the more astronomy tourists it attracts (interviewee 6)".

Atmosphere, is a slang among insiders and it refers to the jargon 'astronomical seeing', which describes conditions on a given night at a given location. It refers to how the Earth's atmosphere perturbs the images of stars as seen through a telescope. Normally, tourists travel to a high-altitude location to stargaze due to its excellent 'astronomical seeing'. This is the reason why eight of the interviewees preferred going to a mountain top to set up their telescopes.

The last element of visibility is skyline or horizon at the observation site. Twelve out of fourteen interviewees advised that a flat and unobstructed horizon is always recommended for stargazing, while the other two respondents pointed that "skylines with spectacular landmarks or remarkable landscapes, though not completely flat and clear, are also attracting astro-photographers to create artworks, such as Uluru in Australia and the Pyramid of Giza in Egypt.

- ***Rareness: long circle of astronomical phenomenon occurrence***

Informants cited "rareness" as a factor which determined the willingness to travel for experiencing and witnessing the wonder. For example, solar eclipses usually attract many types of tourists, irrespective of their special astronomy interests, because of its long cycle, low frequency of occurrence, and transient duration. People are generally told by the media that "*you would wait for a lifetime or even could not see it again if you miss it*" (quote from a blog poster). Such promotional methods raise the interest and the desire for travel. The same principle is applicable for the Transit of Venus, which happened only twice in this century in the year 2004 and 2012, and the next one will occur in the calendar years 2117 and 2125.

- ***Type of attraction***

"Is this attraction sensational?" is a question potential astronomy tourists often ask. According to interviewees and blog study results, people's interest and motive fluctuate with the category of expected attractions or activities. They are always willing to travel for extraordinary wonders and novel events. This links to the factor of 'rareness'. "The rarer the phenomenon is, the stronger the tourists are attracted" (interviewee 6).

- ***Geographic location and settings***

This concern addresses a question frequently asked by many astronomy tourists: "In which particular place will it happen and must I go there to see it?" More specifically, to observe some of the astronomical phenomena which only take place within a small scope of a particular territory on this planet, such as solar eclipses, lunar eclipses and auroras, enthusiasts must travel internationally to "chase" or "hunt" them. Under such circumstances, geographic location is a prerequisite for travel. However, geographic settings are also important in terms of affecting transport. For example, some solar eclipses only happen and can be seen at the sea. Such locations prompt astronomy tourists to select an ‘eclipse cruise’ or even hire a plane to follow and extend the shadow of the moon.

- ***Landscape of the destination***

Interestingly, a further factor mentioned by some interviewees was the landscape of the tourist destination, which seemed have little to do with astronomy issues as the theme of the travel. However, apart from the normally night-time astronomy-related activities they participate in on-site, this group of special interest tourists still have general motives and a willingness to “act normally”— “they still visit scenic spots close by, engage in sightseeing and take photos of the beautiful landscape”. Hence, the aesthetic desire and anticipation for the landscape of the destinations also counts among astronomy tourists’ travel motives.

3.4.5 Trajectory: Group Culture Change and Astronomy Travel Career

This part of the study sought to address two issues as stated in the thesis aims: (1) at an individual level, to portray different trajectories by identifiable milestones in the history of astronomy tourists’ leisure involvement in astronomy travel, and (2) at a group level, to outline and characterize the significant culture change of astronomy tourist tribes.

To reach these two goals, a time tracking analysis approach was employed to review and plot ten astronomy tourists’ online travel blogs from last ten years. Additionally, tracking and comparing ten virtual communities (online forums, BBS websites) from ten astronomy enthusiast neo-tribes. These samples were carefully screened using two criteria: (1) the bloggers must have constantly written and posted their astronomy travel stories for at least 10 years; (2) astronomy club' website or online forum must have been established and operated continuously for minimum one decade; (3) the substantial astronomy club or society must exist and be associated with its relative virtual community; and (4) the online community must be accessible for and rich in its textual and pictorial information built on astronomy travel stories of their members. All the data were coded as qualitative data and used in a descriptive analysis approach.

(1) Culture change of astronomy tourist tribes

By comparison with different messages over the years and notices posted on the club's online forums, some remarkable changes of astronomy tourists' tribal culture can be traced. As a result, two forms of culture change are summarised in the following paragraphs.

- ***Scene changes***

Significant culture changes can be discovered in the scenes of astronomy tourist tribes. More specifically, the virtual communities have seen a remarkable change within last decade due to the generalization of social media and online social networks, such as Facebook, Twitter and Instagram. Transitions to new communication platforms from the club's official online forums onto social media interest groups have emerged among many astronomy clubs. Some clubs even abandoned their former BBS and moved their online group talk platform to Facebook. Since then, members were less likely to write detailed rich-content textual travel blogs, but instead, they interacted more often and were more likely to upload pictures without any notes to exhibit their travel stories. Nevertheless, the physical scenes did not change some flows in the past decade, as the venues of star parties and activity patterns of stargazing are relatively constant.

- ***Signifier changes***

Digital cameras and telescopes as two vital signifiers of astronomy tourist tribes have experienced a technical upgrading period in last decade. As a consequence, members' equipment generally shifted from a manual class to an auto-class, especially auto-equatorial telescopes and advanced CCDs (Charge Coupled Devices) which are now widely used among astro-photographers. Another notable change among the signifiers is the member bulletin, which transited from hardcopies to electronic versions in a decade. This change existed among all the investigated astronomy tourist tribes.

(2) Tracking astronomy travel involvement history and milestones

According to Stebbins (1996b, 2008, 2014), Trauer (2006), Brotherton and Himmetoglu (1997), four categories of people with different leisure involvement degrees can be defined: dabblers, fanatics, enthusiast and specialist. The level of leisure involvement among them varies. Stebbins built methods and indicators to identify leisure types by involvement: casual leisure, project-based leisure, serious leisure and devotee work. Building on and consistent with his findings and framework, this study adopted measures to present a trajectory of individual astronomy tourist's travel involvement. By counting the annual frequency of astronomy-related activities in which each blogger had participated and posted online, a line graph showing their astronomy travel career evolution history is portrayed in Figure 3.8.

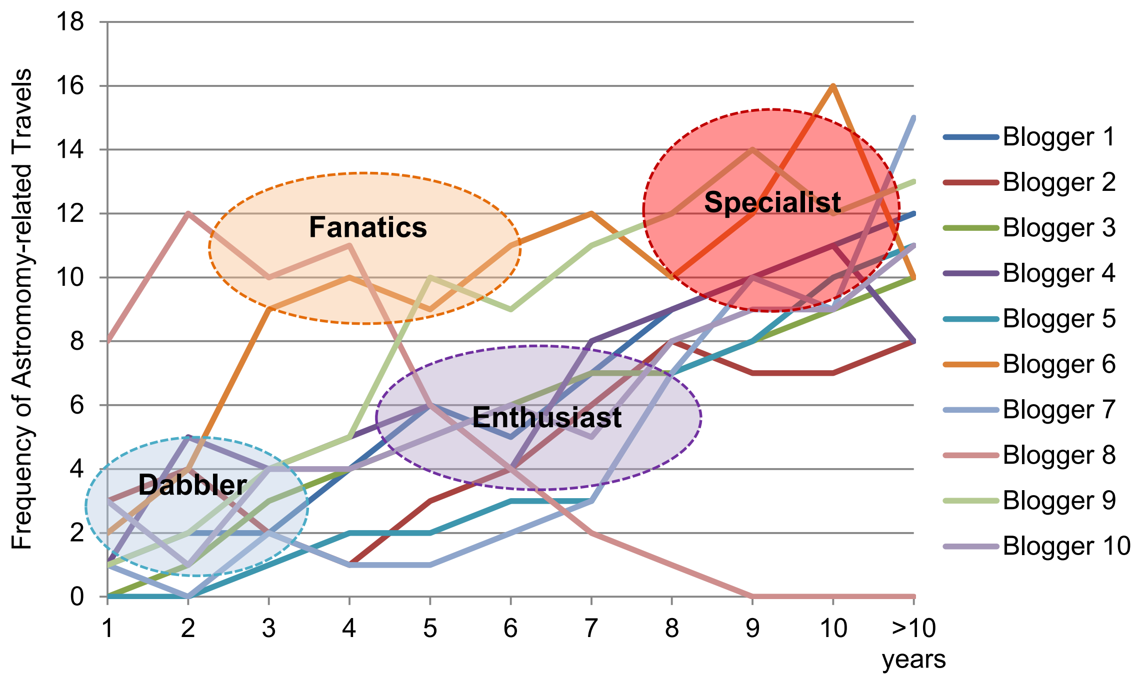


Figure 3.8 Trajectory analysis of ten astronomy tourists' travel career

As presented in Figure 3.8, nine out of ten informants started astronomy travel careers as "dabblers" at an early stage. Blogger 8, by way of contrast, had a very high frequency of posting his astronomy travel stories from the beginning. However, the informant became less likely either to travel or post his travel blogs, and subsequently terminated his astronomy travel career and transited into birdwatching (his blogs turned the focus on posting birdwatching stories after the 9th year). Two out of other seven bloggers experienced a rapid increase in the participation frequency of astronomy-related travels from the 3rd to the 6th year. By definition, their involvement was reinforced strongly and they may be regarded as 'fanatics'. In contrast, other seven informants' interest and involvement in travelling and posting their stories saw a gradual increase over time. They can be labelled as 'enthusiasts', who stabilized or fluctuated in their interest and leisure involvement for a long period. After ten years, most of them have now become ‘experts’ in astronomy-related travels with strong involvement in activities and high frequency of travelling.

These descriptive analyses build a hypothesis which will be further examined and demonstrated in the next study based on surveys and quantitative data. Though it is preliminary result, a conceptual framework can be constructed to underpin and guide the leisure involvement theoretical reasoning in Chapter 4.

3.5 Discussion and Conclusion

In summary, by using a data mining approach this study has contributed knowledge towards understanding the overall astronomy tourism industry as an emerging and unstudied global tourist market. The foundation characteristics of the astronomy tourism market such as product classification and market distribution have been crystalized into a panorama, whereby a comprehensive definition of astronomy tourism can be drawn:

> *Astronomy tourism can be defined as a type of special interest tourism and an emerging tourist market in which tourists travel to a particular destination where the physical settings (atmospheric visibility, geographic location, light pollution, etc.) are suitable for observing and/or photographing celestial objects (such as sun, moon, stars, planets, nebulas, comets, asteroids, galaxies, meteors, satellites and artificial satellites) or periodic/aperiodic astronomical phenomena/events (e.g. Aurora, solar eclipse, lunar eclipse, Transit of Venus, Opposition of planets, occultation, meteor shower, etc.) in either nocturnal or diurnal skies. Additionally, visits to observatories, planetariums or astronomy-related historical sites and traveling for star parties with participation of*

astronomical activities out of one's residential region are also generally included in astronomy tourism (Occurrence only on the Earth -- Space tourism which takes place in outer space is beyond the scope of this interest area).

Drawing upon this, a netnography approach has been employed to interpret the group culture and identities of astronomy tourist neo-tribes. The symbolic and behavioral characteristics of the neo-tribal culture have been unveiled, and subsequently, the online representation of astronomy tourists' travel experience discussed. In particular, the study has addressed the research aim of exploring astronomy tourists' group culture by answering the questions such as: What activities do they describe that they have participated in onsite, which astronomical phenomena or objects do they mostly anticipate and pursue, and what tourism settings do they discuss. Using manual coding and directed content analysis, twenty-four topics throughout the entire tourist's experience procedure have been grouped into seven phases, and also been analyzed by Leximancer for further understanding the centrality and importance of topics. Moreover, with supplementary phone interviews, this study also conceptualized the pull and push factors of astronomy tourist's motivation. Further, a tracking study was undertaken to explore the group culture change and the travel career trajectory of astronomy tourists.

Consequently, the study findings suggest that group identities, cultural distinctions and commonalities do exist, justifying the term neo-tribe. Inside the tribe, members are divided into sub-groups or sub-tribes according to different interests and their degree of leisure involvement. The work also implies that there are some cross-cultural influences on sub-groups from different places of origin. Also, five pull factors have been identified which affect astronomy tourists' travel motives. This foundation exploratory work using netnography, offers information for more studies to explore the individual travel experience of astronomy tourists.

Therefore, Chapter 4 presents a more refined focus on individual astronomy tourists' travel experience and behaviours. The next chapter is conducted with a survey and employs quantitative analyses.

Chapter 4

Gazing into the Individual Experience of Astronomy Tourists: A Questionnaire Based Study

"Persons belonging to future generations have the right to an uncontained and undamaged Earth, including pure skies; they are entitled to its enjoyment as the ground of human history of culture and social bonds that make each generation and individual a member of the human family."

UNESCO, 1994

CHAPTER OUTLINE

4.1 Introduction

As the second stage of the research in this thesis, Chapter 4 presents an empirical study probing the individual travel experience of the astronomy tourist based on questionnaire surveys. This study was constructed and implemented based on the insiders' information from the previous netnographic studies presented in Chapter 3. The conceptualized phase-based model of the tourist experience (Figure 2.1) was used to frame the formulation of the questions. The results from the previous netnographic study (Table 3.4) were also considered in generating the questionnaire items. The research respondents consisted of astronomy tourists who could be classified at all levels of the SIT involvement: dabblers, enthusiasts, fanatics, and specialists.

Compared with the exploratory studies in Chapter 3, this questionnaire based study has two significant features: Firstly, it encompasses a wider group of respondents by building on the number of tourists investigated in the netnographic study. Secondly, an etic or researcher driven orientation is employed to add to the emic based approach of the previous chapter. Based on the voices from the 'devotees' and 'insiders' concerning "how they think and represent their group culture", this study seeks further insights from an etic stance to interpret the individual travel motivation, on-site behaviour and involvement of astronomy tourists. It answers the key question "what they do and why they do it". Key explanatory factors derived from the TCP approach and the SLP theories are used, and the selected demographics, travel experiences, involvement level, on-site activities and satisfaction are studied.

In the questionnaire, several measures are used to investigate the detailed research aims and the associated attributes. These indicators follow from the emic study on the astronomy tourists' group culture. The survey was conducted with a cross-cultural sample, in order to establish research findings at a general and global level. Both existing customers in the present astronomy tourism market and potential consumers were studied. From here some implications for the industry future development can possibly be revealed.

4.2 RESEARCH AIMS

This questionnaire-based study addresses one of the key questions in the overall research thesis, which is:

What travel experience do astronomy tourists have and why do they travel?

Deriving from this key question, this questionnaire-based empirical study aims to:

1) Profile astronomy tourists and portray their travel history and general experiences.

2) Explore the influential factors in astronomy tourists' decision making procedure.

3) Assess the leisure involvement level and travel experience level of astronomy tourists. Based on these two dimensions, cluster and segment the sample into groups for further comparison studies.

4) Examine the travel motivation factors of astronomy tourists via the TCP approach. Compare the motivation patterns between segmented groups with different leisure involvement levels.

5) Reveal the participation intensity of on-site activities and travel experiences of astronomy tourists. Detect possible differences among group segments in these activities and experiences.

6) Disclose the general recollection behaviour and learning outcomes of astronomy tourists. Assess variance in the tourist behaviour and learning outcomes among different leisure involvement groups.

7) Evaluate the satisfaction of astronomy tourists at a general level.

8) Seek and examine the possible demographic differences in the above facets of astronomy tourists' individual experience.

4.3 RESEARCH METHODOLOGY

As stated above, a questionnaire-based survey is the principal research method for this study. This section reviews how the questionnaire was designed, how purposive sampling was conducted and how the survey was distributed, collected and analyzed.

4.3.1 Survey Procedure

The questionnaire-based survey followed the process below:

1) *Generate the item pool and attend to the wording of the questions.*
2) *Conduct a pilot survey as a pre-test*
3) *Reduce items and refine the linguistic expression of questions*
4) *Identify the distribution channels and decide on survey sampling methods*
5) *Implement the survey and collect the data*
6) *Code and analyse the survey data*

At first, the survey was designed as a self-administrated questionnaire in Mandarin and English. It contained five pages and took about 15 to 20 minutes to complete. A preliminary pilot test on moderately sized convenience samples before launching a formal and major scale research can be very useful (Dwyer *et al.*, 2012). Therefore, after generating the primary items for the questionnaire survey based on netnography and existing scales, a pilot test was implemented for item reduction and to improve the wording of questions. A purposive sample of 34 respondents was asked to conduct the pre-test on both versions of the questionnaires. Most of them were astronomy group members from Townsville, Australia and Hangzhou, China. Using a quantitative approach, the value of the questionnaire items was examined and some were eliminated due to validity issues. The Principal Component Analysis (PCA) approach has been suggested as the most effective tool for item reduction (Fadare, Babatunde, Ojo, Iyanda, & Sangogboye, 2011), and thus the PCA was employed in this procedure. As a consequence, 38 out of 44 questions were retained and 6 questions were eliminated, because they overlapped with others or were not directly related to the target constructs of the study (c.f. Item loadings below 0.33 should be deleted (Dwyer, et al., 2012, Comrey & Lee, 1992). Overall, the internal reliability coefficient (Cronbach's Alpha) of the final version of the questionnaire was 0.86 with 38 retaining questions. Next, back-translation was undertaken between Mandarin and English questionnaires. A proof reading procedure was also conducted to ensure the correct wording of all questions for the different cultural settings. Further, the questionnaire was presented in five languages: English, Chinese, French, Japanese and Korean. The structure and content were consistent among these versions except for some slight demographic differences, where geographical origins were sought or currency symbols employed. That is, the questionnaire was customized in the specific language or with reference to the spatial context.

The survey was anonymous and confidential for all respondents, therefore no personal details or identifiable information was collected. An introduction component with an information sheet to the survey was given to all the participants at the beginning stage of the survey (see Appendix II). The sheet acknowledged the respondents' help and explained the purpose of the research. Participants were able to terminate the survey at any time during the process. Upon completion, respondents were placed in a prize draw for reward and encouragement. Appendix III reports the full versions of the questionnaire.

4.3.2 Questionnaire Design

(1) Developing the item pool and wording the questions

Initiating a questionnaire for investigating a new market is difficult, as there is no existing template to follow for developing an item pool. In this study, all items in the questionnaire were generated and administered through the literature review, research conceptual schemes and netnographic results from the exploratory study. In particular, wording the questions involved employing the insiders' language and terms collected in the previous chapter. This ensured the validity of the question asking. After the first draft of questionnaire was developed, a proof reading by two experienced astronomy tourists also eliminated some confusing expressions and/or verbal misunderstanding.

(2) Designing the structure and content

The overall questionnaire contained seven sections relevant to the phase-based model of the tourist experience. These seven components consisted of: (1) introduction and screening, (2) general experiences of astronomy-related travels, (3) assessment of the involvement level, (4) motivation and anticipation of astronomy tourists, (5) on-site activity participation, (6) recollections and learning outcomes in return travel experiences, and (7) demographic information (see Appendix III).

The first component, an introduction and screening question, was designed to address two purposes. The introductory part attempted to inform participants about the work, and directed them to answer the questions independently. The screening part was designed to select effective respondents due both to their willingness to participate and their travel experiences. The later criterion was very important for the tourism linked basis of this thesis. It contained two questions, asking an informant whether he/she had ever had travelled for pursuing an astronomical phenomenon or an astronomy-related activity/attraction. Those who never had astronomy-related travel experiences in the past ten years were regarded as invalid respondents and excluded from the sampling.

The second component asked respondents an array of questions about their general history and experience of astronomy-related trips. It included scale variables such as the total number of astronomy-related travels they had ever taken, the average frequency they had travelled for astronomy-related attractions and the longest stay (number of nights) ever in a single astronomy-related trip. These variables were used to measure quantitatively the travel experience of astronomy tourists. In addition to these scale variables, some nominal variables were also incorporated in this part of the questionnaire to identify the characteristics of their travel experiences. For example, the accommodation type, the transportation, and the destinations visited were all configured into the questions.

The third section, concerning the leisure involvement level of astronomy tourists, used a seven -point Likert type scale with the lowest (scored as 1 = strongly disagree) to the highest (scored as 7 = strongly agree). Respondents were asked to indicate their level of participation in the astronomy-based leisure. They had three options for agreement (serious leisure orientation) and three options for disagreement, while the neutral option stood for ‘neither agree nor disagree’. This scale was developed based on the six qualities of serious leisure developed by Stebbins (1982) and his colleagues’ further work on the serious leisure inventory and measure (SLIM) (Gould, et al., 2008, 2011; Tsaur & Liang, 2008). The initial item pool consisted of 56 statements and six sub-scales as perseverance, leisure career, significant effort, durable outcomes, unique ethos and identification with the pursuit. In this study, each dimension was embodied into two statements, which were adjusted from the original SLIM scale and set into an astronomy tourism context.

The fourth component, dealing with the motivation and anticipation phases of the tourist experience, was drawn from the TCP model. A seven-point Likert scale was used to evaluate 15 travel motives, which were presented into 30 statements. Apart from the initial 14 factors established by Pearce and Lee (2005), the factor of special interest in astronomy was added into the scale due to the netnography findings in the previous study. Each statement's linguistic expression was adapted to match the astronomy tourism setting. Additionally, the extrinsic influential factors were also examined in another Likert scale, including physical, social and product/service facets. They were considered as travel decision making forces to shape tourists' action in choosing an astronomy tourism destination.

The fifth section focused on the on-site phase experience of astronomy tourists. Twenty-one items elicited from the previous netnographic study were used in a seven-point Likert scale to assess respondents' on-site behaviour and learning outcomes resulting from participating in astronomy-related activities. Some dominant activities (top seven in terms of frequencies mentioned in the blog studies) were selected to measure and compare the time they had spent on each activity. Most of the activities were related to the astronomy theme. This diversity was used to assess the centrality of one's astronomy-related travel career.

The next component tackled the questions related to the phases of return travel and recollection. This part contained two scales, measuring satisfaction of the astronomy-related travel and respondents' attitude towards post-travel experience respectively. The items were derived from the previous netnographic study findings, and also from related literature concerning tourist satisfaction and authenticity. This section also generated items for the subsequent adoption of the importance-performance analysis (IPA) approach in interview studies by identifying the issues that concerned the astronomy tourists. This procedure was conducted to assist future planning and development endeavours.

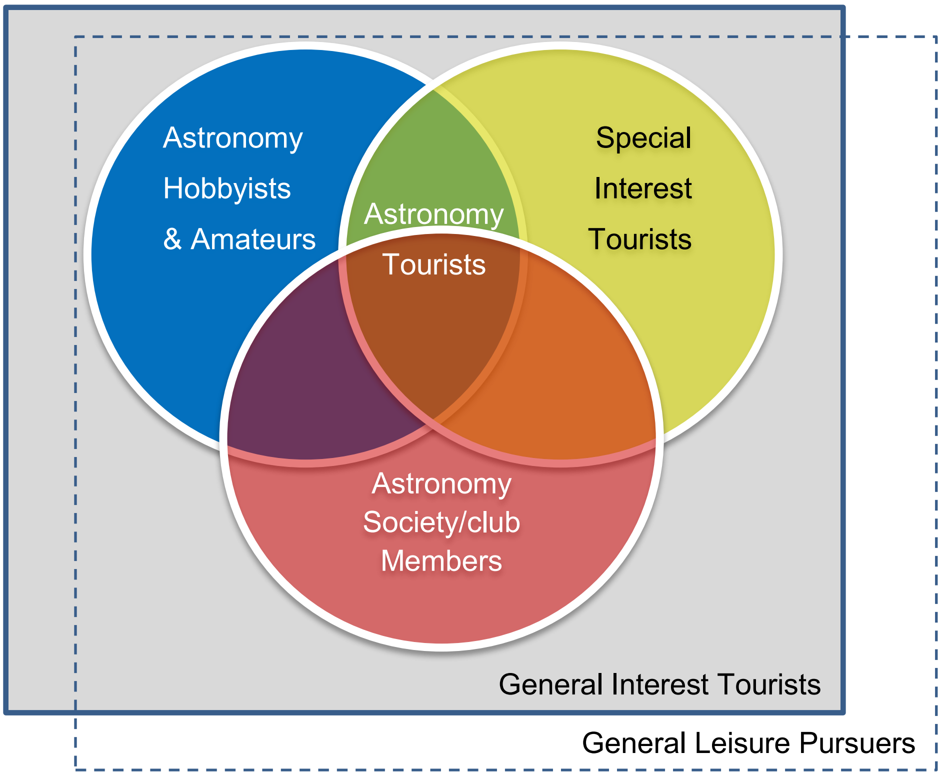
The last section of the questionnaire collected the demographic information about the participants, including gender, age, income and occupation, as well as educational background, place of origin, general travel experience and average expenditure on a single astronomy-related trips.

In this questionnaire-based survey, the overwhelming numbers of questions were closed and respondents were required to answer on seven-point Likert scales. For all the questions in the survey, irrespective of the open-ended or standardized nature, the option of "not available" or "others (please specify)" was available. This was to guarantee the integrity and the validity of the responses.

4.3.3 Sampling and Data Collection

Two interfaces were identified as distribution channels for the survey questionnaires: online and onsite. They targeted different audiences, and therefore covered a wide range of potential and existed astronomy tourists. The potential group embraced general interest tourism (Trauer & Ryan, 2005) and mixed interest tourism (MIT) consumers (Brotherton & Himmetoglu, 1997), who possibly participated in an astronomy-related travel influenced for a one-time project (c.f. project-based leisure pursuers, Stebbins, 2005) or a contingency and transient situation (casual leisure).

Trauer (2006), in the 'leisure-tourism interest cycle' model suggested that astronomy leisure pursuers (hobbyists and amateurs) partially comprised of astronomy tourists, because tourism for pleasure is a mobile form of leisure (Kelly, 1996, p. 28), and thus they are interconnected (Carr, 2002). Accordingly, those hobbyists and amateurs who pursued astronomy leisure predominantly in home-based settings were also considered as a group of "potential" astronomy tourists. Provided they had some astronomy-related travel history (met the premise of becoming valid respondents), they were also eligible to be included in the sampling pool. Figure 4.1 presents a succinct illustration and distinguishes the astronomy tourists, special interest tourists, and those who pursue astronomy as home-based leisure. The main target respondents – astronomy tourists – lie in the overlap between the blue and yellow circles.



Source: based on the "Leisure-tourism interest cycle" (Trauer, 2006)

Figure 4.1 Astronomy leisure-tourism interests and group relationships

Based on this group classification, two distribution channels of the survey were identified. The online distribution channel delivered electronic questionnaires to astronomy society or club members, seeking respondents who had ever travelled for astronomy-related attractions. The online questionnaires were chosen because of their economic viability and to overcome the challenge in reaching a large and diverse astronomy tourist sample. Another reason is that the online virtual communities provide public access to individuals who share particular and mutual interests, beliefs and attitudes (Kozinets, 2010). In this case, astronomy clubs, societies or associations usually possess their own online communication platforms as virtual communities, including social network sites (SNS) and online forums (or BBSs), where their members gather together and interact. The previous netnographic study had also suggested this channel is evidently efficient, because astronomy tourists are very mobile populations but the online platform offers opportunities for researcher access.

In the practical operation, a hyperlink to the survey was posted in a brief introduction with the title "astronomy tourist survey" on their Facebook groups or online forums. Group members were invited to participate in the online survey. Prior to this, an email explaining the purpose of the study was also sent to every organization's president or person in the charge. This attempt had two features: the investigator had acquired an ethics permit for online survey posting; and the top-down tactic was applied and then resulted in boosting a broader distribution to group members through the president's emails. Members were also encouraged by the president to complete the survey during their face-to-face group meetings.

The online survey was edited and distributed by the academic questionnaire toolkit 'Qualtrics' based on the Internet environment. Following the inventory of astronomy associations complied in the last chapter, the survey was distributed to 354 online groups across Asia, Europe, Africa, America, and Oceania to collect data. Four-language questionnaire versions were delivered separately according to the specific cultural context. The data collection procedure was conducted in two stages. The first -stage survey was implemented between February and October of 2014, focusing on emerging markets in Africa and Asia, especially China, Korea and Japan. At the second stage, the survey was undertaken from April 2016 to July 2016, targeting America, Europe and Oceania, the United States, the United Kingdom, Australia and New Zealand. As a result, 524 effective respondents in total were collected during these two stages, with 226 and 298 responses from each stage. Due to its self-administered nature and some required-question settings, the overall response rate was 52% for the online survey (47.4% for stage one and 56.1% for stage two, see Table 4.1)

Correspondingly, the other survey channel – the onsite questionnaires which were mainly targeted at other groups of respondents, was conducted by a different method. Due to its nature and technical constraints, the previous online survey made it difficult to reach two indispensable groups of informants: (1) non-membership astronomy tourists, and (2) latent astronomy tourists (including home-based serious leisure pursuers, and general interest tourists with one-time project-based leisure or a casual leisure in astronomy). Compared to the individuals with astronomy club membership, these audiences are geographically dispersed because they are not always in groups and organized to travel. Nevertheless, some astronomy-related events encourage them to come together, a fact which assisted in distributing the onsite survey based on a personal approach. Hence, three categories of astronomical events were selected to be sampling venues: total lunar eclipse, meteor shower and total solar eclipse. More specifically, in the first two categories two events which took place in China were chosen for sampling: (1) The total lunar eclipse occurred on 8th October 2014, and (2) meteor shower of the Leonids occurred during 17th -18th November, 2014. Dark-sky sites in the rural areas in the Shanghai and Chengdu regions were the specific locations to distribute the surveys respectively. The reasons why these sites were selected were as below:

1) According to preliminary study, they have two of the largest populations of astronomy enthusiasts in China;
2) Astronomy tourists from these two origins both have fixed or regular-visit destinations where are available for the investigator to access and conduct the survey.

The self-administered questionnaires were printed in simplified Chinese and delivered personally by the investigator, local university students and astronomy club members, who were all native Mandarin speakers as well as local dialect users. This guaranteed the response rate and completion rate of the survey as questions could be fully understood by the respondents. Besides, the survey distribution avoided interrupting the ongoing activity of the respondents. Most of the informants completed the survey face to face towards the end of their travels. As a consequence, 194 valid responses were collected from those two events, with 107 from the eclipse and 87 from the meteor shower.

Similarly in Australia, two astronomical events were selected as sampling scenes: (1) the total lunar eclipse occurred on 15th April 2014 and (2) the 'Perseids' meteor shower which happened from 12th to 13th of August, 2015. At this time, the Ayers Rock (a.k.a. Uluru) was chosen as the data collection site, because it is arguably Australia's most famous attraction for astronomy tourists, gathering thousands of international visitors into Australia's inland desert annually. The identical procedure to that used in China's case was employed. The investigator, as a registered member of a club, behaved as experienced astronomy hobbyist in order to access respondents. As a result, 105 questionnaires were returned and 98 of them were properly completed.

According to the result from Leximancer in the previous chapter, total solar eclipses are possibly the paramount attractions for astronomy tourists and general tourists. It is reasonable to collect data from this event though it occurs only occasionally. The total solar eclipse of 9th March 2016 in Indonesia provided a great opportunity for the author to complement the phenomenon sampling. However, due to geographical barriers, the questionnaires were collected in a remote mode. With the assistance of friends and local residents, the survey was conducted in Palembang on the island of Sumatra, Indonesia, where a large number of astronomy tourists gathered from overseas countries. Finally, 66 questionnaires were collected and 50 of them were effective respondents.

In general, the onsite channel for survey distribution basically covered the selected respondent groups. This part of the study included both Eastern and Western contexts. The reason for selecting China and Australia as sampling sites is that, according to the previous study in Chapter 3, respectively they represent a developing market and a relatively developed market for astronomy tourism. Consumers from each country can be different in tourists' motivations, attitudes and experiences. Case comparison is meaningful to distinguish the characteristics of different markets and the tourist experience.

Across all sections of the study, 866 valid cases were collected from the two survey channels. All respondents in the sample met the following criteria:

- Willingness to be investigated;
- Have had at least one time astronomy-related travel experience.
- They had properly completed the survey with a high proportion of questions answered (Any participants marking all items as 4, or completing less than 80% of the questions, were eliminated from the sample).

In summary, 524 (60.5%) questionnaires were collected online and 342 (39.5%) were collected onsite. In total, 60.9% of the 1423 respondents had fully completed the survey, that is, 866 valid cases in total were successfully collected. The statistics for survey distribution and completion are summarized in Table 4.1 below.

Table 4.1 Statistics of questionnaire distribution

Distribution channels			Number started/ delivered	Number returned & fully completed	Fully completed response rate
Online	1st Stage (02/2014-10/2014)		477	226	47.4% [a]
	2nd Stage (04/2016-07/2016)		531	298	56.1% [a]
Onsite	China	Total lunar eclipse (Chengdu)	123	107	87.0%
		Leonids meteor shower (Shanghai)	105	87	82.9%
	Australia	Total lunar eclipse (Uluru)	64	55	85.9%
		Perseids meteor shower (Uluru)	52	43	82.7%
	Indonesia	Total solar eclipse (Palembang, Sumatra)	71	50	70.4%
Total			**1423**	**866**	**60.9%**

[a] This rate was automatically calculated by the online survey platform 'Qualtrics'. It counted the online participants who ever 'started' the survey (could be incomplete) as the 'total response', and the respondents who totally completed the survey as the 'complete response'.

The detailed information about the demographic profiles and basic travel experiences of the respondents are reported in Table 4.2.

Table 4.2 Demographic profiles of survey respondents

Demographic Items			Counts (N= 866)	Percent
Gender	Male		503	58.1
	Female		363	41.9.
Age Group	Unspecified		18	2.1
	Under 20s		135	15.6
	20s		158	18.2
	30s		67	7.7
	40s		76	8.7
	50s		154	17.8
	60s and above		258	29.8
Place of Origin	Asia (N=329) (38.0%)	China	247	28.5
		Hong Kong	11	1.3
		Taiwan	13	1.5
		Japan	20	2.3
		Korea	19	2.2
		India	6	0.7
		Others	13	1.5
	Europe (N=107) (12.4%)	The United Kingdom	42	4.8
		France	23	2.7
		Spain	8	0.9
		Italy	9	1.0
		Norway	14	1.6
		Russia	6	0.7
		Others	5	0.6
	America (N=248) (28.6%)	The United States	201	23.2
		Canada	21	2.4
		Chile	15	1.7
		Mexico	7	0.8
		Others	4	0.5
	Oceania (N=164) (18.9%)	Australia	128	14.8
		New Zealand	34	3.9
		Others	2	0.2
	Africa (N=18) (2.1%)	South Africa	10	1.1
		Egypt	5	0.6
		Others	3	0.3
Education Level	Middle school and under		17	2.0
	High school or equivalent		60	6.9
	University/college diploma or equivalent		125	14.4
	Bachelor Degree or undergraduate		366	42.3
	Master Degree or postgraduate		254	29.3
	Ph.D. or Ph.D. candidature		44	5.1
Usual companions in astronomy-related travels	Unaccompanied		101	11.7
	Travel with friends		225	26.0
	Travel with relatives		64	7.4
	Travel with partner		98	11.3
	Travel with astronomy club members		372	42.9
	Others		6	0.7

Demographic Items		Counts (N= 866)	Percent
Destination of past astronomy-related travels	Both domestic and international	431	49.8
	Domestic only	356	41.1
	International only	79	9.1
Membership	Astronomy club members	603	69.6
	Non-members	263	30.4
Amount of astronomy-related equipment	No equipment	130	15.0
	1	388	44.8
	2	212	24.5
	3 and more items	136	15.7
Number of trips in last 12 months	Nil	24	2.8
	1-5	386	44.6
	6-10	353	40.7
	More than 10	103	11.9
Number of astronomy-related trips in last 12 months	Nil	107	12.3
	1-5	316	36.5
	6-10	341	39.4
	More than 10	102	11.8
Centrality of astronomy-related travel career in last 12 months [a]	0% ~ 24.9%	274	31.6
	25% ~ 49.9%	195	22.5
	50% ~ 74.9%	167	19.3
	75% ~ 100%	230	26.6
Average expenditure per one astronomy-related trip (US dollar)	<100	154	17.8
	100-499	231	26.7
	500-999	199	23.0
	1000- 1999	202	23.3
	2000- 2999	56	6.5
	3000 and above	24	2.8

According to the statistics above, respondents who fully completed the survey were relatively homogeneous in distribution among most of the demographic and travel experience variables. The entire sample consisted of 58.1% males and 41.9% females. In terms of the age group, those in their 50s and 60s as well as young people in their 20s constituted the largest proportion (65.8%) of the sample, while 15.6% of the respondents were relatively young tourists under 20 years old. As for tourist origins, 38% of the respondents were from Asia, 28.6% from North and South America, 18.2% from Oceania, 12.4% from Europe and 2.1% from Africa. China, the United States and Australia were the top three countries of origin, occupying the sample proportions of 28.5%, 23.2% and 14.8% respectively. This might have resulted from the sampling

[a] The centrality rate = total number of astronomy-related trips divides total number of trips in last 12 months

method and survey distribution channels. An overwhelming number (N=292) of the onsite questionnaires were collected in Australia (N=98) and China (N=194), and astronomy club members from the United States completed a large proportion (35.7%) of the online survey. For education levels, more than half of the respondents indicated that they had a tertiary education background, and the majority (42.3%) of them had been granted or at that time were pursuing a bachelor degree.

Concerning their travel experience and astronomy-related facets, while 26% of the investigated astronomy tourists often travelled with their friends, nearly half (42.9%, see Table 4.2) of the respondents reported that they usually undertook astronomy-related travels with other members from the astronomy clubs or societies. This is reasonable because more than half of the respondents (69.6%) identified themselves as astronomy club members, and they usually took club-organized group travels with other club members (according to findings in Chapter 3, also see Table 4.3 below).

Table 4.3 Cross-tabulation between membership and travel companions

Membership status / Usual travel companions	**Astronomy club members**	**Non-members**	**Total**
Unaccompanied	59 (9.8%)	42 (16.0%)	101
Travel with friends	108 (17.9%)	117 (44.5%)	225
Travel with relatives	33 (5.5%)	31 (11.8%)	64
Travel with partner	44 (7.3%)	54 (20.5%)	98
Travel with astronomy club members	358 (59.4%)	14 (5.3%)	372
Others	1 (0.1%)	5 (1.9%)	6
Total	603 (100%)	263 (100%)	866

Further, 85% of the surveyed astronomy tourists claimed that they had at least one item of observational or photographic equipment, only a small portion (15%) of them reported they had not yet bought any equipment for astronomy-related use. Regarding the destination of the astronomy-related travel, more than half of the respondents (58.9%) had overseas experience, whilst 41.1% of them had travelled only within their own nation during their astronomy-related travel career.

The centrality rate (proportion) of astronomy-related travel was calculated as a percentage of: how many times of astronomy-related travels happened out of one's the total number of travels occurred in last 12 months. Results indicated that 45.9% of the respondents reported that more than half of their travels undertaken in the past year were centred on astronomy-related goals, while for the rest of the tourists astronomy-related travels did not feature as the major component of their previous-year travels.

Membership, as stated in Chapter 3, is also important in influencing astronomy tourists' group culture and travel behaviour. This also can be reflected in the cross-tabulation analysis between membership status and centrality of astronomy-related travels (see Table 4.4 below).

Table 4.4 Cross-tabulation between membership status and centrality rate

Membership status / Centrality rate of astronomy -related trips	**Astronomy club members**	**Non-members**	**Total**
0% ~ 24.9%	93 (15.4%)	181 (68.8%)	274
25% ~ 49.9%	123 (20.4%)	72 (27.4%)	195
50% ~ 74.9%	161 (26.7%)	6 (2.3%)	167
75% ~ 100%	226 (37.5%)	4 (1.5%)	230
Total	603 (100%)	263 (100%)	866

Using the Chi-square test, the cross-tabulation indicated that the influence of membership in astronomy tourists is significant (*df* =3, χ^2=141.6, p=.000). For more than half (68.8%) of the non-membership tourists, astronomy-related travels only constituted approximately a quarter of their total travels in the past year. By way of contrast, for the majority (64.2%) of club members, more than half of their travels occurred due to astronomy-related purpose.

In general, the sample of this questionnaire based study had a relatively well-distributed spread for gender, age, and education level. The worldwide respondents from five continents and 36 nations/regions covered many of the main tourist market origins of astronomy tourism. Among all the tourists studied, two identity groups – astronomy club members and non-members – shared some common characteristics in their demographic profiles. However, significant distinctions among them appeared in some facets, such as travel companions and the centrality rate of astronomy-related travels. Further relationships amongst those demographic factors and other indices and variables will be examined and presented in the next section.

4.3.4 Data Coding and Analysis

The valid sample data was coded and analysed in Excel and SPSS (the 22.0 edition). Various statistical methods were employed in data analyses in accordance with different types of variables and the particular aims of the study. Primary analysis methods applied in the study included descriptive analysis, cross-tabulation, cluster analysis, exploratory factor analysis, discriminant analysis, one-way ANOVA, repeated measures one-way ANOVA, independent t-test, principal component analysis and Kruskal-Wallis analysis. Table 4.5 clarifies the purpose for using each analytical approach.

Table 4.5 Questionnaire data analysis plan

No.	Study aims for Chapter 4	Analytical approaches
1	To profile general travel experiences of astronomy tourists, including their frequent-visit destinations, transport, accommodation, frequency of travels favourite attractions, communication methods, etc.	Descriptive analyses Repeated measure one-way ANOVA
2	To explore determinants which affect astronomy tourists' decision making and anticipation towards travel destinations	Principal component analyses (PCA)
3	To distinguish sub-groups of tourists by assessing astronomy tourists' serious leisure involvement levels and their travel experience levels	Cluster analyses; Discrimination function analysis; Cross-tabulation; Kruskal-Wallis analysis
4	To ascertain principal motives of astronomy tourists based on the TCP model, and to test if motivation patterns change among groups with different involvement levels	Principal component analyses (PCA), Independent *t*-test Kruskal-Wallis analysis
5	To document astronomy tourists' general on-site activities and on-site experience, and to verify if they are different among various involvement groups	Descriptive analyses One-way ANOVA Kruskal-Wallis analysis
6	To investigate general learning outcomes and recollection behaviour of astronomy tourists	Descriptive analyses One-way ANOVA
7	To examine which factors affect tourist satisfaction for astronomy-related travel experience	Descriptive analyses One-way ANOVA
8	To examine if there are any demographic differences in astronomy tourists' travel experiences	Independent t-test One-way ANOVA Cross-tabulation

Due to the nature of self-administered questionnaire survey data, reliability tests were used for examining the reproducibility and consistency of the items and concept categories. The Cronbach's Alpha coefficient was utilized as the key indicator for the reliability test. Each section of the questionnaire except the demographic component (section 7) was appraised. The overall Cronbach's Alpha score for the questionnaire was 0.86, with the lowest core of 0.79 in section one (general travel experience) and the highest core of 0.95 in section two (involvement level of astronomy-related travel). These results indicated that the entire questionnaire data had a relatively high level of reliability. The results of the tests are reported in Table 4.6 below.

Table 4.6 Reliability test of questionnaire data

Questionnaire Sections	Reliability Coefficient		Valid Cases	
	Cronbach's Alpha	Number of Items	N	Percent
Section 1	0.79	22	802	92.6
Section 2	0.95	61	830	95.8
Section 3	0.84	10	854	98.6
Section 4	0.89	64	832	96.1
Section 5	0.88	29	838	96.7
Section 6	0.91	24	816	94.2
Total/Average	**0.86**	**210**	**833.7**	**95.5**

Note: Listwise deletion for missing values was applied in all cases and items

4.4 Results and Findings

This section reports results of the questionnaire-based study, directed by the order of research aims.

4.4.1 Interpreting the General Travel Experience of Astronomy Tourists

(1) General travel histories of astronomy tourists

In accordance with the data analysis plan stated before, Table 4.7 below summarizes the general astronomy-related travel histories and experiences of the surveyed astronomy tourists. This array of descriptive statistics tackles the first aim of this chapter. Due to missing values and invalid cases of respondents, the sample size varied from 802 to 850. They are displayed accordingly with each parameter (see Table 4.7)

Table 4.7 Descriptive statistics for general travel histories of astronomy tourists

Factors	Item	Percent	Factors	Item	Percent
Start of the astronomy-related travel (N=825)	Earlier than 1960s	1.9	Astronomy-related travel frequency (N=802)	1/ week and more	3.4
	1960s	4.3		1/ two weeks	6.1
	1970s	7.6		1/ months	8.8
	1980s	12.5		1/ two months	7.0
	1990s	18.7		1/ quarter year	11.6
	2000s	29.2		1/ half year	20.7
	2010s	26.8		1/ year	17.4
Number of astronomy-related travels (N=816)	1-5	33.7		Less than 1/ year	25.0
	6-10	17.8	Preferred destination (N=845)	Touristy places	40.8
	11-15	10.2		Non-touristy places	59.2
	16-20	8.5	Regular-visit destination (N=841)	IDA* places	8.6
	> 20	29.8		National/state parks	28.5
Longest stay (N=812)	0 night	9.8		Unofficial dark sites	39.3
	1-2 nights	25.1		Observatories	10.2
	3-4 nights	23.5		Others	13.4
	5-6 nights	11.0	Distance of regular-visit destination (by driving) (N=815)	1 hour and less	12.9
	≥ 7 nights	30.6		1-2 hours	27.4
Longest trip (by flight) (N=821)	1 hours and less	12.9		2-3 hours	23.9
	1-2 hours	8.4		3-4 hours	14.6
	2-3 hours	14.0		4-5 hours	11.5
	3-4 hours	6.1		> 5 hours	9.7
	4-5 hours	7.8	Furthest destination (N=850)	Overseas	65.8
	> 5 hours	50.8		Domestic	34.2

Note: * IDA refers to the International Dark-sky Association

According to the descriptive analysis results, notable findings are as follows:

(1) The majority (56%) of the tourists started their astronomy-related travel career in the last two decades, however, in the 1960s and earlier there were some pioneers.

(2) Nearly one third of the respondents reported that they had travelled more than twenty times for pursuing astronomy-related attractions. However, more than half (51.5%) of the respondents had travelled less than ten times for astronomy-related purposes.

(3) In terms of the length of stay for astronomy-related travel, the highest portion (69.4%) of the astronomy tourists spent less than a week, while 30.6% of them stayed more than seven nights as their longest trips.

(4) Regarding the longest trip distance, nearly half of them had never travelled beyond a five-hour flight circle, while 50.8% of the tourists had undertaken a five-hour-flight to pursue an astronomy-related event. Accordingly, 65.8% of the surveyed tourists reported they had overseas travel experiences for attending an astronomy-related attraction. The rest (34.2%) had never taken an outbound travel for astronomy-related interest.

(5) Travel frequency is an essential parameter to assess travel experience. On average, 57.6% astronomy tourists travelled more than two times per year, while 17.4% of them completed one trip annually while a quarter of the tourists travelled less than once for astronomy-related reasons.

(6) Concerning the travel destinations, “non-touristy” locations (those without well-established tourism attractions and infrastructure) were preferred by the majority (59.2%) of the astronomy tourists. However, established tourist areas were still the most-visited destinations for the rest of the respondents. Among all types of the destinations, unofficial dark-sites and national or state parks were the top-two popular choices, visited by 39.3% and 29.5% of the astronomy tourists respectively. In comparison, only 8.6% and 10.2% of the respondents chose IDA places (dark-sky reserves, parks and communities) and observatories respectively as their regular-visit destinations. Moreover, most of the regular-visit destinations were within a three-hour driving circle for the astronomy tourists, while 35.8% of them reported travel beyond that distance.

(2) General travel preference of astronomy tourists

The general travel preferences of astronomy tourists were assessed by a descriptive analysis and an array of repeated measure one-way ANOVA. More specifically, the Mauchly's Test of Sphericity and the tests of within-subjects effects were conducted in this section associated with post-hoc tests, in order to examine whether or not some of the items were considered significantly different to others.

The descriptive analysis results are presented in Table 4.8 bellow.

Table 4.8 Descriptive statistics for the general travel preference of astronomy tourists

Factors	Items	Mean	Standard Deviation
Accommodation (N=811)	Premium hotels	1.54	1.50
	Budget hotels	2.36	1.62
	Resorts	1.44	1.47
	Motels	1.98	1.58
	Hostels	1.26	1.22
	Camping (without recreational vehicles)	2.25	1.19
	Recreational Vehicles	1.55	1.87
	Holiday parks	1.32	1.26
	Guest House / B&Bs	1.60	1.54
	Friends' or relatives' dwellings	1.92	1.74
	Others	1.37	1.63
Transportation (N=834)	Airplane	2.37	1.25
	Helicopter	1.02	1.36
	Railway	1.27	1.48
	Private Vehicle	3.37	1.91
	Rental Car	2.20	1.55
	Recreational Vehicle	1.56	1.61
	Bus / Coach	1.34	1.26
	Bike	1.12	1.45
	Boat/Ferry/Cruise	1.66	1.30
	Others	1.31	1.17
Most frequent travel companions (N=839)	Unaccompanied	2.48	1.46
	Travel with friends	3.20	1.13
	Travel with relatives	2.44	1.38
	Travel with partner	3.21	1.51
	Travel with astronomy club members	3.44	1.39
	Others	1.96	1.02

Factors	Items	Mean	Standard Deviation
Frequently-used methods for sharing travel experiences [b] (N=841)	Online forum	2.33	1.32
	Personal blogs	1.69	1.21
	Face-to-face communication	3.54	1.54
	Social media	3.20	1.86
	Phone calls and texts	2.45	1.57
	E-mails	3.19	1.48
Landform of frequent-visit destination [a] (N=818)	Top of mountain/ hill	3.05	1.26
	On the sea	1.58	1.20
	Seaside areas	2.05	1.45
	Plains	2.34	1.64
	Tablelands	1.81	1.02
	River/lake sides	2.04	1.26
	Deserts	2.28	1.33
	Forests	1.66	1.11
	Islands	1.63	1.06
	Ice fields	1.17	1.19

Note: A five-point Likert scale was used, 1 = never, 5 = always. N = number of valid cases.

From the descriptive statistics in Table 4.8 above, the means of self-perceived travel frequencies, their standard deviation and sampled sizes are presented, in response to the extent of five aspects of tourists' travel preference: accommodation, transportation, travel companions, destination landforms and information sharing methods. Items with the highest means in each aspect are highlighted in red colour and the second highest ones are shaded in grey.

Overall, the descriptive statistics suggest that astronomy tourists' travel preference vary among different items. To examine whether or not these travel preferences were reported as significantly different among individual items, a series of one-way ANOVA tests were adopted to compare differences between independent group means. In this study, all the repeated measures one-way ANOVA results suggested a significant distinction among all the items in travel preferences of the five aspects. These results are presented in the following paragraphs.

- ***Accommodation Preferences***

The Mauchly's Test of Sphericity (p=.000) and the test of within-subjects effects (F=11.56, p=.000, η_p^2=.047) in the repeated measures one-way ANOVA suggest that accommodation preferences vary significantly among the astronomy tourists. The differences identified by post-hoc test are reported in Figure 4.2 below. Budget hotels (M=2.36) and camping (M=2.25) were the two most preferred forms of accommodation by astronomy tourists. Unlike the netnographic study results, RVs (M=1.55) were at an intermediate position on the accommodation option list, while motels (M=1.98) and friends'/relatives' dwellings (M=1.92) were moderately preferred by astronomy tourists.

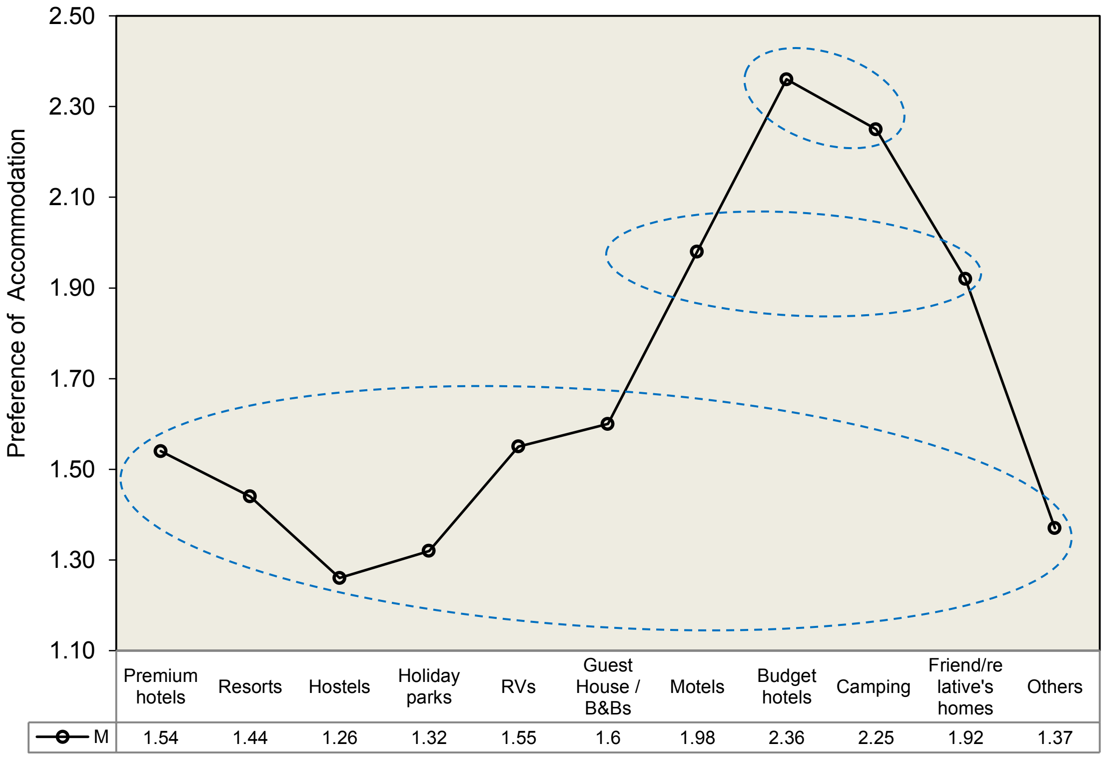


Figure 4.2 Preferences of accommodation of astronomy tourists

- ***Transportation Preferences***

The Mauchly's Test of Sphericity (p=.000) and the tests of within-subject effects (F=12.87, p=.000, η_p^2=.049) in the repeated one-way ANOVA results indicated that the differences among ten forms of preferred transportation were significant. Among all the transportation forms, private vehicles (M=3.37) were the most frequently used by astronomy tourists. Rental cars (M=2.20) and airplanes (M=2.37) were also used as moderately popular transports options for astronomy-related travel. Recreational vehicles (M=1.56) and water transport (M=1.66) were relatively less well used by astronomy tourists but received higher scores than the remaining items (see Figure 4.3 below). The rest items falling into the same dashed circles were not significantly different from each other.

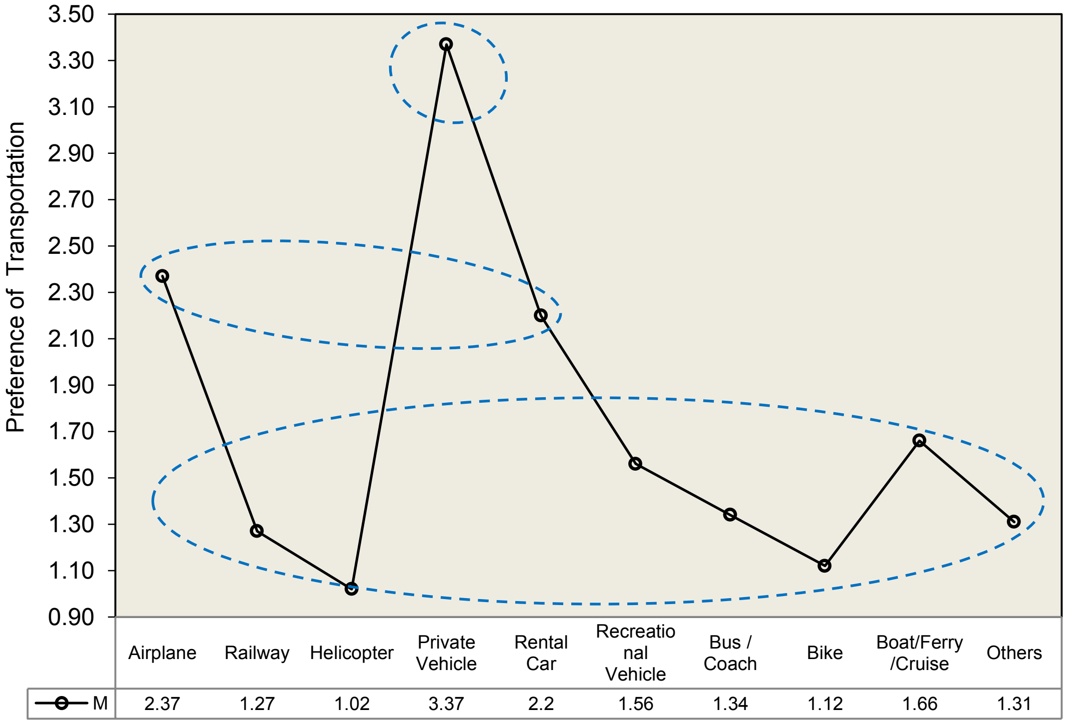


Figure 4.3 Preferences of transportation of astronomy tourists

- ***Preferences of Travel Companions***

In terms of preferred travel companions, there were significant differences as revealed by the Mauchly's Test of Sphericity (p=.000) and the tests of within-subject effects ($F=9.25$, $p=.000$, $\eta_p^2=.044$) in the repeated measures one-way ANOVA. Figure 4.4 illustrates the post-hoc Scheffe test results concerning the preferences of six the types of travel companions. Astronomy club/association members were evidently most preferred (M=3.44) by respondents, while partners (M=3.21) and friends (M=3.20) were also chosen as regular companions. From the post-hoc results, it is clear that traveling with relatives (M=2.44) and traveling alone (M=2.48) were less popular for astronomy-related trips.

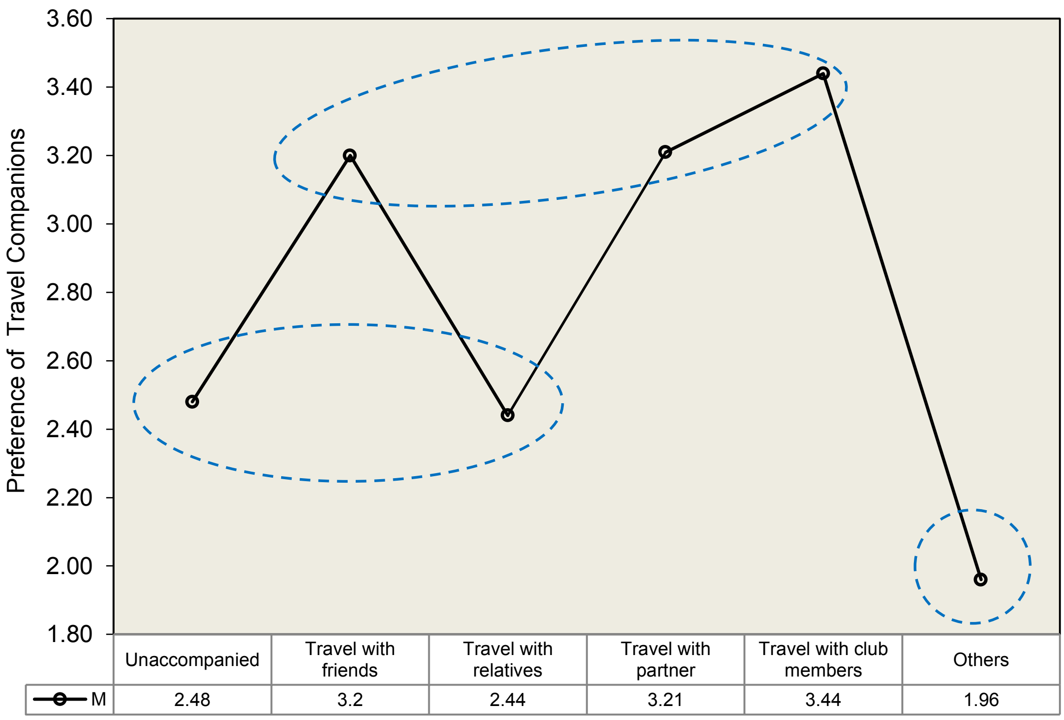


Figure 4.4 Preferences of travel companions

- ***Preferences of Communication Methods***

Figure 4.5 below, incorporating the post-hoc test results, presents the distribution of frequently-used communication methods preferred by astronomy tourists. Using the repeated measures one-way ANOVA, the Mauchly's Test of Sphericity (p=.000) and the tests of within-subject effects (F=12.84, p=.000, η_p^2=.052) indicated that the differences among the preferred travel companions were significant. From the post-hoc results, the face-to-face personal communication was reported as the most frequently used (M=3.54) method to share travel experiences, followed by social medias (M=3.20) and emails (M=3.19). Online forums (M=2.33) and phone calls/texts (2=2.45) were preferred in a middle position among all the items. Interestingly, online travel blogs (M=1.69) were the least frequently used channel to communicate with others or to share astronomy-related travel stories, though many travel blogs were collected and analyzed in the previous netnographic study.

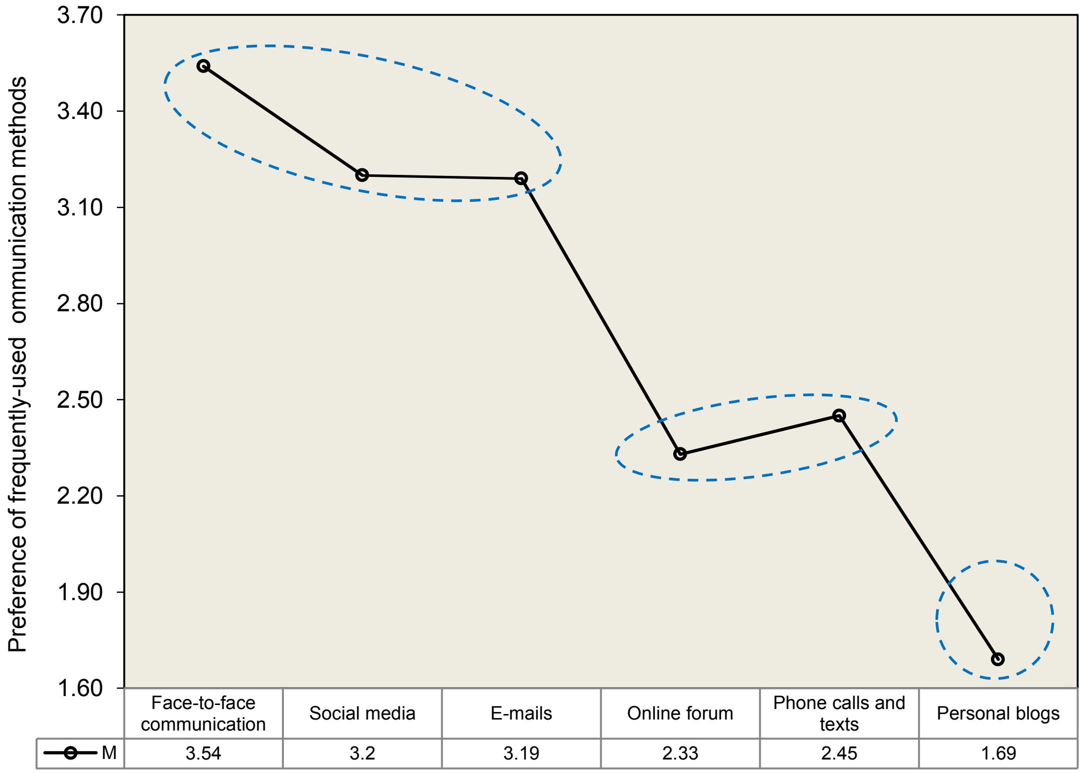


Figure 4.5 Preferences of communication methods by astronomy tourists

- ***Preferences of Destination Landforms***

In terms of the landforms of the destination, astronomy tourists' preferences are rather specific. This can be demonstrated by the Mauchly's Test of Sphericity (p=.000) and the tests of within-subject effects (F=9.66, p=.000, η_p^2=.049) in the repeated measures one-way ANOVA results. The post-hoc analysis results are presented in Figure 4.6. It reports that mountain tops (M=3.05) were the most preferred destination landform for carrying out astronomy-related travel activities. Plains, deserts, seaside areas and river/lake sides were the second most favorite landforms for the astronomy tourists, while tablelands, forests, islands and doing astronomy-related activities on the sea were less preferred. Ice fields (M=1.17) had the lowest score for landform preferences.

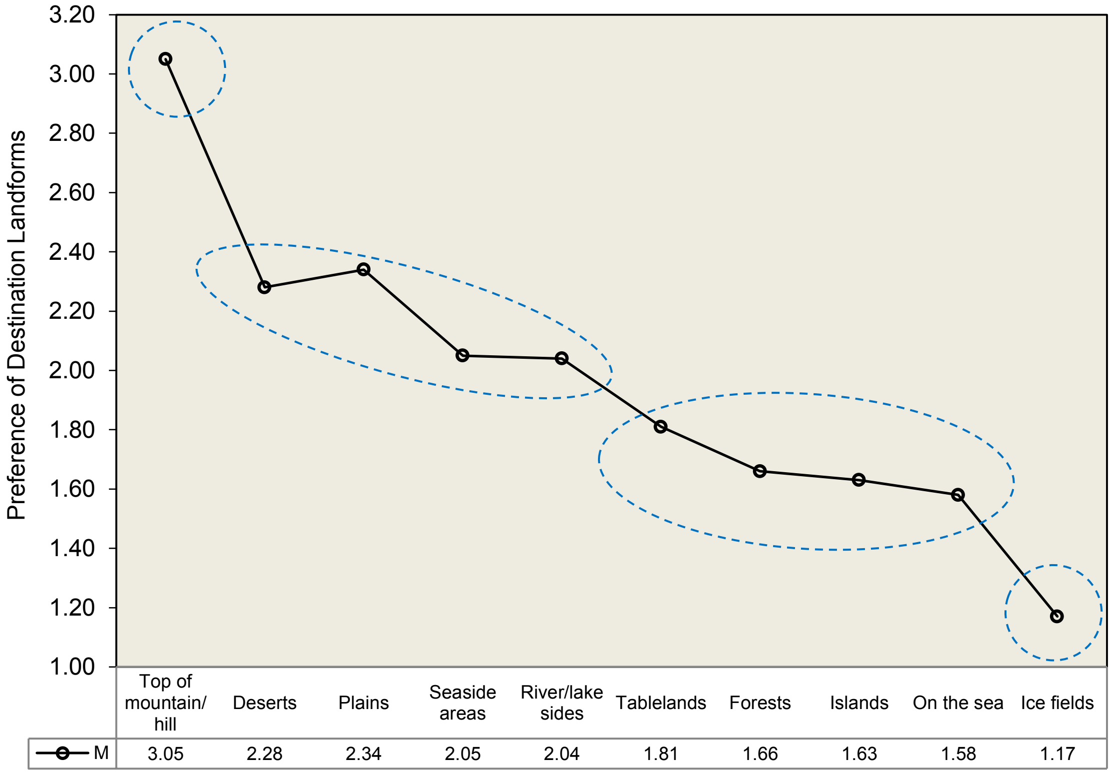


Figure 4.6 Preferences of destination landforms of astronomy tourists

(3) General attractions to astronomy tourists

Next, the preferences of twenty-one astronomy-related attractions, and the numbers of actual trips undertaken by the investigated astronomy tourists were examined by descriptive analysis and one-way ANOVA. The attractiveness of each astronomy-related attraction was measured on a seven-point Likert scale. The number of trips was recorded correspondingly in an open-ended question, specifying the number of actual trips which respondents had ever completed. Responses ranged from one to fifty (The maximum number reported in the survey). Due to the attributes of the attraction classified in Chapter 3, twenty-one attractions were sorted into two groups: astronomy phenomena and astronomy-related activities, with nine and twelve items respectively. Table 4.9 presents the results of the descriptive analysis, including the statistics of sample size, mean values and their standard deviation.

Table 4.9 Preferred tourist attractions and actual numbers of astronomy-related trips

Attraction Type	Attraction objects	Attractiveness [a]		Actual Trips [b]	
		Mean	SD	Mean	SD
Astronomical phenomena (N=844)	Solar eclipses	5.98	1.30	2.37	1.22
	Aurora	5.88	1.46	1.99	3.68
	Meteor Shower	5.85	1.33	3.78	4.58
	Transit of Venus	5.73	1.58	0.97	0.89
	Comet	5.21	1.76	2.49	3.67
	Lunar Eclipse	5.09	1.36	1.60	2.35
	Occultation	4.15	1.32	2.01	3.95
	Transit of Mercury	4.04	1.41	0.84	1.04
	Opposition or conjunction	4.02	1.49	2.21	3.91
Astronomy-related activities (N=846)	Stargazing	5.66	1.36	7.15	5.47
	Travel for star parties	5.60	1.25	6.57	4.34
	Visit observatory	5.01	1.22	3.93	2.94
	Astro-photographing	5.54	1.74	8.22	6.55
	Astronomy-related conference/forum/convention	5.13	1.25	7.29	4.11
	Astronomy-related education (workshop/class/competition/)	5.08	1.31	6.33	3.15
	Watch onsite rocket launch	4.45	1.57	1.33	2.09
	Astronomy-related heritage sites	4.31	1.30	3.94	3.74
	Visit planetarium	4.56	1.25	4.72	3.68
	Starry excursion/Full moon hike	4.49	1.80	1.94	4.14
	Meteorites seeking	3.77	1.58	1.86	2.39
	Astronomy-themed cruise/holiday	3.62	1.67	0.42	1.04

Note: [a] seven-point Likert scale, 7=most attractive, 1= Unattractive at all
[b] value was calculated by the actual numbers of astronomy-related trips

In the descriptive analysis in Table 4.9, items with the highest means in each aspect are highlighted in red and the second highest ones are shaded in grey. The subsequent one-way ANOVA results suggested that there were significant differences among the attractiveness of each item as well as the actual number of corresponding astronomy-related trips. These results and findings presented as follows.

(1) The attractiveness of nine types of astronomical phenomena varied significantly among the astronomy tourists ($F_{8,\ 844}$=12.87, p=.000). The differences lie in the distribution and classification of the nine attractions presented by post-hoc tests (see Figure 4.7).

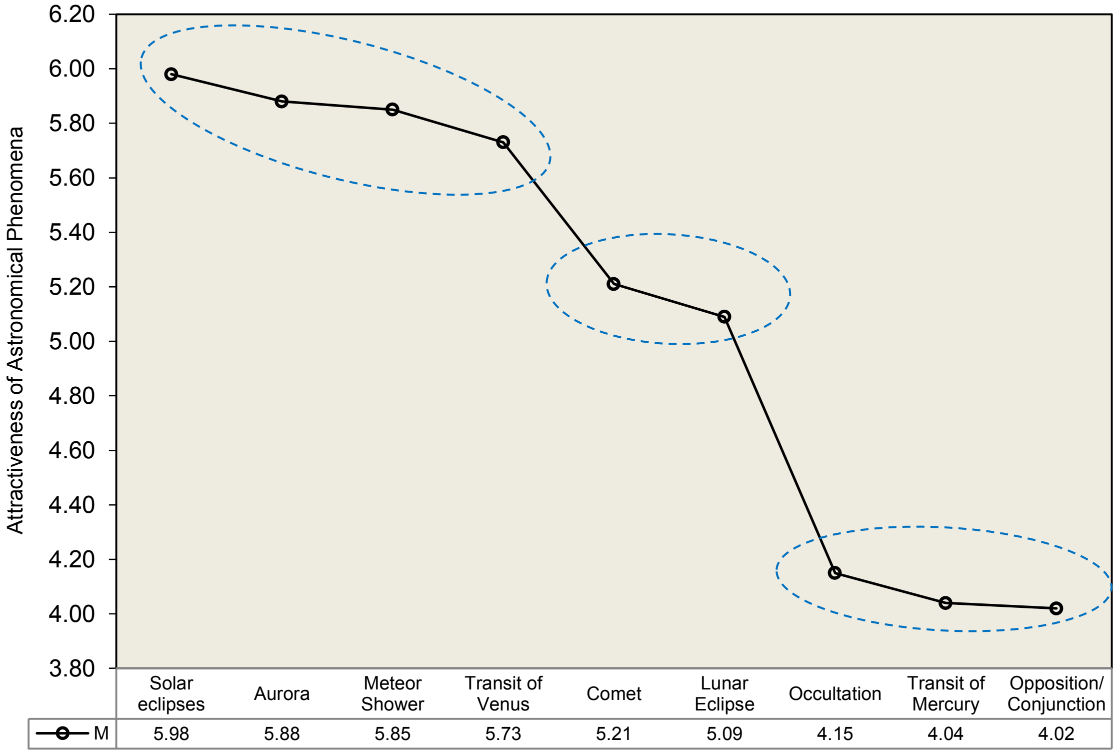
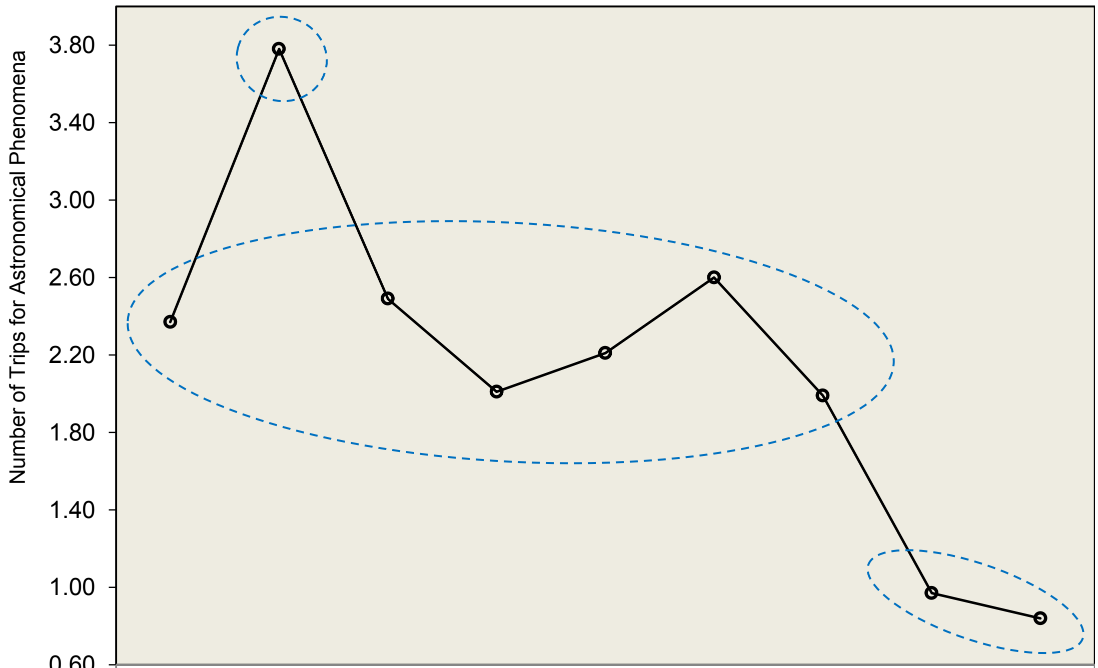


Figure 4.7 Attractiveness of nine types of astronomical phenomena

The post-hoc Scheffe test revealed that three types of astronomical phenomena were in the most attractive group. They were solar eclipse, aurora and meteor shower, in the order of attractiveness score from high to low. Astronomy tourists provided the strongest agreement (SD=1.30) that the solar eclipse is the most attractive phenomenon stimulating them to travel. The Transit of Venus, comet and lunar eclipse were at an intermediate position in terms of attractiveness scores. The least attractive group includes occultation, the Transit of Mercury and the opposition /conjunction of planets.

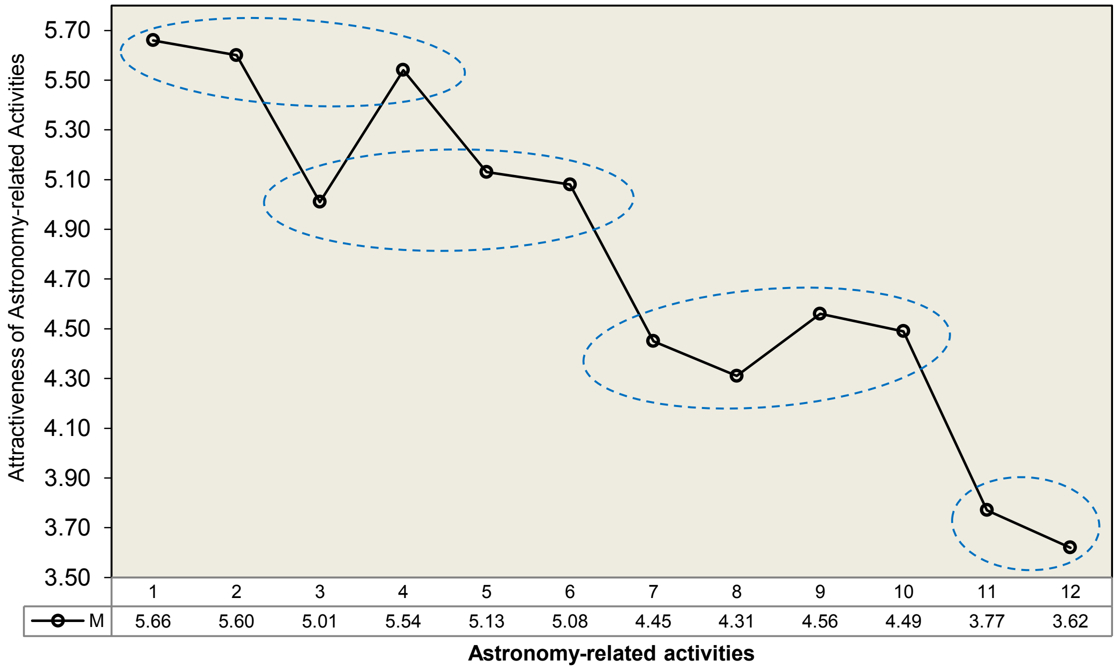
(2) The one-way ANOVA results ($F_{8, 844}$=18.64, p=.000) in Figure 4.8 indicated that there were significant differences among the numbers of actual trips undertaken by astronomy tourists to observe each astronomical phenomenon. Using the post-hoc Scheffe test, the meteor shower (M=3.78) was revealed as the most visited attraction but considerable variability existed in these responses (SD=4.58). There was an intermediate group which caused travel: specifically, solar eclipse, comet, aurora, occultation, lunar eclipse, and the opposition /conjunction of planets. The smallest number of trips undertaken by astronomy tourists falls into the small cluster of the Transit of Venus and the Transit of Mercury.



	Solar eclipses	Meteor Shower	Comet	Occultation	Opposition/ Conjunction	Lunar Eclipse	Aurora	Transit of Venus	Transit of Mercury
M	2.37	3.78	2.49	2.01	2.21	2.60	1.99	0.97	0.84

Figure 4.8 Number of trips to nine types of astronomical phenomena

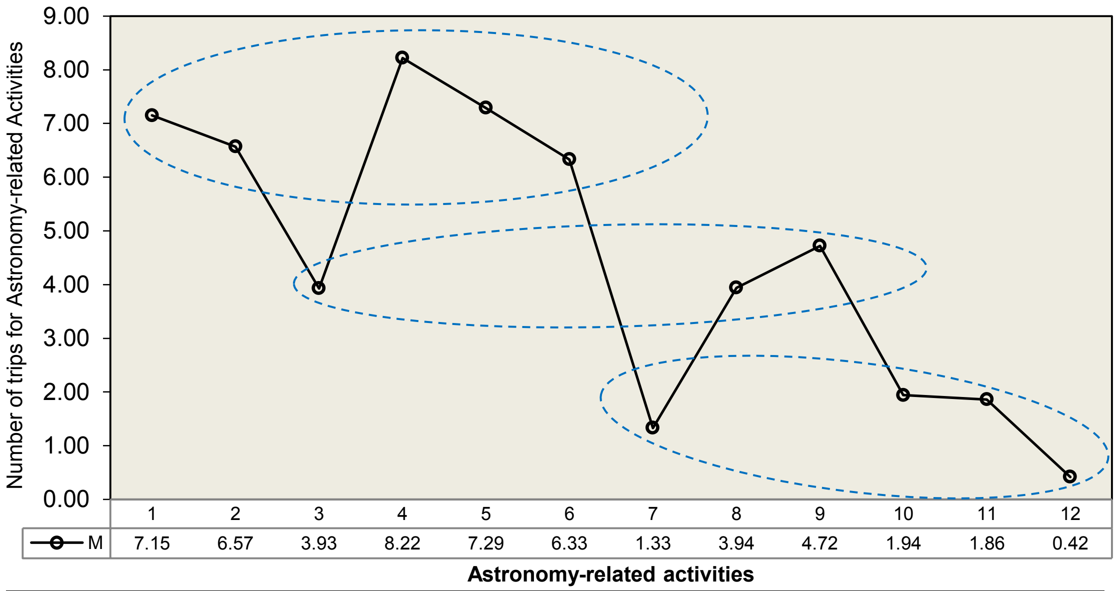
(3) For the astronomy-related activities, the one-way ANOVA results indicated that the differences among the attractiveness of activities were significant (F=11.55, *df* =11, p=.000). The post-hoc test results in Figure 4.9 revealed that tourists were most attracted to travel for three types of astronomy-related activities: stargazing, star parties and astro-photographing. There was a higher-middle attraction group of visiting observatories, participation in astronomy-related forums/conventions and astronomy education programs. Watching onsite rocket launch, visiting astronomy-related historical sites and planetariums comprised a mid-level group of attractions. Meteorites seeking and astronomy-themed holiday/cruise fell into the least attractive group of activities.



The explanation of astronomy-related activities 1-12		
1. Stargazing	5. Astronomy-related conference/forum/convention	9. Visit planetarium
2. Star parties	6. Astronomy-related education (workshop/class/competition/)	10. Night-sky excursion /Full moon hike
3. Visit observatory	7. Watch onsite rocket launch	11. Meteorites seeking
4. Astro-photographing	8. Astronomy-related historical sites	12. Astronomy-themed cruise/holiday

Figure 4.9 Attractiveness of twelve types of astronomy-related activities

(4) Using one-way ANOVA, the post-hoc Scheffe test (see Figure 4.10) indicated that the number of trips undertaken by astronomy tourists to pursue astronomy-related activities was significantly different (F=26.33, *df*=11, p=.000). The statistics revealed that stargazing, star parties, astro-photographing, astronomy-related conventions and astronomy education program comprised the group with the highest frequency of actual trips. The intermediate group consisted of three types of activities: visiting astronomy observatories, planetariums and astronomy-related historical sites. The remaining activities: watching onsite rocket launch, night-sky excursion, meteorites seeking and astronomy-themed cruise/holiday were in the group with the smallest number of actual trips. There was a close correspondence between these results and the pattern of findings in Figure 4.9 for the attractiveness of the activities.



The explanation of astronomy-related activities 1-12		
1. Stargazing	5. Astronomy-related conference/forum/convention	9. Visit planetarium
2. Star parties	6. Astronomy-related education (workshop/class/competition/)	10. Night-sky excursion /Full moon hike
3. Visit observatory	7. Watch onsite rocket launch	11. Meteorites seeking
4. Astro-photographing	8. Astronomy-related historical sites	12. Astronomy-themed cruise/holiday

Figure 4.10 Number of actual trips to nine types of astronomical phenomena

In summary, comparing the perceived attractiveness with the number of actual trips, it is found that the four most attractive astronomical phenomena have slightly higher score than any astronomy-related activities. However, in reality those activities motivated tourists to undertake a larger number of actual trips than any of the top four astronomical phenomena. This may have connections with the rareness (scarcity) of occurrence of those phenomena, which happen periodically (usually meteor shower, solar eclipse and lunar eclipse) or appear with episodic and aperiodic rate (e.g. aurora, comet). Unlike regular activities, these events only occur extremely occasionally (e.g. Transit of Venus only occurs two times in 122 years!). Therefore, astronomy tourists actually travelled infrequently for such phenomena, even though they might strongly propel people to travel. By way of contrast, high frequencies were found in the actual trips for participating in the majority of astronomy-related activities, except astronomy-themed cruise/holiday (M=0.42) and watching a rocket launch. On average, more than half of the activities had stimulated tourists to travels more than three times, Seeking meteorites (M=1.86), visiting astronomy-related historical sites (M=1.33) and hiking under starry skies (M=1.94) engaged tourists' participation less than twice. For other astronomical phenomena, except for the Transit of Venus (M=0.97) and Transit of Mercury (M=0.84), tourists had travelled more than two times.

It is notable that the actual numbers of trips are widely distributed (most of them have a high standard deviation). That is, astronomy tourists have significant differences in the frequency of travels for a specific type of attraction. It is arguably related to different leisure involvement levels in astronomy as a hobby and different patterns of the tourist motivation. These hypotheses will be subsequently examined in section 4.4.3 and section 4.4.4.

4.4.2 Exploring Influential Factors in Decision Making

In this section, the underlying extrinsic influential factors in the astronomy tourists' decision making are explored and identified by principal component analysis (PCA).

Principal component analysis is an exploratory statistical procedure that identifies an underlying structure in an array of variables. It is suitable for simplifying patterns among a large number of items with large-size sample size (Pearce & Lee, 2005). A test on the sufficiency of the sample size was conducted by using the Keiser-Meyer-Olkin (KMO) examination of sample adequacy. This check provides a value ranging from zero to one, with the higher value suggesting a good foundation on which to proceed with the PCA. On this occasion, the KMO value for this analysis was 0.92, implying an adequate sample. Only the Eigen values greater than one were adopted, with the potential dimension in the data being considered to represent a strand of meaning worthy of further analysis. The items with factor loading value above 0.40 were chosen to account for the factor. As a result, the PCA procedure produced three defining factors. The percentage of variance explained by this solution was 60.9%. Cronbach's coefficient alpha was utilized to measure the intrinsic consistency among the items. If the coefficient alpha is above the 0.70 baseline, results can normally be accepted as reliable (Ryan, 1998).

In this study, all the factors coefficient alphas were greater than 0.70 (with the lowest at 0.72 to the highest 0.91), which implies that the consistency among the items in each factor is relatively strong. The detailed results of PCA are reported in Table 4.10. The varimax rotation process was also employed in PCA in this study.

Table 4.10 Extrinsic influential factors in astronomy tourists' decision making

Factors	Influential items	Importance Mean	Loading
Physical (M=6.04) [a] (8.7%) [b] (α=0.91) [c]	Favourable weather condition	6.31	.85
	Stable astronomical seeing	5.99	.68
	Less light pollution	6.28	.81
	Destination landscape	5.05	.49
	Unobstructed skyline	5.86	.74
	Rareness of the astronomical event	6.13	.54
	Geographic location enables the visibility	6.05	.80
Social (M=5.41) (16.4%) (α=0.84)	Experienced tour guide /group leader	4.55	.71
	Excellent companions	5.31	.74
	Friendly local residents	5.81	.45
	Travel safety	5.95	.81
Product /Service (M=4.98) (35.8%) (α=0.72)	Good travel itinerary	5.22	.61
	Well-organized activities	5.84	.59
	Reasonable expenditure	5.77	.65
	Local facilities & services	4.79	.48
	Offer astronomical equipment	3.17	.53
	Convenient transportation	5.14	.66
	Accommodation conditions	4.97	.41
	Tour provider's reputation	4.68	.48

Note: [a] mean score of the factor; [b] variance explained; [c] Cronbach's alpha reliability coefficient. In general, 60.9% of variance explained; influential items with factor loading below 0.40 were discarded.

From the results above, three determining factors which influence astronomy tourist's decision making towards travel destinations were identified in the order of importance. They are: physical, social and product/service factors. Physical factors (M=6.04, 8.7% variance explained, α=0.91) were reported by astronomy tourists as the dominating determinant in destination selecting process. In particular, good weather conditions (M=6.31), light pollution (M=6.28) and the rareness of the event (M=6.13) were the most important factors to be considered in deciding an astronomy-related travel, while the destination's landscape (M=5.05) was reported as the least important element.

The secondary determinant was the social factor (M=5.41, 16.4% variance explained, α=0.84). According to the survey, travel safety (M=5.98) was taken as the first thing into their consideration by many astronomy tourists when thinking of social impact. The next two elements were friendly local residents (M=5.81) and travel companions (M=5.31), while group leader or tour guide (M=4.55) was less important for tourists who decide to travel for astronomy-related purposes.

The third and the least important factor was the service/product factor (M=4.98, 35.8% variance explained, α=0.72). In this facet, well-organized activities (M=5.84) and reasonable travel budget (M=5.77) were two primary factors to be considered. Whether or not the observational equipment was provided by the tour operator or the destination (M=3.17) was less important for astronomy tourists.

4.4.3 Assessing Astronomy Tourist' Leisure Involvement

In this section, astronomy tourists' involvement level in astronomy-interested leisure was firstly measured by the Ward method and K-means cluster analysis. The same method was subsequently employed to classify the surveyed tourists in terms of their astronomy-related travel experience levels. A series of tests on the importance of the item contributing to assessing the travel experience levels was then conducted using discrimination function analysis. Further, in reference to the framework of the 'SIT Experience' model initiated by Trauer (2006), a cross-tabulation analysis was utilized to identify different categories of astronomy tourists based on their leisure involvement and travel experience levels. In the next step, the Kruskal-Wallis analysis was applied to use the specified indicators to describe the identities of these four types of astronomy tourists by documenting travel preferences, decision making determinants and the amount of astronomical equipment. This analysis attempted to uncover indicators to distinguish serious leisure and casual leisure participants in astronomy-related travels. The detailed results were discussed as follows.

In accordance with the procedure of the Ward method and K-Means cluster analysis, a two-cluster solution was selected based on six parameters of serious leisure identified by Stebbins (1982) and his colleagues (Gould *et al.*, 2011; Gould, J. *et al.*, 2008). The first cluster (N=395, 41.2%) was subjectively labelled as 'serious leisure pursuers', because relative to the other cluster, the respondents in this cluster reported the highest scores in regard to the six qualities of the serious leisure concept. The second cluster (N=459, 58.1%) was designated as 'casual leisure pursuers' because that they had relatively low scores in astronomy-related leisure involvement. Table 4.11 below reports the detailed results of K-means cluster analysis.

Table 4.11 K-Means cluster analysis on tourists' leisure involvement levels

Serious Leisure Qualities	Mean Scores of the Clusters		*t*	*p*
	Serious Leisure	Casual Leisure		
Perseverance	6.19	3.56	913.495	.000**
Leisure career	5.92	2.79	648.018	.000**
Significant effort	6.33	3.12	958.349	.000**
Durable outcomes	5.47	3.34	471.647	.001**
Unique ethos	6.11	2.95	931.854	.000**
Identification	6.08	3.04	845.443	.001**
N	395	459		
Proportion	41.2%	58.1%		

Note: A seven-point Likert scale was used in measuring the leisure involvement levels. 1 = completely disagree; 7 = completely agree. N= 854, $^{**}p < 0.01$

In order to validate the cluster analysis results, the discriminant analysis was adopted with two clusters and six leisure involvement parameters. In reference to the results, 96.5% of the respondents were appropriately grouped into clusters, demonstrating a convincing validity of the previous K-means analysis.

Next, a similar approach was applied in examining the travel experience levels of the astronomy tourists. Four variables were adopted to assess respondents' astronomy travel experience levels: 1) Frequency of the astronomy-related travel, 2) total number of astronomy-related trips, 3) length of the astronomy-related travel career, and 4) the proportion of astronomy-related trips within the total number of trips.

In the previous cluster analysis, the factor of travel experience was measured by four parameters on different scales. The units of the measured values were not unified. The standardization of these values was required prior to the implementation of the K-means cluster analysis. This was imperative to avoid the problem that factors with larger scores may be overly powerful in the calculation process of cluster analysis. The four variables were all standardized on a scale, ranging from zero to one. Next, they were imported into the K-means cluster analysis. The results were performed for the two, three and four-cluster solutions. A discriminant analysis was employed again to test the validity of these three solutions. As a consequence, the two-cluster scheme was selected with the largest coverage, encompassing 98.2% of the surveyed tourists. They were clustered into two groups with higher travel experience level and lower travel experience level respectively. The results of the cluster analysis are shown in Table 4.12. The results of the discriminant analysis are presented in Table 4.13.

Table 4.12 Cluster analysis results: travel experience levels

Parameters	Self-perception of travel experience level		ANOVA Sig.
	Higher group	Lower group	
Astronomy-related travel frequency	0.88	0.37	.00
Number of travels	0.74	0.31	.00
Length of the astronomy-related travel career	0.61	0.25	.00
Centrality (proportion of astronomy-related travels)	0.53	0.20	.00
N	351	479	
Proportion	42.3%	57.7%	

Note: N=830

In Table 4.12, the first cluster identifies a group with a higher level of travel experience. It contains 42.3% (351 valid cases) of the total 830 respondents, while the second cluster comprises 479 (57.7%) astronomy tourists. The discriminant analysis was subsequently performed to ascertain which of the four measures contributed most in differentiating the two travel experience groups. It is appropriate if there are small number of variables when the discrimination is applied based on all of the variables. As revealed in Table 4.13, three functions accounted for 89.1%, 8.5% and 1.9% of the explained variance respectively. Function 1 with an eigenvalue of 4.54 contributes the most to the variance, while the other two functions are rejected due to non-significant probability values.

Table 4.13 Significance test of the discriminant function level

Function	Eigenvalue	Variance (%)	Canonical correlation	Wilk's Lambda	Chi-square	Sig.
1*	4.54	89.6	0.91	.081	565.51	.000
2	1.88	8.5	0.55	.597	101.23	.082
3	0.49	1.9	0.24	.942	48.67	.244

Note: only function 1 was adopted in the analysis. * p<0.001

The canonical correlation parameter of 0.91 associated with the function suggests that Function 1 is strongly related to the difference between two travel experience groups. In addition, by squaring the canonical correlation, $(0.91)^2=0.83$, it indicates that 83% of the variance in the dependent variable – two levels of travel experience group, is validly explained. The Wilk's Lambda value (0.081) also suggests that two groups are isolated appropriately. Also, the separation of the travel experience groups is highly significant ($\chi^2=565.51$, $p<0.001$).

To determine which variable contributes the most to function 1, discriminant function coefficients and loadings were checked. The result is presented in Table 4.14 in the sequence of magnitude. The examination of the standardized coefficients suggests that the frequency of taking astronomy-related travels is the most convincing indicator in classifying the two levels of travel experience groups, followed by the number of astronomy-related travels ever taken, length of the astronomy-related travel career and the centrality of astronomy-related travels.

Overall, the values of all the coefficients associated with the measuring parameters are positive, the group centroids indicate that the higher frequency of astronomy-related travels taken, the larger number of travels experienced, the longer the travel career lasts and the higher proportion of astronomy-related travel occupied, tourists are more likely to reach higher level of travel experience. Further, the classification matrix approach was utilized to examine whether the discriminant function is a valid measure to distinguish travel experience groups. The classification matrix results demonstrated that 96.4% of valid cases were reasonably sorted into the correct travel experience group.

Table 4.14 Canonical discriminant function coefficients and loadings

Predictor variables	Unstandardized coefficients	Standardized coefficients	Discriminant loadings
Astronomy-related travel frequency	3.66	0.69	0.78
Number of travels	2.31	0.45	0.56
Length of the astronomy-related travel career	1.58	0.37	0.48
Centrality (proportion of astronomy-related travels)	1.06	0.21	0.39
(Constant)	-4.98	N/A	N/A

Considering the above tests together, the results of the descriptive, cluster, and discriminant function analyses indicate that they were compatible and consistent with each other. This demonstrates that the third part of questionnaire which tackles the assessment of leisure involvement levels is adequate in its reliability.

Further, drawing on the above results, a two-dimension matrix can be established by using cross-tabulation between leisure involvement and the travel experience level of astronomy tourists. As displayed in Table 4.15, this matrix is underpinned by the contextualized framework of the 'SIT Experience model' (Trauer, 2006) as stated in Chapter 2. In this model, a horizontal axis traces the level of involvement in special interest focus (behavioral, cognitive and affective enduring involvement), and a vertical axis represents the travel experience level (initial measurement was proposed as 'frequency', which becomes a predictor variable of travel experience level). Hence, this model consists of four quadrants, identifying four types of SIT tourists by those two dimensions: 'dabbler', 'enthusiast', 'fanatics' and 'specialist'. This is not unlike those suggested in the following cross-tabulation matrix (see Table 4.15).

Table 4.15 Cross-tabulation matrix: Four categories of astronomy tourists

Travel Experience	Lower Involvement Group (Casual Leisure)	Higher Involvement Group (Serious Leisure)	Total
Higher travel experience level*	Fanatics (N=245, 55.5%) [a]	Specialists (N=106, 27.2%)	351
Lower travel experience level*	Dabbler (N=196, 44.5%)	Enthusiasts (N=283, 72.8%)	479
Total	441 (100%)	389 (100%)	830

Note: [a] percentage was displayed within leisure involvement group. *$p < 0.05$

In Table 4.15, a classification for each type of astronomy tourists was identified by cross-tabulation. The Chi-square score were also computed to examine whether there is significant difference at the travel experience level between the two involvement groups. The positive result suggests that the difference is evident. According to the statistics, 44.5% casual leisure pursuers were labelled as 'dabblers' with lower travel experience levels at astronomy-related travels, and nearly equal proportion (55.5%) of the casual leisure participants had higher level of travel experience and were marked as astronomy 'fanatics'. In total, casual leisure tourists comprised 53.1% of the entire sample. In the higher leisure involvement group, 27.2% of the serious leisure travelers were identified as 'specialists' or 'experts' due to their abundant astronomy-related travel experiences. An overwhelming number (72.8%) of the astronomy tourists with strong involvement fell into the quadrant labelled 'enthusiasts'. They were serious leisure pursuers with relatively low levels of astronomy-related travel experience. In general, 46.9% of the respondents were reported as serious leisure astronomy tourists. It is necessary to mention here, this classification of astronomy tourist is the foundation of an array of further analyses in following sections. Several assessments are subsequently conducted based on this finding concerning the four different categories of astronomy tourists.

As discussed previously, membership is a pivotal factor which may reflect astronomy tourists' leisure involvement levels, and vice versa. In order to test this hypothesis, another cross-tabulation was completed. The results are reported in Table 4.16.

Table 4.16 Cross-tabulation: memberships and four types of astronomy tourists

Identify Group	Roles of astronomy tourists				Total
	Dabbler	Enthusiast	Fanatic	Specialist	
Memberships**	15 (7.7%) [a]	237 (83.7%)	227 (92.7%)	103 (97.2%)	582
Non-membership**	181 (92.3%) [a]	46 (16.3%)	18 (7.3%)	3 (2.8%)	248
Total	196 (23.6%) [b]	283 (34.1%)	245 (29.5%)	106 (12.8%)	830 (100%)

Note: [a] percentage within each category of the four roles; [b] proportion of the total respondents.
** $p < 0.001$

From Table 4.16, it is clear that dabblers, enthusiasts, fanatics and specialists occupy 23.6%, 34.1%, 29.5% and 12.8% of the total number of surveyed astronomy tourists respectively. Enthusiasts constitute the largest group. Within these groups, the identity of the astronomy club's membership varies significantly. For dabblers, only 7.7% of them are registered members of astronomy clubs of societies, while 92.3% of them are non-members, and they contribute 73.0% of all the non-membership tourists. By way of contrast, for the enthusiasts, fanatics and specialists, the largest proportion of them are astronomy tourists with memberships, with the percentages of 83.7%, 92.7% and 97.2% respectively. Enthusiasts and fanatics make up most (79.7%) of the reported astronomy club members. It is possible to argue that with the higher leisure involvement in the astronomy interests and the higher astronomy-related travel experience levels, respondents are more likely to become official members of astronomy clubs/societies. Nevertheless, the results imply that membership can still reflect an astronomy tourist's role and category, as a key indicator of tourist identity.

A further Kruskal-Wallis analysis was conducted to determine other indicators characterizing the representation and group identity of the four types of astronomy tourists. The results are reported in Table 4.17.

Table 4.17 Kruskal-Wallis H-test: Distinguishing general travel experiences among four categories of astronomy tourists

General Travel Experience Indicators	Variables	Mean Rank				H (χ^2)	Sig.
		Dabbler	Enthusiast	Fanatic	Specialist		
Amount of astronomy equipment ever had	Amateur-level equipment**	7.66	12.35	9.13	21.84	29.47	.002
	Professional-level equipment**	1.44	9.42	5.61	12.64	20.45	.000
Decision making determinant	Physical factors**	13.16	15.98	14.35	16.51	18.32	.001
	Product/Service factors **	17.24	12.57	16.88	11.25	16.61	.005
	Social factors	15.97	15.34	16.01	15.23	0.78	.431
Extent of the attraction preference	Solar eclipses	18.40	18.02	18.35	19.58	0.45	.633
	Lunar Eclipse	16.86	16.47	16.88	17.01	1.56	.421
	Meteor Shower*	17.52	15.60	16.45	18.62	15.37	.035
	Aurora	18.12	17.46	18.43	17.35	1.46	.114
	Comet*	14.52	17.91	15.52	18.45	16.47	.017
	Transit of Venus	16.42	17.06	16.81	17.14	0.84	.398
	Transit of Mercury**	12.03	17.84	12.62	18.12	24.16	.005
	Occultation*	13.75	15.48	13.85	16.49	17.34	.019
	Opposition or conjunction*	12.31	14.32	13.24	14.67	9.41	.026
	Stargazing	16.66	16.97	16.27	17.21	1.03	.292
	Travel for star parties**	9.23	18.80	12.69	17.76	35.11	.000
	Astro-photographing**	11.12	15.68	13.94	18.46	29.45	.000
	Visit observatory*	16.81	17.42	16.35	15.27	2.68	.016
	Astronomy-themed cruise/holiday**	17.54	11.26	16.98	9.14	75.44	.000
	Visit planetarium**	16.25	12.91	17.17	10.53	49.41	.000
	Full-moon excursion/hiking**	16.30	11.44	15.16	9.54	54.28	.000
	Meteorites seeking**	12.16	13.41	13.59	14.60	3.52	.001
	Watch onsite rocket launch**	16.43	12.27	17.64	8.95	68.64	.000
	Astronomy-related conference/forum/convention*	9.35	16.51	12.84	17.22	59.91	.011
	Astronomical education program**	10.37	15.94	11.20	16.09	5.16	.002
	Astronomy-related historical sites	12.58	12.36	12.88	11.97	0.86	.415

Table 4.19 (continued)

General Travel Experience Indicators	Variables	Mean Rank				H (χ^2)	Sig.
		Dabbler	Enthusiast	Fanatic	Specialist		
Accommodation Preference (N=811)	Premium hotels	5.42	5.05	5.98	5.15	0.33	.366
	Budget hotels	9.87	9.49	9.84	9.01	0.12	.740
	Resorts	5.61	5.08	6.10	5.74	1.25	.098
	Motels	6.52	6.34	6.75	6.18	0.21	.854
	Hostels	4.52	5.01	4.81	4.29	0.88	.121
	Camping (without RVs)**	7.21	15.24	9.33	12.65	58.20	.000
	Recreational Vehicles**	6.95	9.68	7.52	11.85	35.41	.000
	Holiday parks**	6.54	9.44	7.67	12.20	41.23	.000
	Guest House / B&Bs	6.18	7.06	6.23	6.32	0.58	.245
	Friends' or relatives' dwelling	5.93	6.47	6.39	6.16	0.44	.317
	Others	3.25	3.12	2.98	3.04	0.22	.877
Transportation Preference (N=834)	Airplane	8.40	7.88	8.11	7.42	0.89	.146
	Helicopter	2.22	2.01	2.13	2.10	0.15	.928
	Railway	3.55	2.97	2.84	3.13	0.74	.192
	Private Vehicle **	11.23	14.65	12.58	15.46	24.11	.000
	Rental Car **	15.32	10.21	14.64	9.88	38.47	.000
	Recreational Vehicle **	7.14	11.10	8.42	12.35	20.18	.000
	Bus / Coach	2.55	2.84	2.17	2.08	0.14	.933
	Bike	2.10	2.36	2.22	2.05	0.15	.927
	Boat/Ferry/Cruise	3.21	3.34	3.51	3.38	0.17	.908
	Bare Foot	1.98	2.11	1.95	2.07	0.21	.854
	Others	1.84	2.30	1.91	2.21	0.53	.271
Most frequent travel companions (N=839)	Unaccompanied **	5.90	9.77	7.27	11.98	48.40	.000
	Travel with friends	9.30	10.14	9.85	9.77	1.45	.086
	Travel with relatives	6.45	7.14	6.51	6.39	0.89	.136
	Travel with partner	9.39	9.28	9.84	10.27	1.03	.098
	Travel with club members **	3.58	14.25	8.38	10.08	84.61	.000
	Others	3.33	3.81	3.72	3.10	0.74	.192

Table 4.19 (continued)

General Travel Experience Indicators	Variables	Mean Rank				H (χ^2)	Sig.
		Dabbler	Enthusiast	Fanatic	Specialist		
Frequent-used methods for sharing travel experiences (N=841)	Online forum **	2.47	5.81	3.44	4.60	4.15	.001
	Personal blogs **	1.15	2.46	1.83	3.87	2.84	.002
	Face-to-face communication **	6.94	11.72	8.15	12.59	35.21	.000
	Social media**	15.62	14.33	16.42	10.78	18.30	.000
	Phone calls and texts	4.58	4.99	5.21	4.23	0.97	.214
	E-mails**	1.96	3.65	2.69	5.84	16.45	.000
Landform of frequent-visit destination (N=818)	Top of mountain/ hill	9.25	9.98	9.30	10.05	0.84	.154
	On the sea	2.61	2.57	2.44	2.08	0.67	.325
	Seaside areas	4.79	5.44	5.10	4.09	1.44	.059
	Plains	4.26	4.95	4.87	5.13	0.82	.175
	Tablelands	4.45	5.87	4.62	5.50	1.15	.086
	River/lake sides	4.86	4.28	4.59	4.12	0.58	.454
	Deserts	4.63	5.21	4.68	5.11	0.69	.320
	Forests	3.55	2.48	3.56	2.26	1.21	.071
	Islands	2.65	2.91	3.47	2.70	0.93	.128
	Ice fields	1.20	1.46	1.29	1.82	0.45	.568

Note: * $p<0.05$, ** $p<0.01$; *df* =3; N= number of valid cases

Kruskal-Wallis test by ranks was employed to distinguish the features of general travel experiences among the dabblers, enthusiasts, fanatics and specialists. Kruskal-Wallis analysis is a non-parametric variance test on two or more independent samples of equal or different sample sizes. It was adopted because there were more than two groups without normal distribution assumption so Kruskal-Wallis test was available to ascertain which of the indicators were relevant in distinguishing the four different groups of astronomy tourist. Defining four identity groups of astronomy tourists as independent variables, the other features of general travel experiences were then used as dependent variables. Most of these factors were examined in previous sections and here they were tested again to see whether some of them can become identity signifiers to differentiate those four categories of astronomy tourists. As the results revealed in Table 4.19, items with significance value greater than 0.05 were shaded in grey color. Several insightful findings are as follows:

(1) Among dabblers, enthusiasts, fanatics and specialists, there is a significant difference in the amount of astronomy apparatus, at both amateur (χ^2=29.47, p=.002) and professional level (χ^2=20.45, p=.000). Serious leisure participants (enthusiasts and specialists) have more equipment (at both professional and amateur levels), than project leisure (fanatics) and casual leisure (dabblers) pursuers do.

(2) When considering the extrinsic influential factors on decision making, tourists have relatively coherent consideration about social factors (χ^2=0.78, p=.431), such as travel safety and local communities, but their opinions are divided about physical factors (χ^2=18.32, p=.001) and product/service factors (χ^2=16.61, p=.005).

Physical factors are regarded as of the most critical by specialists (mean rank=16.51), while dabblers consider them as the least important determinant (mean rank=13.16) since they put the factor of product/service (mean rank=17.24) at their first concerns. By way of contrast, serious leisure pursuers (specialists and enthusiasts) believe product and service are the last criteria (mean rank=11.25) to consider before undertaking astronomy-related trips.

(3) For the astronomy-related attractions, for all categories of astronomy tourists, there is not a significant preference for solar eclipse (χ^2=0.45, p=.633), lunar eclipse (χ^2=1.56, p=.421), aurora (χ^2=1.46, p=.114), Transit of Venus (χ^2=0.84, p=.398), stargazing (χ^2=1.03, p=.292) or visiting astronomy-related historical sites (χ^2=0.86, p=.415). They are all attractive to astronomy tourists at equal levels. However, the rest of the attractions differ for the four types of tourists in terms of preference. For example, seeking comets is very attractive for those pursuing serious leisure (specialists: rank=18.45; enthusiasts: rank=17.91), while the casual leisure tourists (dabblers: rank=14.52; fanatics: rank=15.52) see this feature as less attractive. Astronomy-related activities such as visiting planetariums are one of the favorites for dabblers (mean rank=16.25) and fanatics (mean rank=17.17), but it is a less attractive category for specialists (mean rank=10.53) and enthusiasts (mean rank=12.91). It is notable that even though an astronomy-themed cruise or holiday is relatively weak in attracting tourists in general (χ^2=75.44, p=.000) (see findings in section 4.4.1), it is preferred more by causal leisure takers (mean ranks =17.54 for dabblers; 16.98 for fanatics) than by serious leisure pursuers (mean ranks =11.26 for enthusiasts; 9.14 for specialists).

(4) In terms of travel accommodation, the results presented few significant differences between four types of tourists in selecting majority of the options, except for three types of accommodation: camping without RVs (χ^2=58.2, p=.000), RVs (χ^2=35.4, p=.000), and holiday parks (χ^2=41.2, p=.000). More specifically, astronomy hobbyists with serious leisure overwhelmingly preferred RVs, holiday parks and camping when they were on an astronomy-related trip, while casual and project-leisure participants had fewer preferences for these three options. The 'lifestyle' of astronomy tourist neo-tribes can arguably account for this finding, since travelling by RVs was one of the signifiers for their group culture.

(5) For transportation, RVs were also significantly preferred (χ^2=20.2, p=.000) by specialists and enthusiasts rather than by dabblers and fanatics. Private cars were selected by serious astronomy tourist (mean ranks= 14.65 for enthusiasts; = 15.46 for specialists) as their first transport (χ^2=24.1, p=.000), while rental cars were preferred more by those casual and project-based leisure respondents (χ^2=38.5, p=.000) (mean ranks=15.32 for dabblers, =14.64 for fanatics).

(6) Concerning selecting travel companions, among the four groups there were not any evident differences among tourists' preference for travelling with friends, partners or relatives (χ^2<1.50, p>.50). A strong willingness to travel with other astronomy club members can be seen for the enthusiasts, but it did not appear in dabblers (mean rank=3.58) and fanatics (mean rank=8.38) (χ^2=84.6, p=.000). Unlike other groups, specialists (mean rank=11.98) favour unaccompanied forms of travels, and travelling with astronomy club members ranks at the second place (mean rank = 10.08) in their companion preferences.

(7) Among the frequently-used methods for sharing travel experience, there were not any significant differences among the tourist preferences for using phones and text messages (χ^2=0.97, p=.214); however, significant differences emerged in the other five types of methods. The online forms (χ^2=4.15, p=.001) were most frequently used by enthusiasts (mean rank=5.81) and then specialists (mean rank=4.6), but were not strongly preferred by dabblers (mean rank=2.47) and fanatics (mean rank=3.44). Personal blog posting was used more by specialist (mean rank=3.87) than any others (χ^2=2.84, p=.002), though it was the least used method for all of the respondents (see findings in section 4.4.1). Face-to-face conversations were the favourite form of communication for specialists (mean rank=12.59) who were the weakest fans of using social media to share travel stories (mean rank=10.78), while fanatics were the biggest fans of using social media (mean rank=16.42). Social media was also the favourite communication method for enthusiasts and dabblers. Although emails were not popular among any of the astronomy tourists, specialists (mean rank=5.84) still preferred to utilize them rather than online blogs (mean rank=4.60), phone calls and texts (mean rank = 4.23). The rest of the respondents showed less interest in using emails, especially the fanatics and dabblers.

(8) For the categories of the preferred landforms and frequently-visit destinations, no significant differences emerged among the four groups of astronomy tourists

(χ^2<1.50, p>.500). It implied that astronomy tourists did not have preferences for a specific terrain of the regular-visited destination.

In summary, the Kruskal-Wallis test results demonstrated that a series of indicators describing general travel experiences showed significant differences among the four groups of astronomy tourists. These indicators were used to distinguish astronomy tourists with different involvement levels: casual leisure novices with situational involvement (dabblers), project-based leisure participants (fanatics), and serious leisure devotees (enthusiasts and specialists). Their travel experience represented different features in tourist destination decision making, types of attractions preferred, and selection of the accommodation, transportation and travel companions.

4.4.4 Dissecting Tourist Motivation

In this section, the hybrid motives of astronomy tourists are clarified and motivation patterns of participants with different involvement levels are distinguished.

(1) Exploring the general motives

Drawing on the conclusions in Chapter 3, tourist motives to undertake an astronomy-related travel appears to be a hybrid system, composing of elements such as novelty, escaping, nature, social relationships, and special interests in astronomy. To determine the importance and the structure of these factors, the principal component analysis (PCA) was again employed in a varimax rotation following KMO examination. To the conceptual scheme of the research, the ‘travel career pattern’ (TCP) approach initiated by Pearce (1987, 2005b) underpins this study to explore astronomy tourists’ general motives. The results of the PCA are presented in Table 4.18.

Table 4.18 Astronomy tourists' motivation factors and their importance

Factors	% [b]	α [*]	Motive items	Mean	Loadings
Novelty (6.12) [a]	1.82	0.79	Seeing something different/unique	6.23	.55
			Experiencing great wonders or events	5.98	.57
			Pursuing something peculiar/interesting	6.17	.42
Escape/Relax (5.91)	2.13	0.80	Getting way from daily routines/pressure	6.06	.54
			Escaping from the urban stress	5.75	.61
			Relaxing with inner harmony/peace	5.90	.52
Nature (5.87)	4.45	0.91	Being close to the natural world	6.02	.48
			Viewing scenery or landscape	5.69	.66
Isolation (5.73)	2.77	0.92	Experiencing peace and calm	5.84	.73
			Enjoying isolation	5.62	.58
Stimulation (5.65)	11.64	0.85	Feeling excitement	5.71	.77
			Exploring the unknown	5.55	.63
Relationship (5.53)	9.26	0.86	Making new friends	5.50	.59
			Following others who share similar interest	5.48	.84
			Strengthening relationships with others	5.63	.49
Self-development (5.19)	5.58	0.77	Develop an important aspect of myself	5.40	.50
			Gaining sense of achievement	5.22	.53
			Obtaining sense of self-confidence	4.97	.64
Self-actualize (4.98)	6.76	0.89	Developing knowledge or skills	5.11	.69
			Actualizing personal dreams/values	4.82	.71
Local involvement (4.76)	1.92	0.81	Experiencing different cultures	4.78	.82
			Meeting the locals	4.74	.67
Recognition (3.54)	4.13	0.71	Showing others I have been there	3.59	.60
			Being recognized by other people	3.48	.74
Romance (3.21)	2.30	0.85	Experiencing something romantic	3.40	.65
			Having romantic relationships	3.03	.51
Autonomy (3. 05)	3.42	0.74	Being independent/obligated to no one	2.95	.43
			Doing things my own way	3.14	.62
Nostalgia (2.82)	1.91	0.73	Reflecting on past memories	2.86	.78
			Thinking about good times in the past	2.77	.44

Note: [a] factor's mean score; [b] % of variance explained; [*] Cronbach's alpha reliability coefficient.
In total, 58.1% of variance explained. Motive item with factor loading <0.40 was deleted.

The overall sample size was found to be sufficient to conduct the PCA procedure by using the KMO examination. In this analysis the KMO value (.915) was beyond the baseline of 0.70, which suggested an adequate sample size. Finally, fourteen factors were extracted (with eigenvalues greater than one, the factor 'relationship (security)' was eliminated due to low eigenvalue), explaining 58.1% of the overall variance before a varimax rotation. In order to check the reliability and internal consistency of each factor, the Cronbach's alpha scores were referred to determine the eligibility of each factor. The test result showed that the alpha coefficient for all the factors were between 0.73 and 0.92, demonstrating a relatively high reliability of the results.

As can be seen from the PCA results, thirteen travel motives from astronomy tourists were clarified in the sequence of importance. They were identified as the following factors: (1) novelty, (2) escape/relax, (3) nature, (4) isolation, (5) stimulation, (6) relationship, (7) self-development, (8) self-actualization, (9) local involvement (host-site involvement), (10) recognition, (11) romance, (12) autonomy, and (13) nostalgia. The statistics demonstrated that the motivational elements of novelty, escape/relax and nature are three dominating factors in shaping the travel motivation of astronomy tourists. Three least important factors were nostalgia, autonomy and romance.

(2) Motivation differences between casual leisure and serious leisure tourists

Next, the link between travel motivation of astronomy tourists and their involvement levels are to be considered. It explores whether or not the motivation systems vary among astronomy tourists with different levels of leisure involvement.

Firstly, independent *t*-test was employed to analyze the underlying tourist motivation differences between serious leisure devotees and casual leisure neophytes. Secondly, further analysis by PCA was conducted to test different motivation patterns between four categories of astronomy tourists: dabblers (casual leisure), fanatics (project-based leisure), enthusiasts and specialists (serious leisure).

The independent t-test was used to determine which motivational factors were distinct at different astronomy-related leisure involvement levels. The results are presented in Table 4.19 below.

Table 4.19 Independent *t*-test: Motivation factors by leisure involvement levels

Factors	Serious leisure devotees		Casual leisure neophytes		*t*-score	Sig.
	Factor score	M	Factor score	M		
Novelty*	-0.18	5.78	0.16	6.33	-2.34	.02
Escape/Relax**	-0.35	5.46	0.37	6.28	-4.84	.00
Nature**	-0.29	5.44	0.31	6.20	-3.91	.00
Isolation**	-0.45	5.31	0.51	6.16	-5.05	.00
Stimulation*	-0.22	5.25	0.23	5.94	-2.62	.01
Relationship**	0.37	5.97	-0.34	5.08	5.17	.00
Self-development*	0.41	5.32	-0.39	4.67	2.69	.01
Self-actualization*	0.26	5.51	-0.20	4.89	2.33	.02
Local involvement	-0.09	4.70	0.05	4.81	-1.24	.22
Recognition**	-0.61	2.49	0.72	4.53	-7.44	.00
Romance**	-0.58	2.45	0.62	3.91	-6.38	.00
Autonomy	-0.08	3.03	0.03	3.07	-0.67	.49
Nostalgia**	-0.33	2.26	0.24	3.15	-3.16	.00

Note: 2-tailed distribution, $^{*}p<0.05$, $^{**}p<0.01$

In reference to the independent *t*-test results, three motivational factors are more important to the respondents with serious leisure involvement than those with casual leisure involvement: relationship (t=5.71, p=.00), self-development (t=2.69, p=.01) and self-actualization (t=2.33, p=.02). By way of contrast, the remaining ten factors are more important to those astronomy tourists with casual leisure involvement than they are to the serious leisure pursuers. For those serious leisure devotees, the factors of relationship (M=5.97), novelty (M=5.78) and self-actualization (M=5.51) are the dominating reasons for them to undertake an astronomy-related trip, while for those casual leisure novices, novelty (M=6.33), escape/relax (M=6.23) and nature (M=6.20) are the key motives which drive them to involve in an astronomy-related trip.

There are significant differences between the two leisure involvement groups lying in eleven out of total thirteen motivation factors. Those two factors with non-significant differences are autonomy (t=-1.24, p=.22) and host-site involvement (t=-0.67, p=.49). It is notable that for the factors of recognition (t=-7.44, p=.00) and romance (t=-6.38, p=.00), there are significant distinctions between the two leisure involvement groups. Compared with serious leisure pursuers, casual leisure neophytes are much more motivated by these two factors, and the motives for seeking isolation (M=4.76) and nostalgia (M=3.15) also have stronger effects in motivating them to participate in astronomy-related travels.

Though the above t-test results revealed the motivation system vary between tourists groups at two leisure involvement levels, the influence of other key independent variables of travel experience level remained to be explored. Drawing on the findings in the previous section (4.4.3), the two involvement groups can be further divided by the level of astronomy-related travel experience, and then four categories of tourist can be identified: dabblers, fanatics, enthusiasts and specialists. The next step of the study will focus on examining the principal motivation patterns for each category of astronomy tourists. In order to address this issue, PCA method was again employed with varimax rotation and KMO measurement. The results are reported in Table 4.20 in the following page.

Table 4.20 PCA results: Travel motivation differences among four categories of astronomy tourists

Motivation Factors	Dabblers (N=196)[a]			Fanatics (N=245)[a]			Enthusiasts (N=283)[a]			Specialists (N=106)[a]		
	M	**% of Variance**	**α** *	**M**	**% of Variance**	**α**	**M**	**% of Variance**	**α**	**M**	**% of Variance**	**α**
Novelty	6.45	3.2	.87	6.22	1.7	.83	5.87	4.2	.85	5.54	2.6	.88
Escape/Relax	6.31	1.8	.85	6.25	2.2	.91	5.40	2.5	.82	5.29	3.7	.84
Nature	6.28	2.0	.92	6.14	1.3	.90	5.48	1.6	.78	5.32	1.4	.80
Isolation	6.16	4.9	.88	5.75	2.5	.75	5.27	3.1	.72	5.06	5.3	.90
Stimulation	5.73	5.6	.81	5.84	3.4	.86	5.45	3.6	.77	5.41	3.8	.87
Relationship	4.89	3.7	.79	5.22	2.8	.88	6.26	2.3	.86	5.25	8.9	.77
Self-development	4.72	7.1	.91	5.03	4.6	.79	5.63	8.5	.84	5.21	5.7	.86
Self-actualization	4.53	6.8	.88	4.81	4.4	.81	5.02	5.7	.91	6.07	6.3	.92
Local involvement	5.01	2.4	.75	4.60	3.3	.83	4.71	1.9	.75	4.68	10.2	.91
Recognition	5.12	8.6	.84	4.03	7.4	.90	2.53	2.6	.87	2.39	4.7	.86
Romance	5.04	5.3	.83	3.08	9.1	.89	2.64	3.7	.90	1.98	1.6	.81
Autonomy	3.35	4.5	.78	2.82	5.5	.76	2.87	2.4	.85	3.42	1.5	.75
Nostalgia	3.16	1.4	.75	3.14	4.9	.80	2.27	1.3	.79	2.24	1.1	.90
Total variance explained		57.3%		53.1%			43.4%			56.8%		

Note: KMO measure of sample adequacy: 0.92; [a] Number of valid cases; * Cronbach's alpha reliability coefficient.

Based on the PCA statistics from Table 4.20, key findings can be interpreted as below:

(1) The principal motivation factors (shaded in grey cells) varied significantly among four categories of astronomy tourists; the importance sequence of travel motives also shifted among four groups.

(2) For casual leisure novices (dabblers), travelling for novelty (M=6.45, α=0.87), escape/relax (M=6.31, α=0.85) and nature (M=6.28, α=0.92) were the uppermost motives. Stimulation, recognition, romance and involvement with locals were the secondary important motives for them. In particular, as for the importance of recognition (M=5.12, α=0.84) and romance (M=5.04, α=0.83), they had much higher factor mean scores than any other types of astronomy tourists.

(3) For project-based leisure neophytes (fanatics), the top-three key motives were the same as dabblers', but the most important one was escape/relax (M=6.25, α=0.91) rather than novelty (M=6.22, α=0.83). However, all of these three factors were not stronger for the fanatics than they were for the dabblers, while stimulation, isolation, relationship and self-development were at the intermediate layer to motivate them to travel for astronomy-related attractions.

(4) For serious leisure participants (enthusiasts), the core motives were relationship (M=6.26, α=0.86), novelty (M=5.87, α=0.85) and nature (M=5.48, α=0.78). In particularly, relationship is the most pivotal motive for them. The motives falling into the middle layer were escape/relax, self-development, stimulation, and nature. Compared with other groups, the self-development factor was the more important one to enthusiasts. In addition, the factors of nostalgia, recognition and romance were the least important motives falling in the outer layer of motivation system.

(5) For serious leisure devotees (specialists), the factor of self-actualization (M=6.07, α=0.92) is the dominant motive in the motivation system, and then the factors of novelty (M=5.54, α=0.88) and stimulation (M=5.41, α=0.87), which fall into the middle layer of the TCP. Romance, recognition and nostalgia were the three least important motivation factors for specialists. The importance of such factors is significantly different to that of dabblers.

In summary, these results indicate that the motivation patterns of astronomy tourists vary among the casual leisure novices (dabblers), the project-base leisure neophytes (fanatics), the serious leisure participants (enthusiast) and devotees (specialists). Different travel motivation patterns can be identified and they will be discussed further the conclusion section of Chapter 6.

4.4.5 Unveiling the On-site Activities

In this section, the on-site phase of the astronomy tourist experience was studied. Key concerns lay in the comparisons among participation in the general on-site activities. Based on the findings in Chapter 3, they were sorted into two categories: (1) activities related to astronomy, and (2) non-astronomy activities. Using descriptive analysis with mean scores and standard deviations, the intensities of participating for each activity were measured. The results are presented in Table 4.21 and Table 4.22.

Table 4.21 Descriptive statistics for activity participation (Astronomy-related)

Activity type	Mean	Standard Deviation
Astronomy-photographing	5.62	2.23
Naked-eye observing	5.43	1.74
Observing through equipment	5.27	2.55
Participating astronomical education program	4.53	1.67
Discussing astronomy-related topics	4.66	1.48
Visit astronomy-related people or places	3.11	1.20
Other activities related to astronomy	2.93	1.89

Note: measured by a seven-point Likert-type scale, 1 = never, 7 = always; N= 832

From the descriptive statistics in Table 4.20, the astronomy-related activities are presented in the order of participation intensity. Among the seven categories of on-site activities, astro-photographing gains the highest intensity of participation (M=5.62), while other activities related to astronomy (M=2.93) are the least participated by tourists. The participation intensity of observing through equipment (SD=2.55) is the most widely distributed among respondents.

Using one-way ANOVA, significant differences among the participation intensity of each activity were identified (F=15.36, *df*=6, p=.000). The post-hoc Scheffe test (Figure 4.11) revealed that astronomy-photography and observation through apparatus or naked eyes were in the most participated group, while there was an intermediate group of astronomy educational program and discussions on astronomy-related topics. The category of other activities involved the lowest level of participation.

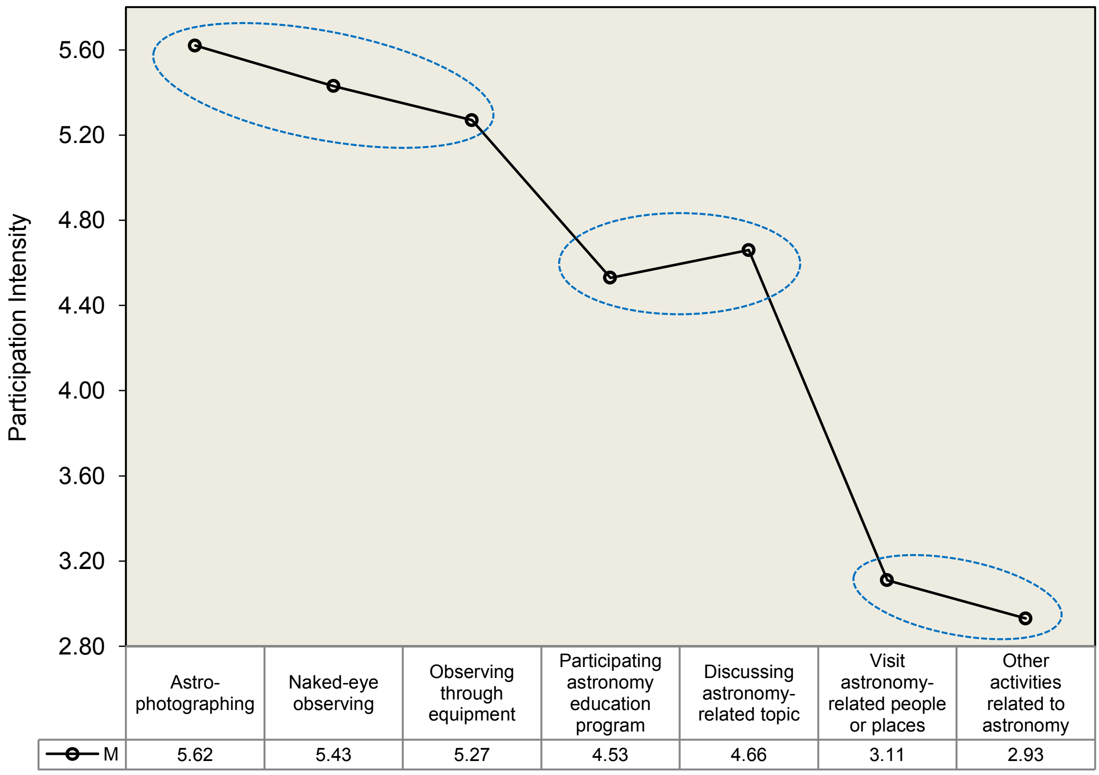


Figure 4.11 Post-hoc test on the activity participation (Astronomy-related)

Additionally, the activities within the moderate participation intensity group were focused on interpersonal activities such as astronomy-related educational programs, conventions and workshops, where tourists were interested in exchanging astronomic knowledge and discussing about astronomic topics.

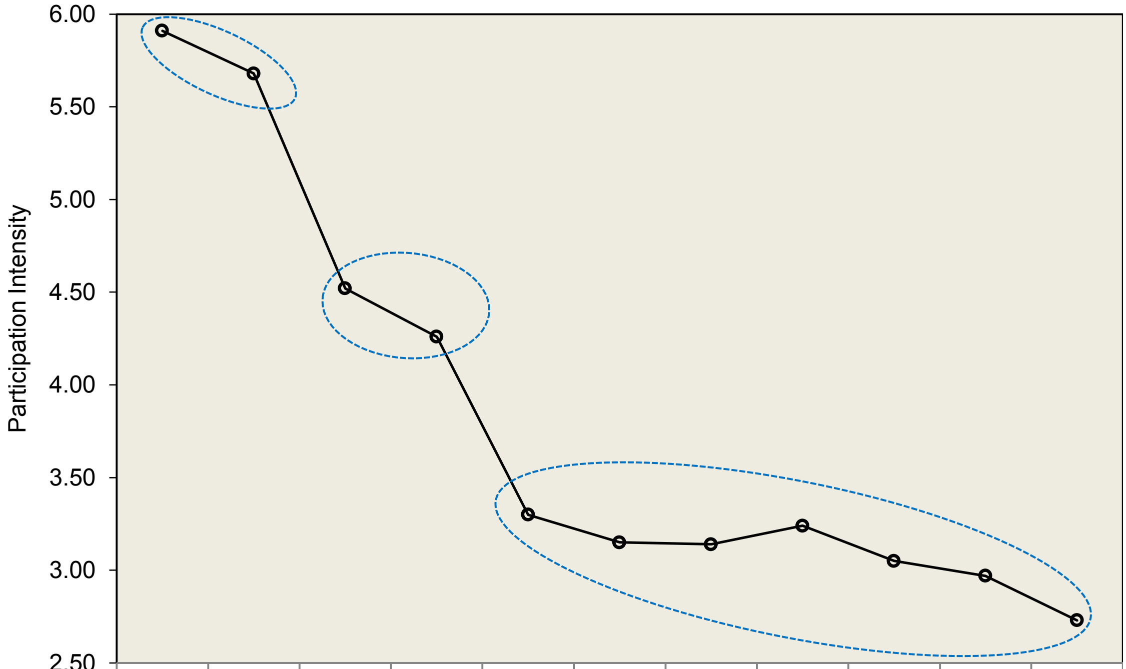
Table 4.22 below reports the descriptive statistics concerning how often the tourists participate in eleven types of non-astronomy activities during astronomy-related trips. Among the eleven activities, sightseeing (M=5.91) was ranked the highest (SD=1.14), while surfing (M=2.73) was reported as having the lowest participation score.

Table 4.22 Descriptive statistics for activity participation (Non-astronomy)

Activity type	Mean	Standard Deviation
Sightseeing nearby	5.91	1.14
Just stay there and relax	5.68	1.47
Hiking	4.52	2.43
Bird watching	4.26	3.18
Swimming	3.30	2.35
Cycling	3.15	1.84
Barbequing (BBQ)	3.14	2.62
Social networking	3.24	1.75
Other activities NOT related to astronomy	3.05	2.89
Fishing	2.97	1.36
Surfing	2.73	1.20

Note: measured by a seven-point Likert-type scale, 1 = never, 7 = always; N= 832

Next, the one-way ANOVA using post-hoc analysis was conducted. The results were reported in Figure 4.12. From the test, it was clear that the participation intensity of non-astronomy activities varied significantly among tourists (F=15.27, *df*=10, p=.000). The differences identified by the post-hoc Scheffe test revealed that sightseeing and relaxation activities attracted most participation while hiking and birdwatching lay at an intermediate position. The remaining seven types of activities were grouped as the least participated by astronomy tourists, including 1) swimming, 2) cycling, 3) barbequing, 4) social networking, 5) fishing, 6) surfing, and 7) other activities not related to astronomy.



	Sightseeing	Relaxing	Hiking	Bird watching	Swimming	Cycling	BBQ	Networking	Others	Fishing	Surfing
M	5.91	5.68	4.52	4.26	3.3	3.15	3.14	3.24	3.05	2.97	2.73

Figure 4.12 Post-hoc test on the activity participation (Non-astronomy)

Drawing on the above findings, a comparison study can be made between four types of astronomy tourists with different leisure involvement and travel experience levels. By comparing the participation intensity of the two categories of onsite activities among dabblers, fanatics, enthusiasts and specialists, differences and characteristics among each group can be revealed. In order to tackle this topic, the Kruskal-Wallis *h*-test was adopted again and the results are shown in Table 4.23 below.

Table 4.23 Kruskal-Wallis *h*-test: four types of astronomy tourists and participation intensity of on-site activities

Activities Type	Activities	Mean Rank				df	h (χ^2)	Sig.
		Dabbler	Fanatic	Enthusiast	Specialist			
Related to astronomy	Astro-photographing	9.75	10.54	13.85	19.21	3	88.42	.000
	Naked-eye observing	16.27	13.23	10.41	9.85	3	48.75	.000
	Observing through equipment	5.93	8.66	13.72	15.07	3	85.21	.000
	Participating astronomical education program	5.62	7.75	9.13	11.86	3	28.46	.000
	Discussing astronomy-related topic	6.54	8.43	12.29	14.50	3	64.87	.000
	Visit astronomy-related people or places	4.98	5.61	7.67	9.43	3	19.81	.000
	Other activities related to astronomy	2.15	3.38	9.56	11.35	3	86.82	.000
Not related to astronomy	Join club's other activities	4.21	7.40	5.86	8.55	3	18.83	.000
	Sightseeing nearby	18.49	16.85	17.57	14.28	3	18.33	.000
	Just stay there and relax	16.31	15.89	15.97	14.74	3	2.46	.002
	Bird watching	3.73	5.02	9.18	11.62	3	61.57	.000
	Fishing	6.47	7.54	5.10	3.19	3	4.48	.001
	Barbequing	8.43	9.19	5.62	3.52	3	24.16	.000
	Hiking	10.87	11.48	7.45	6.67	3	17.64	.000
	Cycling	7.51	7.95	5.38	4.16	3	14.37	.000
	Swimming	8.46	9.09	6.26	4.87	3	17.72	.000
	Surfing	5.42	4.31	3.27	2.14	3	10.76	.000
	Other activities NOT related to astronomy	7.68	8.45	5.12	4.25	3	11.58	.000

Note: $p<0.01$, N=832

The Kruskal-Wallis test results demonstrated that there were significant differences among four groups of astronomy tourist in terms of the frequency of participating in all the on-site activities (*df*=3, $2.46 \leq \chi^2 \leq 88.42$, p=.000). Specific findings included but were not limited to the following points:

(1) In general, serious leisure participants were more strongly engaged in most types of the astronomy-related activities (except naked-eye observation) than those casual and project-based leisure participants. The later groups were more highly involved in larger varieties of activities (whether or not relevant to astronomy), rather than merely concentrating on those astronomy-themed activities (such as the specialists who almost put major focus on astronomy-related activities except sightseeing around the spot).

(2) Among all astronomy-related activities, specialists were the highest involvement group (mean rank from 9.43 to 19.21) and enthusiasts were the second highest involvement group (mean rank from 7.67 to 13.85) in all types of activities except for naked-eye observation. By way of contrast, dabblers (mean rank = 16.27) were the most engaged participants in observing night skies without telescopes or binoculars. This way of observing astronomy events is an entry-level activity for novices and is easy to starting point.

(3) For the activities unrelated to astronomy, all four groups are intensively engaged in sightseeing around the travel destination (χ^2=18.33, p=.000) and seek to relax (χ^2=2.46, p=.002), but significant differences still exist among each group. In particular, dabblers are the most involved in sightseeing (mean rank=18.49) and relaxation (mean rank=16.31). Birdwatching is participated in by specialists and enthusiasts with relatively high intensity, while those casual leisure pursuers have relatively stronger involvement in all other activities except for bird watching. Hiking also attracted more dabblers and fanatics, while the serious astronomy leisure group participated less in this pursuit. Casual and project-based leisure participants were more active in trying various activities that were unrelated to astronomy, rather than focusing on a narrow interest area of astronomy.

4.4.6 Recollection and Learning Outcomes

This section concerned the post-travel phase of the astronomy tourist experience. Firstly, descriptive analysis was conducted to explore general recollection behaviors following an astronomy-related trip. Secondly, the PCA approach was utilized to analyze tourists' learning outcomes which were identified and are subsequently presented in the order of their importance. The results of descriptive analysis are presented in Table 4.24 below. The recollection behavior items were shaped by the netnographic study results.

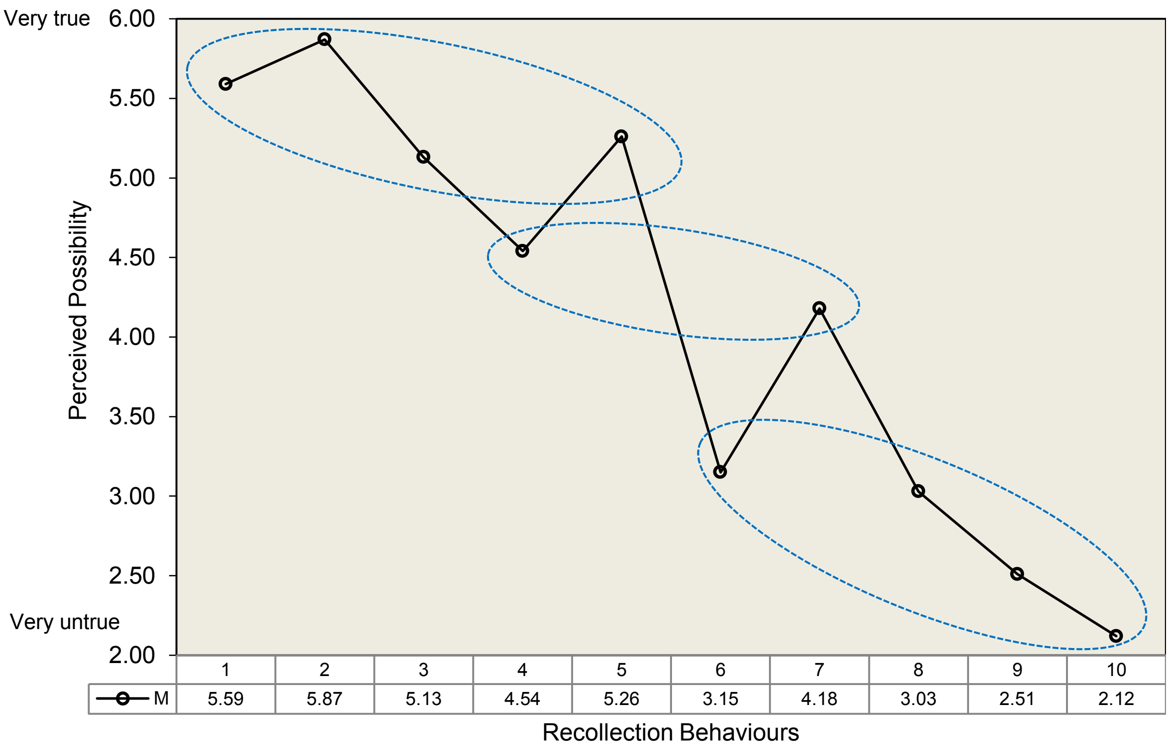
Table 4.24 Descriptive statistics for recollection behaviors

Recollection Behavior	Mean	Standard Deviation
Share travel stories through social media	5.59	3.34
Reinforce the interest in astronomy	5.87	1.75
Enhance astronomy-related travel demand	5.13	1.81
Share travel stories on club's online forum	4.54	3.28
Share travel stories face to face	5.26	3.42
Share travel experience in online blogs	3.15	2.37
Involve more people to involve in astronomy	4.18	2.56
Print out photos of the trip/astronomical events	3.03	2.31
Buy more astronomical equipment	2.51	2.10
Join an astro-photography competition	2.12	3.29

Note: measured by a seven-point Likert-type scale, 1 = very untrue, 7 = very true; N= 838.
The item selection was based on the netnographic findings in Chapter 3.

In Table 4.24, ten categories of the recollection behaviors from astronomy tourists are displayed. The means of the recollection behavior fall between 2.12 and 5.87. In general, respondents strongly and widely agree that they have reinforced the interest in astronomy (M=5.87, SD=1.75) and have created future travel demand (M=5.13, SD=1.81). Joining in an astro-photography competition is considered as the least likely behavior of astronomy tourists after travelling (M=2.12).

One-way ANOVA and the post-hoc test were subsequently employed and the results are presented in Figure 4.13 below.



	1	2	3	4	5	6	7	8	9	10
M	5.59	5.87	5.13	4.54	5.26	3.15	4.18	3.03	2.51	2.12

The explanation of recollection behaviour code 1-10	
1. Share travel stories through social media	6. Share travel experience in online blogs
2. Reinforce the interest in astronomy	7. Involve more people to involve in astronomy
3. Enhance astronomy-related travel demand	8. Print out photos of the trip/astronomical events
4. Share travel stories on club’s online forum	9. Buy more astronomical equipment
5. Share travel stories face to face	10. Join an astro-photography competition

Figure 4.13 Post-hoc test on astronomy tourists’ recollection behaviours

The recollection behaviour varies significantly among astronomy tourists ($F=16.71$, $df=9$, $p=.000$). The differences identified by post-hoc tests (Figure 4.13) indicate that sharing travel experience through social media (M=5.59) and face-to-face personal communication (M=5.26) are the most likely to be performed rather than posting on travel blogs (M=3.15). Sharing travel stories through online forums (M=4.54) is also one of the most preferred methods. After travelling, the surveyed tourists are less likely to participate in astronomy-photography competitions (M=2.12), to buy more astronomical apparatus (M=2.51) and to print out travel photos (M=3.03). They are moderately willing to involve more friends in the future trips (M=4.18).

Next, the general learning outcomes of astronomy tourists were studied by the PCA method and the results are reported in Table 4.25.

Table 4.25 PCA results: learning outcome factors and their importance

Factors	% [b]	α [*]	Learning outcome items	Mean	Loadings
Cognitive development (5.68)[a]	22.31	0.85	Astronomy-related knowledge	6.04	.79
			Communication skills	5.52	.65
			Decision making skills	5.13	.48
			Environmental learning	5.67	.53
Affective development (5.57)	16.47	0.92	Making or maintaining relationship	5.75	.81
			Patience	5.81	.74
			Humbleness (Respect the nature)	5.69	.55
			Responsibility	5.26	.46
Psychomotor development (4.93)	13.54	0.90	Information literacy	4.65	.61
			Mastery over tools	5.86	.72
			Physical skill enhancement	4.72	.54
Ego development (4.71)	9.83	0.87	Self-awareness	5.11	.63
			Self-confidence	4.23	.70
			Teamwork	4.78	.44
			Independence	4.56	.52

Note: N=838; 62.2% variance explained; [a] mean score of the factor; [b] variance explained; [*] Cronbach's alpha reliability coefficient; items with factor loading below 0.40 were discarded; Varimax rotation was used; KMO measurement value = 0.90.

From the PCA results in Table 4.25, four main factors regarding astronomy tourists' learning outcomes were identified (KMO=0.90, N=838, 62.2% variance explained). They are the acquisition of cognitive (M=5.68, α=0.85), affective (M=5.57, α=0.92), psychomotor (M=4.93, α=0.90) and ego (personal) developments (M=4.71, α=0.87), in the order of factor mean scores (importance level). In detail, the acquisition of astronomy-related knowledge (M=6.04) and environmental learning (M=5.67) were the most important items in tourists' cognitive development. In the realm of affective development, making or maintaining relationship, patience and humbleness were the three most important items. It is notable that patience (M=5.81) and humbleness (M=5.69) were particularly highlighted by astronomy tourists rather than by any other general interest tourists, since these two emotion-linked skills possibly lie in the nature of the astronomy-related activity such as stargazing. That is because people may need to be patient to spend hours staring and seeking meteors, or they may feel that mankind is really small against the countless stars and picturesque image of the magnificent Milky Way. In addition, mastery over tools (such as learning how to take control of observational apparatus) was the dominating item in astronomy tourists' psychomotor development (M=5.68). In the personal development facet, self-awareness (M=5.11) was the most influential element for astronomy tourists' learning outcome.

4.4.7 Measuring Tourist Satisfaction

This part of the analysis was conducted to assess the tourist satisfaction of astronomy-related travels at a general level. All the satisfaction factors were built on the previous netnographic study findings in Chapter 3. Descriptive statistics of the mean scores and standard deviation were measured and the results are presented in Table 4.26.

Table 4.26 Tourist satisfaction of astronomy-related travels

Factors	Mean	Standard Deviation
Authenticity of the travel experience	6.07	1.86
The overall astronomy-related travel experience	5.85	2.54
Travel safety	5.63	1.71
Services of the destination	5.08	2.65
Accommodation and food	4.39	2.37
Infrastructure of destination	3.51	3.12
Comfort of the trip	3.14	3.09
Destinations Accessibility	2.76	1.44
Travel convenience	2.23	1.58

Note: N= 816 valid cases; measured by a seven-point Likert-type scale, 1 = strongly unsatisfied, 7 = strongly satisfied.

According to the descriptive analysis results, authenticity of the astronomy-related travel experience provides the most satisfaction (M=6.07). Among the total nine facets, the item of travel convenience (M=2.23) was perceived as the least satisfying to meet tourists' need. It was clear that tourists' opinions about satisfaction of the overall astronomy-related travel experience varied across the facets asked. However, they consistently agree that the safety of the astronomy-related travels is satisfying.

Using the one-way ANOVA approach, it was clear that the tourists' perception of the satisfaction facets varied significantly (F=16.39, df=8, p=.000). The variation found by the Scheffe post-hoc test revealed that authenticity, travel safety and the overall travel experience were the most satisfying items. An intermediate satisfaction group incorporated the items of service, food and accommodation. Infrastructure, comfort of the trip, destination accessibility, and travel convenience fell into the lowest group of tourist satisfaction elements. These results are presented in Figure 4.14.

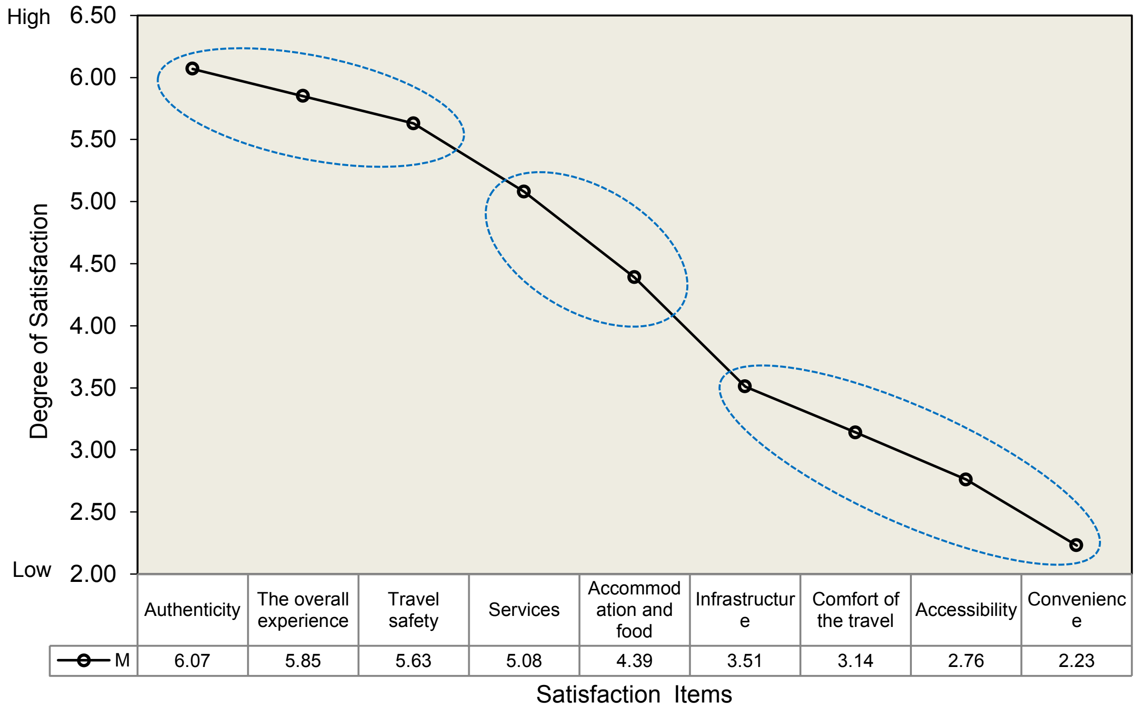


Figure 4.14 Post-hoc Scheffe test results on the satisfaction of astronomy tourists

4.4.8 Demographic Differences

In this section, demographic factors were used to compare among dabblers, fanatics, enthusiasts and specialists. Gender and tourist origins were the major independent variables adopted in the analyses. Cross-tabulation method was employed to analyze these demographic differences.

(1) Gender differences in dabblers, fanatics, enthusiasts and specialists

Using the cross-tabulation, all the gender differences were identified and the result can be seen in Table 4.27.

From the cross-tabulation results, it was clear that females accounted for the majority number (67.9%) of dabblers while males accounted for 32.1%. For fanatics, gender distribution was quite even: males were less than 10% higher than females. Casual leisure participants mostly consisted of female astronomy tourists. However, males accounted for the overwhelming portion of the astronomy tourists with serious leisure involvement. They comprised 72.7 % of the enthusiasts and 85.8% of the specialists, while females only accounted for 27.3% and 14.2%.

Table 4.27 Gender differences in four types of astronomy tourists

Gender	Dabblers	Fanatics	Enthusiast	Specialists	Total
Male	63 (32.1%)[a]	154 (54.4%)	178 (72.7%)	91 (85.8%)	486
Female	133 (67.9%)[a]	129 (45.6%)	67 (27.3%)	15 (14.2%)	344
Total	196 (23.6%) [b]	283 (34.1%)	245 (29.5%)	106 (12.8%)	830

Note: [a] percentage within each type of astronomy tourists;
[b] proportion of the total respondents.
** $p < 0.001$

(2) Geographic Differences

Aside from gender variances, the tourist origin is also am important variable affecting the differences of travel experience and the portion of each type of astronomy tourists. It was also examined by the cross-tabulation, and the results are reported in Table 4.28.

For Asian respondents, fanatics comprised the majority (44.4%) of the astronomy tourists' population. This percentage was also the highest among all the origin groups. Casual leisure participants were the dominant group (68.2%) of Asian astronomy tourists. For European tourists, enthusiasts accounted for the major part (42.5%) of astronomy tourists. Compared to other tourist origins, Europe had the highest proportion of the 'enthusiasts'. American astronomy tourist mostly consisted of serious leisure pursuers, with 38.8% enthusiasts and 21.2% specialists. They had the highest proportion of specialists among all the tourist origins. Oceania respondents mainly consisted of dabblers (43.7%) and fanatics (26.3%), and the percentage of dabblers was the highest figure compared to other tourist origin groups. Similarly, casual leisure participants accounted for the dominant part of African astronomy tourists (70.6%).

Table 4.28 Geographic differences in four types of astronomy tourists

Origins	**Dabblers**	**Fanatics**	**Enthusiast**	**Specialists**	**Total**
Asia	74 (23.8%)[a]	138 (44.4%)	71 (22.8%)	28 (9.0%)	311 (37.5%)[b]
Europe	20 (19.6%)	27 (26.5%)	43 (42.5%)	12 (11.8%)	102 (12.3%)
America	25 (10.4%)	71 (29.6%)	93 (38.8%)	51 (21.2%)	240 (28.9%)
Oceania	70 (43.7%)	42 (26.3%)	34 (21.3%)	14 (8.7%)	160 (19.3%)
Africa	7 (41.2%)	5 (29.4%)	4 (23.5%)	1 (5.9%)	17 (2.0%)
Total	**196**	**283**	**245**	**106**	**830**

Note: [a] percentage within each origin group;
[b] proportion of the total respondents.
** $p < 0.001$

Additionally, a series of the one-way ANOVA method was employed to analyze other demographic differences in tourist motivation, attraction preference, and decision making determinants. In previous analyses, these facets of the tourist experience study were elaborated with substantial statistics and interpretation. Further comparisons by demographic variables are available in Appendix I.

4.5 DISCUSSION AND CONCLUSION

Drawing on the previous exploratory study (Chapter 3), this chapter gazed into the “space” of astronomy tourists’ individual travel experience. It employed a holistic approach to portray the detailed study aims, methodologies, sampling procedures, data analyses and result interpretations of 866 questionnaire surveys. The eight sections of the questionnaire were individually analyzed and links were built to each other. An array of quantitative methods was adopted to dissect different dimensions of the tourist experience. Such dimensions contain travel history, tourist decision making determinants, leisure involvement level, travel motivation, onsite activity participation, post-travel behaviour, and tourist satisfaction. Using one-way ANOVA, selected demographic variables affecting various facets of the astronomy tourist experience was ascertained.

In this empirical study, the findings from the overall travel experiences of astronomy tourists provided evidence to build on the previous literature. In terms of market size, although there is no direct data reporting the magnitude of the astronomy tourism, from the tourists’ perception and attitudes investigated in this study, it suggests that stargazing and star parties are the most attractive astronomy-related activities driving people to travel. This empirical finding does not support the speculation by Weaver (2011) who suggested that visiting observatories to observe night skies is the most prevalent activity. The numbers of independent stargazers as well as star party participants are the biggest proportion of astronomy tourists. Both groups appear to have been “overlooked” by researchers. In practice, they represent regular forms of astronomy-related travels since they provide more repeat visits than other groups of astronomy tourists. The travel to a particular location to encounter the starry skies occurs not only because of participating in astronomy or a dark sky program (Collison & Poe, 2013), but also because they chase the optimal physical settings (weather, astronomical seeing, light pollution) for observational and photographical purposes. In this study, solar eclipses (especially the total eclipses) and Aurora Borealis/Australis were the most attractive episodic astronomical phenomena. They usually attract a large number of tourists worldwide. This finding supports anecdotal evidence by Weaver (2011). In addition, as noted by previous researchers, (Cater, 2010; Collison & Poe, 2013; Weaver, 2011), the present empirical study fills a need for further understanding astronomy tourists’ behavior at a micro level, including motivation, preferred demand and recollections.

An important conceptual discussion in this chapter is the bridge between the study of tourist motivation and the assessment of astronomy tourists’ leisure involvement. The work explored the differences in tourist motivation patterns among casual leisure, project-based leisure and serious leisure pursuers in an astronomy tourism context, integrating Pearce’s (1988; 2005b; 2011) ‘travel career patterns’ (TCP) approach and Stebbins’s (1982; 2010) serious leisure perspective (SLP). Meanwhile, associated with the established ‘SIT experience’ model from Trauer (2006), four categories of astronomy tourists were segmented by the level of leisure involvement and travel experiences. Distinct representations of tourist behaviour were compared among various groups. Some consistent and similar conclusions from previous TCP studies (Pearce, 2005b; Pearce and Lee, 2005; Paris &Teye, 2010) were drawn showing that motivation patterns indeed vary with travel experiences, and they also shift with the dynamic trajectory of tourists' leisure involvement. Aside from the particular interest and strong leisure involvement which played a fundamental role in motivating astronomy hobbyists (with serious leisure), the TCP framework provided a pathway to reveal that astronomy tourists' travel motivation system is a hybrid and dynamic complex with different layers or levels. In this system, various factors together affect different 'travel career patterns'. These motivation patterns varied significantly among four groups of astronomy tourists. More specifically, four different roles of tourists: serious leisure pursuers (participants and devotees), casual leisure novices (dabblers) and project-based leisure neophytes (fanatics) were distinguished and characterized by their travel experience and leisure involvement levels. They were found to be significantly different in several aspects of the tourist experience: travel motivation, on-site activity participation, and overall travel preferences and general travel experiences. The integration of the TCP and the SLP approaches provides a potential means to segment the astronomy tourist market and further, to identify different leisure involvement groups or individuals in other forms of special interest tourism.

Together, these findings have addressed the eight study aims outlined at the start of this chapter. The next chapter assesses the stakeholders' attitudes towards the future of the astronomy tourism sector.

Chapter 5

Assessing the Industry Future of Astronomy Tourism:

An Interview Based Study

"Generating new tourist products based on the observation of the firmament and the phenomena of the night, opens up unsuspected possibilities for cooperation among tourism stakeholders, local communities, and scientific institutions."

UNWTO, 2009

CHAPTER OUTLINE

5.1 INTRODUCTION

Chapter 5, as stated previously, presents the third empirical study with interviews as the key research technique. It aims to assess stakeholders' attitudes towards the future development of astronomy tourism. Focus groups and the key informant technique were employed to conduct in-depth and semi-structured interviews with six types of tourism stakeholders: experienced astronomy tourists, astronomy society organizers, tourism enterprises, dark-sky destination administrators, tourism authority personnel from government sectors, and dark-sky local communities. The selection of these six categories of stakeholders was planned to represent a wide spectrum of responses across different loops in the industry chain. Moreover, the assessment of the present versus future perspectives was expected to reveal stakeholders' perception and prospects about astronomy tourism.

The conceptual scheme for this interview study was based on the literature of tourism futures studies. As a plural term rather than the singular form of only one "future", futures studies break the boundary to envision and create "alternative" and "preferred futures", because the postmodern era is characterized by uncertainty and contingency (Yeoman, 2012). Based on this notion, this study embraced not only one outcome by single-point forecasting, but also explored several possibilities and complex choices when trying to manage the uncertain changes (Bergman, Karlsson & Axelsson, 2010).

5.2 RESEARCH AIMS

The interview studies reported in this chapter mainly addressed the third key question of the current thesis. That is, to answer "*What are industry stakeholders' perspectives towards the future development of astronomy tourism?*" In detail, this chapter aims to:

1) Assess industry stakeholders' perceptions of the current situation of astronomy tourism, including the astronomy tourism assets, product, destinations and markets.
2) Explore industry stakeholders' attitudes towards the futures of astronomy tourism, including potential challenges, threats and opportunities.
3) Compare key informants' perception of the present situation and the attitudes towards the future of astronomy tourism through the IPA approach (Importance-Performance Analysis), indicating key measures to sustainably develop astronomy tourism markets and identifying key solutions to preserve the astronomy tourism resources.

5.3 METHODOLOGY

5.3.1 Overview

Interviews were the main research methods adopted in this study. Two forms of interviews were employed: focus groups and key informant approaches. The term "interview" in this chapter is synonymous with the in-depth interview. The specific techniques, however, varied due to the contextual situation and research steps. In focus groups, unstructured and open-ended conversations were adopted, while in the key informant technique the selected approach was a semi-structured interview with both open-ended and standardized questions. The background information about the respondents was collected and sampling procedures for each interview technique were presented accordingly. Finally, the data from two focus groups and twenty-six key informant interviews were coded, and the reliability of coding was checked before data analysis and interpretation. The detailed methodology is specified in the following sections.

5.3.2 Interview Procedures and Methods

The interviews in the present study were conducted by following the process below:

1) Design preliminary questions based on the results of focus groups
2) Implement a pre-interview as a pilot test
3) Amend questions and structures
4) Select interviewees and interview venues
5) Conduct the interviews with the Key Informant Technique

(1) Planning the Questions: Focus Groups

To plan and generate initial questions for interviews, the focus groups approach was applied. Focus groups offer strengths in collecting opinions from various stakeholders in a relatively efficient format and hence they are particularly useful in the early stages of research (Cater & Low, 2012). They can provide a broad overview of a topic and generate questions that can be further examined by other methods (Veal, 2006). Similar to interviews, focus groups are qualitative in their unstructured nature and the voices of respondents can represent an emic approach (Weber, 2001). Focus groups came relatively late to tourism research, but they have been recently employed by an increasing number of tourism scholars as a grounded or complementary study method (Morgan, 1996; Waligo, Clarke, & Hawkins, 2013).

In the current study, two focus groups were conducted in China and Australia. The two places were chosen because they were identified in the previous study (Chapter 3) as two leading markets in the global astronomy tourism industry, and also they were representatives of an emerging astronomy tourism destination and a mature setting respectively. The first group (C-FG-1) from China was organized in October 2014 in

Chengdu by the researcher and a key informant (president of a local astronomy society). Using the pre-exiting friendship and personal networks, four other informants were recruited to participate in the group interview. The second focus group from Australia was implemented in Sydney. With researcher's personal connections to a regional astronomy society, some experienced astronomy tourists from the club were invited to the group interview by emails and phone calls. With the assistance of the key-informants, an administrative staff of the Sydney Observatory, and a person from national park authority personnel were also included in the second focus group (A-FG-1). The profiles of the focus groups of informants are reported in Table 5.1 below.

Table 5.1 Profiles of two focus groups (China and Australia)

<table>
<tr><th>Group</th><th>Identity of the informant(s)</th><th>No. of informants</th><th>Length</th><th>Date</th></tr>
<tr><td rowspan="3">C-FG-1</td><td>Tourism enterprise managers</td><td>2</td><td rowspan="3">67 minutes</td><td rowspan="3">13/10/14</td></tr>
<tr><td>Local astronomy society presidents</td><td>2</td></tr>
<tr><td>Local tourism sector representative</td><td>1</td></tr>
<tr><td rowspan="4">A-FG-2</td><td>Regional astronomy club members (experienced tourists)</td><td>2</td><td rowspan="4">75 minutes</td><td rowspan="4">28/10/14</td></tr>
<tr><td>Local astronomy club president</td><td>1</td></tr>
<tr><td>Observatory administrative staff</td><td>1</td></tr>
<tr><td>National park authority personnel</td><td>1</td></tr>
</table>

Note: the code for 'C' refers to China, 'A' to Australia, 'FG' to focus groups, and the number to the specific group. This information is used in documenting the source of later quotations.

The two focus groups were conducted using an unstructured approach with open-ended questions about three themes: 1) What do they think the current situation of astronomy tourism? 2) What do they think the prospect of astronomy tourism? 3) What measures or solutions should be taken to develop astronomy tourism markets? Specific topics were further discussed, including tourism assets, market potentials, preferred products, challenges, threats, opportunities, development plans and strategies for the future of astronomy tourism. During the focus groups, the researcher acted as a moderator to lead the process, to encourage the participants and to guide the discussion from topic to topic, ensuring that all the informants contributed their opinion and views. Upon permission from every informant, the focus groups were audio-recorded throughout the entire process for further data collection and data analysis.

The insights and opinions identified from the two focus groups facilitated the design of the follow-up interview questions and structures. After the focus groups, the initial questions for the subsequent interviews were generated and the preliminary structures were constructed.

(2) Adjusting the Design: A Pilot Test

Drawing on the questions that were raised from the two focus groups, an in-depth semi-structured interview was designed. Both open-ended and standardized questions were used in the initial design. The questions were initially constructed in English and then translated into Chinese Mandarin. A back-translation was also verified by a fluent dual language speaker to amend any misunderstandings or unclear words in the translation process. This approach is important to improve the reliability of the translation (Temple & Young, 2004).

Subsequently, a pilot test was conducted to assess whether or not these questions were difficult to understand due to contextual issues and linguistic barriers. Using an experimental approach within a small group of individuals who are similar to the target audience and familiar with the research context is usually employed as a pilot test (McGehee, 2012). Therefore, three Chinese and two English native speakers who were also astronomy hobbyists were involved in the trial interviews on an individual basis. Questions raised from the focus groups were all tested in the pilot interviews to avoid implied bias and to ensure that respondents did not misunderstand. After the pilot test, they all provided feedback about the interview questions and structures, suggesting at time that the researcher could adjust and refine the interview design and wording.

The data collected from the pilot test were not included in the final study. Only refinement to the original wording and interview structure was adopted.

(3) Conducting the Interviews: the Key Informant Approach

After piloting a pre-test and refining the wording, the formal interview questions were developed. The key informant technique was applied in conducting the interviews. As stated in Chapter 2, the key informant technique involves interviewing stakeholders and is a very useful tool for data collection, as important respondents are likely to provide insights from a number of broad perspectives (Marshall, 1996; Tremblay, 1957). Here, the key informant technique was also used in recruiting participants and organizing interviews through the key-informants' personal networks.

Based on the results from focus groups and previous netnographic study, stakeholders from six areas were selected as key-informants or targeting interviewees in this study:

1) Highly-experienced astronomy tourists
2) Astronomy club/society/association organizers
3) Administrators form dark-sky tourist destinations
4) Tourism authority personnel from government sectors
5) Tourism enterprises which provide products relevant to astronomy tourism
6) Dark-sky local communities accredited by International Dark-sky Association

Before starting the interviews, every informant was provided with an information sheet (see Appendix IV) to be aware of the interview procedure.

Each individual semi-structured interview consisted of two parts. Part I consisted of two series of open-ended questions: the first series concerned about stakeholders' attitudes towards the industry future, the second series asked plans, measures and solutions for the future development of astronomy tourism. Part II contained eight standardized questions, preparing for the later IPA analysis. It asked questions about the informants' perception of the current performance of astronomy tourism and the importance of several aspects. Throughout the interview process, interviewees were able to answer questions in different orders from the record sheets (Appendix V), which were only utilized for guiding them through all the questions without leading their opinions.

5.3.3 Sampling and Data Collection

Two approaches were employed in the sampling process. The first one was similar to what is usually named as the 'snowball technique' (Veal, 2006). The key-informants were firstly selected and they were empowered by the researcher to involve interviewees through personal networking. The second tactic was a more directed approach. It targeted the remaining participants groups which were beyond the reach of the key-informants' social networking. Such an approach was conducted by tracking personal blog/social media and organizations' websites to build contact with the key person through emails and phone calls. Once agreement was achieved by the participants, the information sheets and consent forms were sent to them, and the appointments were scheduled.

The interviews were conducted in two formats: phone/video call interviews from a distance and onsite face-to-face conversations. The remote interviews were chosen because some interviewees were physically distant from the researcher. However, they were important figures whose perspectives might represent other key overseas markets. Missing the data from such a group could result in reducing the diversity of respondents and the generality of research findings. Facilitated by the technique of teleconference and video chatting, the remote interviews were realised. The onsite face-to-face approach was adopted if the geographical proximity to the informants was easy. The interview participants who lived in the same country or region with the researcher were usually selected.

Both the remote and onsite interviews complied with an identical procedure developed by the same researcher to ensure the consistency and data validity, but they were conducted under different language environmental settings, either English or Chinese Mandarin. Five countries were selected in targeting sample: China, Australia, United States, United Kingdom, and New Zealand. They were selected not only because they were revealed in the previous study (Chapter 3) as the primary astronomy tourism markets, but also because the researcher was able to approach the key informants from those countries without language barriers.

The duration of each key informant interview ranged from 21 to 55 minutes. During the interviews, the researcher's main role was to ask questions in a flexible order and to write key words or sentences on the record sheet. Meanwhile, the interviewees were also encouraged to disclose any additional information related to the topic of astronomy tourism. Additionally, further questions were sometimes added to the end part of the interviews in accordance with informants' responses during the progress of the interview.

All the interviews were anonymous and only limited demographic data were collected. Most interviews were audio-recorded after obtaining the participants' consent. Base on the audio record, the scripts of interview were written, transcribed and filed for data coding uses immediately after completion. Overall, twenty-eight interviews were conducted. The profiles of the interviewees are presented in Table 5.2.

Table 5.2 Profiles of the twenty-eight key informants interviewed

Country	Identities	Interview venues		Total
		Onsite	Remote	
China	Experienced astronomy tourists (EAT)*	4		9 (32.1%)
	Tourism enterprise managers(TEM)*	2		
	Astronomy society presidents (ASP)*	2		
	Tourism authority personnel (TAP)*	1		
Australia	Administrator of dark-sky destination [a]	1		7 (25%)
	Tourism authority personnel	1		
	Astronomy society presidents	2		
	Experienced astronomy tourists	3		
United States	Dark-sky community residents [b] (DCR)		2	7 (25%)
	Experienced astronomy tourists		3	
	Astronomy society presidents		1	
	Tourism enterprise managers		1	
United Kingdom	Administrators of dark-sky destination (ADD)*		1	3 (10.7%)
	Dark-sky community residents		2	
New Zealand	Tourism enterprise managers		1	2 (7.1%)
	Administrators of dark-sky destination		1	

Note: * Codes for the six categories of stakeholder. These codes were also used in documenting the source of quotes and data interpretation in the subsequent sections.

[a] This includes any type of dark-sky destinations where tourists are functioned, whether or not accredited by the International Dark-sky Association (IDA);

[b] Only the communities nominated by the IDA are included.

In Table 5.2, the statistics reveal that the seven types of key-informants are all incorporated in the sample. It contains:

- Ten highly-experienced astronomy tourists (35.7%)
- Five astronomy club/society/association presidents (17.9%)
- Three administrators form dark-sky tourist destinations (10.7%)
- Two tourism authority personnel from government sectors (7.1%)
- Four residents from dark-sky local communities accredited by the IDA (14.3%)
- Four managers from tourism enterprises which provide products relevant to astronomy tourism (14.3%)

In summary, the sample was well distributed across important countries and the key informants' identities were of desirable diversity.

5.3.4 Data Coding and Analysis

Content analysis as a qualitative research approach was undertaken to code and analyse the data collected from both focus groups and interviews. As stated in Chapter Three, content analysis is commonly used in exploring the perception of an individual based on free-elicitation survey responses for enrichment and triangulation purposes (Stepchenkova, Kirilenko, & Morrison, 2009). It is an emic approach by which the data are analysed and interpreted with a researcher-oriented observational method (Tsaur, Yen, & Chen, 2010). Three methods are usually applied in content analysis: conventional, directed and summative methods (Kitheka & Backman, 2016; Yeung & Yee, 2012). In this chapter, the combination of the conventional and the summative content analysis approach was used. That is, the study started with observation and keywords which were derived from both the data and the researcher's interest. With this feature, the codes or keywords were defined both before and during the data analysis.

To code and analyse focus group data is somewhat difficult since limited examples can be followed in tourism context (Cater & Low, 2012; Wu & Pearce, 2014b). This study adopted the five-step framework initiated by Krueger (1997; Krueger & Casey, 2014) to code and analysis the interview data. The five steps were familiarisation, theming, indexing, charting and interpretation. The first step – familiarisation was to gain a general sense of the focus groups and seek primary themes. It was conducted by listening to the audio records, reviewing the transcripts and the observational notes which were taken during the focus groups. The second step – theming identified a thematic framework by rewriting memos along the margins of the transcripts in short phrases and words to help categorise themes of the topics. The third step – indexing, was to screen and code the data, to highlight quotes and to group them for comparisons. The fourth step – charting, was extracting quotes from the original contents and re-organizing them based on the thematic framework developed in step two. The fifth step – interpretation, attempted to understand and interpret the individual quotes, seeking the connections among quotes and the links between the data and focus group objectives. To analyse the focus group data, the present study employed the five-heading method suggested by Krueger and Casey (2014): 1) frequency, 2) emotions, 3) specificity of responses, 4) extensiveness and, 5) big picture. It was adopted as the framework to guide the data analysis and interpretation.

For the interview data derived from the open-ended questions in Part I, the coding procedure complied with the similar process in Pearce and Foster's (2007) study on backpackers' learning through travelling. Firstly, terms and keywords derived from the interview contents were filtered, grouped and coded into a log sheet in Nvivo 10.0.

Demographic data were also recorded and coded. Secondly, the results from the focus groups were used to code the interview keywords and quotes which covered the two themes of open-ended questions. The same codes were given to the similar topics which overlapped with the previous focus group data. If new topics emerged from the contents of interviews, they were labelled with new codes.

For the standardized questions in the interview Part II, the data coding and analysis procedure paralleled with the previous questionnaire-based study. Using the IPA (Importance-Performance Analysis) approach, the scale data from the Likert-type questions were coded from one to five, to measure the perception of the 'importance' and attitude towards 'performance'. The data were coded in SPSS (the 22.0 edition) for further analysis and interpretation.

5.4 RESULTS AND FINDINGS

This section presents the research findings from the focus groups and key-informant interviews. All the qualitative data and content analysis results were interpreted. The interpretation was reported in the order of study aims and contents, rather than the sequence of research methods. In other words, it contained the results and findings to reach three study aims, that is, the perception of the present situation, the attitudes towards the future development, and the implications of measures to sustainably develop the astronomy tourism industry.

5.4.1 Perception of the Potential Assets, Products and Markets

(1) Perception of Astronomy Tourism Assets and Development Aspiration

Assets of astronomy tourism were identified in focus groups and were emphasized in the key-informants interviews. The desirability of stakeholders for developing these assets was also revealed in the interview results.

- *Four Categories of Assets*

The time-space characteristics were identified by focus groups as the key criteria to categorize the assets of astronomy tourism. The reliability of such criteria was also reinforced by key-informants in twenty-eight interviews. Associated with the findings from the previous netnographic study, these assets were sorted into a two-dimension synthesis and whereby grouped into six facets (Table 5.3). The horizontal quadrant represents the elasticity of the sites - where these assets can be utilized or where the relevant astronomy-related events/phenomena occur. The vertical quadrant manifests the time flexibility, describing how difficult or how often the assets can be used.

Table 5.3 The time-space attributes of astronomy tourism assets

Attributes	**Fixed site / Site specific**	**Unfixed site / Non-site specific**
Daily	Observatories Planetariums Astronomy-related heritage sites Astronomy-related museums/centres	Deep sky objects Solar system objects (Sun, Moon, planets, satellites)
Periodic	Solar eclipse, Lunar eclipse Transit of Venus, Transit of Mercury Midnight sun Rocket/space shuttle launch	Comets (named) Meteor showers Occultation/opposition of celestial objects
Contingent	Aurora borealis/australis	Supernova, Sundog Meteorites/meteors, Comets (unnamed)

Integrated with the above time-space attributes and the findings from the previous netnographic study, the astronomy tourism assets were classified into four categories (Table 5.4): 1) astronomy phenomena, 2) celestial objects, 3) astronomy-related sites, and 4) astronomy-related human events and activities. The time-space attributes of astronomy tourism assets were also mentioned in the interviews and thus reported in the content of Table 5.4 accordingly.

Table 5.4 Four types of astronomy tourism assets perceived by stakeholders

Category	Attribute of time	Attribute of sites	Examples
Astronomical phenomena	Periodic/ Contingent	Fixed & unfixed	Solar/lunar eclipse, Transit of Venus, meteor shower, aurora, comet, occultation, midnight sun
Celestial objects	Regular/Daily	Unfixed	General stargazing objects (deep sky objects, solar system objects, meteors, asteroids), meteorites seeking, sunspots
Astronomy-related sites	Daily	Fixed	Observatories, planetariums, astronomy heritage sites, space centers, rocket/space shuttle launch observing sites, museums, dark-sky destinations, dark sites
Astronomy-related human events/activities	Regular/	Fixed & unfixed	Astronomy conferences, forums, conventions, educational programs, workshops, competitions, star parties

The typology used in classifying the assets attempted to avoid any overlap among categories. Nevertheless, a few intersections still occurred. For example, the assets of general stargazing objects and star party activities co-exist, as the latter activities may incorporate stargazing to some extent. A similar overlap exists between observatories and genera stargazing as well. At a general level, this four-category typology of assets was widely adopted by most interviewees and focus groups.

- *Perceived Value of the Assets and Aspiration for Development*

Based on the previous asset classification, the value of each asset was reviewed and the aspiration for developing the assets was assessed during the interviews. The tables (Table 5.5 to Table 5.8) in the following paragraphs present the detailed content analysis results of these assets as perceived by stakeholders, including the frequently used descriptive keywords, perceived values of the assets and informants' aspiration for developing these assets.

For the first category of assets (see Table 5.5), experienced astronomy tourists and tourism enterprise managers gave higher value to astronomical phenomena than other groups did. They considered solar eclipses, auroras and meteor showers as the most typical and precious assets, which were the "*driving force*" of astronomy tourism.

Table 5.5 Perception of the astronomical phenomena as tourism assets

Identities	Frequency	Descriptive phrases & keywords	Perceived value	Desirability for Development
Experienced astronomy tourists (EAT) [a]	17	Spectacles, wonders, big event, driving forces	EV (3)* VV (5) MV (2)	VD (8)* D (4)
Tourism enterprise managers (TEM)	7	Scarcity, rare event, trademarks, first brand, precious	EV (4) VV (6)	VD (2) D (3)
Astronomy society presidents (ASP)	10	Contingent event, spectacular	VV (8) MV (2)	VD (6) D (3)
Tourism sector representative (TSR)	5	Typical, world-class resource,	VV (4) MV (7)	VD (2) D (2)
Administrators of dark-sky destinations (ADD)	9	Top attraction, festival for all, cannot miss in a life pan,	VV (5) MV(2)	VD (1) D (3)
Dark-sky community residents (DCR)	4	Astonishing, lucky to see, contingent	MV (3) N (3)	VD (5) ND (1)

Note: [a] The codes for the six types of interviewed stakeholders are used in the sections forward.
* The numbers in the brackets present the frequency of these descriptions being mentioned; Codes EV = extremely valuable, VV=very valuable, MV= moderately valuable, N= neutral.
Codes VD=very desirable, D=desirable, ND=not desirable

Other groups of interviewees also perceived the astronomical phenomena as "very valuable" tourism assets, while they were regarded as less valuable by the residents from dark-sky communities. These residents claimed that "*astronomical phenomena are somewhat contingent and every time they shift from one place to another, such as solar eclipses*." "*It is difficult to bring tourists to us and benefit from them based on luck." However, "meteor shower is another story as it only requires darkness which is the specialty of the dark-sky community*." In general, all the other stakeholders had strong desires to develop astronomy phenomena as potential and valuable assets.

The celestial objects (both the diurnal and nocturnal) were recognized as the second category of astronomy tourism assets. Table 5.6 reports the perceived value of such assets and the stakeholders' desirability of developing them for tourism purposes.

Table 5.6 Perception of the celestial objects as tourism assets

Identities	Counts	Descriptive phrases & keywords	Perceived value	Desirability for Development
Experienced astronomy tourists	21	Deep sky, galaxies, starlight, pure night skies, milky way, stargazing, astro-photos, starry skies, firmament, humbleness	EV (10) * VV (12) MV (9)	VD (3)* D (4) ND (9)
Tourism enterprise managers	4	Stargazing tours, solar system objects, planets, meteors	MV (3) N (4)	D (3) ND (2)
Astronomy society presidents	7	Night-sky without light pollution, stargazing,	EV (1) VV (5)	VD (1) D (2) ND (5)
Tourism sector representative	3	Stargazing, meteorites, nighttime natural resources	MV (1) N (2)	D (2) ND (1)
Administrators of dark-sky destinations	18	Starlight, dark-skies, celestial bodies, asteroids,	EV (4) VV (12)	VD (11) D (5)
Dark-sky community residents	14	Peace under the stars, nebulas, stargazing through telescopes	VV (8) MV (3)	VD (7) D (6)

Note: Codes: EV = extremely valuable, VV= very valuable, MV = moderately valuable, N= neutral.
Codes: VD = very desirable, D = desirable, ND = not desirable

Celestial bodies as tourism assets were recognized with different value by the six types of informants. Experienced astronomy tourists, astronomy society presidents and administrators of dark-sky destinations perceived celestial objects with higher value than other groups of interviewees assessed, while tourism enterprise managers and tourism sector representatives did not significantly realized the potential value of such assets, and therefore, they appeared relatively low interest in developing relevant tourism products.

For the development aspiration, although the experienced astronomy tourists and astronomy society presidents attached important value to the celestial objects, their desirability for developing such assets did not parallel. In the interviews, they worried that "*tourists with limited astronomy interest may intrude on our daily stargazing and break the peace of our observation spots*" and "*They may bring crowds to compete for our limited facilities and distract our daily activities*". However, for the dark-sky destination administrators and local residents, developing stargazing programs towards celestial objects observation and photographing was very much welcomed. They considered the regular stargazing tourism programs were beneficial for both the tourist destinations and local communities.

Table 5.7 presents the third category of astronomy tourism assets, the astronomy-related sites which possesses the potential to attract tourists. Some of the discussed sites were assigned as the Dark-sky Destinations by the IDA (International Dark-sky Association); the others were all included in the examples of astronomy-related sites in Table 5.4 previously.

Table 5.7 Perception of the astronomy-related sites as tourism assets

Identities	Counts	Descriptive phrases & keywords	Perceived value	Desirability for Development
Experienced astronomy tourists	5	Astronomical observatories Historical sites, touristy, crowed, poor infrastructure	VV (1)* MV (3)	VD (2) D (1) ND (2)
Tourism enterprise managers	17	Popular, easy for the public, attract general tourists, well-developed commercialized	EV (3) VV (13) MV (2)	VD (8) D (5)
Astronomy society presidents	6	Tangible and intangible, space center, attractive	VV (1) MV (5)	D (3) ND (1)
Tourism sector representative	11	Heritage sites, science and technology – related, educational, modern facilitated	EV (3) VV (7) MV (2)	VD (3) D (7)
Administrators of dark-sky destinations	7	Good facilities, convenient, architectural value	VV (1) MV (4)	VD (4) D (2)
Dark-sky community residents	3	Distinctive, beautiful, highly valuable, amazing simulation	VV (1) MV (2)	V(1) D (1)

Note: * The numbers in the brackets present the frequency of these descriptions being mentioned;
Codes EV = extremely valuable, VV=very valuable, MV= moderately valuable, N= neutral.
Codes VD=very desirable, D=desirable, ND=not desirable

Concerning the perception of astronomy-related sites as tourism assets, there were some differences among the informants. Tourism enterprise managers and tourism sector representatives considered such assets as having large potential and high value, and also they had strong aspirations to develop these tourism resources into products, especially for observatories, planetariums, astronomy-related museums, and space centers. However, the other groups of interviewees attached lower value to the astronomy-related sites. Several informants from these groups considered astronomy heritage sites, dark-sky destinations (reserves, parks, communities) were the most valuable assets. In particular, some remote places with poor tourism infrastructure were the priorities to be developed. Another difference of development desirability emerged in some of the experienced tourists and astronomy club presidents. They disagreed on the development of dark sites (as their frequently-visited places) and observatories. Some concerns and worries about the capacity and over-development of such sites were reported during their interviews, which might account for their negative attitudes towards the future development.

Astronomy-related human activities were identified as the fourth category of tourism assets. Table 5.8 below reports the perceived value of these assets and the desirability of stakeholders for developing the potential resources.

Table 5.8 Perception of the astronomy-related human activities as tourism assets

Identities	Counts	Descriptive phrases & keywords	Perceived value	Desirability for Development
Experienced astronomy tourists	24	Educational, fun, interesting communication platform, diverse, friendly atmosphere	EV (6)* VV (8) MV (7)	VD (2) D (15) ND (7)
Tourism enterprise managers	2	Rocket launch, scientific, extraordinary, educational	VV (1) MV (1) N (2)	VD (2)
Astronomy society presidents	15	Conventional, diversified, attractive, regular activities,	VV (2) MV (7) N (11)	D (4) ND (12)
Tourism sector representative	3	Educational, raise awareness of the public,	VV (2) MV (1)	VD (1) ND (1)
Administrators of dark-sky destinations	8	Participatory, vivid, meaningful, good for children	EV (3) VV (2) MV (4)	VD (3) D (2) ND (1)
Dark-sky community residents	6	Easy to begin with, fun, traditional	VV (4) MV (1)	VD (3) D (3)

Note: * The numbers in the brackets present the frequency of these descriptions being mentioned;
Codes EV = extremely valuable, VV=very valuable, MV= moderately valuable, N= neutral.
Codes VD=very desirable, D=desirable, ND=not desirable

Differences existed among informants' perception of the value of astronomy-related activities as tourism assets. For experienced astronomy tourists and presidents from astronomy clubs, their opinions were widely distributed. Some reported that potential value did exist in astronomy educational programs and conferences; however, not significant value was recognized in their regular star parties and conventions. Also, they had somewhat negative demands to develop club-organized activities and trips into tourism products, as "*they are not suitable for developing into commercial products which were usually organized by tour operators*" (interviewee from the ASP). By way of contrast, the remaining group of stakeholders had positive perception and desirability to develop astronomy-related human activities as a valuable tourism asset. At a general level, these groups had strong motivation for developing the potential assets, only a few interviewees from the tourism authority sectors and dark-sky destinations held less enthusiastic views.

(2) Perception of Astronomy Tourism Products and Destinations

- *Perceived Products and Development Status*

Table 5.9 presents stakeholders' perception of the development status of astronomy tourism products. Based on the previous market research in Chapter 3, the products were sorted into four categories in terms of suppliers.

According to the data assessed in the key-informant interviews and focus groups, the development status of the four products can be described as undeveloped, developing and developed. The undeveloped were reported as those products with potential value but not yet realized and developed by the relative stakeholders (suppliers) to date. The developing category included those products which had been recognized the value but in the status of immature or under planning/construction. The developed group was perceived by the informants as those products which were already commercialized and regarded as representative by the suppliers. It is important to note that the club-type products are mostly organized by interest groups or consumed by independent tourists who are astronomy hobbyists. Significant concerns need to be placed on those products which were identified as 'undeveloped' by informants. For the club-type products, the activities and events related to astronomy interest were undeveloped and non-specialist tourists engage in them infrequently. For the destination-type of products, meteor shower tours and other astronomy-themed accommodations lacked development. A similar situation occurred in the enterprise-type products, and the transit of Venus and comets seeking tours were also reported as undeveloped. For the products provided by dark-sky local communities, meteor shower and astro-photo taking workshops were recognized as a neglected area of development. A quote from an interviewed resident presented this status. "*As a regular and spectacular event, meteor showers occur quarterly but we ignored their potential to attract tourists. It may be the future direction of the local tourism programs...and meteor seeking can be a daily activity to attract tourists*".

Table 5.9 Perceived products and development status

Category	Undeveloped	Developing	Developed
Club-type (FIT* and or interest groups)	Astronomy convention conference/forums, astronomy competition, meteorites seeking	astronomy excursion Star parties, Stargazing group tours, aurora tours	Interest group tours to solar/lunar eclipses, meteor showers, independent trips to observatories/planetariums
Destination-type	Meteor shower guide tours, astronomy-themed accommodations,	Dark-sky destination guide tours, stargazing guide tours, IDA astronomy programs, rocket launch watching	Observatory/planetarium guide tours, aurora watching, solar eclipse chasing, space centers
Enterprise-type	Meteor shower tours, Transit of Venus tours, Comet seeking tours	Space center/ rocket launch tours, astronomy holidays	Aurora or solar eclipse package tours/cruises
Community-type	Meteor shower guide tours, astro-photo workshop tours, meteorites seeking	Astronomy-themed B&Bs, stargazing guide tours	(Nil)

Note: * FIT refers to fully independent tourists

- *Potential Destinations and Perceived Importance*

In the interviews, potential destinations for developing astronomy tourism were noted and the relative importance perceived by the key informants was recorded. The results are presented in Table 5.10 below. The classification of destinations followed the segmentation of the 'Starlight Reserve Concept' initiated by the UNESCO-WHC[1] (Initiative Astronomy and World Heritage) in 2009. The destinations mentioned by the interviewees were sorted with this concept (see Appendix VI), and the perceived importance of the potential destinations was assessed according to informants' verbal descriptions during the interviews.

Table 5.10 Potential astronomy tourism destinations and perceived importance

Categories	Important	Neutral	Unimportant
Heritage Sites	7*	5	5
Astronomy Sites	24	3	0
Natural Sites	14	2	1
Starlight Landscapes	2	5	9
Starlight Oases (human habitats)	11	6	3
Mixed Starlight Sites	3	7	2

Note: * The numbers present the frequency of these descriptions being mentioned by interviewees.

Referring to the results reported in the table, six categories of potential destinations were identified and given different levels of importance by the interviewees. Among all the destinations, astronomy sites and natural sites were frequently labelled as 'important' destinations by most of the informants. Starlight oases (human habitats)

[1] UNESCO-WHC refers to United Nations Educational, Scientific and Cultural Organization - World Heritage Committee

were also considered as important destinations for potential value. By way of contrast, heritage sites and starlight landscapes were perceived as somewhat unimportant to be developed as astronomy tourism destinations by several industry stakeholders.

(3) Perception of Astronomy Tourist Markets

The astronomy tourist market was segmented into seven subsets in the previous study (see section 3.4.1 in Chapter 3). Using this segmentation, the industry stakeholders' perception of the market positioning for each subset was revealed by the interviews. The statistical results are manifested in Table 5.11. Three levels of market positioning were noted in the interviews and conceptualized from the informants' descriptions: core markets, secondary markets and potential markets.

Table 5.11 Perception of the market positioning for seven market segments

Market Segments	Six types of industry stakeholders					
	EAT*	TEM	ASP	TSR	ADD	DCR
Stargazers	C (8) [a] P (2)	P (2)	C (1) P (4)	P (2)	C (3)	C (3) P (1)
Eclipse chasers	C (2) S (4)	C (3) P (1)	C (4)	C (2)	S (2)	S (3)
Aurora hunters	C (7) S (1)	C (4)	C (2) P (1)	C (1) P (1)	P (2)	C (1) P (2)
Observatory visitors	C (2) S (4) P (1)	C (1) S (2) P (1)	P (1) C (2)	C (1)	C (1) P (1)	S (2) C (1)
Meteor seekers	C (9) P (1)	P (3) C (1)	C (2) S (1) P (2)	P (2)	P (2) C (1)	P (3) C (1)
Star party travellers	S (1) P (6)	S (3) P (1)	S (1) P (3)	S (1) P (1)	C (2) P (1)	P (2)
Other interest travellers	S (2) P (3)	S (1) P (2)	P (2)	S (1) P (1)	S (1) P (1)	S (1) P (2)

Note: * Refer to the note of Table 5.5 for the codes of the six types of interviewees;
[a] Codes 'C' refers to core markets, 'S' refers to secondary markets, 'P' refers to potential markets. The numbers in the brackets present the frequency of these descriptions being mentioned.

From the interview results, different perception of market positioning was revealed among six categories of industry stakeholders. The stargazers sub-market was deemed as a core market as well as a potential niche market by many informants. Similarly, the 'eclipse chaser' market was recognized as a key market for future development, but slight disagreement appeared in some of the experienced astronomy tourists, dark-sky community residents and dark-sky destination administrators.

Concerning the aurora viewing market, many interviewees positioned it as the 'core market' for astronomy tourism, while a few opinions placed aurora viewing into the potential subset, because "*aurora watching is spreading out from those well-known destinations, but many areas with better aurora resources remain un-known*" (quoted from an interviewee in the TEM group). Observatory visitation was identified as a core market for astronomy tourism by all groups of informants, but some interviewees considered it as a potential area or secondary market, since they realized that "*observatories have limited capacity and brand effect*" and "*they have potential in functioning students or running educational programs*". The meteor viewing and seeking market was reviewed as a core position by many interviewed stakeholders, especially the experienced tourists. Its market potential and less-developed status were also realized by the majority of the informants. The star parties as well as related travels (independent travels), were mostly organized by astronomy clubs or interest groups. Except for the ADD group, many interviewees considered the star party traveller market as a potential segment or secondary market. In particular, the managers from tourism enterprises "*hardly see any potentials or benefits to develop a self-organized form of travel into a profitable tour package product*". However, for the administrators from dark-sky destinations, the potentials of star parties "*may lie in the opportunities that astronomy clubs may choose our destination as a fixed venue* *for star parties, which will certainly bring traffic and crowds to visit us."* Regarding the last category of market segments - other interest travellers, such as watching space shuttle launch and seeking for meteorites, they were perceived as either the potential markets or secondary markets, because such segments "*attract limited populations and therefore the market niche is very small*" (quote from an informant in the TSR).

5.4.2 Attitudes towards Future Difficulties, Threats and Opportunities

(1) Difficulties: Constraints of the Products

The informants of the focus groups and interviews pointed out the main challenges for the future development of astronomy tourism. In their views, the principal difficulties lay in the essential attributes of the astronomy-related activities which were easily and frequently affected by weather, light pollution, time and locations. These attributes bring several constrains, impeding the development of a specific product. These difficulties can dominate tourists' decision making, and a hybrid of constraints normally work together for a single product or activity. That is, to tackle the challenge of developing a specific astronomy tourism product, several constraints may need to be considered as a whole, even though a dominating constraint exists for a specific product. However, "*the dominating constraints may vary among different types of products or activities. This is a challenge for the market developers*". (Quoted from an informant in the ASP)

Four types of constraints were recognized by the key informants: visibility, time determinant, location determinant, and interest / attraction determinant. The visibility constraint was further divided into two subsets: brightness and weather. The contents in Table 5.12 report a summary of these four constraints described by the astronomy tourism stakeholders.

Table 5.12 Four constraints for astronomy tourism products and activities

Constraints		Representative product/activities
Visibility	Brightness-dominated	Stargazing, observatories, astro-photography, meteor shower
	Weather-dominated	Solar/lunar eclipse, meteor shower, midnight sun, Transit of Venus/Mercury, aurora, full moon hiking
Time-determinant (Rareness/Contingency)		Aurora, meteor shower, solar/lunar eclipse, Transit of Venus/Mercury, occultation, opposition/conjunction
Location-determinant		Solar/lunar eclipse, midnight sun, aurora, rocket/space shuttle launch, Transit of Venus/Mercury, astronomy B&Bs/Inns,
Attraction/interest-determinant		Heritage sites, observatories, planetariums, museums, astronomy competition/convention/forum/workshops, space centres, astronomy-themed park/cruise, star parties, meteorites seeking

In addition to the product constraints, the difficulties in targeting and meeting the demands of the tourists with different interest levels were reported by interviewees. "*The needs of those beginners or potential customers are very much different from the needs of astronomy hobbyists or amateurs*." To know the various needs and motives of different groups of astronomy tourists was considered as a pivotal and challenging task for industry stakeholders. Specific channels and strategies need to be identified to connect the demand and supply. Using the questionnaire survey results in Chapter 4, several measures will be provided in Chapter 6 to address this issue as implications arising from the research.

(2) Threats: The Receding Starlight and Climate Change

The artificial light pollution was reviewed by many interviewees as the major threat to the development of astronomy tourism. Light pollution has become a worldwide problem as it is gradually diminishing the capacity to observe the stars. "*This new waste from the intelligent lighting possibly generates cultural, environmental and even ecological impacts with unforeseeable consequences.*" Light pollution can be defined as the introduction by humans, directly or indirectly, of artificial light into the natural environment. The common consequence of these phenomena is the loss of the capacity to observe the stars, together with unnecessary impacts on people life quality, waste of energy, habitat deterioration and negative effects on wildlife. Such results were anticipated by the interviewed stakeholders as potential threats to the future of astronomy tourism. Among all causes having a negative effect on night sky quality, light pollution was the highest immediate risk but, at the same time, it can be reduced through viable solutions.

Aside from the brightness of artificial light, the global climate change was mentioned by the interviewees as a potential threat to astronomy tourism. The impact of climate change was recognized as affecting two areas. The first effect possibly occurs on the local and regional weather. "*The places once with favorable weather conditions may become no longer suitable for stargazing due to regional climate change, which can negatively affect the astronomical seeing*". The second threat may affect particular areas where the aurora tourism is thriving. Climate change was suspected to impact the observational conditions of the places around the Arctic and Antarctic circles, since "*these areas are significantly influenced by the global warming and glaciers are melting quickly…This changes the local weather and landscapes…aurora tourists will become worried…they will be less likely to visit those destinations*" (quote from one interviewee from the TEM group).

(3) Opportunities

Opportunities for the future development of astronomy tourism were foreseen by the informants in focus groups and interviews. Such opportunities lie in four areas: 1) the niche markets in emerging destinations countries, 2) the benefit from the ICT industry and the smart tourism, 3) the connection to popular culture industry, and 4) the global concerns of dark-skies and starlight conservation.

For the first aspect, the market potentials were recognized in the countries with rapid growing astronomy tourism. The interviewees from China, Australia and the United States all mentioned that China, India and African countries were the niche markets with emerging opportunities. "The potential populations of astronomy tourists in these markets are considerably large and still growing rapidly". Meanwhile, these countries were also considered as the main origins of astronomy tourists. "*China, especially polluted by the light in urban areas, has strong demand to seek clear skies and bright stars overseas*".

The second opportunity was described by the informants as the bonus from the ICT industry and smart tourism. Astronomy tourism can benefit from smart travellers in the digital era. Social media was considered as an important pathway to attract public focus onto peculiar events and to raise people's interest and knowledge in astronomy. In addition, interviewees also pointed that new technology may shape the behavioural pattern of astronomy tourists. With the improving communication and information technology, travelling to a distant area for an astronomy-related purpose will become faster, earlier and more accessible for potential tourists. "*It will break down the barriers to enter the field of astronomy tourism*".

The third opportunity was described as the underlying connection to popular culture, movie industry in particular. Examples were given by the interviewees, including the science fiction films ‘Interstellar’ ‘Lost in Space’ ‘Gravity’ ‘Star Wars’ ‘Star Trek’. Such films always brought a new wave of enthusiasts with transient astronomy interests and curiosities. “Specific astronomy tourism products need to be designed and associated with the film industry to target this latent market segment”.

Last but not least, the opportunity to address the global concerns about dark-skies and starlight conservation was noted by many informants in focus groups and interviews. They also mentioned numbers of initiatives and programs launched by international organizations, including UNECO (United Nations Educational, Scientific and Cultural Organization), IAU (International Astronomical Union), UNWTO (World Tourism Organization), and CIE (International Commission on Illumination). Such programs were considered as positive signs to preserve the dark-sky resources by developing astronomy tourism. With the funding and political support from the authority, “*it may encourage the undeveloped dark-sky sites to transform into future tourist destinations where the local communities can benefit from the astronomy tourism programs*”.

5.4.3 IPA results: Key Measures and Solutions

In the previous focus groups, the key measures and solutions for the sustainable development of astronomy tourism were discussed. Eight measures were frequently mentioned and thus they examined more closely in the interviews. They are listed as follows:

- Preserve dark-skies and control light pollution
- Deliver astronomy educational programs to young generations
- Develop diverse tourism products to meet different needs
- Improve accommodation facilities and services of the local community

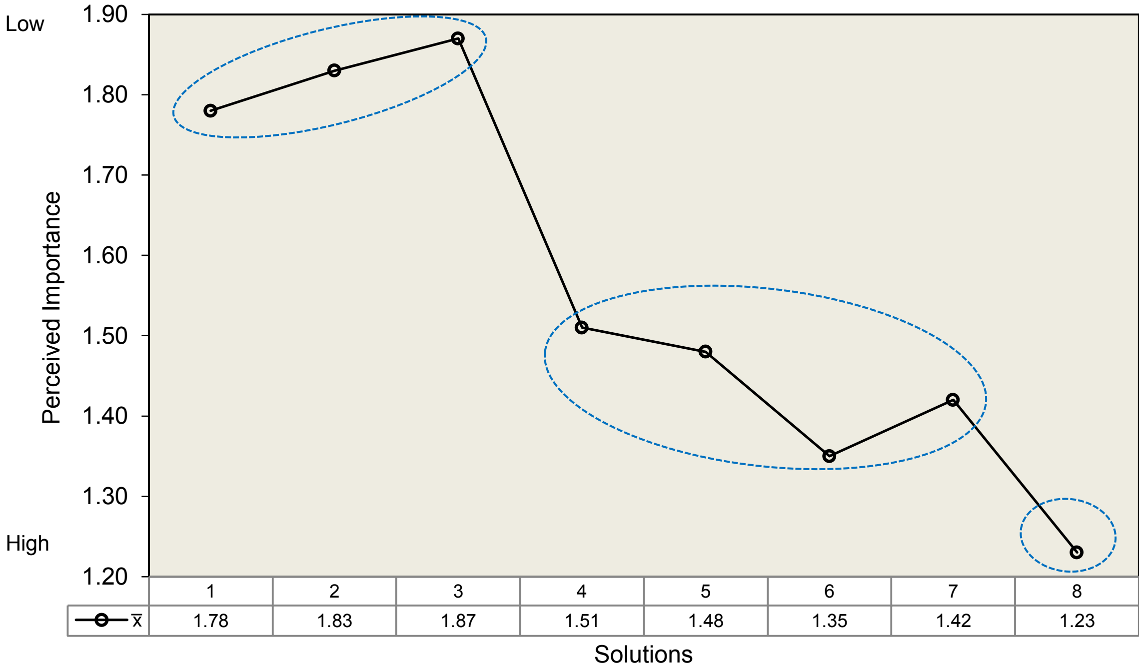
- Optimize the infrastructures of the distant dark-sky sites
- Enhance marketing and promotion strategies
- Make sustainable tourism plans for dark-sky destinations
- Raise potential tourists' awareness and interest in astronomy

At the second part of the interviews, informants were asked to answer standardized questions concerning the eight measures. The response to the questions was in the form of a five-point Likert scale, and interviewees were allowed to complete the form independently. The following section of the chapter reports how these measures and solutions were perceived and their future anticipated by the interviewees based on the importance and expected performance analysis (IPA).

(1) Perceived Importance of the Key Solutions for the Future Development

One-way ANOVA was conducted to examine if the perceived importance of the eight solutions significantly varied among the interviewed stakeholders. Figure 5.1 presents a visual illustration of the importance values and the differences among the eight solutions.

In reference to the descriptive analysis results, all the eight solutions were perceived as somewhere between important and very important. The one-way ANOVA results revealed that there were significant differences among the perceived importance of the eight solutions ($F=5.26$, $df=7$, $p=.002$). The post-hoc Scheffe test (see Figure 5.1) demonstrated that the eighth solution 'preserve dark-skies and control light pollution' was recognized in the most important group, while an intermediate group of solutions, including 'launch astronomy educational programs to young generations' 'develop diverse tourism products to meet different needs' 'improve accommodation facilities and services of the local community' and 'optimize the infrastructures of the distant dark-sky sites', was perceived as medium important. The remaining three solutions (1-3), 'enhance marketing and promotion strategies' 'make sustainable tourism plans for dark-sky destinations' and 'raise potential tourists' awareness and interest' fell into the least important group (see Figure 5.1).

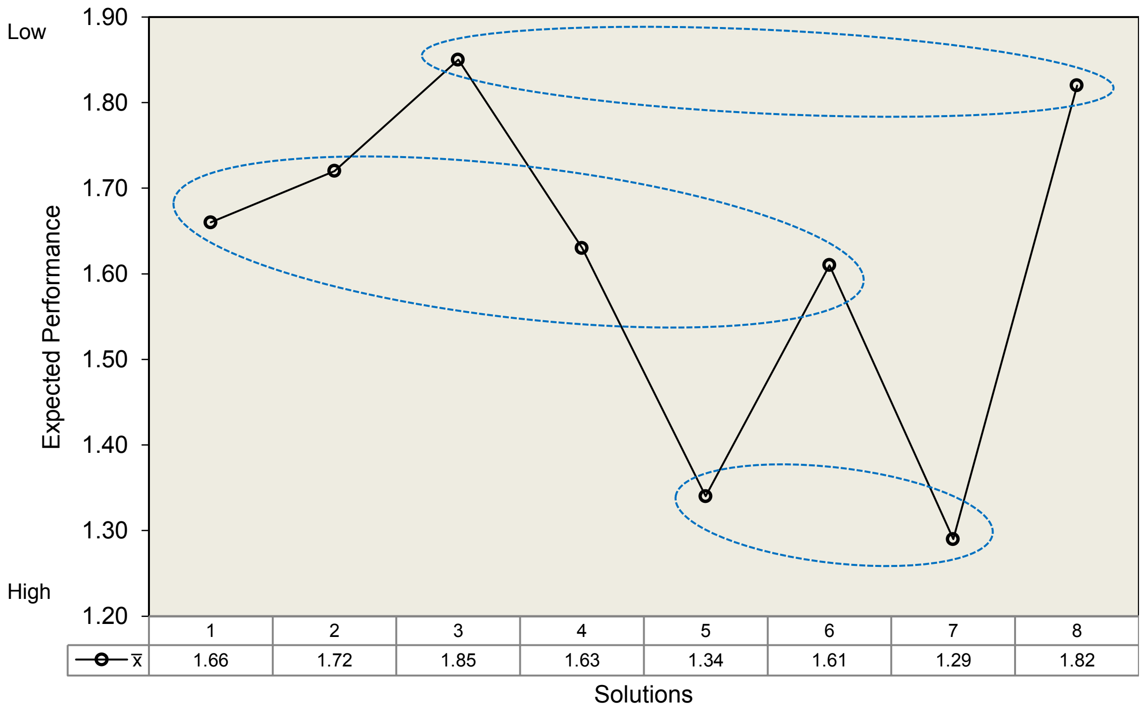


The explanation of solutions 1-8 for the future development of astronomy tourism			
1	Enhance marketing and promotion strategies	**5**	Develop diverse tourism products to meet different needs
2	Make sustainable tourism plans for dark-sky destinations	**6**	Optimize the infrastructures of the distant dark-sky sites
3	Raise potential tourists' awareness and interest	**7**	Improve accommodation facilities and services of the local community
4	Deliver astronomy educational programs to young generations	**8**	Preserve dark-skies and control light pollution

Figure 5.1 Post-hoc Scheffe test on the perceived importance of the key solutions

(2) Perception for the Expected Performance of the Key Measures

Concerning the expected performance of each solution, the interviewees' attitudes were quite optimistic. The mean scores of the eight solutions were all under 1.90, implying that these solutions, to a large extent, were perceived to be positive and effective to develop astronomy tourism and were likely to come true in the future. The one-way ANOVA results indicated that significant differences existed among the expected performance of the eight solutions (F=4.78, *df*=7, p=.004). The differences identified by the post-hoc Scheffe test revealed that the most realizable measures were solution 5 'develop diverse tourism products to meet different needs' and solution 7 'improve accommodation facilities and services of the local community'. The solution 3 'raise potential tourists' awareness and interest' and solution 8 'preserve dark-skies and control light pollution' were anticipated as the least realizable group of measures. The remaining solutions were expected to be realized in the intermediate position somewhere between the above mentioned two groups of solutions (see Figure 5.2).



The explanation of solutions 1-8 for the future development of astronomy tourism			
1	Enhance marketing and promotion strategies	**5**	Develop diverse tourism products to meet different needs
2	Make sustainable tourism plans for dark-sky destinations	**6**	Optimize the infrastructures of the distant dark-sky sites
3	Raise potential tourists' awareness and interest	**7**	Improve accommodation facilities and services of the local community
4	Deliver astronomy educational programs to young generations	**8**	Preserve dark-skies and control light pollution

Figure 5.2 Post-hoc Scheffe test on the expected performance of the key solutions

(3) IPA Results: the Key Measures and Implications

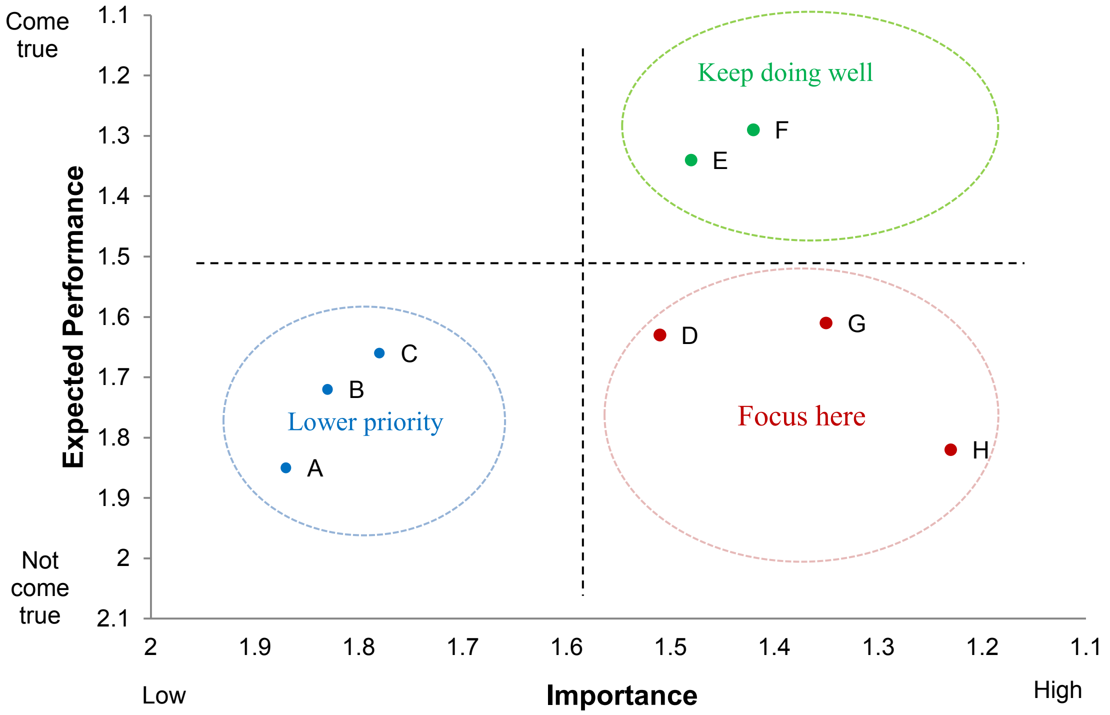
Using the interview data from twenty-eight respondents, the importance-expected performance analysis (IPA) was adopted to compare each key solution. Table 5.13 presents a full list of the overall evaluation for the eight solutions which are reordered in terms of the importance value from high to low. Higher scores mean less perceived importance value or lower expected performance.

Table 5.13 IPA results of the key solutions for developing astronomy tourism

Label	Measures and solutions	Importance $\bar{x}$ (SD) *	Expected Performance $\bar{x}$ (SD)	$\bar{x}$ (importance) - $\bar{x}$ (expected performance)
A	Raise potential tourists' awareness and interest	1.87 (1.02)	1.85 (.94)	.02
B	Make sustainable tourism plans for dark-sky destinations	1.83 (.81)	1.72 (1.13)	.11
C	Enhance marketing and promotion strategies	1.78 (.94)	1.66 (1.17)	.12
D	Deliver astronomy educational programs to young generations	1.51 (1.13)	1.63 (1.05)	-.12
E	Develop diverse tourism products to meet different needs	1.48 (.76)	1.34 (1.20)	-.06
F	Improve accommodation facilities and services of the local community	1.42 (.98)	1.29 (.86)	.13
G	Optimize the infrastructures of the distant dark-sky sites	1.35 (.87)	1.61 (.97)	-.36
H	Preserve dark-skies and control light pollution	1.23 (.55)	1.82 (1.09)	-.59

Note: For questions concerning perceived importance, 1=very important, 5 = unimportant at all; for expected performance, 1=will certainly come true, 5=will never come true. * SD = standard deviation.

Based on the IPA data, a succinct two-dimension quadrant was drawn as Figure 5.3. The horizontal axis presented the mean scores of perceived importance, and the mean scores of expected performance were depicted in the vertical axis. The dash lines were positioned and crossed after considering the previous one-way ANOVA and post-hoc tests results to differentiate each group of the key solutions. Hence, $\bar{x}_{\text{(importance)}} = 1.58$ and $\bar{x}_{\text{(expected performance)}} = 1.51$ were adopted to segment the grid into four quadrants.



The explanation of solutions A – H for sustainable development of astronomy tourism			
A	Raise potential tourists' awareness and interest	**E**	Develop diverse tourism products to meet different needs
B	Make sustainable tourism plans for dark-sky destinations	**F**	Improve accommodation facilities and services of the local community
C	Enhance marketing and promotion strategies	**G**	Optimize the infrastructures of the distant dark-sky sites
D	Deliver astronomy educational programs to young generations	**H**	Preserve dark-skies and control light pollution

Figure 5.3 IPA results of the key measures for the future of astronomy tourism

From the IPA results associated with the two-dimension scatter graph, the eight key solutions can be sorted into three groups in terms of implementation priorities. The solutions in the first priority group were those which were perceived by the industry stakeholders as very important but expected with lower or average performance.

Particular concerns from the stakeholders are needed to focus on such solutions in the future. In the astronomy tourism context, these concerns include solutions D, G and H. (see the red dashed circle in Figure 5.3). In particular, solution H (‘reserve dark-skies and control light pollution’) was recognized as the most important solution by the informants, but was anticipated as the second lowest expected performance. The key informants, either from focus groups or interviews, kept emphasizing that protecting the dark-sky resources are pivotal for developing astronomy tourism in a sustainable approach. Such an approach is an essential prospect for all groups of the industry stakeholders in astronomy tourism.

For the solutions A-C, they all embedded in the ‘lower priority’ group which was incorporated in the blue dashed circle. These solutions were relevant to the marketing and promotion strategies for expanding the astronomy tourists’ population. Compared with the remaining solutions, they were perceived as less important and less realizable. Therefore, these solutions may be considered as long-term strategies for the future development of astronomy tourism but should not be overlooked at the present.

Two measures (solutions E and F) were in the ‘keep doing well’ group: ‘Develop diverse tourism products to meet different needs’ and ‘improve accommodation facilities and services of the local community’. They were placed in the top-right position in the green dashed circle, with relatively high importance value and expected performance. They were anticipated as more likely to be realized, which does not mean they can be neglected (the expected performance does not equal to the actual performance in the reality). Compared with the ‘focus here’ group, they were perceived as more feasible for action.

Additionally, there were other solutions proposed by the key informants aside from the above eight measures. Due to the frequency analysis results from the focus group studies, these measures were not used for interview questions. However, they are still worthwhile to be listed below for further considerations. These measures and tactics include:

- Identify night-sky associated resources aiming to develop scientific and cultural tourism related to astronomy.
- Promote the exceptional nocturnal skyscapes as basic resources in a new generation of tourist products.
- Establish alliances between travel agents to preserve and put into value the tangible and intangible cultural heritage connected with astronomy and star observation as a tourism resource.
- Support the development of responsible tourist products related to astronomical observatories and non-professional observation sites of interest.
- Incorporate the clear sky criterion in the strategies of sustainable tourism destinations.
- Promote the inclusion of responsible lighting and night sky protection within the responsible tourism certification criteria and eco-labels.

5.5 Summary and Conclusion

The "firmament" as a scenario for tourism in modern times, has been present as a basic background since this vital resource is almost neglected due to the rapid standardisation and massification of tourism. The present challenge is to reintroduce this resource as a basic part of the offer for those destinations which still have a chance to recover the clarity of their night sky. Tourism, one of the most important and innovative activities on our planet, could act as the vector of a new alliance to promote the quality of the night sky. As an additional scenic element, the potential value of a starry sky in any tourist destination should not be ignored. At times, the starry sky and other nocturnal phenomena form part of the very essence of the tourism product, such as the observations of Northern Lights, eclipses, visits to astronomical observatories, and the sailing holidays featuring navigation by the stars, some pilgrimage routes, or the innovative visions offered by desert tourism at night. Recitals of local stories and tales related to stars and festivals under the starry sky will add tourist interest, besides being an effective educational program for children and contributing to folklore protection and local community conservation. Clear sky availability can rightly constitute an asset for the development of specific products geared towards astronomy tourism.

In this chapter, an interview-based study on the future development of astronomy tourism was conducted. It not only revealed the industry stakeholder’s perception of the potential assets, products, destinations and markets of astronomy tourism, but also assessed their anticipation and attitudes towards the latent difficulties, threats and opportunities of the industry. Four types of astronomy tourism assets were identified by the key informants: astronomical phenomena, celestial objects, astronomy-related sites, and astronomy-related human events/activities. The development status of four categories of products was also discussed in focus groups and interviews. Further, six potential astronomy tourism destinations and their importance were assessed. Among these destinations, ‘natural sites’ and ‘astronomy sites’ were perceived as the most valuable potential destinations for further development. Next, the underlying and existing markets were reviewed and positioned at three levels by the interviewees.

The markets of stargazers and meteor seekers were considered as the underlying markets with most of the respondents' consensus.

The stakeholders also foresaw the difficulties, threats and opportunities of astronomy tourism. Four constrains of astronomy tourism products and activities were considered as the attributes which led the challenges and difficulties: visibility, time-determinant, location-determinant, and interest/attraction-determinant. The facts of fading starlight and climate change were realised as the most possible threats for the development of astronomy tourism, while positive signs were still anticipated as opportunities, such as the emerging astronomy tourism markets in China, India and African countries. Also, the connection to popular culture, the rapid development of the ICT industry and more international concerns and related programs from the United Nations and other world-wide organizations were all underlying chances for boosting the rising markets and industry of astronomy tourism.

Using the IPA approach, key measures and solutions for the sustainable development of astronomy tourism were indicated by interviewees. Among eight solutions, three of them were assessed as the first priorities: 1) deliver astronomy educational programs to young generations, 2) optimize the infrastructures of the distant dark-sky sites, and 3) preserve dark-skies and control light pollution. Particular attention needs to be paid to such solutions to sustainably develop astronomy tourism assets. Additionally, to enhance the marketing and promotion strategies was proposed by the key informants. Practical marketing strategies and action plans to identify the link between demand and supply were aspired by the interviewed stakeholders. Based on the questionnaire survey results in Chapter 4, specific measures will be provided in the next chapter to address this issue as the implications from the current research.

Chapter 6

Synthesis and Summary

"Interest in astronomy, or simple contemplation of starry skies, has always had profound implications for philosophy, science, arts, culture and for the general conception of the universe in every community all over the world."

The Starlight Declaration, 2007

Chapter Outline

6.1 INTRODUCTION

The aim of this chapter is to finalize the thesis in three ways. The results and findings from the previous netnographic study, the questionnaire-based study and the interview study are brought together in this chapter under three themes; findings, implications and limitations directed to future research opportunities.

Firstly, the major research findings of the three empirical studies will be synthesized. Through a holistic perspective, such syntheses deliver an integration of the research results across different chapters. Connections and links are bridged among the study outcomes to offer a comprehensive understanding of the astronomy tourism market, effectively addressing the overall research aims of this thesis. In particular, mutually supportive evidences from Chapter 3-5 are highlighted, focusing on the overall characteristics of the astronomy tourism market (tourism assets, resources, products, activities and destinations), the connections between the group culture and individual travel experience of astronomy tourists, and the links between tourist motivation pattern and leisure involvement levels.

Secondly, the implications of the thesis are summarized at both a theoretical level and a practical level. These summaries will also deliver the contributions of the thesis work, linking the present research achievements to previous studies in the related areas. These research outcomes are presented in the domains of research methods, theoretical contributions and potential applications of the work.

Finally, the limitations of the research in this thesis are indicated and directions for further study efforts are suggested. Possibilities to conquer these limitations are also outlined, pointing out the future opportunities in the interest area of astronomy tourism.

6.2 SYNTHESIS OF FINDINGS: A HOLISTIC PERSPECTIVE

A holistic approach was employed in this section. It synthesized the key findings of each empirical study and, more importantly, it combined separate fragments of the research puzzle into an organic entity, connecting with specific contexts that were pivotal to understand astronomy tourism at a holistic level. This synthesis considered three major connections: an integrated understanding of the astronomy tourism market, a comprehensive consideration of the group culture and individual experience, and a systematic interpretation of astronomy tourists' motivation patterns and serious leisure involvement.

6.2.1 Astronomy Tourism: An Integrative Understanding

Previously, the group culture of astronomy tourists as a neo-tribe, the individual travel experience and the industry future of astronomy tourism have been explored. These three empirical studies were conducted to address the overall research question and identified opportunities as stated in Chapter one. Using the etic and emic approaches with the qualitative and quantitative analyses, this research collected a wide spectrum of insights from both the astronomy tourists and the key industry stakeholders. The following section presents a succinct summary of the major research findings related to the understanding of the astronomy tourism market and industry. It discloses the study conclusions through a holistic perspective rather than in the order of chapters. Astronomy tourism, the theme of the thesis, can be reconsidered across chapters at a whole market level. More specifically, the astronomy tourist destinations, the assets and resources, the products and activities, the market segmentation and distribution, and the travel experience and group culture of astronomy tourists can be connected together to build an integrative understanding of such an emerging market. Figure 6.1

depicts a panoramic view with connections to the research results of related chapters, providing an integrated understanding of the research topic of astronomy tourism.

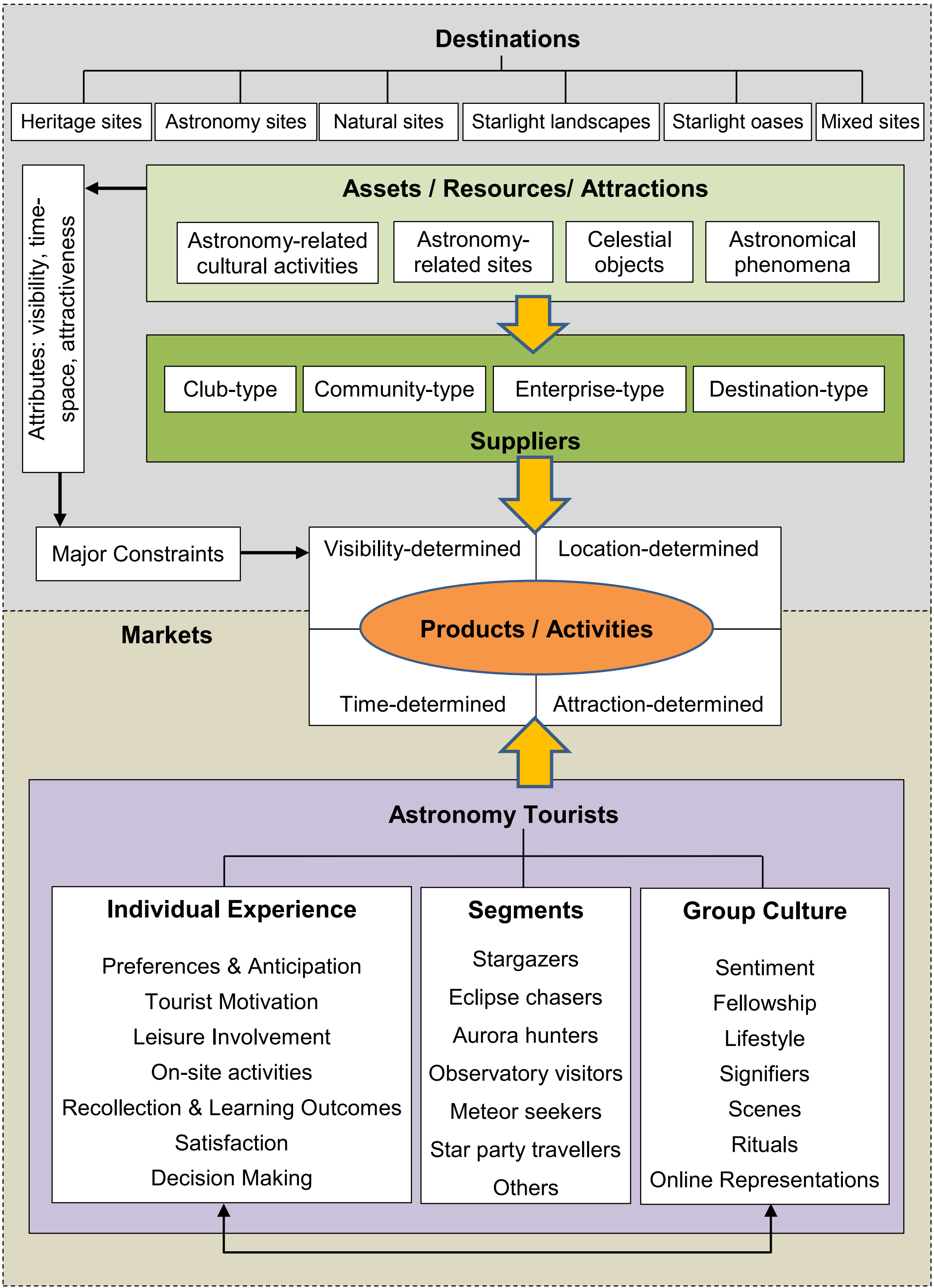


Figure 6.1 An integrated understanding of astronomy tourism

From the supplier side, four major tourism assets and resources are distributed in seven categories of astronomy-related destinations. In terms of trip organizers, four types of tourism products are provided by four different suppliers: astronomy clubs, tourism enterprises, tourist destinations and local communities. There are four main constraints for developing and consuming these products. Such constraints lie in the visibility attributes (weather, light pollution), the attractiveness of the tourism assets and the time-space attribute. Examining into the demand side, the market is divided into seven segments that can be sorted by the actual number of trips undertaken by astronomy tourists. In terms of scale, that is large to small, they are the segments of stargazers, star party travellers, observatory visitors, meteor seekers, eclipse chasers, aurora hunters and other astronomy-interest tourists (see section 4.4.1 and Table 4.9). Further syntheses of each segment market are given below and reported in Table 6.1.

(1) Stargazers

Stargazers constitute the largest proportion of the astronomy tourists' population. The fully independent tourists who usually travel spontaneously account for the majority of this sub-market, while the group tourists, either organized by astronomy clubs or tour operators, account for the minor part. Regular celestial objects of the night skies without light pollution are the primary tourism assets as well as the major attraction that drive people to travel. Stargazing is a type of weather and brightness dependent activity that can be conducted nightly. It acts as the key attraction in the undeveloped and developing dark-sky destinations, or as a complementary function to extend tourists' stay and nocturnal activities in those well-developed tourist destinations. Observing stars through equipment or by naked eyes are the popular on-site activities that are welcomed by all types of tourists, while astro-photo taking requires special skills.

Table 6.1 A synthesis of the seven segments of the astronomy tourism market

Segments	Type of Assets	Destinations	Determinants	Frequency	Key organizer	On-site activities	Preferred by
Stargazers [1]	General celestial objects and some astronomical phenomena (e.g. comets, occultation, opposition)	Dark-sites, The dark-sky destinations	BD*, WD	Daily	Clubs, dark-sky destinations,	Stargazing	All groups of tourists
						Astro-photographing	S>E>F>D [a]
Eclipse Chasers [5]	Astronomical phenomena (Solar eclipses, lunar eclipses)	Unfixed, but within a certain area	LD, TD, WD	Twice a year on average	Enterprises, clubs	Astro-photo taking, observing through equipment	S>F>E>D
Aurora Hunters [6]	Astronomical phenomena (Aurora borealis/australis)	Antarctic and Arctic regions	LD, WD, TD	Winter periods	Enterprises, clubs, local communities	Naked-eye observing, Astro-photo taking	All groups of tourists
Observatory Visitors [3]	Astronomy-related sites; Celestial objects,	Observatories, planetariums, museums	AD, BD, WD	Daily	Observatories, clubs	Educational programs, observing through professional telescope	E>D>F>S
Meteor Seekers [4]	Astronomical phenomena (meteor showers, meteorites random meteors)	Dark sites, the Dark-sky destinations	WD, BD	Periodic & contingent	Dark-sky destinations, clubs	Naked-eye observing, Astro-photo taking	S>D>F>E
Star-party Travellers [2]	Astronomy-related cultural activities	Venues of the club, dark sites, dark-sky destinations	AD, LD, WD	Regular	Clubs, local communities	Stargazing, discussing astronomy topics, visiting friends	E>S>F>D
Others	Rocket launch observation	Space centres	AD, LD, TD	Regular & daily	Mixed	Mixed	F>D>E>S
	Astronomy-themed cruises	Natural sites	AD, BD,WD				D>F>E>S
	Transit of Venus/Mercury	Natural sites	VB, WD, TD				All tourists
	Astronomy cultural activities	Starlight oases	AD, LD, TD				S>E>F>D

Note: [1-6] the ranking among six segments in terms of the actual number of trips; * Codes refer to the determinants: BD=brightness-determined, WD=weather-determined, LD=location-determined, TD=time-determined, AD=attraction/interest-determined; [a] Codes S=specialists, E=Enthusiasts, F=Fanatics, D=Dabblers, the sequences are based on the questionnaire-based study results in section 4.4.3 (refer to Table 4.17)

Though the travel radius for stargazers is normally small because the proximity is the first consideration, some tourists still travel overseas particularly for stargazing to destinations which have top-class observational conditions, or to observe specific constellations which can only be visible in the other hemisphere or distant settings.

Stargazing has large potential for the future market development, especially for the destinations with well-preserved dark-sky resources but poor conventional tourism assets. The stargazing market has not yet been widely developed, though the underlying value and potential niche have been clearly recognized by the stakeholders surveyed in this study. Improving the accessibility of transportation, refining the infrastructures and accommodation at the dark-sky destinations and promoting stargazing tour products as well as astronomy educational programs are perceived as priorities to develop the emerging stargazing market.

(2) Star Party Travellers

Unlike the stargazing segment, star party travellers are essentially all those astronomy club members who travel regularly to participate in star parties. Though stargazing is one of the important activities included in star parties, the participants also participate in other cultural activities that are related to astronomy. Astronomy clubs play an important role in operating these activities such as astronomy forums, conventions and workshops. It is the strong fellowship in their group culture and the relationships among club members that motivate the tourists to travel. Non-touristy dark-sky destinations or dark-sites such as mountaintops, seaside and waterfront areas are the main venues for their star parties. Interpersonal communication and group discussion to exchange astronomy knowledge and related observational or photographic skills are the typical forms of the on-site activities. Compared to other segments, traveling for star parties has not yet become a tourism commodity that is supplied by tourism professionals. Hence, to some extent the real 'market' is recessive and intangible for developers. However, neither the researchers nor the practical realm can neglect its existence, as star party travellers are the second largest streams of astronomy tourists and there are potential opportunities for future marketing and commercialization. The astronomy-related human activities and cultural events in star parties are perceived as latent tourism assets, representing the group culture and attracting potential tourists to begin astronomy-related travels. Additionally, as the main stage for the neo-tribal representation, star parties shape and present several elements of the group culture charactering astronomy tourists. By interacting with club members and travelling for big astronomy events, beginners and potential tourists can evolve their astronomy travel career trajectories as they increase their levels of leisure involvement.

(3) Observatory Visitors

The third largest market share lies in the observatory visitors. As a daily indoor tourist product, visiting observatories and planetariums has fewer time constraints and less restrictive visibility conditions than other outdoor observational activities. Though the product is usually associated with observational activities through telescopes where good weather is a must, visitors are still able to complete the trip without using the telescopes since other educational activities are the alterative attractions. Location is a key factor driving visitors flow to observatories. Light pollution and brightness of the night skies remain as constraints and depend on the geographic location which is a critical determinant of destination decision making for astronomy tourists. Some old observatories in the heavily light-polluted urban areas have altered their functions from observing natural skies to cultural uses and educational purposes.

Visiting local, national or international observatories is a mature and well-developed tourism product in North America, Europe, Japan, Hong Kong and Oceania, while in most emerging markets such as China, India and Latin American countries, and the product is less popular due to accessibility and tourists' preferences. The second study reported that dabblers and enthusiasts were the most interested group in visiting observatories, while fanatics and specialists showed less interest. From the perception of the industry stakeholders, observatories and planetariums are helpful tools to raise the public awareness and interest of astronomy and astronomy tourism, and also they can deliver educational programs and sense of nigh-sky conservation to the young generations. Such a market strategy is perceived as a breakthrough to bring new customers and an effective approach for the sustainable development of astronomy tourism.

(4) Meteor Seekers

Meteor seeking mainly includes the observation of the periodic meteor showers as well as the contingent meteors in the night-skies, and searching for the meteorites that have landed on the ground is also a minor subset. Similar to stargazing, viewing meteor showers is weather dependent, and the brightness of the dark-sky is also an important influential factor. Unlike stargazers who travel to avoid light pollution, meteor seekers take the favourable weather condition as the first priority and the key determinant of decision-making. The main reason explained by most respondents was that meteor showers have less frequency of annual occurrence than stargazing. Provided the brightness is acceptable, the opportunities to view meteor showers throughout year do exist. Time however is a constraint as the visible meteor showers only occur at a certain time window within a few periods of a year.

The market of meteor seeking tourists is overlooked by tourism authority sectors, tourism enterprises, and dark-sky destinations as well as by the local communities. Only a few products were found which provided related tours of viewing meteor showers, while most of the trips were undertaken by independent travellers and group tourists organized by astronomy clubs. Seeking meteors without telescopes is the main activity for the meteor-shower tourists, while capturing photos of meteor tails requires special skills and hence it involves more experienced tourists.

It is notable that the experience of viewing meteors especially meteor showers was reported as a symbol of romance. Such a motivation factor, to a large extent, drives the potential tourists and astronomy-hobby novices to travel, especially for the young Asian females. The market of meteor-seeking tourism was recognized as one with the most potential segment for the future development of astronomy tourism. For those undeveloped destinations where the weather is often calm (annual serenity rate is high), developing meteor-seeking products is a favorable pathway to use the night-sky natural resources.

(5) Eclipse Chasers

According to the empirical study results in chapter three and four, solar eclipses are the most attractive events, attracting all groups of tourists. The total solar eclipses were appraised by the respondents as the most desired phenomena among astronomy-related attractions. The scarcity of this type of tourism resource is due to the rare occurrence of solar eclipses. The rarity also leads to the limited scale of the tourist flows. However, it is the attribute of scarcity that stimulates people to undertake long-haul journeys, irrespective of whether they are dabblers or specialists. Another attribute of eclipses lies in the shifting observational locations and the narrow eclipse path during every occurrence. This attribute results in the emergence of 'eclipse chasers'. The concept of 'chaser' has two meanings. Firstly, it describes the tourists who travel worldwide to not miss any total solar eclipses. The secondly meaning is in the context of a single event. It discourses the enthusiasts who track the shadow of the moon by planes, flying along the eclipse path.

Solar and lunar eclipses are constrained by time and space. The mobility of the eclipse paths accounts for the varying tourist destinations. Therefore, it was perceived by the respondents as an impossible task to develop fixed destinations for eclipse watching. To overcome this difficulty, some special mobile package tours (e.g. solar eclipse cruises, charter planes) were provided by international operators. Nevertheless, the present research revealed that such tours were among the least preferred group of products at a general level (see section 4.4.1, Table 4.9), though they were somewhat more attractive to the general interest tourists with casual leisure involvement in astronomy than they are to the serious leisure hobbyists with special interest in astronomy tourism. The latter normally undertake spontaneous travel and constitute the principal components of the market. Destination capacity issues, accommodation and professional services are the main challenges for future managerial practices.

(6) Aurora Hunters

Aurora-viewing tourism is confined to limited destinations in particular regions in the world during a certain period of time: winters in the high-latitude regions in the Arctic and Antarctic. Aurora watching depends heavily on the 'luck' of weather conditions. Similar to meteors, the contingency of the occurrence is the main attribute of auroras. Revealed as one of the most attractive phenomena (refer to Figure 4.7 in Chapter four), auroras also have a symbolic and cultural meaning of romance, especially in the Asian context. There were not any significant differences found in the preferences of aurora viewing among the dabblers, fanatics, enthusiasts, or specialists.

Aurora-borealis tourism markets are thriving in Northern Europe, Northern Canada and Alaska, where the local tourism enterprises and communities have been providing aurora tourism products for decades. However, in the Antarctic region as well as the Southern parts of Australia and New Zealand, the aurora australis still remains undeveloped. Recently there has been a tendency to see more Asian tourists in many aurora-viewing destinations. In particular, consistently growing numbers of Chinese and Japanese tourists were reported as aurora hunters in the Northern Territory of Canada, Alaska, Iceland, Norway and Finland. The Aurora-viewing segment was positioned by the interviewed stakeholders as either a core market or a potential market for astronomy tourism (see section 5.4.1 and Table 5.11 in Chapter 5).

(7) Other Astronomy-interest Tourists

The remaining forms of astronomy-related travellers are all grouped in the segment of other astronomy-interest tourists. They were identified as minor streams of astronomy tourism in terms of the number of actual trips undertaken by the respondents. Such a segment includes travelling for the Transit of Venus/Mercury, visiting space centres, watching rocket/space shuttle launch onsite, and other forms of astronomy-related travels involving cultural activities. These markets were reported as small-scale subsets but the presence of such tourists cannot be ignored. Future opportunities for the culture-based astronomy tourism, such as visiting space centres and watching space shuttle launches, represent a connection with the science fiction-themed popular culture. Visiting astronomy-related heritage sites was perceived as involving possibilities and future directions associated with vivid story-telling activities and stargazing guided tours.

6.2.2 Linking the Group Culture to Individual Experience

The group culture of astronomy tourists' neo-tribes and its links to the empirical study of the individual travel experience were synthesized in this section. In Chapter three, several elements of the astronomy tourists' group culture were explored and the online representation of their travel experiences was preliminarily portrayed. These results established the framework to guide the subsequent questionnaire-based study and then the uncertain arguments were settled and further findings were concluded in Chapter four. How these findings were linked remained unknown. In particular, the emic and etic approaches used as well as the qualitative study results and quantitative analysis results revealed in the relevant chapters need an integrative understanding. Using the framework of the netnographic study of the neo-tribal culture, the further quantitative research findings and related statistical evidence in the questionnaire-based study of the tourists' individual experience are identified as study reflections and links. Such integration was summarized and presented in Table 6.2.

Table 6.2 Links between the studies of group culture and individual experience

Group culture element			Reflection and links to the Individual experience
Symbolic	Collective sentiment	Shared interest	• Serious leisure involvement in astronomy tourist was identified in the measure factor 'unique ethos'(p.183)[*]; • Both serious and casual leisure pursuers had strong willingness to share their astronomy interest and travel experiences but different in the preferred methods (p.212); • Travel with astronomy club member with same interest was most preferred by tourists (p.171) • Serious leisure tourists highly involved in sharing astronomy-related topics and interest onsite (p.209)
		Fellowship	• Membership played an important role in identifying the leisure involvement levels of astronomy tourists (p.189); • Membership reflected the centrality of astronomy-related trips. Club members had higher frequency of trips (p.161); • Membership influenced the choice of travel companions; Travel with other comrades was most chosen by tourists with club membership (p. 160).
	Lifestyle		• Fluid in full-time and par-time flow was evidenced in the membership and shift among and travel career patterns of astronomy tourists (p.161, section 4.4.4 and 4.4.5); • Preferences of the onsite activities, transportation and accommodation were significant different. RV lifestyle was pursued by serious leisure tourists (p.209, p.192)
Behavioural	Signifiers		• Larger amount of astronomy equipment was obtained by the respondents who were club members; • Using telescopes and capturing astro-photos were highly involved in astronomy tourists' onsite activities (p.206).
	Scenes		• Astronomy tourists' preferences of dark-sites' landforms and travel destinations varied significantly (p.173); • Astronomy tourists' participation intensity of onsite activities was significantly different (p.205-211).
	Rituals		• Astronomy tourists participated in several activities in star parties, participation intensity varied among tourists with different leisure involvement (p.205-211); • Astronomy tourists shared learning outcomes through different methods, and they had high involvement in sharing travel stories online via social media (p.211-212).

Note: * references can be found in the relevant pages in the present thesis.

The links built between the two empirical studies provided a better understanding of the relationship between the group culture and the individual travel experience of astronomy tourists. It was revealed that the group culture of astronomy tourists shape their individual behaviour, and in turn the individual behaviour is a mirror, reflecting the culture of the neo-tribes. To a large extent, the representation of the group culture can be found in those members from astronomy clubs rather than in the non-members who travel spontaneously.

6.2.3 Integrating the Travel Career Patterns with Leisure Involvement

In Chapter four, the motivational factors of astronomy tourists were examined through the TCP approach. The previous empirical study also revealed that travel experience and leisure involvement had joint influences on travel motivation in the sample of astronomy tourists. Using the one-way ANOVA and independent t-test, significant differences in the motivation patterns were found between casual leisure participants and serious leisure pursuers. Distinctions were identified between these two types of astronomy tourists in eleven motivation factors. The mean scores of each motivation factor for the two types of tourists were calculated and compared with each other. Figure 6.2 illustrates the comparison of the motivation factors between the two groups of tourists with serious leisure and casual leisure involvement in astronomy. It is clear that the travel career patterns significantly vary between the two groups of tourists. The factors of autonomy and local involvement were the only two motives that had non-significant differences. Tourists with serious leisure involvement in astronomy obtained stronger motives in relationship (strengthen and safety), self-development and self-actualization, while tourists with casual leisure involvement had stronger motives in novelty, escape/relax, nature, isolation, stimulation, recognition, romance and nostalgia.

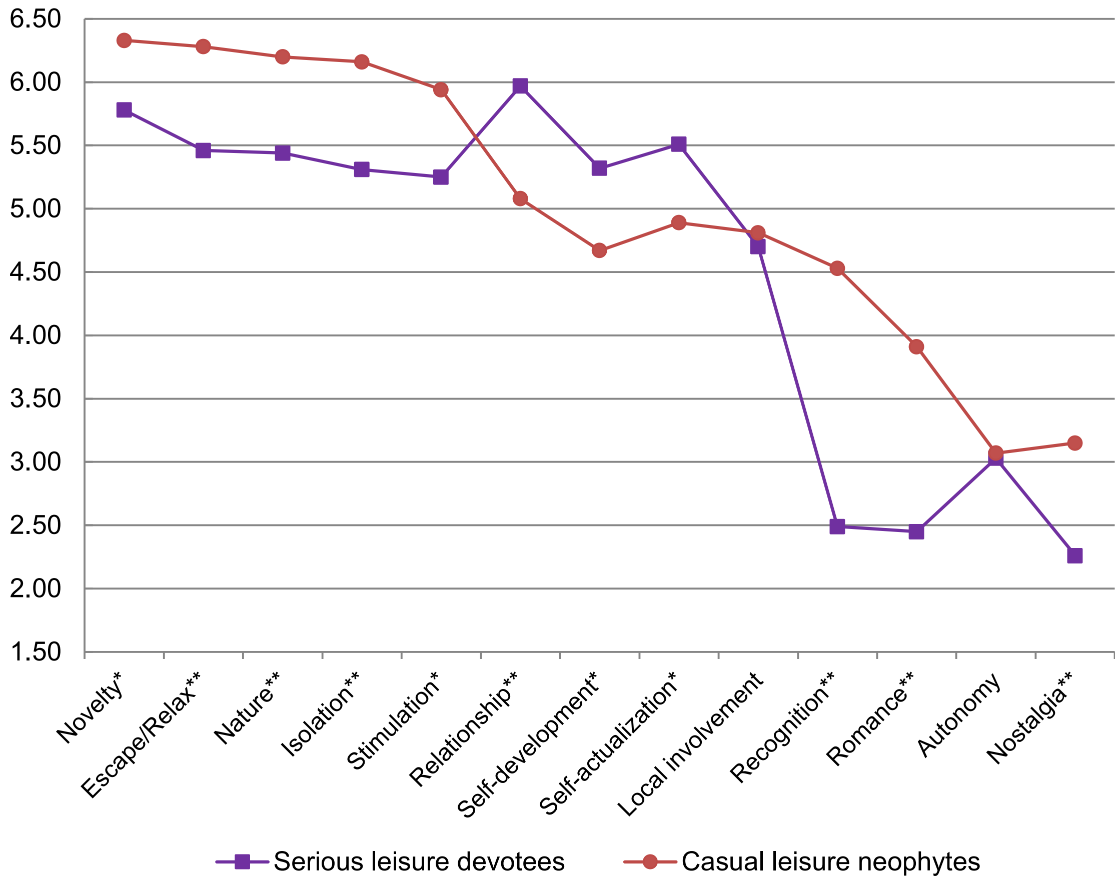
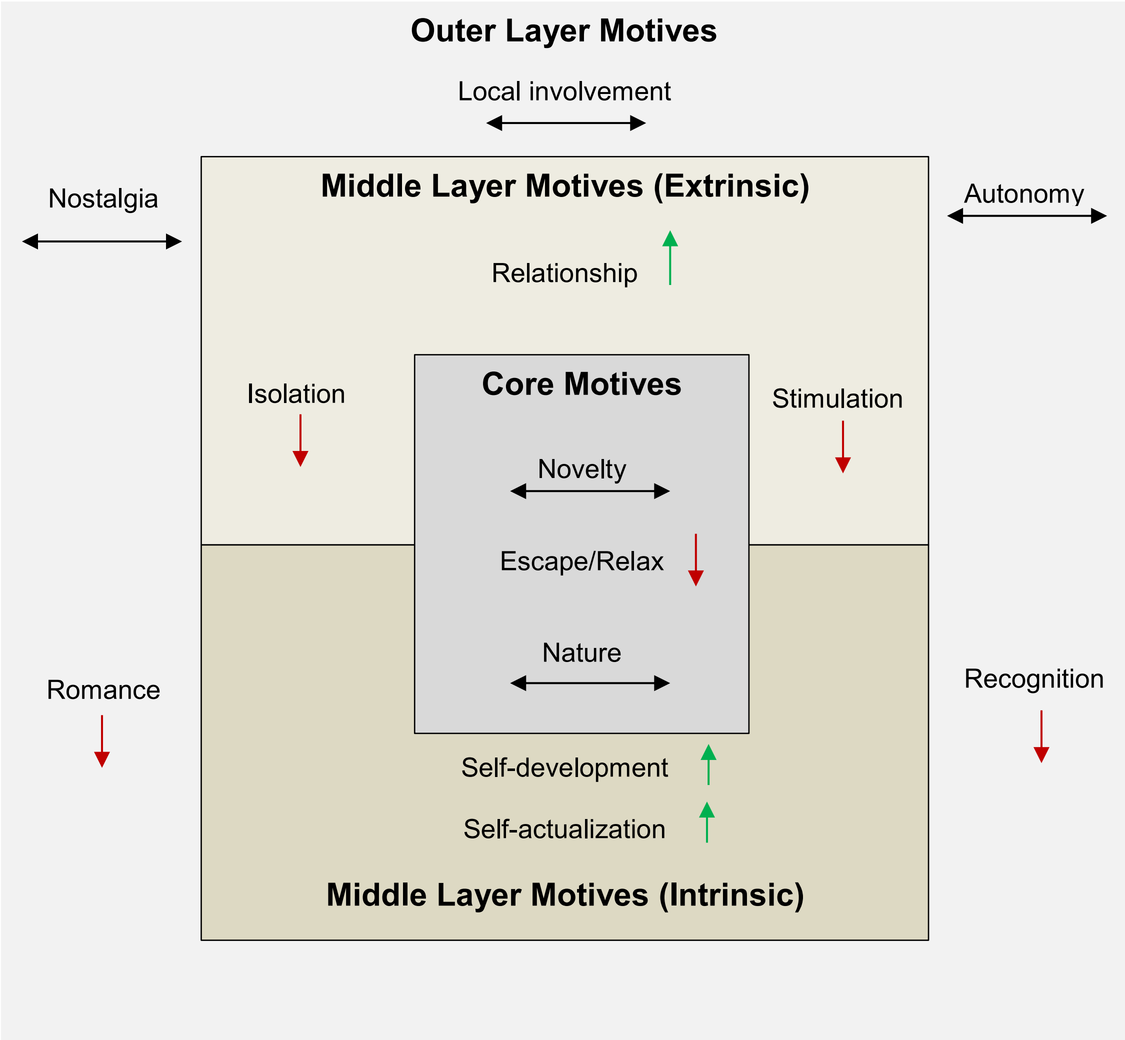


Figure 6.2 Comparison of the travel motives between serious leisure and casual leisure

Drawing on the comparison and the integration of Pearce's (2011) work, a pictorial presentation of the travel career pattern (TCP) in the context of astronomy tourism was provided in Figure 6.3. It covered thirteen motives of the initial TCP work after combining the two factors of relationship (relationship for strengthen and relationship for security) into one. The figure revealed the dynamic mechanism concerning the travel career patterns alternate with rising levels of leisure involvement in astronomy. It is clear that the two motives, self-actualization and self-development both reinforce with the rising level of leisure involvement. This finding is not different to Stebbins'

(2014) work which portrayed the career in serious leisure from 'dabbler' to 'devotee' is a pursuit of self-fulfillment.



Note: The directions of the arrows indicate changing emphases with rising level of leisure involvement

Figure 6.3 The travel career pattern of astronomy tourists

Further, four categories of travel career patterns were classified by cross-referencing the high and low levels of both leisure involvement and travel experience, depicting the differences of tourist motivation system among dabblers, fanatics, enthusiasts and specialists. The four travel career patterns were illustrated in Figure 6.4 by comparing the mean score of each factor.

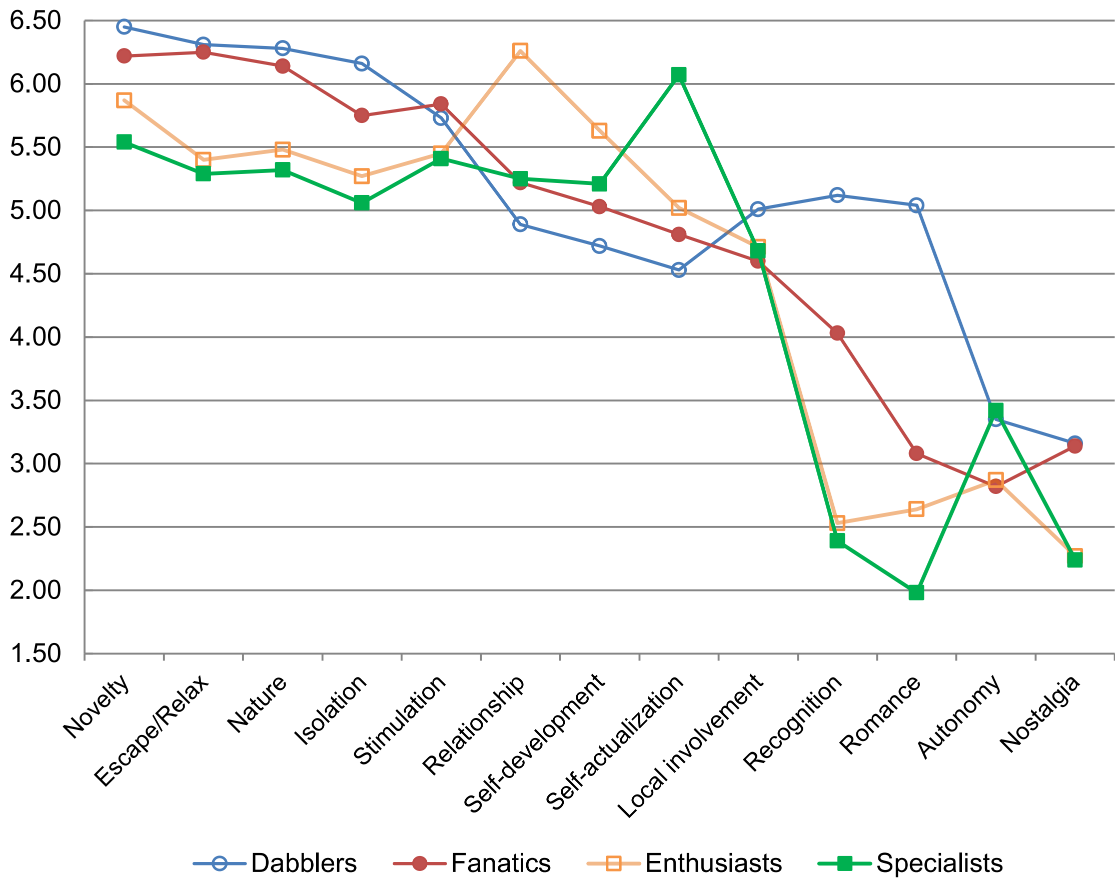


Figure 6.4 Comparison of the travel motives among four groups of astronomy tourists

Based on the comparison among four types of the travel career patterns, key findings and conclusions were drawn. The factors of novelty, escape/relax and nature always played the most fundamental roles in motivating all types of astronomy tourists. For dabblers and fanatics, these three factors constituted their core motives, while there were slightly differences in the core motives in two factors: isolation and stimulation. Dabblers had stronger motives of isolation but weaker motives of stimulation than the fanatics. Compared with the casual leisure novices (dabblers) and project-based leisure neophytes (fanatics), the core motives for serious leisure pursuers were very different. Novelty and nature factors still stayed in the core layer, but for enthusiasts the relationship factor was the strongest motive and the self-development factor immerged into the core layer. For specialists, the factors of self-actualization became the strongest motive and the stimulation factor shifted into one of the core motives. Other significant differences exist in the factors of recognition, romance, autonomy and nostalgia. In comparison with other groups, dabblers had much stronger motives of recognition and romance than others. Specialists and dabblers had slightly stronger motive of autonomy, while dabblers and fanatics had moderately stronger motive of nostalgia.

The representation of the four types of astronomy tourists were depicted in separate travel career patterns models, which were illustrated in Figure 6.5 to Figure 6.8.

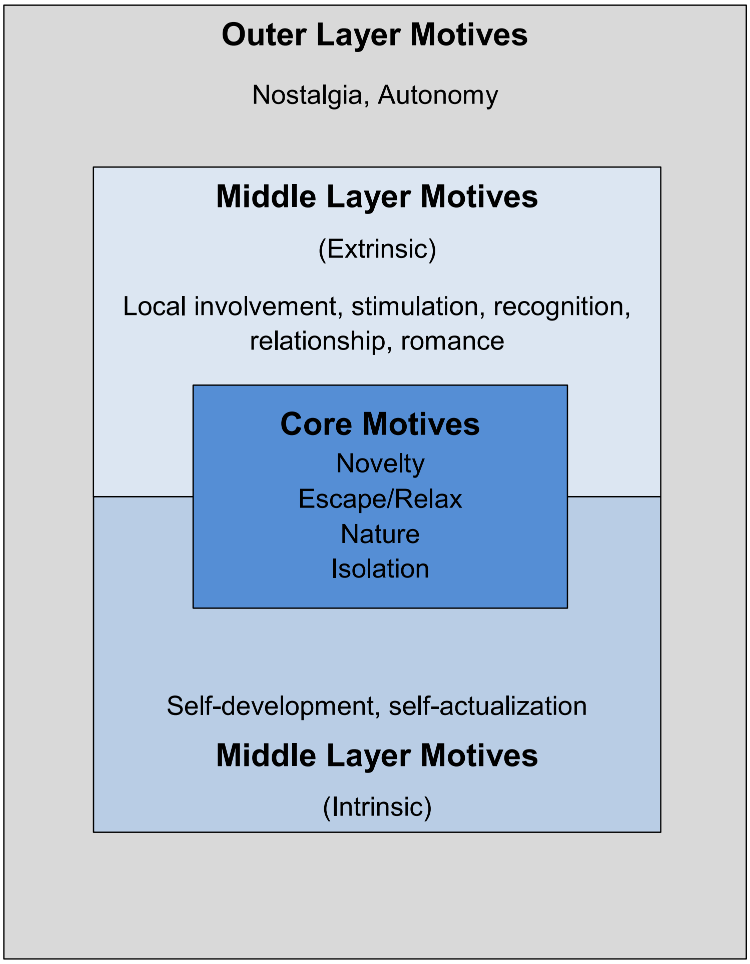


Figure 6.5 The travel career pattern of 'Dabblers'

Concerning the travel career pattern of dabblers, the core motives (with factor means greater than 6.0) consist of novelty, escape/relax, nature and isolation. The extrinsic factors of host-site involvement, stimulation, recognition and romance fall into the middle layer (factor means between 4.0 and 6.0), while intrinsic part of the middle layer embraces the factors of self-development and self-actualization. The outer layer consists of two factors, autonomy and nostalgia (factor means lower than 4.0).

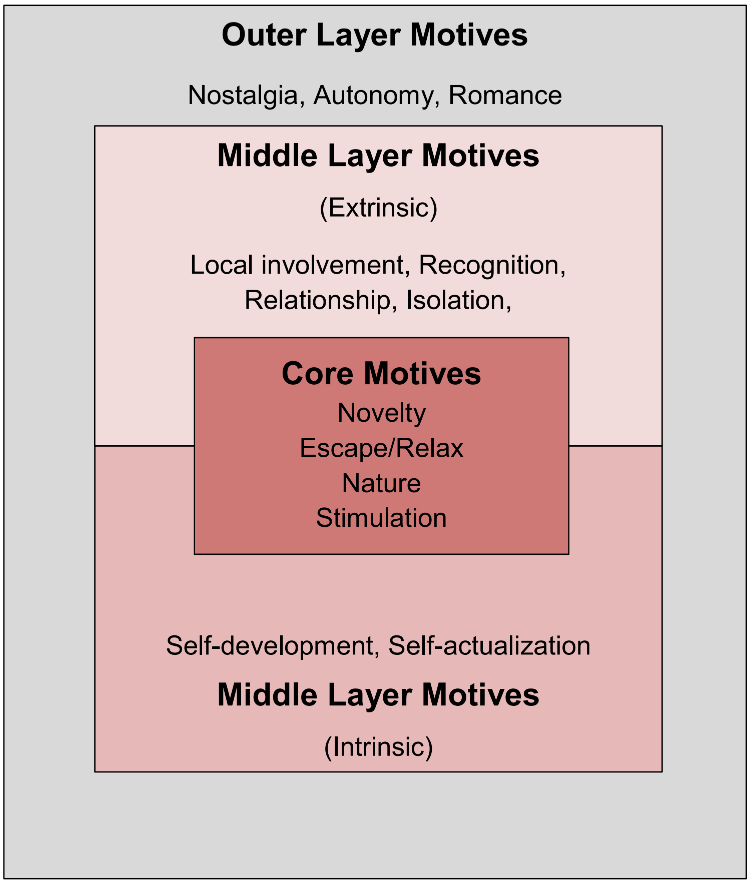


Figure 6.6 The travel career pattern of 'Fanatics'

The motivation pattern of fanatics is quite similar to dabblers' with slight differences. The stimulation factor moves into the core layer, replacing the isolation factor which shifts out to the middle layer. Romance is no longer embedded in the middle layer and relocated into the outer layer. The remaining factors all stay the same layout of the dabblers' pattern.

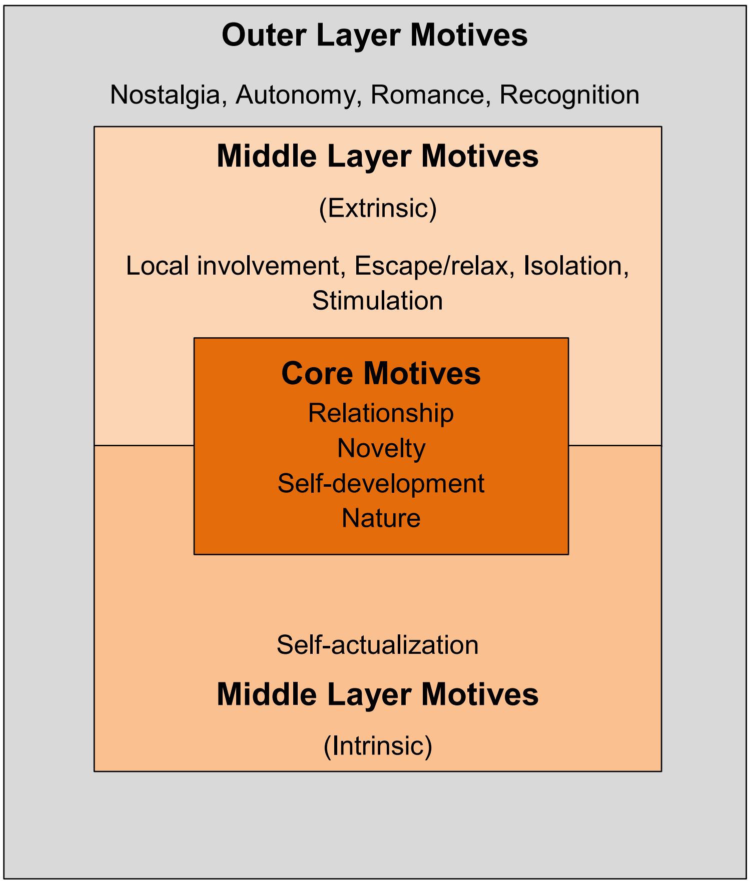


Figure 6.7 The travel career pattern of 'Enthusiasts'

Enthusiasts' motivation pattern varies significantly from fanatics'. The commonality is that novelty and nature still stay as the core motives, but the motives of relationship and self-development are embedded in the core layer, replacing the position of escape/relax and stimulation. The latter factors shift from the core layer to the middle layer. Additionally, the recognition factor slips out from the middle layer into the outer layer. The other factors remain the same setting as fanatics.

Similarly, the pattern of specialists slightly varies from enthusiasts. The core motives of self-development and relationship are replaced by stimulation and self-actualization. The former two shift into the middle layer as an intrinsic factor. The remaining factors stay the same as enthusiasts.

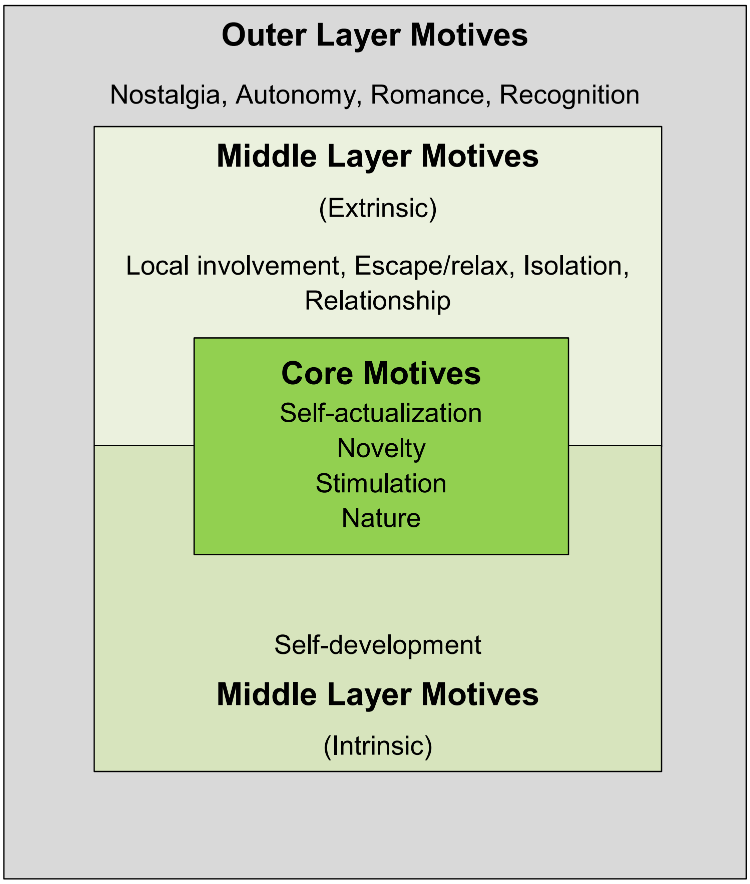


Figure 6.8 The travel career pattern of 'Specialists'

6.3 OVERALL CONTRIBUTIONS AND IMPLICATIONS

6.3.1 Research Contributions

(1) New areas explored in emerging tourist market and special interest tourism

As previously stated in the first Chapter, astronomy tourism as a novel research topic with niche research opportunities lies in the study areas between the emerging tourism market and special interest tourism. A set of empirical studies in the current thesis seized the study opportunities and filled the literature gap.

Firstly, using the typology and nomenclature from Cooper (2005), Novelli (2005) and Claveria (2016) in the context of emerging tourism market studies, the phenomenon was defined as ‘astronomy tourism’. Further, a new definition was suggested by the researcher after a netnographic study with a substantial blog data base and empirical findings. Arguments about the definition was discussed considering the work of Weaver (2011), Carter (2010), Collison and Poe (2013) and then refinements were provided. Several subsets of attractions and activities were added in the territory of astronomy tourism, and the market segments were sorted in a different order in terms of the number of actual trips undertaken by the surveyed astronomy tourists. The definition as well as the conceptualized framework of astronomy tourism was also consistent with the recent literature of special interest tourism studies (Chaney & Ryan, 2012; Gyimothy, 2009; Wu, 2015). Following the frameworks, the astronomy tourists were profiled with demographic statistics, travel preferences, push-pull motives, and online representations. These efforts provided an overall understanding of the astronomy tourism market and addressed the research questions about who they are, what they do, why they travel, and how they describe their astronomy travel stories.

Secondly, a new perspective from the neo-tribe theory was adopted to explore the group culture of the astronomy tourists’ tribes. The findings in this thesis strengthen the neo-tribe research work of Hardy and her colleagues (Hardy *et al.*, 2013; Hardy *et al.*, 2012; Hardy & Robards, 2015). The commonalities found in the sample of astronomy tourists have reinforced the applicability of the neo-tribe perspective to the tourism context in a different sub-culture context.

Thirdly, the validity of Trauer’s (2006) theoretical conception of the ‘special interest tourism experience’ was examined through a set of empirical studies in this thesis.

Trauer's model was associated with a phase-based approach to tourist experience (Cutler & Carmichael, 2010) and Stebbins' (1996b) serious leisure perspective to explore the individual travel experience of astronomy tourists. As a result, the general travel experiences, tourist decision making determinants, serious leisure involvement, tourist motivation, the onsite activity participation, recollection behaviour, tourist learning outcomes and tourist satisfaction were all studied. These results, taken as a whole, provided a panoramic view of the astronomy tourism market and offered insights at the micro level of astronomy tourist behaviour and experience.

Additionally, the future of astronomy tourism was assessed and forecast by industry stakeholders. In this way the thesis links an emerging tourism market and special interest tourism with the perspective of future studies. In summary, this research explored an emerging and special interest tourism segment with an integrative view of group culture studies, individual experience studies and future studies. It expanded the limited literature on astronomy tourism and pioneered a new area in emerging tourism markets and special interest tourism.

(2) New work in tourist motivation studies: the TCP approach and SLP theory

Building the links between the travel career pattern (TCP) and the serious leisure perspective (SLP) is a significant contribution of the thesis at the theoretical level. Consistent findings with the recent tourist motivation work on the TCP were revealed (Chen *et al.*, 2014; Filep & Greenacre, 2007; Panchal & Pearce, 2011; Paris & Teye, 2010; Wu & Pearce, 2014c). This research indicated that the travel career patterns do vary with increasing travel experience. However, slight differences existed in the context of astronomy tourism. More specifically, the isolation and stimulation motives usually appeared in the outer layer in the previous TCP studies (Li, Pearce, & Zhou, 2015; Pearce, 2005b, 2011b) in different culture and sample contexts, but these two factors immerged into the middle layer for the astronomy tourists sample. Also, the motive of nature shifted from the middle layer of general tourists to the core layer. The relationship factor moved from the core motive to the middle layer in the special interest tourism context, which did not support the findings in the work of Moscardo, McCarthy, Murphy, and Pearce (2009).

Travel career patterns not only transform with travel experience, but also vary with the rising level of tourists' leisure involvement. Cross-referencing travel experience and leisure involvement parameters, four categories of tourists were divided and their motivation patterns were illustrated respectively. The results revealed that dabblers, fanatics, enthusiasts and specialists had significantly differences in tourist motivation patterns. Different layouts of the motives were portrayed and they were considered as complement or further development for the TCP model in a different study context of special interest tourists with wider cross-cultural sample. With the rising level of leisure involvement, the motives for self-actualization and self-development alternate from the middle layer onto the inner layer of tourists' travel career patterns. Namely, serious leisure pursuers are motivated more by the ego factors, while casual leisure participants are not very much different from the regular TCP model. This finding supports the study results of amateur distant runners (Getz & Andersson, 2010).

Additionally, this study provided new evidence in tourism literature, expanding and strengthening the SLP theory. Empirical findings reported in this thesis indicated the existence of a trajectory from casual leisure novices to serious leisure devotees. The trajectory among casual leisure, project-based leisure and serious leisure was examined in this research. Such findings suggested that Stebbins' recent SLP work (Stebbins, 2014, 2015b) could be reinforced in the context of astronomy tourism.

(3) New research approaches: Using hybrid methods in an unstudied area

The multidimensional perspectives and research approaches used in this thesis is one of the key innovations in terms of methodological contributions. The integration of the netnographic study, data mining technique, archival approach, focus groups, phone interviews, key informant interviews and questionnaire surveys was adopted in this exploratory study. The comprehensive research methods that were employed in this thesis proved a hybrid solution to address a brand new topic. Rather than using a single approach to study an emerging tourism market, the researcher adopted both the emic and etic approaches, associated with the qualitative and quantitative analyses, and integrated both empirical and theoretical studies to explore a less-studied domain in tourism literature. Such attempts represent a systematic pathway, conducting multiple studies in diverse areas of tourists' group culture and individual experience.

Additionally, the use of the future study perspective which was suggested by the recent tourism literature (Pearce & Wu, 2016; Yeoman, 2012; Yeoman & McMahon-Beatte, 2016; Yeoman *et al.*, 2015) is another significant contribution in researching emerging tourism markets. The future studies in this thesis provided an addition helping to understand the sustainable development of astronomy tourism.

6.3.2 Managerial Implications

Astronomy tourism is important at a strategic marketing level. For market developers, it is an intriguing segment of the special interest tourism and a niche market. The thesis revealed the limited attention to astronomy tourism as it has been somewhat overlooked by both scholars and industry stakeholders. The empirical and quantitative findings suggested that the size of the market is expanding but the potential customers were somewhat underestimated. The qualitative analysis results from the future studies also indicated that a large number of astronomy tourism assets and potential resources were neglected. Special concerns need to be focused on the segments of stargazers, meteor seekers and star party travellers. Underlying opportunities not only exist in the exist markets such as China, India and Latin America, but also emerge in the undeveloped dark-sky destinations where the light pollution and conventional tourism resources are poor. Accordingly, several managerial strategies and actions for future market stimulation and resource protection are needed to capitalise on this new tourism interest area.

Developing desirable tourism products in the future to meet the multiple needs of different types of tourists according to their travel preferences is important to expand the market (Claveria, 2016; Crouch *et al.*, 2009; Pearce, Wu, & Chen, 2015). Both the netnographic study and the questionnaire-based study reported that astronomy tourists' motivation is a hybrid system within dynamic multi-layer patterns (see section 3.4.4 and 4.4.4). In reference to the key study results concerning the travel preferences of astronomy tourists, demographic differences (see Appendix I), tourist motivation, the participation intensity of onsite activities and tourist satisfaction, managerial plans and marketing strategies are possible to be constructed and then implemented. This thesis contributes much primary data and analytical outcomes to empower the future development of astronomy tourism.

Last but not least, several key solutions from the stakeholders were assessed in this research. Important suggestions such as "deliver astronomy educational programs to young generations" "optimize the infrastructure of the distant dark-sky destinations" and "preserve dark-skies and control the light pollution" are helpful in developing the astronomy tourism markets in a sustainable way.

6.4 RESEARCH LIMITATIONS AND FUTURE DIRECTIONS

6.4.1 Limitations of this Research

The primary limitations of this thesis lie in the sampling procedure and some research methods. Concerning the sampling in the netnographic study, though the diversity of the sample was fostered by accessing online communities from multiple cultures, the majority of the blogs were collected from China and English-speaking countries due to researcher's language capability and research budget. Some limited blog data were collected and translated from the non-English speaking countries, such as Korea, Japan and France. Language barriers limited the researcher from fully comprehending the true meaning of the online group representation of astronomy tourists' neo-tribes, and hence some misunderstandings may occur during the interpretation of the qualitative data. The same situation occurred in the sampling of questionnaire survey due to the limited accessibility to the non-English speaking sample.

Aside from the issue of the sample countries, some unevenness in the distribution of the sample also existed among different themes in the travel blog stories. The overwhelming proportion (44.5 %) of the collected blogs described the travel stories about observing solar eclipse, while aurora viewing only accounted for 19.7% and stargazing accounted for 15.6%. This uneven distribution may lead to a halo effect or a fallacy of composition when interpreting the overall online representation of the astronomy tourists' neo-tribes. The researcher attempted to reverse the homogenous status of the sample by selecting diverse travel stories intentionally. However, only a few blogs focused on other themes. The significantly different attractiveness of various astronomy events is arguable a reason for this phenomenon, because the solar eclipses were revealed as the most preferred attraction for all the tourists and therefore a large number of travel blogs were centralized on it.

Another research limitation appears along in the use of the research methods and techniques. Even though a series of mixed research methods were jointly adopted in this thesis to avoid advantages of using a single method, limitations usually still exist due to the imperfection of any research paradigms (Dwyer *et al.*, 2012). The time-consuming nature of the interview method (McGehee, 2012), the low overall number of participants in focus groups but 'rich' information in transcripts (Cater & Low, 2012), and the difficulty to verify the authenticity of the informants' identity and statements in netnography (Mkono, 2012; Wu & Pearce, 2014a) all represent research limitations and deviations in this thesis.

6.4.2 Directions and Areas for Further Research

Future directions for further studies on astronomy tourism appear but are not confined to the following five areas:

Firstly, the seven market segments of astronomy tourism identified in this thesis need further confirmation and more detailed empirical studies. The culture and its representation of specific interest groups may vary from one to the other. The tourist experience, motivation pattern, decision making determinants, travel preferences, and onsite activity participation are possibly different among stargazers, meteor seekers, aurora hunters, and other particular interest groups. Further studies will clarify these differences and refine the results of the current research. One recent emerged example in the tourism literature can be found in the aurora tourism area (Heimtun & Lovelock, 2017).

Secondly, future opportunities can be sought in comparison studies between different cross-cultural contexts, tourists from different market origins and varied tourist destinations for astronomy tourism. In a wider context, new questions concerning commonalities and differences between astronomy tourism and other forms of special interest tourism can possibly be addressed by comparative studies on tourist motivation, group culture and other related issues.

Thirdly, longitudinal studies concerning the individuals' trajectory in their astronomy travel career and serious leisure involvement could be explored. This was begun in the current thesis, but only the travel career of a limited number of astronomy tourists were traced through their blogs. The significance of the longitudinal studies lies in their power to explore individual change over time. It should be possible to unearth interesting findings to portray the dynamic process of tourists' leisure involvement and depict their travel careers in more complete way with extensive longitudinal work.

As a fourth direction, further studies concerning the onsite emotions and sentiments of the astronomy tourists are potential directions. Tourist onsite affect is an emerging topic in the tourist experience literature. It is unstudied in the current thesis but several elements were elicited from the previous netnographic findings and the TCP model. Feelings such as humbleness, harmony, marveling and others were found in the onsite experience of astronomy tourists. The orchestra model adopted by recent tourism literature concerning the Asian tourists (Wu & Pearce, 2016a) offers possibilities to address this issue.

Further, as a fifth area of further development, the potential customers who had no astronomy-related travel experience were missing in this research. Future efforts to consider new inductees into the astronomy neo-tribe represent an opportunity to understand the start of a niche interest. Exploring their willingness and anticipation towards the astronomy tourism is one of the valuable directions to provide research contributions as well as practical implications for the industry. As a final note, this thesis has "observed" the observers; in doing so the research addresses a special global resource to share across time and cultures.

> *"The night-sky, our common and universal heritage, is an integral part of the environment perceived by humanity. Humankind has always observed the night-sky either to interpret it or to understand the physical laws that govern the universe."*
>
> The Starlight Declaration, 2007

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APPENDICES

APPENDIX I: DEMOGRAPHIC COMPARISONS

In this appendix, demographic factors were utilized to compare the variance in several dependent variables of the travel experience of astronomy tourists. Gender and tourist origins were the key independent variables adopted in analyses. One-way ANOVA method was employed to analyze demographic differences, such as tourist motivation, attraction preference, and decision making determinants. In previous analyses, these facets of the tourist experience study were elaborated with substantial statistics and interpretation. In this section, only those factors with significant variance among demographic groups are presented in the results.

(1) Gender differences in astronomy tourists' travel experience

Firstly, gender differences were dissected throughout all dimension and phases of the individual tourist experience. Using one-way ANOVA, all the significant differences were identified and the result can be seen in Table I-1.

Table I-1 Gender differences in astronomy tourists' travel experience

Dimension	Factor	Mean Score		F	Sig.
		Female	Male		
Tourist Attraction Preference	Aurora	6.15	5.78	4.34	.00
	Meteor Shower	6.08	5.64	5.68	.00
	Transit of Venus	5.43	6.01	6.52	.00
	Comet	5.21	5.84	7.08	.00
	Occultation	3.98	4.27	3.89	.01
	Transit of Mercury	3.56	4.49	8.54	.00
	Astro-photographing	4.55	6.32	12.91	.00
	Visiting Planetariums	4.24	4.87	7.04	.00
	Visiting astronomy-related historical sites	5.27	4.83	4.95	.00
Decision Making Determinant	Physical	5.79	6.27	5.07	.00
	Social	5.53	5.26	3.86	.02
	Product/Service	5.34	4.65	7.23	.00
Travel Motivation	Relationship	5.86	5.23	7.09	.00
	Local Involvement	5.11	4.47	7.12	.00
	Romance	4.05	2.38	11.87	.00
	Recognition	4.10	3.03	9.42	.00
Involvement Level	Perseverance	4.97	5.42	5.03	.00
	Significant effort	4.86	5.39	5.62	.00
	Identification of pursuit	4.45	5.47	9.38	.00
Travel Experience Level	Length of the travel career [a]	3.65	5.11	10.54	.00
	Travel frequency [b]	4.92	5.88	8.97	.00
	Travel centrality [c]	0.19	0.37	15.62	.00
On-site Activity Participation Intensity	Astro-photographing	4.81	6.29	10.86	.00
	Observing through equipment	5.03	5.48	4.99	.00
	Sightseeing around	6.24	5.62	7.21	.00
	Bird watching	3.12	4.53	10.10	.00
	Others unrelated to astronomy	3.96	2.19	12.90	.00
Recollection Behavior	Social media posting	5.98	5.24	7.61	.00
	Online forum posting	4.15	4.83	7.28	.00
	Equipment purchasing	2.20	2.77	5.73	.00
	Participating astro-photo competition	1.87	2.42	5.69	.00
Learning Outcomes	Cognitive development	6.08	5.33	7.64	.00
	Affective development	5.94	5.26	7.27	.00
	Ego-development	4.89	4.54	4.23	.00
Satisfaction	Comfort of the travel	2.22	3.98	12.88	.00
	Service of the destination	4.76	5.34	6.52	.00
	Food & accommodation	4.26	4.51	3.84	.03

Note: p=0.05, df=1; [a] measured by the calendar year; [b] measure by an eight-point Likert scale. [c] measured by the proportion of astronomy –related travels (value from 0 to 1). The remaining factors were measured by seven-point Liker-type scales. 1 = strongly disagree, 7= strongly agree.

From the one-way ANOVA results in Table I-1, an array of differences in tourists' individual experience between the male and the female can be indicated. Key findings include the following nine points:

- Significant differences were found in the preference of nine categories of attractions ($12.91 \geq F \geq 4.34$, $p<0.01$). Females are more interested in viewing aurora, meteor showers, and visiting historical sites related to astronomy. Male tourists are more attracted by the Transit of Venus, Transit of Mercury, comets and occultation of stars, and they more prefer related activities of astro-photographing and visiting planetariums than female respondents.

- Male and female astronomy tourists are evidently different in determining choices on tourist destinations ($7.23 \geq F \geq 3.86$, $p<0.02$). Physical factors are more heavily considered by males while female tourists concern more about the factors from product/service and social influential realms.

- Gender has significant influences in the tourist motivation. Female astronomy tourists have stronger motives from 'romance' ($F=11.87$, $p=.00$), 'recognition' ($F=9.42$, $p=.00$) 'local involvement' ($F=7.12$, $p=.00$) and 'relationship' ($F=7.1$, $p=.00$) than male participants.

- Gender also has impact on the leisure involvement level of astronomy tourists. Compared to men, women have lower levels of perseverance ($F=4.97$, $p=.00$), significant effort ($F=5.62$, $p=.00$) and identification of pursuit ($F=9.38$, $p=.00$) in terms of serious leisure measurement.

- The experience level of astronomy-related travels witnesses a clear variance between genders. On average, the male have longer travel career ($F=10.54$, $p=.00$), higher travel frequency ($F=8.97$, $p=.00$), and higher travel centrality ($F=15.62$, $p=.00$) in astronomy-related travels than the female respondents.

- Regarding the on-site activities, males are involved in astro-photo capturing ($F=10.68$, $p=.00$), observing through astronomical apparatus ($F=4.99$, $p=.00$)

and bird watching (F=10.1, p=.00), while females are more interested in sightseeing (F=7.20, p=.00) and other activities (F=12.90, p=.00) which are unrelated to the astronomy theme.

- The after-travel recollection behavior differences are evident in gender. Male tourists are more likely to purchasing astronomical equipment (F=5.73, p=.00), participating in astro-photography competitions (F=5.69, p=.00), and posting stories on clubs' online forums (F=7.28, p=.00) than females, yet the latter are more possible to post their travel experiences on social media (F=7.61, p=.00).

- Learning outcomes also have different performance between genders. Female tourists acquire higher level of cognitive (F=7.64, p=.00), affective (F=7.27, p=.00) and ego developments (F=4.23, p=.00) than male participants.

- The tourist satisfaction towards astronomy-related travels varies between men and women. The comfort of the travel slightly dissatisfies female respondents but by way of contrast, male tourists are moderately satisfied with it (F=12.88, p=.00). They also have higher satisfaction marks on the destination service (F=6.52, p=.00), and accommodation & food (F=3.84, p=.03) than females.

The other facets of the astronomy tourist travel experience hardly saw any significant differences between genders. Nevertheless, males and females have been proved their distinctions in many areas of the individual travel experience in astronomy tourism.

(2) Geographic differences in astronomy tourists' travel experience

Aside from gender variances, the tourist origin is also an important variable affecting in different travel experience elements. It was also examined by the one-way ANOVA and the results are reported in Table I-2.

Table I-2 One-way ANOVA result: Distinguishing the travel experience by tourist origins

Dimension	Factors	Mean Score					F	Sig.
		Asia	America	Europe	Oceania	Africa		
Accommodation preference [a]	Premium hotels	2.04	1.53	1.41	1.39	1.15	9.96	.00
	Camping	1.98	2.46	2.23	2.15	2.59	6.27	.00
	Holiday park	0.76	2.31	1.56	2.25	0.64	15.31	.00
Transportation preference [a]	Rental car	1.85	2.92	2.24	2.68	0.97	18.54	.00
	Recreational vehicle	0.81	2.24	1.78	2.39	0.56	16.12	.00
Travel experience sharing methods [a]	Social media	4.23	2.87	3.30	3.61	2.45	15.63	.00
	Face-to-face communication	3.19	3.75	3.61	3.47	3.91	7.40	.00
	Online forum	3.24	2.80	2.59	2.42	2.08	11.26	.00
Attraction preference [b]	Aurora	6.15	5.73	5.62	5.96	6.13	5.85	.00
	Meteor shower	6.06	5.51	5.85	5.64	6.10	6.13	.00
	Astronomy-themed cruise/holiday	4.67	2.98	3.53	3.83	2.62	19.18	.00
Tourist motivation [b]	Romance	4.52	2.46	2.58	2.79	3.24	19.25	.00
	Relationship	5.94	5.29	5.83	5.71	5.43	6.89	.00
	Recognition	4.50	2.62	3.51	3.45	4.22	16.26	.00
On-site activities [b]	Astro-photographing	5.61	5.73	5.54	5.40	5.05	6.97	.00
	Discussing astronomy-related topic	4.29	4.86	4.47	4.66	4.39	3.84	.03
After-travel behaviors [b]	Buying more astronomical equipment	3.33	1.94	2.36	2.52	3.10	12.73	.00
	Join astro-photography competition	3.15	2.07	1.82	1.76	2.64	12.81	.00

Note: p=0.05, df=4; [a] measured by a five-point Liker scale; [b] measure by a seven-point Likert scale.

Using one-way ANOVA, the statistics distinguished the travel experience by tourist origins (see Table I-2). Some significant differences were identified as follows:

- The preferences of premium hotels (F=9.96, p=.00), camping (F=6.27, p=.00) and holiday parks (F=15.31, p=.00) vary significantly among the astronomy tourists from different origins. The Asian respondents have stronger preference to stay in premium hotels than any other groups, while they have the weakest interest in camping during an astronomy-related travel. Holiday parks and camping are more attractive to the tourists from America, Europe and Oceania.

- Transportation preferences, including rental cars (F=18.54, p=.00) and RVs (F=16.12, p=.00), vary significantly among tourist origins. American, European and Oceanian respondents have higher desires to use rental cars and cars and recreational vehicles than the tourists from Asia and Africa.

- When sharing travel experiences, the communication methods of social media (F=15.6, p=.00), face-to-face contact (F=7.4, p=.00) and online forums (F=11.3, p=.00) are significantly different among tourist origins. Asian tourists have the highest frequency in using social media and online forums. African, European and American tourists are more interested in face-to-face personal conversations. Oceania places at the intermediate level of those three communication methods.

- Astronomy-related attractions of aurora (F=5.58, p=.00), meteor shower (F=6.13, p=.00) and astronomy-themed cruise/holiday (F=19.18, p=.00) that are preferred by those five tourist origins are also significantly different. Asian and African respondents have the strongest desires to watch aurora (which does not normally appear in Asia or Africa), and they also have strongest willingness to observe meteor showers. Astronomy-themed holiday or cruise products, though originate from America and Europe, they are much less demanded by their indigenous tourists than by Asian markets.

- Three factors of the tourist motivation were reported significant differences by comparing the tourist origins: romance (F=19.25, p=.00), relationship (F=6.89, p=.00) and recognition (F=16.26, p=.00) factors. In the post-hoc tests, Asian respondents possess the strongest motives in the factors of relationship, romance and recognition among all the groups, while American tourists show the lowest level of motives on those three factors.

- The participation in on-site activities among five tourist origins was reported significant differences in two areas: astro-photographing ($F=6.97$, $p=.00$) and astronomy topic discussion ($F=3.84$, $p=.03$). The post-hoc Scheffe test results identify that American and Asian participants have higher involvement in astro-photographing than other groups, and African tourists have lowest participation intensity in it. Tourists from Oceania (mostly Australia and New Zealand) and America are more active in discussing astronomy-topics and socializing with other travel companions than other groups of tourists.

- After-travel recollection behaviors among the five tourist origins also appeared significant differences in two items: buying astronomical equipment ($F=12.73$, $p=.00$) and joining astro-photography competition ($F=12.81$, $p=.00$). In reference to the post-hoc analysis results, Asian tourists are more likely to purchase more apparatus and join astro-photography competitions, while American people have lowest possibility to invest more money on the rigs and Oceanian respondents are reported less likely to join a travel-story photo or night-skyscape photo competition.

Appendix II: Information Sheet for the Questionnaire Survey

INFORMATION SHEET
FOR THE QUESTIONNAIRE SURVEY

PROJECT TITLE: “Astronomy Tourism: Individual Experience and Industry Future”

You are invited to take part in a research project about a novel issue named ‘Astronomy Tourism’, which is an emerging tourism market within Australia and this survey is designed to study astronomy tourists’ individual experience. The study is being conducted by Mr Junjie WEN and will contribute to his PhD degree program in tourism at James Cook University.

Taking part in this study is completely voluntary and you can stop taking part in the survey at any time without explanation or prejudice. If you complete this survey you will be eligible to enter a draw to win an iPad. The survey, with your consent, will be conducted without any record of your personal identity or private information, and should only take approximately 20 minutes of your time.

If you know of others that might be interested in this study, can you please pass on this information sheet to them so they may contact me to volunteer for the study?

Your responses and contact details will be strictly confidential. The data from the study will be only used in research publications and academic reports. You will not be identified in any way in these publications.

If you have any questions about the study, please feel free to contact the investigator, Junjie WEN or his supervisor, Professor Philip Pearce.

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If you have any concerns regarding the ethical conduct of the study, please contact:
Human Ethics, Research Office
James Cook University, Townsville, Qld, 4811
Phone: (07) 4781 5011 (ethics@jcu.edu.au)

APPENDIX III: SURVEY QUESTIONNAIRE (ENGLISH EDITION)

Note: the questionnaire based survey was designed in multiple-languages (English, Mandarin, Korean, French, Japanese and Spanish) and was distributed through both online and onsite channels. Considering the length of this thesis, only the English version is presented here. The other versions are available upon request.

Astronomy-related Travel Experience Survey

I have been aware of the above information and agreed to participate in this survey.

☐YES ☐NO

Please Note: this is NOT a quiz or an exam, so there is NO correct or wrong answer to the question. Please read carefully and choose the answer most truly and precisely describes your own opinions or real situation.

Section I: We would like to know your general astronomy tourism experience

We want to know about the general experience of your past astronomy-related travels. Please tick "**X**" in the boxes, fill numbers or specify words/sentences in the blank space(s).

1. **In the past ten years, how many times have you ever travelled (MUST be away from your home) to pursue the following astronomy-related attractions? (Please fill numbers in the blanks)**

______ Lunar Eclipse
______ Solar Eclipse
______ Meteor Shower
______ Aurora
______ Transit of Venus
______ Transit of Mercury
______ Comet
______The Opposition or Conjunction of a celestial body
______Regular stargazing (such as stars, moon, planets, asteroids, galaxies, nebulas)
______Astro-photographing
______Travel for star parties (away from resident town)
______Watch rocket launch on site
______Visit Observatories
______Visit Planetariums
______Astronomy-related heritage sites
______Full-moon night hiking/Starry night excursion
______Meteorites seeking
______Astronomy-themed holidays/ cruises
______Astronomy-related educational programs (workshop/class/competition/)
______Astronomy-related conference/forum/convention
______Others (please specify here ________________________________)
______Never travelled for astronomy-related purposes

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2. **In which year was your first trip to pursue astronomy-related attractions? ______________**
3. **How many times altogether have you ever TRAVELED for astronomy-related attractions? _______**
4. **How many nights were your longest stays in a single astronomy-related trip? ____________**
5. **On average, how often do you TRAVEL for astronomy-related attractions?**
   - ❍ More than once a week
   - ❍ Once a week
   - ❍ Every two weeks
   - ❍ Once a month
   - ❍ Every two months
   - ❍ Every three months
   - ❍ Every half year
   - ❍ Once a year
   - ❍ Less than one time per year

6. **Are there any destinations you regularly visit to for pursuing astronomy-related attractions?**
   - ❍ Yes (please specify the name below, e.g. XX Dark Sky Reserve, XX National Park, XX mountain.)
     ____________________ (go to question 7)
   - ❍ No (go to question 8)

7. **How far is it from your home?**
   - ❍ <1 hour's drive
   - ❍ 1~2 hours' drive
   - ❍ 2~3 hours' drive
   - ❍ 3~4 hours' drive

8. **For pursuing astronomy-related attractions, which type of the destination did you visit more often?**
   - ❍ Tourist destinations (such as national parks, reserves or scenic spots)
   - ❍ Non-tourist destinations

9. **In your past astronomy-related trips, what was the longest distance away home?**
   - ❍ <1 hour flight
   - ❍ 1~2 hours flight
   - ❍ 2~3 hours flight
   - ❍ 3~4 hours flight
   - ❍ 4~5 hours flight
   - ❍ >5 hours flight

10. **In your astronomy trips, where was the furthest destination you have ever been to?**
    - ❍ Within home country (Please specify the state/province ________________)
    - ❍ Outside home country (Please specify the foreign country_______________)

11. Which accommodation did you usually choose during your astronomy trips?

	Never	Sometimes	About half the time	Often	Always
Premium hotels	❍	❍	❍	❍	❍
Budget hotels	❍	❍	❍	❍	❍
Resorts	❍	❍	❍	❍	❍
Motels	❍	❍	❍	❍	❍
Hostels	❍	❍	❍	❍	❍
Recreational Vehicles (RVs)	❍	❍	❍	❍	❍
Camping (without RVs)	❍	❍	❍	❍	❍
Holiday parks	❍	❍	❍	❍	❍
Guest House / B&Bs	❍	❍	❍	❍	❍
Friends' or relatives' homes	❍	❍	❍	❍	❍
Others (specify ________________)	❍	❍	❍	❍	❍

12. During astronomy trips, how often did you use the following transportation?

	Never	Sometimes	About half the time	Often	Always
Airplane	❍	❍	❍	❍	❍
Helicopter	❍	❍	❍	❍	❍
Railway	❍	❍	❍	❍	❍
Private Vehicle	❍	❍	❍	❍	❍
Rental Car	❍	❍	❍	❍	❍
Recreational Vehicle (RV)	❍	❍	❍	❍	❍
Bus / Coach	❍	❍	❍	❍	❍
Bike	❍	❍	❍	❍	❍
Water Transport	❍	❍	❍	❍	❍
On Foot	❍	❍	❍	❍	❍
Others (specify ________________)	❍	❍	❍	❍	❍

13. Who did you usually go for astronomy trip with?

	Never	Sometimes	About half the time	Often	Always
Unaccompanied (Travel alone)	❍	❍	❍	❍	❍
Travel with friends	❍	❍	❍	❍	❍
Travel with relatives	❍	❍	❍	❍	❍
Travel with partner	❍	❍	❍	❍	❍
Travel with astronomy club members	❍	❍	❍	❍	❍
Others (specify ________________)	❍	❍	❍	❍	❍

14. Which methods did you usually use to communicate with other astronomy travel companions?

	Never	Sometimes	About half the time	Often	Always
Online forum	❍	❍	❍	❍	❍
Personal blogs	❍	❍	❍	❍	❍
Face-to-face communication	❍	❍	❍	❍	❍
Social media	❍	❍	❍	❍	❍
Phone calls and texts	❍	❍	❍	❍	❍
E-mails	❍	❍	❍	❍	❍

15. To what extent did (or will) you to TRAVEL for the following astronomy-related attractions?

	Strongly attractive	Very attractive	Somewhat attractive	Neutral	Somewhat unattractive	Very unattractive	Unattractive at all
❍ Solar eclipses	❍	❍	❍	❍	❍	❍	❍
Aurora	❍	❍	❍	❍	❍	❍	❍
Meteor Shower	❍	❍	❍	❍	❍	❍	❍
Transit of Venus	❍	❍	❍	❍	❍	❍	❍
Comet	❍	❍	❍	❍	❍	❍	❍
Lunar Eclipse	❍	❍	❍	❍	❍	❍	❍
Occultation	❍	❍	❍	❍	❍	❍	❍
Transit of Mercury	❍	❍	❍	❍	❍	❍	❍
Opposition or conjunction	❍	❍	❍	❍	❍	❍	❍
Regular stargazing	❍	❍	❍	❍	❍	❍	❍
Travel for star parties	❍	❍	❍	❍	❍	❍	❍
Astro-photographing	❍	❍	❍	❍	❍	❍	❍
Visit observatory	❍	❍	❍	❍	❍	❍	❍
Visit planetarium	❍	❍	❍	❍	❍	❍	❍
Watch onsite rocket launches	❍	❍	❍	❍	❍	❍	❍
Meteorites seeking	❍	❍	❍	❍	❍	❍	❍
Astronomy-related heritage sites	❍	❍	❍	❍	❍	❍	❍
Astronomy-related conference/forum/convention	❍	❍	❍	❍	❍	❍	❍
Astronomy-related education (workshop/class/competition/)	❍	❍	❍	❍	❍	❍	❍
Starry excursion / Full moon hike	❍	❍	❍	❍	❍	❍	❍
Astronomy-themed cruise/ holiday	❍	❍	❍	❍	❍	❍	❍

16. Which landforms did you usually choose as the destinations of your past astronomy trips?

	Never	Sometimes	About half the time	Often	Always
Mountain/hill tops	❍	❍	❍	❍	❍
On the sea	❍	❍	❍	❍	❍
Seaside areas	❍	❍	❍	❍	❍
Plains	❍	❍	❍	❍	❍
Tablelands	❍	❍	❍	❍	❍
River/lake sides	❍	❍	❍	❍	❍
Deserts	❍	❍	❍	❍	❍
Forests	❍	❍	❍	❍	❍
Islands	❍	❍	❍	❍	❍
Ice fields	❍	❍	❍	❍	❍

17. How important do the below elements affect you decide to undertake an astronomy trip?

	Extremely important	Very important	Somewhat important	Moderately important	Slightly important	Somewhat unimportant	Unimportant at all
Favourable weather condition	❍	❍	❍	❍	❍	❍	❍
Stable astronomical seeing	❍	❍	❍	❍	❍	❍	❍
Less light pollution	❍	❍	❍	❍	❍	❍	❍
Destination landscape	❍	❍	❍	❍	❍	❍	❍
Unobstructed skyline	❍	❍	❍	❍	❍	❍	❍
Rareness of the astronomy-related event	❍	❍	❍	❍	❍	❍	❍
Geographic location enables the visibility	❍	❍	❍	❍	❍	❍	❍
Experienced tour guide /group leader	❍	❍	❍	❍	❍	❍	❍
Excellent companions	❍	❍	❍	❍	❍	❍	❍
Friendly local residents	❍	❍	❍	❍	❍	❍	❍
Travel safety	❍	❍	❍	❍	❍	❍	❍
Good travel itinerary	❍	❍	❍	❍	❍	❍	❍
Well-organized activities	❍	❍	❍	❍	❍	❍	❍
Reasonable expenditure	❍	❍	❍	❍	❍	❍	❍
Local facilities & services	❍	❍	❍	❍	❍	❍	❍
Offer astronomical equipment	❍	❍	❍	❍	❍	❍	❍
Convenient transportation	❍	❍	❍	❍	❍	❍	❍
Accommodation conditions	❍	❍	❍	❍	❍	❍	❍
Tour provider's reputation	❍	❍	❍	❍	❍	❍	❍

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Section 2: We would like to know your astronomy hobby

18. Do the statements below describe your real situation? (1=completely disagree, 7=completely agree)

	1	2	3	4	5	6	7
I have persistent interest in astronomy	❍	❍	❍	❍	❍	❍	❍
I overcome difficulties in the astronomy hobby by being persistent	❍	❍	❍	❍	❍	❍	❍
I try my best to never miss any significant astronomy-related event	❍	❍	❍	❍	❍	❍	❍
I put substantial effort to improve knowledge and skill in astronomy	❍	❍	❍	❍	❍	❍	❍
I have made progress in the astronomy hobby since beginning	❍	❍	❍	❍	❍	❍	❍
There are defining moments within the astronomy hobby that have significantly shaped my involvement in it.	❍	❍	❍	❍	❍	❍	❍
I demonstrate my skills and abilities in the astronomy hobby	❍	❍	❍	❍	❍	❍	❍
I make full use of my talent in the astronomy hobby	❍	❍	❍	❍	❍	❍	❍
Astronomy hobby is enjoyable to me	❍	❍	❍	❍	❍	❍	❍
Astronomy hobby has added richness to my life	❍	❍	❍	❍	❍	❍	❍
Astronomy hobby for me is an expression of myself	❍	❍	❍	❍	❍	❍	❍
Astronomy hobby provides me with a profound sense of satisfaction	❍	❍	❍	❍	❍	❍	❍
I enjoy interacting with other astronomy enthusiasts	❍	❍	❍	❍	❍	❍	❍
I feel important when I am a part of my astronomy group's accomplishments	❍	❍	❍	❍	❍	❍	❍
I share many of the sentiments of my fellow astronomy hobbyists	❍	❍	❍	❍	❍	❍	❍
I share many of my astronomy group's ideals	❍	❍	❍	❍	❍	❍	❍
I am often recognized as one devoted to astronomy	❍	❍	❍	❍	❍	❍	❍
Others that know me understand that astronomy is a part of who I am	❍	❍	❍	❍	❍	❍	❍

Section 3: We would like to know your travel motivation

19. Assume that you are having an astronomy trip, do you agree with the statements below?

(1=completely disagree, 4=neutral, 7=completely agree)

	1	2	3	4	5	6	7
I travel because I want to see something novel	❍	❍	❍	❍	❍	❍	❍
I want to experience wonders/events	❍	❍	❍	❍	❍	❍	❍
I desire to see some peculiar astronomy-related attractions	❍	❍	❍	❍	❍	❍	❍
I travel for getting way from daily routines	❍	❍	❍	❍	❍	❍	❍
I want to escape from the urban crowds	❍	❍	❍	❍	❍	❍	❍
I want to relaxing with inner harmony	❍	❍	❍	❍	❍	❍	❍
Being close to the natural world is my motive to travel	❍	❍	❍	❍	❍	❍	❍
I want to view beautiful landscape	❍	❍	❍	❍	❍	❍	❍
To experience peaceful life is the reason for my astronomy trip	❍	❍	❍	❍	❍	❍	❍
Enjoying isolation is my pursuit during an astronomy trip	❍	❍	❍	❍	❍	❍	❍
I want to have exciting moment during the astronomy trip	❍	❍	❍	❍	❍	❍	❍

(1=completely disagree, 4= neutral, 7=completely agree)

	1	2	3	4	5	6	7
Exploring the unknown stimulates my astronomy trip	❍	❍	❍	❍	❍	❍	❍
I want to make new friends during the astronomy trip	❍	❍	❍	❍	❍	❍	❍
I want to follow others who share similar interest	❍	❍	❍	❍	❍	❍	❍
I want to strengthen relationships with others	❍	❍	❍	❍	❍	❍	❍
I want to develop an important aspect of myself	❍	❍	❍	❍	❍	❍	❍
I want to gain a sense of achievement during the trip	❍	❍	❍	❍	❍	❍	❍
I want to obtain a sense of self-confidence	❍	❍	❍	❍	❍	❍	❍
I want to develop knowledge and skills in astronomy	❍	❍	❍	❍	❍	❍	❍
Having an astronomy trip can actualize my personal value	❍	❍	❍	❍	❍	❍	❍
I want to experience different cultures	❍	❍	❍	❍	❍	❍	❍
I want to meet the local people during the trip	❍	❍	❍	❍	❍	❍	❍
I want to show others I have been there	❍	❍	❍	❍	❍	❍	❍
I want to be recognized by other people	❍	❍	❍	❍	❍	❍	❍
I expect to witness something romantic	❍	❍	❍	❍	❍	❍	❍
I hope a romantic relationship during the trip	❍	❍	❍	❍	❍	❍	❍
Being obligated to no one is one of the motives for my trip	❍	❍	❍	❍	❍	❍	❍
During the trip I can do things my own way	❍	❍	❍	❍	❍	❍	❍
I travel because I want to think about good times in the past	❍	❍	❍	❍	❍	❍	❍
I wish to recall my childhood such as counting stars	❍	❍	❍	❍	❍	❍	❍

Section 3: We would like to know your on-site travel activities

20. To what extent do you agree or disagree with the statements below? (1=never, 4= neutral, 7=always)

	1	2	3	4	5	6	7
Astronomy-photographing	❍	❍	❍	❍	❍	❍	❍
Naked-eye observing	❍	❍	❍	❍	❍	❍	❍
Observing through equipment	❍	❍	❍	❍	❍	❍	❍
Participating astronomical education program	❍	❍	❍	❍	❍	❍	❍
Discussing astronomy-related topics	❍	❍	❍	❍	❍	❍	❍
Visit astronomy-related people or places	❍	❍	❍	❍	❍	❍	❍
Other activities related to astronomy	❍	❍	❍	❍	❍	❍	❍
Sightseeing nearby	❍	❍	❍	❍	❍	❍	❍
Just stay there and relax	❍	❍	❍	❍	❍	❍	❍
Hiking	❍	❍	❍	❍	❍	❍	❍
Bird watching	❍	❍	❍	❍	❍	❍	❍
Swimming	❍	❍	❍	❍	❍	❍	❍
Cycling	❍	❍	❍	❍	❍	❍	❍
Barbequing (BBQ)	❍	❍	❍	❍	❍	❍	❍
Social networking	❍	❍	❍	❍	❍	❍	❍
Fishing	❍	❍	❍	❍	❍	❍	❍
Surfing	❍	❍	❍	❍	❍	❍	❍
Other activities NOT related to astronomy	❍	❍	❍	❍	❍	❍	❍

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Section 4: We would like to know your recollection and learning outcomes after the trip

21. To what extent do the statements below describe the true status AFTER your astronomy trip?

(1= very untrue, 4= neutral, 7= very true)

	1	2	3	4	5	6	7
I shared travel stories through social media	❍	❍	❍	❍	❍	❍	❍
The trip reinforced my interest in astronomy	❍	❍	❍	❍	❍	❍	❍
I desire a return travel after the trip	❍	❍	❍	❍	❍	❍	❍
I shared travel stories on club's online forum	❍	❍	❍	❍	❍	❍	❍
I shared travel stories face to face	❍	❍	❍	❍	❍	❍	❍
I shared travel experience in online blogs	❍	❍	❍	❍	❍	❍	❍
Involve more people to involve in astronomy	❍	❍	❍	❍	❍	❍	❍
Print out photos of the trip/astronomical events	❍	❍	❍	❍	❍	❍	❍
Buy more astronomical equipment	❍	❍	❍	❍	❍	❍	❍
Join an astro-photography competition	❍	❍	❍	❍	❍	❍	❍

22. To what extent do your agree with the following statements about your learnings from the trip?

(1= completely disagree, 4= neutral, 7=completely agree)

	1	2	3	4	5	6	7
I enhanced my astronomy knowledge	❍	❍	❍	❍	❍	❍	❍
I improved my communication skills	❍	❍	❍	❍	❍	❍	❍
I improved my decision making abilities	❍	❍	❍	❍	❍	❍	❍
I gained learnings about natural environment	❍	❍	❍	❍	❍	❍	❍
I have maintained relationship	❍	❍	❍	❍	❍	❍	❍
I reinforced my patience	❍	❍	❍	❍	❍	❍	❍
I learnt humbleness to respect the nature	❍	❍	❍	❍	❍	❍	❍
I gained more sense of responsibility	❍	❍	❍	❍	❍	❍	❍
I obtained skills concerning information literacy	❍	❍	❍	❍	❍	❍	❍
I gained mastery over astronomy equipment	❍	❍	❍	❍	❍	❍	❍
I enhanced my physical skill	❍	❍	❍	❍	❍	❍	❍
My view of myself has improved in the trip	❍	❍	❍	❍	❍	❍	❍
I felt more confident after the astronomy trip	❍	❍	❍	❍	❍	❍	❍
My teamwork skills have improved	❍	❍	❍	❍	❍	❍	❍
I learnt to be more independent	❍	❍	❍	❍	❍	❍	❍

Section 5: We would like to know your satisfaction after the trip

23. How strongly do you satisfy with your previous experience of astronomy-related travels?

(1= completely dissatisfied, 4= neutral, 7=completely satisfied)

	1	2	3	4	5	6	7
Authenticity of the astronomy trips	❍	❍	❍	❍	❍	❍	❍
The overall astronomy-related travel experience	❍	❍	❍	❍	❍	❍	❍
Travel safety of astronomy trips	❍	❍	❍	❍	❍	❍	❍
Services of the destination	❍	❍	❍	❍	❍	❍	❍
Accommodation and food	❍	❍	❍	❍	❍	❍	❍
Infrastructure of destination	❍	❍	❍	❍	❍	❍	❍
Comfort of the trip	❍	❍	❍	❍	❍	❍	❍
Destinations accessibility	❍	❍	❍	❍	❍	❍	❍
Travel convenience	❍	❍	❍	❍	❍	❍	❍

Section 6: Please tell us more about yourself

For the comparison purpose of our research, please provide the following information:

1. Your gender: ☐**Male** ☐**Female**

2. Your age: ________

3. Your place of origin: Nationality________, State/Province________

4. Your educational background:

❍ Primary school
❍ Secondary school
❍ High school
❍ College Diploma or Certificate
❍ Bachelor Degree
❍ Master Degree
❍ PhD
❍ Other (please specify) ____________________

5. Your occupation:

❑ Student
❑ Retired
❑ Full time employed
❑ Part time employed
❑ Disabled

6. Your monthly income is AUD __________

7. How much on average do you spend on a single astronomy trip? (AUD)

☐<1000 ☐1000-2000 ☐2000-3000 ☐ 3000 -4000 ☐4000-5000 ☐ >5000

8. In the past 12 months, how many trips have you had in total? ________

9. In the past 12 months, how many times have you travelled for astronomy-related purposes? ______

We wish to email you the prize draw results as well as our study reports. Please leave your email address if you want to join the prize drawn or be updated about the research. **E-mail**___________________________

APPENDIX IV: INFORMATION SHEET FOR INTERVIEWS

Note: The information sheet was designed in two languages (English and Chinese Mandarin). Due to the length of this thesis, only the English version is presented here. The other versions are available upon request.

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Project Introduction

You are invited to take part in a research project about a novel issue named 'Astronomy Tourism', which is an emerging tourism market worldwide and this interview is designed to study the industry future of astronomy tourism. The study is being conducted by Mr Teddy WEN and will contribute to his PhD degree program in tourism at James Cook University.

Taking part in this study is completely voluntary and you can stop taking part in the study at any time without explanation or prejudice. If you agree to be involved in the study, you will be invited to complete an interview with audio recording. The survey, with your consent, will be conducted without any record of your personal identity or private information, and should only take approximately 40 minutes of your time.

Your responses and contact details will be strictly confidential. The data from the study will be only used in research publications and academic reports. You will not be identified in any way in these publications.

If you know of others that might be interested in this study, can you please pass on this information sheet to them so they may contact me to volunteer for the study?

Purpose of Interviews

In-depth and semi-structured interviews are adopted in this research as qualitative study approach after focus groups. They aim to help the researcher understand the industry stakeholder's perception of the present astronomy tourism assets, resources, products and markets, as well as their attitudes towards the future development of the industry.

If you have any questions about the study, please feel free to contact the investigator, Junjie WEN or his supervisor, Professor Philip L. Pearce.

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APPENDIX V: RECORD SHEET FOR INTERVIEWS

Part 1： Open-ended questions

1. What type of resources/attractions are the important assets for astronomy tourism?
2. How valuable are they in the future development of astronomy tourism?
3. Some of the assets mentioned above have not been developed for tourism use. What is your opinion in using them? Do you have desire to develop them?
4. What key measures or methods should we adopt to develop the above assets in a sustainable way?
5. What do you think about the present development of the astronomy-related tour products?
6. Among the following destinations, which do you think are important to the market of astronomy tourism? (refer to Appendix VI)
    - *Astronomy heritage sites*
    - *Astronomy observational sites*
    - *Natural sites*
    - *Starlight landscapes*
    - *Starlight Oases*
    - *Mixed starlight sites*

7. Which market segments are important to astronomy tourism industry? How do you position them in the market?
8. Are there any constraints or difficulties to develop the astronomy tourism products?
9. What are the opportunities for the future development of astronomy tourism?
10. What are the external threats or challenges to the future of astronomy tourism?

Part 2： Standardized questions

1. How important are the following solutions to the future development of the astronomy tourism industry?

   Please give scores to measure the importance. 1= very important, 2= important, 3= moderately important, 4=unimportant, 5= unimportant at all.

Measures and solutions	Importance score
Raise potential tourists' awareness and interest	
Make sustainable tourism plans for dark-sky destinations	
Enhance marketing and promotion strategies	
Deliver astronomy educational programs to young generations	
Develop diverse tourism products to meet different needs	
Improve accommodation facilities and services of the local community	
Optimize the infrastructures of the distant dark-sky sites	
Preserve dark-skies and control light pollution	

2. Will these solutions come true in the near future?

   Please give scores to measure the possibilities. 1=will definitely come true, 2= likely come true, 3=neutral, 4=less likely come true, 5= will never come true

Measures and solutions	Expected Performance
Raise potential tourists' awareness and interest	
Make sustainable tourism plans for dark-sky destinations	
Enhance marketing and promotion strategies	
Deliver astronomy educational programs to young generations	
Develop diverse tourism products to meet different needs	
Improve accommodation facilities and services of the local community	
Optimize the infrastructures of the distant dark-sky sites	
Preserve dark-skies and control light pollution	

Categories	Explanation	Examples
Starlight Heritage Sites	Archaeological and cultural sites or monuments created by man as an expression of its relationship with the firmament, which reflect the development of astronomy and its manifestation in the arts and traditions	• Monuments or groups of buildings related to astronomy, of outstanding value from the point of view of history, art or science • Relevant sites and manifestations of cultural heritage related to sky observation, including archaeological-astronomy sites • Areas where still survive expressions of tangible and intangible cultural heritage associated with astronomy and starlight, including music, traditions, legends, folk tales, and folklore, of particular importance for education in astronomy and the development of research on cultural heritage and sky observation • World Heritage Properties and Biosphere Reserves
Starlight Astronomy Sites	Exceptional observation sites for optical, infrared, and radio astronomy, including potential future sites	• Relevant astronomical observatories and their environment. Astronomical observatories by their nature are extremely sensitive to light pollution, as well as to atmospheric and radio electric pollution • Potential areas for advanced astronomical observation, recognized by the IAU and the international scientific community • Exceptional astronomical observation sites, whose characteristics give them a special interest for the development of educational and scientific activities or for the promotion and spreading of astronomy
Starlight Natural Sites	Natural areas where the integrity natural conditions, including natural night sky quality, are preserved	• Habitats of particular relevance that host nocturnal wildlife species particularly sensitive to the loss of night sky quality or vulnerable to the effects of photo pollution • Terrestrial and marine areas used as corridors and resting sites by migratory wildlife species whose habits and displacements could be affected negatively by glare or loss of natural sky brightness • Protected natural areas with a special relevance for the development of night-time environment research and management and the study of the natural patterns of light and dark • World Heritage Properties, Biosphere Reserves, Ramsar Sites and marine or terrestrial protected areas of international importance • All protected nature areas in general, since all species and ecosystems depend on natural cycles of day and night

Starlight Landscapes	Places where aesthetic manifestations of the night sky can be observed, as well as natural and cultural landscapes related to starlight where natural manifestations or human works beautifully blend with the view of the firmament	• Areas where the starry sky, as well as exceptional manifestations of light-related phenomena can be observed with high quality and aesthetic strength • Expressions of nature and geological monuments associated to the firmament and related phenomena, which create night landscapes of acknowledged value • Cultural landscapes or expressions of combined works of nature and of man where the astronomical dimension prevails, as well as associative cultural landscapes related to starlight • Natural Heritage Properties (cultural and associative landscapes) and Biosphere Reserves
Starlight Oases - human habitats	Populated areas relatively free from the negative effects which impede star viewing and decrease night sky quality;	• Rural areas of outstanding singularity where the starry sky view is part of their recognized identity and values • Small villages keeping their night sky reasonably free from atmospheric and light pollution effects, where this resource is considered a social, environmental and citizens' cultural right • Within urban areas, the Urban Star Parks, whose requirements are of course less strict than those established for Starlight Reserves, carry out a very important public function, especially related to education, amateur astronomy or simple stargazing, as well as promote recovering of emblematic nocturnal skyscapes
Mixed Starlight Sites	Sites that combine two or more of the previously described categories.	

Appendix VII: Code Book for the Travel Blog Study

Theme (code)	Topic (code)	Brief explanation	Codes
Motivation (MOV)	Internal purpose for traveling (IPF)	Escape	ESP
		Nature	NAT
		Novelty	NOV
		Special Interest in astronomy	SIA
		Self-actualization/development	SAD
		Nostalgia	NOS
		Relationship	RET
		Recognition	REC
		Relax	REX
		Romance	ROM
	External drivers for traveling (EDT)	Visibility factors	VBF
		Geographic location	GPL
		Type of the attraction	TOA
		Rareness of the event	ROE
Anticipation (ATP)	Expected Astronomical phenomenon (EAP)	Solar Eclipse	SEC
		Aurora	AUR
		Meteor Shower	MTS
		Lunar Eclipse	LEC
		Transit of Venus	TOV
		Comet	CMT
		Transit of Mercury	TOM
		Occultation	OCC
		Opposition or Conjunction of a celestial body	OPP
	Proposed Astronomy-related activities (PAA)	General Stargazing	GSG
		Astro-photography	APH
		Travel for Star Parties	TSP
		Astronomy-themed Cruise/Holiday/Vacation	ATH
		Observatory Visitation	OTV
		Astronomy Conference/Forum/Convention	ASC
		Planetarium Visitation	PLT
		Astronomy-related Educational Program/Competition	AEP
		Full-moon excursion/hiking	FME
		Meteorites Seeking	MRS
		Visit Astronomy-related historical Sites	AHS
		Witness Onsite Rocket Launch	ORL
	Itineraries (ITI)	Travel route	TRR
		Travel timeline	TTL

Theme (code)	Topic (code)	Brief explanation	Codes
Travel to site (TTS)	Transportation they use (TTU)	Airplane	AIR
		Railway	RAI
		Private car	PVC
		RV	RV
		Rental car	RC
		Ship/Boat/Ferry/Cruise	SBFC
		Helicopter	HLC
		Bus/Coach	BUC
		Bicycle	BIK
	Accommodation (ACC)	Premium hotel	PHL
		Budget hotel	BHL
		Resort	RES
		Motel	MOT
		Hostel	HOS
		Camping	CAM
		RV-ing	RVI
		B&Bs/Guest house	BBG
		Friends' or relatives' dwelling	FRD
		Others	OTH
	Food & drinks (FDD)	Dining experience during travel	DET
	Social communication (SOC)	With Local people	WLP
		With travel companions	WTC
		With travel guide/leader	WTG
		Anecdotes	ANC
On-site activities (OSA)	Equipment/rig (EQP)	Telescope	TEL
		Binoculars	BNC
		Cameras	CMR
		Other astronomical devices	OAD
	Astronomy-related activities (ARA)	Naked-eye Observing	NEO
		Observing through equipment	OTE
		Astro-photographing	ASPH
		Networking with others	NOW
		Star-parties/conventions	SPC
		Educational program	EDP
	Other activities (OTA)	Sightseeing nearby	SSN
		Bird watching	BWA
		Fishing	FIS
		Barbequing	BBQ
		Hiking/excursion	HIK
		Swimming	SWM
		Cycling	CYC
		Surfing	SUF
		Visiting friends or relatives	VFR

Theme (code)	Topic (code)	Brief explanation	Codes
	Astronomical objects / celestial bodies (AOB)	Specific term or language used to describe celestial objects	STL
	Physical Scenes (PHS)	Weather	WEA
		Light pollution	LPT
		Vegetation	VEG
		Wild life	WDL
		Terrain	TER
	Perception of the activities (POA)	Belongingness to a group	BTG
		Self-development	SFD
		Feeling of fulfilment	FOF
		Authenticity of the nature	AON
	Affection during the activities (ADA)	Relaxation	REL
		humility	HUM
		Reverence/respect to the universe	REU
		Excitement	EXC
		Enjoyment	ENJ
Return travel (RTT)	Social Networking (SNW)	Social Media interactions	SMI
		Physical interactions	PHI
	Shopping (SHO)	Shopping behaviour	SHB
	Transportation (TST)	Transportation facts on way back	TWB
	Post-travel stories (POT)	Other facts on the way back home	OWB
Recollection (RCL)	Travel history/career (THC)	Stimulants for involvement	SFI
		Regular destination of traveling	RDT
		Travel distance	TDI
		When did they start the career	WSC
		Length of stay	LOS
	Learning outcomes (LOC)	Astronomical knowledge	ASK
		Observation or photography skills	OPS
		Personal travelling skills	PTS
	Blog posting (BLP)	The fact of posting blogs online	PBO
Satisfaction (SAT)	Satisfaction or dissatisfaction of the travelling experience (STE)	The overall experiences	TOE
		Travel safety	TSF
		Service of the destination	SOD
		Facilities of the destination	FOD
		Convenience of the travel	COT
		Comfort of the travel	CFT
		Accessibility to the destination	ACD