

Applying Neuroscience in Understanding the Astana Gunungjati Pilgrimage Tour, Cirebon, Indonesia

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Abstract

Neuroscience is able to explain how brain functions and how people think and work. Neuroscience can thus help tourism developments. Understanding a person's tourism experience requires understanding more than facts. The pilgrimage tour of Astana Gunungjati, is a touristic experience that plays a role in the spirituality of tourists. This experience is personal and can barely be revealed by approaches using questionnaires. Hence, Neuroscience can help understand these experiences.

The objective of this research is to map the electroencephalogram results from the visitors, and the officers at Astana Gunungjati and tourists who have never visited the destination. The method of approach is to stimulate through a movie about pilgrimage tourism to 7 respondents, consisting of 3 bekels (tomb officers), 2 visitors and 2 people who have never visited the Astana Gunungjati.

Data processing and analysis used Matlab, an additional extension program for Matlab namely EEGLAB, and Microsoft Excel. The results show a gamma wave frequency ≥ 45 Hz in the brain work of the officers and visitors who had been to the tomb, while with the people who had never visited the tomb, the Gamma waves are not detected.

Tomb officers and visitors who go on pilgrimage tours have a memory of the tourist space, while those who have never had a different memory of space. These results show that Neuroscience can be an approach to detecting the human mind in a space.

Keywords: Astana-Gunungjati; Neuroscience; Pilgrimage-Tour.

Introduction

Tourism is a classical realm where spirituality and religiosity can be experienced in search of meaning (Kujawa, 2017; Norman and Pokorny, 2017), extensive research has shown that there is a relationship between tourism and religion (Sharpley and Sundaram, 2005). The notion of spirituality, a concept related to religiosity (Willson, McIntosh and Zahra, 2013) has gained attention in the popular culture (Singleton, 2017) along with the growing interest in spiritual tourism destinations where the demand for "religious" travel seeks to be "challenging, immersive, intellectual, transcendental and sometimes life-changing or life-affirming experiences" (Cheer, Belhassen and Kujawa, 2017). Spiritual tourism as a "self-awareness project" aims to increase the "sense of being well" (Moufakkir and Selmi, 2018). Beside

tourism as a social and economic development aspect (Aji and Faniza, 2021) which can increase regional development (Aji, Pramono and Rahmi, 2018) and community empowerment (Aji, 2020), it is also known as spiritual or cultural tourism.

Spiritual tourism objects still survive in the Astana Village, Gunung Jati District, Cirebon Regency, Indonesia. As the name implies, Astana Gunungjati means the grave of Sunan Gunungjati and his descendants. Sunan Gunungjati is the King of the Kacirebonan Sultanate and a propagator of Islam in West Java (Agustina *et al.*, 2016; Agustina and Hindersah, 2019). He is a *wali* or a holy person who has supernatural powers, so his grave is still attractive because it is considered to still provide positive energy. The tomb complex is a heritage area and has been designated as a pilgrimage tourism destination by the local government. This area is supported by the traditions and culture of the palaces in Cirebon which still survive today because they are descendants of Sunan Gunungjati. Pilgrimage tourism emphasizes more on the personal experience of sacredness.

Sacred knowledge has a unique awakening experience and brings them closer to their true selves (Coghlan and Weiler, 2018). This has an impact on the emotions, motivations, and perceptions of tourists (Armario, 1996; Kandampully, 2000; Ngurah *et al.*, 2017; Chatterjee and Mandal, 2020; Pestana, Parreira and Moutinho, 2020).

Understanding traveling is useful for measuring tourist experiences conveying a positive impression (Armario, 1996). One way to measure it is through the application of neuroscience. Neuroscience is a science that is able to explain how the brain functions and changes, and is able to know how the subconscious mind works (Giudici, Dettori and Caboni, 2017). Knowing preferences through neurals can help make decisions, provide tourism experiences and improve tourism performance (Ma *et al.*, 2014). The use of classical methods is still considered too subjective to be able to assess validity (Ma *et al.*, 2014), and therefore neuroscience is used to increase the validity (Greenman, 2007). One of the measurement tools in neuroscience is the electroencephalograph (EEG). EEG which is a brain scanning tool that uses sensors to capture signals resulting from brain activities and can measure consciousness (Wu and Yuan, 2012; Giudici, Dettori and Caboni, 2017).

The current tourism planning process is influenced by the evolution of the tourism industry (Rahmafritia *et al.*, 2020). The evolution of the tourism industry is the result of the development of innovation (Brandão, 2014). One of the innovations currently developing is the application of neuroscience in certain fields, in the field of tourism, where neuro-tourism has emerged. Neuro-tourism is the study of neuroscience with tourism (Giudici, Dettori and Caboni, 2017). In fact, neuro-tourism has now been used for tourism management and marketing (Parrinello, 2012; Ma *et al.*, 2014; Giudici, Dettori and Caboni, 2017). The use of neuroscience is considered to provide benefits in tourism development (Alvino *et al.*, 2020). For this reason, the purpose of this research is to map the results of the electroencephalogram of tourists, and the officers at Astana Gunungjati and people who have never been to these locations. The findings will demonstrate how subjectively-experienced brain activities were influenced by the visual stimuli of pilgrimage tourism in Astana Gunungjati. The results of brain wave mapping can provide factual clues. The importance of spirituality as a result of pilgrimage tourism has not yet been established empirically. Neuroscience is able to map these brain waves factually, especially the experience of spiritual tourism.

A Review of Literature

In general, the term pilgrimage can be classified into three categories. First, there is "inner pilgrimage", which denotes "the journey of the soul" in spiritual lifelong growth from childhood to maturity. Second, a literal pilgrimage in a holy place is a paradigm of religious goals itself. This literal journey can be called "extrovert mysticism". Third, a journey to a holy place (Wu, Chang and Wu, 2019). Nowadays, pilgrimage tourism is considered incompatible with the modern scientific era. At the International Religious and Tourism Pilgrimage Conference (IRTP) which took place from 28th June to 1st July 2017 in Armeno, Lake Orta, Italy, Haller (2017) talked about the possibility of pilgrimage in a Scientific World. He discloses a scientific worldview that puts aside many traditional ideas regarding pilgrimage, such as

miracles and prayer effectiveness. He shows that the pilgrimage idea is inconsistent with the modern scientific worldview. This conference was initiated due to the growing stigma that pilgrimage tourism is black, dark, and ancient, that has graveyards as tourist destinations.

Tourism is one of the worldwide main socio-economic drivers that have an impact on the development, prosperity, and well-being of the world. With more than one billion travelers, tourism generates 9% of the world's GDP and exports 1.4 trillion USD. Tourism promotes additional employment opportunities and more importantly helps to improve the structure and balance of economic activity in society (Antunes, 2017). The Global Code of Ethics for Tourism (UNWTO, 2001) considers religion as one reason that drives rapid and sustainable growth of tourism activities. Pilgrimages give benefit areas where the revered images/objects/sites are located and generate tourism and business niches that provide significant economic income for the population concerned (González-González and Fernández-Álvarez, 2022).

Pilgrimage tourism has come into a paradigm shift where the emphasis is not on spiritual interests, but more on commercial interests (Cassar and Munro, 2017). Religious tourism explores the motivation for new experiences that are considered more modern and leave traditional experiences (Antunes, Amaro and Henriques, 2017; Barroco, 2017). Undoubtedly, there has been a degradation of religious beliefs with the progress of modernity (Paul, 2022). Individual spiritual sensations by pilgrims need to record as a form of factual experience documentation. Factual experience is needed to answer whether there is a shift that occurs from a pilgrimage tourism activity. Even that factual experience can be a potential economic experience (Wiltshier, 2017). There is a need for technological support in pilgrimage tourism to optimize product marketing and answer the scientific challenges of pilgrimage tourism (Aulet and Prats, 2017).

The occurrence of after-event sensation is due to (a) the presence of a stimulus; (b) processes that convert a stimulus into a bioelectric signal suitable for nerve transmission; and (c) organism-specific responses to coded messages (Mildner, 2008). Neuroscience describes the process of this sensation as the occurrence of brain waves map. Even decision-making and motivation are linked to the performance of the human brain (Zaehle *et al.*, 2017; Wilhelm, Miller and Gable, 2019; Huang, Sun and Wan, 2020; Anderson *et al.*, 2021).

Tourist experiences include more than just a physical journey to a place, as they can also involve spiritual elements, psychological and physical benefits, self-development, and life changes journey. It shows that the emotional/spiritual relationship parallels the escapism dimension. While cognitive engagement parallels the educational dimension. In these two dimensions, tourists need to actively participate in spiritual experiences. This emotional connection and cognitive engagement take turns lead to a tourism destination loyalty (Özer, Duman and Güzel, 2017). The results of this study can bring clarity to the facts of spiritual experiences from pilgrimage tourism activities that have been considered dark.

The Research Methodology

Context of the Study

The research was conducted at the Astana Gunungjati pilgrimage tour location. It is located in the Astana Village, Gunungjati District, Cirebon Regency, West Java Province, Indonesia. This area is a heritage area designated by the local government.

The location of this area is in Fig. 1 below.



Fig. 1: Location of Cirebon City in West Java Province Scope
Source: Author, 2021

Data Collection Procedure

Data collection is carried out in the following stages:

a. Stimulus Preparation

Before recording the EEG waves, it is necessary to determine the stimulus given to the respondents. The stimulus is presented in the form of a short movie video about the atmosphere of the pilgrimage tourism. The video has a duration of 3 minutes 47 seconds with details which can be seen in the table 1 below:

Table 1. Stimulus Video Details
Source: Author, 2021

Duration	Description
00.00 – 00.55	Overview and Market Conditions
00.56 – 01.50	The tomb
01.51 – 03.21	Rituals
03.21 – 03.27	Qur'an verses

b. EEG Recording Process

There were 7 respondents, three were bekel (tomb officers) of Astana Gunungjati, two were pilgrim tourists who often visited, and two had never been to Astana Gunungjati or were non-pilgrim tourists. Each respondent must be in fine condition and not have problems with the nerves in the head. An EEG was taken in a room not exposed to direct sunlight where there is no noise. Each respondent took turns in using an EEG recording device, namely the Muse Headband and watched a stimulus video to stimulate the brain responses. The respondent must be in a relaxed and focused position. The EEG reading is connected to the Muse Monitor application to view the resulting waveform response. The waves were recorded into four types of waves namely Alpha, Beta, Gamma, Theta, and Delta through four main channels namely AF7, and AF8 in the frontal cortex or the front of the head and TP9 and TP10 in the temporal cortex (Fig. 2).

c. Determination of Channels and Waves

The response of each respondent produced various waves; each channel and type of wave has a different response. The types of waves used were only Gamma, Beta and Alpha waves, but the waves that are more concerned are gamma waves. Gamma waves appear when there is a process of full attention and perception of an object and appears when information

processing occurs. Besides that, they are heavily involved in the memory process. However, beta and alpha waves are still being watched to see the condition of calm and focus of respondents.

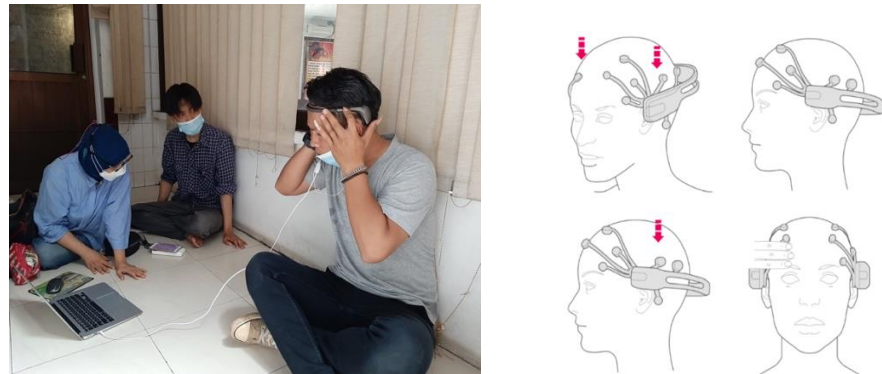


Fig 2. Installation of the Emotiv EPOC X . Headset

Source: Author, 2021

Methods of Analysis

Data analysis was performed using Matlab, an additional Matlab extension program, namely EEGLAB, and Microsoft Excel. The main processing of the data is used through EEGLAB with the following stages:

- Import EEG data into the Matlab or EEGLAB extension tools, then determine the channel location for tracking the electrode position, rereferencing the electrode, and most importantly, doing highpass and lowpass filtering in order to get the features and types of waves needed, to be able to get alpha, beta waves , and gamma, then the highpass and lowpass are at frequencies of 8 and 45 Hz.
- After getting the results from EEGLAB, a butterworth filter was performed using Matlab to reduce other noise and to make data classification easier.
- Classification and determination of wave patterns is done by looking at the results of wave filtering that has been carried out in the previous stages. and determination of wave patterns can be done using Microsoft Excel. Channels AF7, AF8, TP9, and TP10 have their respective functions in viewing the respondent's response, so that each channel is used without eliminating one channel to see the response of each wave.

Results and the Discussion

Results

Research used brain wave detections to produce clearer facts. The results of the case of pilgrimage tourism have shown more realistic results. Neuroscience research on sensorimotor control with emotional language and feelings becomes affective research in the future (Williams *et al.*, 2020). The results shown are no longer a form of falsity from the real facts because through the conventional approach, there are a lot of pretenses, so it will not produce an optimal solution. The motivation to pretend seems to have an impact on the magnitude of the simulation. This has an impact on decision making.

The results of waves of 4 channels AF7, AF8, TP9, and TP10 from these seven respondents showed different wave reactions. Respondents were grouped into Bekel (tomb officers), Pilgrim Tourists and Non Pilgrim Tourists.

a. Bekel Respondent Group (Tomb officers)

The results of this group wave detection are in the alpha to midrange beta waves. This means there is a little sense of relaxation. The first respondent responded at the 42nd second

with the presence of gamma waves, when the visual video showed the market atmosphere. Gamma waves at a magnitude of 40Hz indicate an increase in focus and thinking power or respondents in that space. The first wave of respondents was detected on channels TP9 and TP10. The results showed the gamma waves at the 30th second on the market visuals, the 42nd to 44th second on the market visuals, the 57th second on building visuals, and the 66th second on visualization of crowds of people doing pilgrimage. Gamma waves arise in the temporal part, meaning that there is a memory process. (see Fig. 3 and 4). Spatial memory is an essential cognitive function for studying and exploring the surrounding environment. Spatial memory is the ability to acquire spatial information, enabling it to locate locations. Spatial memory is an important ability for living (Chen *et al.*, 2020).

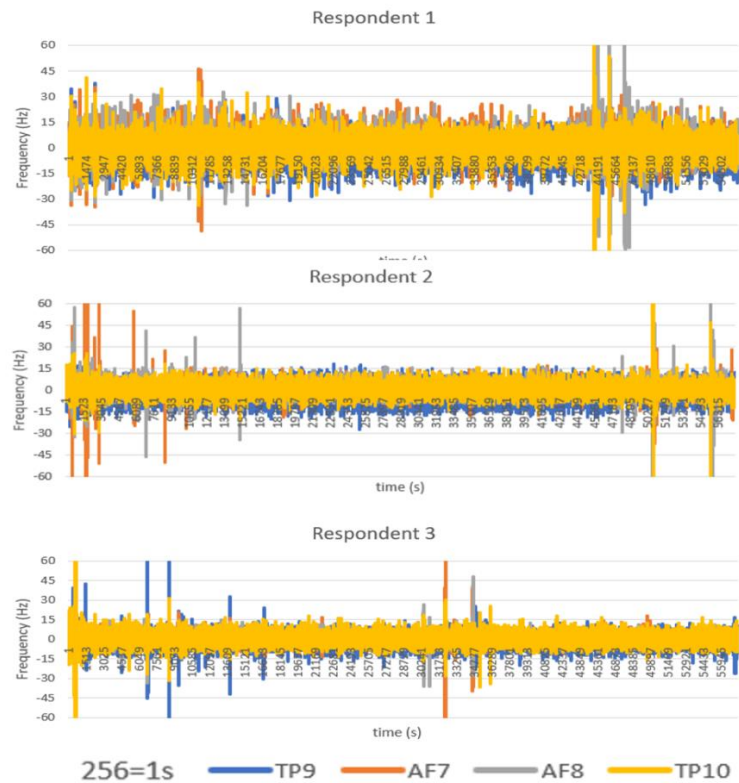


Fig. 3: Wave of Bekel Respondent Groups (Tomb Officers)
Source: Author, 2021



Fig. 4: Market and Building Atmosphere
Source: Author, 2021

b. Pilgrim Tourist Group Respondents

Respondents of the pilgrim group, namely respondent number four and five had an interest in the atmosphere in Astana. The fourth respondent produced the gamma waves on channels AF7 and AF8 in the 30th second on the visual market atmosphere (food market), the 44th-47th second on the market visual, the 62 and 101 seconds on the pilgrimage atmosphere,

and at the 222nd second on the Qur'anic verse. On the TP9 and TP10 channels, there is a gamma wave at the 30th second on the visual of the market (food) atmosphere, at the 84th second the visual film shows the pilgrimage atmosphere, and at the 123rd second it shows the ritual. The waves are in the alpha to mid-range beta conditions.

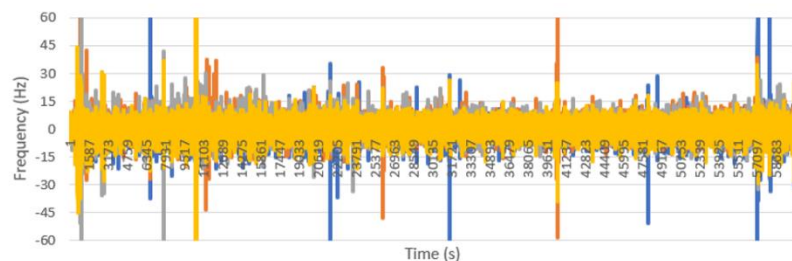
For the fifth respondent, gamma waves appeared on channels AF7 and AF8 in the 14th second on the visual of the building, at the 54th-59th second on the market visual and the 72nd-77th second on the pilgrimage atmosphere, the average remaining waves are in the alpha to midrange beta condition. It can be assumed that the respondent's interest in the visualized space in the stimulus is relatively no different under normal conditions. In the TP9 and TP10 sections, there are no significant gamma waves formed. The resulting waves are in the alpha to low beta positions in the 8-15Hz range, or occasionally appear up to the midrange beta. The fifth respondent does not have a high form of brain activity but shows memory activity (see Fig. 4 and 5). Spatial memory has a special role in the mnemonic repertoire, because all things learned at one time are experienced in a particular place. Thus, understanding how spatial memory is used in the brain can provide important clues about how our episodic (autobiographical) memory is for personally experienced events (Spiers and Maguire, 2007).



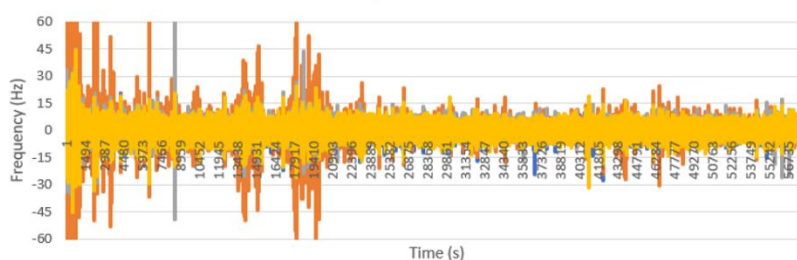
Fig 4: Pilgrimage Situation

Source: Author, 2021

Respondent 4



Respondent 5



256=1s TP9 AF7 AF8 TP10

Fig 5 Pilgrimage Respondent Group Wave

Source: Author, 2021

c. Non-pilgrim Tourist Respondent Group

Non-pilgrim groups are those who have never done pilgrimage tourism activities in Astana Gunungjati. The number of respondents were 2, the serial number of respondents is the

sixth and seventh. The sixth respondent produced gamma waves in the AF7 and AF8 channels that appeared at the 34th to 37th second of the visual market atmosphere. The average remaining waves are in the alpha to low beta conditions. In the TP9 and TP10 sections, there are no gamma waves formed, the average waves produced are in the alpha to low beta positions in the 8-15Hz range, so that in the sixth respondent, there is no form of high brain activity in the temporal section or similar to normal conditions. The seventh respondent, on channels AF7 and AF8 gamma waves appeared in the last seconds of the visual reading of the Qur'an. The remaining average waves are in the alpha to low beta conditions. It can be assumed that the respondent's interest in the visual of the stimulus is relatively no different under the normal conditions. In the TP9 and TP10 sections there are no gamma waves formed; the average waves produced are in the alpha to midrange beta positions, so that in the seventh respondent there is no form of high brain activity in the temporal part. The non-pilgrim group did not produce gamma waves in channels TP9 and TP10 (see Fig. 6)

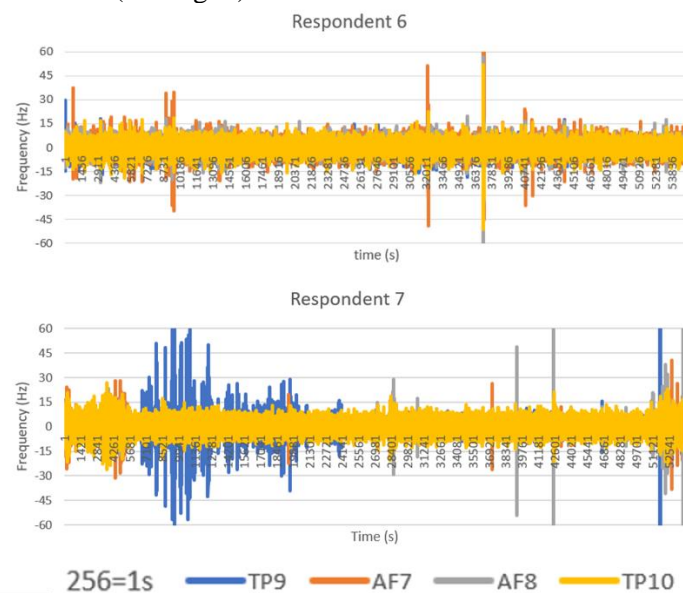


Fig. 6: Waves of Non-pilgrim Respondents
Source: Author, 2021

The Discussion

Brain wave memory activation was shown by bekel respondents (tomb officers - respondents 1-3) and 2 pilgrim tourists (respondents 4-5). This means that memory occurs from the experience of space that is formed. If it is associated with emotions, there is a balance, activation of the brain on the left and the right side of the brain. In each respondent, there is a wave whose magnitude is >45 Hz. In the first 10 seconds of TP9 and TP10, gamma waves were found, meaning that a memory was formed for the stimulus that occurred. The memory of the sacred pilgrimage not only travels to recapture fond memories, but can also revisit places associated with personal experiences of emotional healing (Moscovitch *et al.*, 2006; Marschall, 2012).

The results of brain wave recordings from non-pilgrim respondents (respondents 6-7) did not show memory. Channels TP9 and TP10 do not occur waves with frequencies that reach the gamma frequency (>30Hz), because there is no memory recognition that has been received or space experience. Emotionally, non-pilgrim respondents experienced positive emotions. Tourist emotions have an important role in the cognitive evaluation and behavioural responses of tourists (Volo, 2021).

The results of brain wave recording show the response of the brain's work from respondents to various pilgrimage tourism objects. Diversity of responses due to the capture of human senses carry information about external objects (Serino and Haggard, 2010). Neurobiology underlies brain-behavioral relationships (Bigler, 2003).

Humans are highly visual creatures. Neurophysiologists say that the human cerebral cortex contains more than two dozen visual areas (Smith, 2008). Effects of complex determinants, such as culture show reciprocal interactions between neurochemistry and social processes (Pérez-Arce, 1999). Human behavior is strongly influenced by the social context (Baltruschat *et al.*, 2021). Diversity is captured in brain waves and it occurs due to the various influencing factors

The results of this analysis show that there are differences in brain memory from those who have experienced recognition with those who have not, although both experience positive emotions. The findings of a well-cited study to see the motivation of tourists are drawn from the experience of tourist attractions (Pearce, 2016). People understand their identity from the idea of place/space (Salazar, 2012). However, the positive perception that appears is still not optimal, because the perception without an appropriate external event is called a hallucination (Miskovic, Bagg, *et al.*, 2019; Miskovic, Lynn, *et al.*, 2019). Recognition of a place imprints on brain memory.

The human experience of traveling must be imprinted in the memory of tourists. Destination promotion should increasingly lead to the design of tourism experience opportunities (Moscardo, 2020). The senses give importance to the conceptualization of the tourism experience. Sensory information about places is usually the target of marketing approaches (Jirásek *et al.*, 2021). Tourism promotion is focused on the experience memory of tourists.

The spiritual experience of Gunungjati pilgrimage tourism must be able to generate tourist motivation. Authenticity is an attraction and motivation that must be maintained, especially in the context of preserving intangible cultural heritage, history, often plays an important role in the local heritage and tourism experiences (Amaro, Antunes and Henriques, 2018; Bec *et al.*, 2019; Agapito, 2020). This motivation has fueled the demand for spiritual tourism (Buzinde, 2020). The driving force that makes spiritual tourism able to survive, including the pilgrimage tourism of Astana Gunungjati.

Conclusions

The observation results provide real information from tracking changes in brain waves brought on by the Astana Gunungjati room's vision stimuli. Gamma waves are produced in the brains of bekel and pilgrims in response to visual stimuli such as market space, cemeteries, and pilgrimage activities. The respondent can get a sensory reaction from the spaces and ritual actions. Non-pilgrim responders, however, did not produce gamma wave frequencies. This means that the neuroscience method using gamma wave maps can identify the spirituality feeling produced by the activity of bekel and pilgrims' brain waves. Their brainwave maps reflect a factually established spirituality.

It has been demonstrated that Astana Gunungjati's pilgrimage tourism creates a real sense of spirituality. This documentation demonstrates the factual intangible heritage of tourism-related activities that needs to be preserved. Tourist spaces and their activities need to be maintained because they have shown factual sensations in the form of gamma waves

Neuroscience can record the work of human brain waves on the stimulus they see. This gives an indication that this approach can be used as an alternative to see human perception of space. The findings show that the memory recognition process is strengthened for respondents who have experienced the pilgrimage process. Thus, the recognition process becomes a market opportunity for those who have never done pilgrimage tours. Neuroscience research must continue to be developed in an interdisciplinary manner. Especially in the future space policy, neuroscience can be used as an alternative to the spatial phenomenon approach.

Acknowledgement

Thank you to the Directorate General of Higher Education, Research and Technology, Ministry of Education, Culture, Research and Technology of the Republic of Indonesia for providing research funds through the main contract 156/E5/PG.02.00.PT/2022 and the derivative contract 092/SP2H/RT-MONO/LL4/2022.

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