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Dark skies, bright lives: An exploration of how engagement with dark skies can promote a positive sense of well-being within an international dark sky reserve in the United Kingdom

Submitted in accordance with the requirements for the degree of

Master of Arts by Research

York St John University

York Business School

Emma Jane Sunley

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Author's Declaration

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Emma Jane Sunley

York St John University

2026

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Emma Sunley, stargazing at Dalby Forest. Image credit: Astrodog

Aurora over Yorkshire countryside, October 2024

Abstract

Having a positive sense of well-being means living a fulfilled, meaningful, and contented life, which significantly contributes to overall health. However, it has been affected by the fast pace of modern life and a recent global pandemic. In parallel, we are witnessing a climate crisis, including a rapid rise in light pollution, a major threat to the natural world and our relationship with it. However, there is strong evidence that immersion in nature benefits well-being through its restorative and stress-relieving properties, especially within protected spaces such as national parks. Despite the positive link between nature and well-being, research remains limited on how people engage with dark skies as part of nature in national parks and how this engagement can positively impact well-being. Through bringing together the theory of nature connectedness with the positive psychology PERMA model (Seligman, 2011), a novel conceptual approach explores eudaimonic well-being. This research, based in the North York Moors National Park, United Kingdom, one of only 25 internationally recognised dark sky reserves, explores the connection to nature in a dark sky context through the public engagement programme of dark sky festivals.

Sensory ethnography is applied to recognise the significant role of the senses in dark sky engagement, to understand how non-verbal behaviours form connections with nature, and to explore sensations of well-being. Interpretive analysis suggests that sensory changes in nocturnal environments enable participants to form new and exciting connections with darkness. The findings suggest national parks and dark sky zones should promote dark sky festivals as valuable nature-based leisure activities for well-being. The research recommends extending the emerging trend of prescribing nature for health and well-being to dark sky settings and highlights the urgent need to improve access to dark skies for those living in light-polluted areas.

Keywords: Dark skies, festivals, national parks, nature connection, public engagement, sensory ethnography, well-being.

Table of Contents

Contents

Author's Declaration i
Acknowledgements ii
Abstract iv
Table of Contents v
List of Abbreviations viii
List of Figures ix
List of Tables x
Chapter 1 Introduction 1
Background to the study 1
Rationale 2
Research aim 2
Research objectives 2
Study significance 2
Chapter 2 Literature Review 3
Dark skies and the issue of light pollution 3
Setting a global context on light pollution 4
The dark sky movement to protect the night 5
The rise in astrotourism 6
Well-being 6
Dark skies and well-being 7
National parks as dark sky destinations 8
Dark skies and communities 9
Exploring the links between science and art in the context of dark skies 10
Dark sky festivals 11
The link between nature connection and well-being 12
Theoretical underpinning 14
Eudaimonia and hedonism 14
Nature connectedness and the biophilia hypothesis 14
Well-being frameworks 16
The research gap 19
Introducing the North York Moors as an international dark sky reserve 20
Dark sky festivals in the national park 22

2025: A celebratory year marking the 10th anniversary of the dark sky festival 23
Chapter 3 Methodology 24
Research philosophy: Interpretivism 24
Research approach: Inductive 25
Methodological choice: multi-method qualitative 25
Research strategy: Ethnography 25
Sensory ethnography 26
Time frame 28
Data collection and analysis 28
Population and sampling 29
Interview questions covered the following areas: 30
Thematic analysis 30
Ethical considerations 31
Data storage and retention 31
Essential fieldwork kit 32
Chapter 4 Results and Discussion 33
Emerging well-being themes 33
A. Change in sensory perceptions in the dark trigger curiosity, imagination and creativity 34
Reduced night vision 34
Night walking 36
Use of red lighting 38
Ultraviolet lights to illuminate 38
Amplified sound and deep listening 42
Sense of touch 44
Curiosity and imagination 45
Constellations 48
Art for creativity, self-expression and therapeutic qualities 50
Astrophotography 53
B. Practice mindfulness and slowing down to observe natural darkness 54
Tranquillity and calm 57
Observing and appreciating the natural rhythms 59
C. Mood boosting experiences evoke wonder and awe 60
Wonder, awe and the creation of ‘wow’ moments 60
Emotion of happiness 61
Seasonal Affective Disorder (SAD) 62
D. Sense of community and promote individual and collective empowerment 62

Community 63
Place 65
E. Childhood interest in space and positive family influences 70
Chapter 5 Conclusion 74
Recommendations 77
Limitations 78
Future research 79
References 82

List of Abbreviations

ART	Attention Restoration Theory
ALAN	Artificial Light At Night
ART	Attention Restoration Theory
AONB	Area of Outstanding Natural Beauty
BAA	British Astronomical Association
CNS	Connectedness to Nature Scale
DSA	Dark Sky Area
GDPR	General Data Protection Regulation
IAU	International Astronomical Union
IDA	International Dark Sky Association
INS	Inclusion of Nature in Self Scale
LEDs	Light Emitting Diodes
NBI	Nature Based Interventions
NCS	Nature Connectedness Scale
NRF	National Research Foundation
NHS	National Health Service
NYMNP	North York Moors National Park
NSCI	Night Sky Connectedness Index
OAD	Office of Astronomy for Development
PERMA	Positive Emotions, Engagement, Relationships, Meaning, Accomplishment; A Theory of Well-being: (Seligman, 2011)
PLP	Protected Landscape Partnership
SAD	Seasonal Affective Disorder
SDG	Sustainable Development Goal
SPD	Sensory Processing Disorder
SRT	Stress Reduction Theory
SSSI	Site of Special Scientific Interest
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UK	United Kingdom
UV	Ultra Violet
WHO	World Health Organisation
WWF	World Wildlife Fund

List of Figures

Figure 1: Light pollution across Europe. Image credit: https://www.lightpollutionmap.info 5
Figure 2: Hierarchy of Needs. Source: Maslow (1943) 16
Figure 3: Visualisation of Seligman's (2011) PERMA model of well-being. Image credit: PositivePsychology.com 16
Figure 4: Interpretation of theories on nature and well-being in a dark skies context (Author's own) 17
Figure 5: Conceptual framework linking the PERMA model, nature connectedness and dark sky festivals (Author's own) 18
Figure 6: Dark sky zone: Image Credit North York Moors International Dark Sky Reserve Application, September 2020 21
Figure 7: Light imagery of the North York Moors National Park. Image credit: https://www.lightpollutionmap.info 21
Figure 8: Light imagery of the dark sky reserve of the North York Moors and Yorkshire Dales. Image credit: https://www.lightpollutionmap.info 22
Figure 9: The Research Onion (Saunders, Lewis and Thornhill, 2019, p. 174) 24
Figure 10: Phases of thematic analysis. Source: Braun and Clarke (2006, pg. 87) 30
Figure 11: Muddy walking boots, notebook, pen and headtorch 32
Figure 12: Researcher walking with participants at night, Sutton Bank 36
Figure 13: Red lights to guide participants to stargazing event, Dalby Forest 38
Figure 14: Red lighting at Dalby Forest stargazing hub, February 2025 38
Figure 15: UV light shone on woodland 39
Figure 16: UV light illuminating fungi on the ground 39
Figure 17: Red and UV lighting illuminating trees and fungi 39
Figure 18: Participant taking photograph of fungi on tree, Danby Lodge 40
Figure 19: Snake skin in a clear plastic bag illuminated with a UV light 40
Figure 20: Neon painting workshop, Sutton Bank 41
Figure 21: Participants facing windows looking out to the natural environment 41
Figure 22: UV light illuminating neon artwork 41
Figure 23: Neon painting with UV lighting 42
Figure 24: Planning of artwork on black paper 42
Figure 25: Participant taking home their artwork at the end of the workshop 42
Figure 26: Sutton Bank viewing platform at night 44
Figure 27: Tree moss in spotlight, observed from Sutton Bank viewing platform 44
Figure 28: Space rock in spotlight 46
Figure 29: Stargazing at Dalby Forest with Orion overhead. Image credit: Astrodog 47
Figure 30: Constellations represented as animals during an indoor presentation 48
Figure 31: Visualisation of constellations, Danby Lodge 49
Figure 32: Dome light showing constellation rotation 49
Figure 33: Image taken from Mars, shared at an indoor presentation 49
Figure 34: Dark skies art workshop signage 50
Figure 35: Watercolour nightscapes 50
Figure 36: Nightscapes using watercolour 51
Figure 37: More nightscapes using watercolour 51
Figure 38: Neon painting of planets 52
Figure 39: Mountains and moon with neon paints 52
Figure 40: Signage for felt planet workshop 52

Figure 41: Felt planet advertising board 52
Figure 42: Attaching planets to form a hanging decoration 53
Figure 43: Shaping the wool planets 53
Figure 44: Finished solar system hanging decoration 53
Figure 45: Moon craters seen through telescope at Sutton Bank. Image credit Prof Brendan Paddison 60
Figure 46: View of the Milky Way, indoor presentation, Ampleforth Abbey 61
Figure 47: Handymag February 2025 advertising the dark sky festival 66
Figure 48: Ice telescope advertising the festival during York Ice Sculpture Trail, February 2025 66
Figure 49: Night sky products aimed at children in the North York Moors Visitor Centre shop ... 66
Figure 50: Dark sky books available in the Dalby Forest Visitor Centre Shop 66
Figure 51: Leaflet on how to preserve dark skies. Image credit: NYMNP 67
Figure 52: NYMNP Stargazing guide 67
Figure 53: Poor lighting choices outspill light 67
Figure 54: Improved dark sky friendly lighting 67
Figure 55: Light pollution mapping in the UK, indoor dark sky presentation 68
Figure 56: Dark sky friendly lighting choices 68
Figure 57: Raising awareness of moths for biodiversity 68
Figure 58: Constellation dial maker, given out at Danby Lodge 70
Figure 59: Astronomy apps provided at Ampleforth Abbey 70
Figure 60: Linking dark sky engagement with the PERMA model for well-being (Seligman, 2011) Author's own 72
Figure 61: Mapping the well-being impact of dark sky engagement. Credit: Author's own 73

List of Tables

Table 1: List of participants (Author's own) 29

Chapter 1 Introduction

As we enter the second quarter of the 21st century, we are witnessing a global rise in mental health concerns such as anxiety, stress and depression, exacerbated by the recent global pandemic COVID-19 (Santamauro *et al*., 2021). One contributing factor is increasing artificial light pollution (Falchi *et al.,* 2016) which has been shown to have a detrimental impact on natural rhythms and cycles, disrupting animal behaviour such as hunting, pollination and migration (Longcore and Rich, 2004) and affecting human health such as disruption of sleep and increased health risks such as cancer (Chepesiuk, 2009) and Alzheimer's Disease (Voigt, Ouyang and Keshavarian, 2024). In addition, there is growing concern that we are losing our connection with the natural world amid a climate crisis, and light pollution has become an increasing focus in both environmental and social justice research (Flies *et al*., 2023). This study, centred on the public engagement programme of dark sky festivals delivered within an international dark sky reserve and national park in the United Kingdom (UK), adopts an interpretivist approach to nature connection for well-being in a dark sky context and seeks to better understand how and why people connect with dark skies through festival events, and how this connection evokes positive emotional responses that create sensations of well-being.

Background to the study

The United Kingdom has 15 national parks, which are nature reserves with special qualities that provide habitats for wildlife and opportunities for people to interact with the landscape and its ecosystems (National Parks UK, 2026). The North York Moors National Park (NYMNP) achieved its International Dark Sky Reserve status in 2020. This accolade enabled the community of key stakeholders; residents, local businesses and visitors, to explore the night landscape and its flora and fauna, relatively unaffected by the glow and glare from artificial light pollution sources, particularly in comparison to urban conurbations outside the reserve.

The NYMNP is a popular tourist destination, attracting 9 million visitors in 2024 (NYMNP, 2026), with most visitors arriving during the mild, sunny months between May and September. This research challenges more traditional behaviours and perceptions of daytime visits to national parks, by focusing instead on after dark activities within the park to explore how engaging with dark skies can positively contribute to well-being. Instead of chasing the sun and viewing national parks as places to enjoy in the heat of a mid-summer day, what if we chase the dark in the quieter shoulder season of autumn and winter?

Rationale

There are few existing empirical studies in UK national parks, and specifically in international dark sky reserves, that explore stakeholders' thoughts and experiences regarding the night sky connection (Derrien and Stokowski, 2020), particularly focused on dark sky festivals (Hvenegaard and Banack, 2024; Hall, Paddison and Jones, 2025). Through the theoretical lens of nature connection and by applying an existing positive psychology well-being framework, this research will critically explore the behaviours and narratives of those who connect with dark skies. Ethnographic well-being research gathered through public engagement programmes at dark sky festivals in the United Kingdom is limited; therefore, this research offers a significant new insight into community engagement with dark skies and the resulting sensations of well-being.

Research aim

To explore how participants at dark sky festivals experience sensations of health and well-being in national parks in the United Kingdom through theories of nature connectedness.

Research objectives

1. To explore the impact of light pollution and the emergence of the dark sky movement in national parks in the context of nature connectedness and well-being.
2. Through sensory ethnography, explore participants' experience of nature connectedness, whilst engaging in dark sky festival events.
3. To identify how participants experience well-being through connecting with nature when engaging with dark skies.
4. To make recommendations for further dark skies research beyond the scope of this project.

Study significance

This research is an important step towards better understanding the importance of connecting with natural darkness, not only for the conservation of biodiversity and habitats within national parks but also for psychological well-being. If there is evidence of a link between dark sky engagement and the generation of well-being sensations, this could indicate that dark sky engagement is a useful nature-based activity for well-being and could be better integrated into public healthcare and sustainability policies to support human well-being, nature, and their connection.

Chapter 2 Literature Review

Current literature is critically examined, with a focus on the rural context of national parks as dark sky tourism destinations. The dark sky movement to protect the night from light pollution is introduced, alongside key factors for community advocacy, such as astrotourism. The connection between art and science in dark sky engagement is highlighted, and how this permeates national park festivals as celebrations of darkness. Well-being is defined, and its dimensions are explored. This research takes a novel approach by integrating a positive psychology perspective with a theoretical lens of nature connectedness and uses a new framework to underpin the research and address an identified gap in the literature.

Dark skies and the issue of light pollution

Dark skies occur when the night sky is naturally dark and relatively unaffected by the glow and glare caused by artificial light sources (DarkSky, 2025). Our relationship with dark skies began with the birth of humankind, and it has played a significant role in shaping cultural heritage, from Aboriginal art to star navigation, and has been a topic of fascination spanning science and art (Clarke, 2020). The sun and moon were our first calendars, and despite evolution of humans taking over 2 million years, widespread artificial lighting was invented only within the last few centuries, with the first gas lamp in 1792, and this has been followed by rapid degradation of the night sky since the 1820s (Bjelajac, Đerčan and Kovačić, 2021). Light pollution in both rural and urban contexts, and at local, national, and global scales, has become a major cause of concern, and, in parallel, there has been an exponential rise in light pollution research since the 1970s (Davies and Smyth, 2018).

As a diurnal species, we extend productive time through Artificial Light at Night (ALAN), but this, together with misinterpretations of night and fear of darkness, overlooks the rich potential of darkness for our state of being and our senses (Dunn, 2016). A primal fear of darkness remains evident in responses to nighttime environments and in the polarisation of day and night as good and evil, with daytime commonly seen as more desirable than night (Bjelajac, Đerčan and Kovačić, 2021). However, ALAN has been shown to have detrimental impacts on wildlife, natural cycles, behaviours, and health. It disrupts nocturnal animals such as owls, bats and major pollinators such as moths (Anderson, Rotheray and Mathews, 2023) and can cause animals to become disoriented, affecting foraging, reproduction, communication, migration and whole community ecology (Longcore and Rich, 2004) and has been shown to have a negative effect on biodiversity (Davies and Smyth, 2018). Prolonged exposure to unnecessary and intense artificial lighting has also been shown to disrupt the secretion of sleep hormone melatonin, interfere with circadian rhythms, and disturb sleep (Bjelajac, Đerčan and Kovačić, 2021). Such disturbances

can lead to significant health issues, including insomnia, depression, cardiovascular disease (Choudhary and Kumar, 2023); cancer risks (Chepesiuk, 2009) and Alzheimer's Disease (Voigt, Ouyang and Keshavarian, 2024).

Setting a global context on light pollution

Global mapping of light pollution has shown the extent of artificial light, with more than 80% of the world and more than 99% of US and European populations living under light-polluted skies (Falchi *et al.*, 2016). This revolutionary research discovered that the view of the Milky Way is hidden from over a third of humanity, indicating that a large proportion of humankind does not have the opportunity to view our own galaxy. Furthermore, a citizen science study of global sky brightness from 2011-2022 reported that stars visible by the naked eye decreased by an amount that can be explained by an increase in sky brightness of between 7-10% per year, a faster rate than those indicated by satellite observations (Kyba *et al.*, 2023), indicating the problem of artificial light pollution is more significant than previously indicated. The rise in popularity of Light Emitting Diodes (LEDs), driven by their improved efficiency and cost savings, has exacerbated the problem due to their broad-spectrum, dazzling white light, and is a significant issue in both urban and rural settings (Davies and Smyth, 2018). Therefore, light pollution has been a growing focus of attention within both environmental and health research, with exposure to unnecessary artificial light pollutants often concentrated in communities experiencing socioeconomic disadvantage (Flies *et al.*, 2023).

Despite concern over the loss of the night sky due to light pollution, Davies and Smyth (2018) argue that it does not take the same prominence as other global change phenomena within the climate crisis, such as carbon emissions, temperature changes, or extreme weather events like heatwaves and floods. They present ten reasons why ALAN should be a focus of global change in the 21st century, given its harmful effects on humans and biodiversity, and argue that a new approach could play a key role in a more sustainable future. Their opinion piece highlighted the importance of dark sky preservation and the need for united efforts to reduce light pollution for all species (Davies and Smyth, 2018).

The psychological impact of the loss of dark skies was explored by Venkatesan and Barentine (2023), who introduced the concept of 'noctalgia' or sky grief, a term used to explain the emotional distress caused by light pollution and the resulting loss of dark sky environments. Their research indicated that people mourn the loss of dark skies. Although Venkatesan and Barentine's (2023) study draws links between dark skies and emotional responses, this new research presented here focuses on the well-being benefits of dark skies rather than the negative effects of their loss. Despite this, it is important to acknowledge Venkatesan and Barentine's

(2023) 'noctalgia' as it supports the view that humans are emotionally attached to dark skies, and that when they are lost to light pollution, this can have a detrimental impact on well-being.

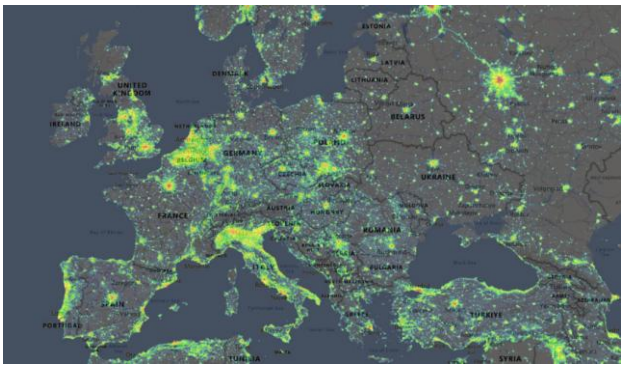

Figure 1: Light pollution across Europe. Image credit: https://www.lightpollutionmap.info

Figure 1 shows light pollution clusters across Europe, including northern Italy, Belgium, the Netherlands, Paris in France and UK major cities such as London in the South, Birmingham in the Midlands, Liverpool in the Northwest and Newcastle and Sunderland in Northeast England. This visually demonstrates the significant geographic spread of artificial light from major cities, which impacts humans, biodiversity and our view of the night sky.

The dark sky movement to protect the night

The dark sky movement began in 1988 with the establishment of DarkSky (formerly the International Dark Sky Association, abbreviated as IDA), whose primary aim is to protect the night sky from artificial light sources. There are now over 160,000 square kilometres of protected land and night skies in 22 countries, 15 in Europe, on 6 continents, and this is increasing year on year through the certification of protected areas (DarkSky, 2025). DarkSky's mission is to encourage communities to preserve and protect dark skies through programmes of outreach, advocacy and conservation, focusing on linkages between culture, heritage and well-being (DarkSky, 2025). The dark sky movement is relevant to this study, which focuses on community engagement with dark skies through festivals within a UK international dark sky reserve.

Furthermore, Wartmann *et al*. (2019) argued that dark skies should be viewed as a landscape quality, alongside wilderness and tranquillity, and that these landscapes should be studied not only physically and ecologically but also in terms of human interaction, thereby demonstrating the importance of taking both environmental and social approaches to better understand community engagement with dark skies as natural environments. Whilst dark sky preservation is often championed by amateur and professional astronomers, light pollution is a social justice issue that profoundly alters the fundamental human experience of viewing the night sky (Flies *et al*., 2023). Therefore, exploring how a community interacts with and attaches meaning to the

nightscape, both in terrestrial and celestial terms, and its link to well-being is the primary focus of this research.

The rise in astrotourism

As well as an increase in artificial light at night in recent decades, there has been a growing demand for astrotourism, as people seek to reconnect with the natural world at night as a way of taking a break from the fast pace of modern living and temporarily escape overuse of artificial lights in urban areas to observe dark skies (Barbosa *et al*., 2022; Rodrigues, Rodrigues and Peroff, 2015). Gankhuu *et al*. (2023) explored how astronomy may benefit mental health and well-being, especially for people living under quarantine. During the global COVID-19 pandemic, isolated nomads in remote areas of Mongolia found the starry night sky helpful for their mental health and well-being, as it alleviated stress and feelings of isolation. Their study contributed to the body of knowledge on astronomy initiatives aimed at improving mental health and strengthened the argument that observing dark skies can benefit well-being. Additionally, the Office of Astronomy for Development (OAD), a joint project of the International Astronomical Union (IAU) and the South African National Research Foundation (NRF), is researching the potential of using astronomy as a tool to improve mental well-being, with encouraging results (OAD, 2025). Despite this, Bjelajac, Đerčan and Kovačić (2021) highlighted that more research has been conducted on the relationship between well-being and green nature than on the relationship between natural dark environments and well-being. This new research aims to contribute to this gap. Next, well-being will be defined for context and to clarify its specific interpretation in this research.

Well-being

The most widely cited definition of health is that of the World Health Organisation (WHO) as complete physical, mental and social well-being, not merely the absence of disease or infirmity (WHO, 2025). Similarly, health researchers defined well-being as "*a state of successful, satisfying, and productive engagement with one's life and the realization of one's physical, cognitive and social-emotional potential*" (Gil and Bedini, 2010, pg. 17). Therefore, health is not merely the absence of illness and well-being is a fundamental aspect of overall human health (Keyes, 2002). Mental health is a state of well-being in which an individual realises their own abilities, can cope with the normal stresses of life, works productively and is able to contribute to their community (WHO, 2025). It is therefore argued that positive mental health not only enhances an individual's life but also contributes to community health.

Dimensions of well-being may be physical, emotional, social, intellectual, spiritual, environmental and occupational, and these are interconnected and complex (Bjelajac, Đerčan

and Kovačić, 2021). In the United Kingdom, the National Health Service (NHS) outlines five pillars for well-being: connect with others, be active, learn new skills, give to others, and pay attention to the present through mindfulness (NHS, 2025). Mindfulness has been found to be effective for improving quality of life and reducing anxiety and stress (Barton *et al.*, 2016).

The recent global pandemic of COVID-19 was shown to have had a detrimental impact on mental health. For example, Santomauro *et al.* (2021) studied the global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 and found that the pandemic has created an urgency to strengthen mental health systems. Mental health problems are associated with lower quality of life, as noted by Coventry *et al.* (2021), who conducted a meta-analysis of nature-based interventions (NBIs) in community settings. Their research demonstrated that NBIs were effective for improving mood and reducing anxiety. There was less evidence of improved physical health, but their research highlighted a positive correlation between nature-based activities and better mental health outcomes (Coventry *et al.*, 2021), supporting the argument that a positive relationship with nature is beneficial for health. In addition, the recent inclusion of mental health in the United Nations Sustainable Development Goal (SDG) 3, Good Health and Well-Being (UN, 2026), highlights the urgent need to gain a better understanding of the interplay between mental health and development and supports the opinion that mental health should be a global priority for sustainability (Mills, 2018).

Dark skies and well-being

Bjelajac, Đerčan and Kovačić (2021) stated that natural darkness and sleep quality are of paramount importance to human health and considered the interconnected roles of natural darkness and technology for astrotourism and well-being. They emphasised the appropriate use of technology in dark sky conservation to promote well-being and sustainable astrotourism. They argued that, when used appropriately, technologies that contribute to artificial light can be used in astronomy to promote dark skies, linking to wellness and restorative behaviours. In a similar vein, Barbosa *et al.* (2022) argued that astrotourism and citizen science in dark sky destinations within rural areas are key to their protection. Their research focused on a training programme for young people to use a smart, compact telescope during the COVID-19 pandemic to observe deep space in a certified dark sky area in central Portugal. They argued that citizen involvement in astronomy is important for dark sky connection and preservation, which evidenced the potential for citizen science initiatives to support community engagement with dark skies.

The link between dark sky activities and well-being was explored by Bell *et al.* (2014), who introduced the concept of ‘dark nature’ activities, such as stargazing, as a way of interacting with nature in nocturnal environments. Their findings suggested that people with more years of

stargazing and those who noticed wildlife whilst stargazing felt most connected to dark skies. Their findings support the view that exposure to natural nighttime environments can reduce stress, enhance mood and improve overall mental health and stargazing was found to encourage mindfulness and generate sensations of awe (Bell *et al.*, 2014). These emotions were highlighted by social psychologist Keltner (2023), who argued that happiness is found in the emotion of awe and is associated with greater life satisfaction. Previously, Monroy and Keltner (2022) proposed that awe is an emotion that promotes mental health through the engagement of five key processes: shifts in neurophysiology, diminished focus on self, increased relationality, greater social integration, and a heightened sense of meaning, all of which benefit well-being (Monroy and Keltner, 2022). They applied this process model to illustrate that experiencing awe in natural environments strengthened the body and mind, lowered heart rate and increased oxytocin. Awe, therefore, shifts perspective on identity and is key to well-being (Keltner, 2023).

To measure personal connection to the dark skies, Barnes and Passmore (2024) developed a 'Night Sky Connectedness Index' (NSCI) surveying 400+ people with varying levels of interest in the night sky, using two subscales: connection to and protection of the night sky. They found strong evidence that a greater connection with the night sky was significantly and positively correlated with a person's mental health and happiness. Their research indicated that those living in more light-polluted areas are less likely to connect to the night sky and feel less inclined to protect it. This highlighted the importance of outreach to help those living in urban areas understand the value of dark skies and facilitate connections, not only for dark sky conservation but also to promote dark skies for well-being. Therefore, it is argued that the development of the NSCI is useful not only for rewilding night skies and protecting dark environments and community heritage, but also for quantitatively measuring dark sky connection and its impact on well-being (Barnes and Passmore, 2024).

National parks as dark sky destinations

There can be a significant economic advantage for national parks to offer dark sky tourism during the shoulder season, when visitor numbers drop due to colder weather, thereby enabling more efficient use of community and tourism-related resources year-round (Mitchell and Gallaway, 2019; Rodrigues, Rodrigues and Peroff, 2015). It is argued that national parks are well-positioned landscapes to support astrotourism as a form of sustainable rural development, hosting astronomy sites of global importance (Jacobs, Du Preez and Fairer-Wessels, 2020). Due to their rural location, they benefit from naturally darker skies and attract visitors seeking to explore the night. Weaver (2011) highlighted the importance of collaboration between ecotourism operators and astronomy organisations to establish dark sky reserves that support celestial ecotourism,

including witnessing mega-skies, visiting observatories, and viewing the aurora. Within dark sky reserves, wellness retreats that combine mindfulness, spirituality, and stargazing are an emerging trend. For example, in the Yorkshire Dales National Park, guests at Broughton Sanctuary can star-bathe whilst lying in an empty Victorian bathtub, gaze at the cosmos, and focus on mindfulness and deep breathing, helping reset the sympathetic nervous system whilst appreciating the vastness and beauty of the universe (Broughton Sanctuary, 2024).

Collison and Poe (2013) studied a well-developed astronomy programme in Bryce Canyon National Park in the United States and contended that dark skies are a neglected landscape, yet the park is well positioned to leverage its attributes and educate visitors about their importance. They recommended that more research be conducted on visitor characteristics to better understand perceptions and whether they would return and recommend the dark sky programme. The 2019 Glover Landscape Review of National Parks and Areas of Outstanding Natural Beauty (AONBs) recognised the importance of management plans of special places and created a Protected Landscapes Partnership (PLP) to ensure the government acknowledged that protected landscapes not only have a significant role in nature recovery but are also a positive force for the nation's health and well-being (Gov.uk, 2024). Additionally, a countryside charity conducted a citizen star count in February 2023, involving 4,000 people, and found that only 5% enjoy the wonder of a truly dark starry sky. This highlights the importance of dark sky reserves as places where people can experience truly dark skies, which is often not possible at homes outside of national parks and dark sky reserves (CPRE, 2023). This new research is therefore timely, as it explores the perceptions and experiences of those using the NYMNP to engage with dark skies through the public engagement programme of dark sky festivals.

Dark skies and communities

Dark skies and nighttime environments are part of our society and culture (Edensor, 2013) and are an interdisciplinary topic of great significance for community heritage, beliefs and values (Dunn and Edensor, 2023). However, despite the night sky being an asset that has had a role shaping our history, Gallaway (2010) argued it is at risk of being lost to humanity, and largely to blame is an inability to adequately express the true value of natural beauty: "*Society's poor handling of passive pleasures, such as the enjoyment of beauty, helps explain the largely un-mourned loss of dark skies*" (Gallaway, 2010, pg. 85). He reasoned that preservation of the night sky requires an understanding of light pollution issues, technologies to mitigate poor use and reduce its impact and called for a more explicit way to express the importance of the instrumental value of dark skies, suggesting their loss is due to inability to explain why they are

important, beyond passive pleasure. This suggests stronger intent is required to articulate the significance of dark skies and their benefits.

In terms of the values communities' place on dark sky protected zones, Marr (2024) mapped the values of the Galloway Forest Dark Sky Park, a status achieved in 2009, and how key community stakeholders imagined, experienced, and interacted with it. Marr's (2024) rich ethnographic research affirmed Dark Sky Parks as sites of cultural importance and socioecological interaction. Similarly, McGhie's (2024) 5-year practice-based research project at Kielder Observatory, Northumberland International Dark Sky Park, used a sensory-oriented approach, including photography, sound trails, and exhibitions, to explore the sensorial experience of darkness and community encounters with the environment and wild darkness. Additionally, Blair's (2018) community-based qualitative research undertaken in the famous Dark Sky Community and the first Dark Sky Island of Sark, Channel Islands indicated that the night sky can foster community connection, storytelling, sense of awe and other positive transformative feelings of enjoyment as well as evoke nostalgic childhood memories, further supporting the argument that there is a positive link between dark skies and well-being. The research, carried out through intuitive enquiry by Blair (2018), a psychotherapist with a background in environmental psychology, theorised that dark skies can positively impact well-being and strengthened claims made by the dark sky movement (DarkSky, 2025).

Exploring the links between science and art in the context of dark skies

Alongside community and heritage, it is important to consider the merging of science and art in a dark-skies context. Morris (2011) linked art, landscape and sensory perception at night, drawing together contemporary theory on installation art and how individuals experience the nocturnal landscape. Their research highlighted the importance of not focusing on personal narratives in isolation, because what an individual experiences is often caused or shared by others (Morris, 2011). This emphasises the importance of art and community in dark sky engagement, and that social interplay is a key consideration for research on dark sky festivals in dark sky protected zones.

A flagship piece of research by Derrien and Stokowski (2020) introduced the concept that communities and protected areas have programmes to promote and protect dark skies, but that there is limited research on how and why night skies are meaningful to people. Based in Acadia National Park, their work addressed the use of language, personal narratives, and discursive practices among visitors to contextualise night sky experiences in social, cultural, and spatial terms, identifying symbolism, social influences, and place-based memories that shape personal imaginations of dark skies. Their research envisioned dark skies as unreachable spaces, offering

a new approach to qualitative interpretivist research on dark skies, uncovering rich visitor imaginaries to better understand people's meaning of dark skies and their importance as a natural and cultural resource (Derrien and Stokowski, 2020).

Creative approaches help to better understand the value and meaning of dark skies to communities, and it has been shown that creative interventions increase curiosity and beneficial well-being outcomes (Schutte and Maloff, 2022), and curiosity has been linked to better mental health and a protective factor against anxiety and depression (Zainal and Newman, 2023). A collaboration between DarkSky and More Than Just Parks resulted in a short film 'Know the night' (DarkSky, 2025), which visually celebrated the magic of natural darkness and highlighted the importance of community engagement in dark skies protection. Capturing starry skies over the NYMNP Dark Sky Reserve, the film represented a call for communities to look up, be inspired, and join the dark sky movement to reclaim the night (DarkSky, 2025). This brings the focus to festivals as a medium for engaging communities in the celebration of natural darkness.

Dark sky festivals

Public engagement programmes in national parks are a common practice to spread conservation and regenerative tourism messages through group activities (Hall, Paddison and Jones, 2025). Dark sky festivals bring together key community stakeholders of visitors, residents, local businesses and public officials working within the reserves to celebrate the night through a diverse range of events such as stargazing, night walks and artistic workshops. However, research on how public engagement through dark sky festivals in national parks can positively impact people's social, emotional, and mental health and well-being remains limited (Bell *et al.*, 2014). It is argued that when something is meaningful to people, they are more likely to want to protect it, and dark sky destinations are well-positioned to leverage their natural assets through dark sky programmes that educate visitors about the importance of preserving dark skies (Collison and Poe, 2013). In addition, there has been a recent revival of the old Dutch ritual of observing the natural shift from light to dark, day to night, termed 'dusking', as a way to disconnect from artificial light sources such as mobile phones and computer screens and to seek peace and contentment. Despite a lack of literature on 'dusking', in February 2026, a brand-new event was run at Orchard House within Helmsley walled garden as part of the NYMNP dark sky festival, which incorporated soothing sounds and storytelling at dusk (The Guardian, 2026).

Although limited, some research has taken place on dark sky festival events in national parks, for example, the empirical study by Hvengaard and Banack (2024) on visitor experiences as part of the Jasper dark sky festival in Alberta, Canada. They found a high level of visitor satisfaction when attending festivals, but discovered a gap between awareness and action, as only 42% of

participants planned to change behaviours to protect dark skies. Their research called for action to address barriers to visitor behaviour change to protect dark skies within national parks (Hvengaard and Banack, 2024). Their work emphasised the importance of festival organisers addressing barriers to encourage individuals to tackle light pollution beyond dark sky festivals. Although this research will not specifically address behaviour change, which would be more conducive to a longitudinal study, it will contribute to a better understanding of how the community in a dark sky reserve values dark skies and how this connection contributes to well-being. Recent research by Hall, Paddison and Jones (2025) emphasised the potential of dark sky festivals within dark sky protected zones to act as catalysts for regenerative tourism practices. Their research, gathered during the February 2024 dark sky festival in the NYMNP investigated key stakeholder practices and perceptions and highlighted the importance of a sensory methodology in immersive nighttime environments.

The link between nature connection and well-being

There can be synergistic health benefits of being immersed in nature, including exercise, education, and therapy (Barton *et al.,* 2016). Romagosa, Eagles and Lemieux (2015) found a link between parks and protected areas and enhanced human health. The research recommended a combined effort among policymakers, social and healthcare professionals, and researchers to better link human well-being and protected areas to enhance health promotion, suggesting that parks and protected areas are better utilised as health resources. This recommendation, relevant to national parks though not dark sky focused, aligns with the intentions of this research to better understand dark sky engagement for well-being.

Richardson *et al.* (2021) found that nature connection predicts higher levels of happiness and vitality and argued that even simple connections with nature, such as smelling flowers, generate positive emotions. In addition, Capaldi, Dopko and Zelenski (2014) highlighted a correlation between nature connectedness and happiness. Similarly, a recent report found that people who spend more than 120 minutes with nature each week gain the greatest well-being benefits compared to those who spend less time with nature (White *et al.*, 2019; Natural England, 2025). When exploring human–nature relationships and nature connectedness as a psychological construct, Lengieza and Aviste (2025) argued that a person's closeness to nature is based on meaningful contact. Tourist well-being shaped by guided slow adventures, such as stargazing, was studied by Farkić, Filep, and Taylor (2020), who found that meaningful moments with nature were forged through immersive guided experiences where time was not pressured and a sense of belonging was established in small social groups. Their research, grounded in positive psychology, was contextualised in relation to the Sustainable Development Goal (SDG) 3; Good

Health and Well-being (United Nations, 2026). They revealed through semi-structured interviews in the Scottish Highlands and Islands that mindful experiences and slow stargazing adventures in natural environments are supported by tour guides. Their focus highlighted the vital role of these guides in fostering togetherness within a social group immersed in a natural environment, facilitating social interactions in unfamiliar surroundings and helping establish belonging.

The role of nature for mental health restoration, in particular coping with psycho-physiological stress, was studied by Berto (2014), who found that natural environments can help people cope with stress and mental fatigue. Natural places that allow the renewal of personal resources to meet the demands of everyday life are referred to as restorative environments and help to enhance positive emotions (Ohly *et al.*, 2016). Ohly *et al.* (2016) argued that natural environments promote calm and restoration compared to urban environments. In addition, Piccininni *et al.* (2018) surveyed 30,000 Canadian young people and found that exposure to outdoor environments was a protective factor for young people's mental health, highlighting the importance of engaging with outdoor spaces for well-being. There is an emerging trend among healthcare professionals to prescribe nature-based leisure activities as a mental health intervention (Fullam *et al.*, 2021) and to prescribe tourism for well-being (Filep, 2014).

In October 2024, the World Wildlife Fund (WWF) launched a 'prescription for nature' campaign, underpinned by the belief that short regular immersion in nature is good for well-being. The campaign encouraged people to spend at least 20 minutes per day in nature to boost mental health, reduce anxiety and stress, and improve mood (WWF, 2025). In line with this, health professionals are now beginning to prescribe nature as a healthcare intervention for those suffering from anxiety and depression, and there is hope that this will help to forge a symbiotic relationship between humans and nature (Romagosa, Eagles and Lemieux, 2015). Other research on nature connection and well-being was conducted by Maller *et al*. (2008), who summarised the contribution of parks and protected areas to five key components of human health; physical, mental, spiritual, social and environmental. They suggested that parks and other natural environments are vital support for well-being in the access they provide to nature.

In addition, the Natural Health Service for North Yorkshire is a new green social prescribing programme designed to build deeper connections with nature and enhance health and well-being through sensory and nature-based activities in the region (York and North Yorkshire Combined Authority, 2026; NHS England 2025; York St John University, 2025).

In terms of measuring nature connection, Mayer and McPherson Frantz (2004) produced the Connectedness to Nature (CNS) Scale and Schultz (2001) devised the Inclusion of Nature in Self Scale (INS). Similarly, Bratman, Hamilton and Daily (2012) proposed a system of categorisation

for nature experience and its effects on mental health but argued that more research is needed to explore how people connect with dark skies and nature, and the impact this can have on well-being, which strongly aligns with this research.

Theoretical underpinning

This study takes a novel approach, bringing together key theories to examine how participants at dark sky festivals within a UK dark sky reserve experience well-being. Using a theoretical perspective of nature connectedness, it considers the concept of eudaimonia, which encompasses deep happiness and meaning, alongside a wellbeing framework rooted in positive psychology. This theoretical foundation supports the research and introduces diverse yet interconnected dimensions to better understand and interpret how participants experience well-being through engaging in dark sky festival activities within a national park.

Eudaimonia and hedonism

Two key terms help differentiate happiness and well-being. Firstly, hedonism, which holds that positive experiences should outweigh negative ones, dates back to the 4th-century BC Greek Philosopher Aristippus, who preached that the ultimate goal in life should be to maximise pleasure and avoid pain (Henderson, Knight and Richardson, 2013). However, a deeper form of happiness and meaning, known as eudaimonia, is attributed to the 4th-century BC Greek philosopher Aristotle, who argued that it is the highest human good and refers to a state of flourishing and living well, associated with personal development, growth, purpose, and virtue. Eudaimonia extends beyond the simple pleasures of hedonism to emphasise the importance of profound meaning, self-realisation, and fulfilment, involving a journey of self-discovery and the achievement of excellence, thereby creating a deeper sense of happiness and well-being. In the context of nature connectedness, Henderson, Knight, and Richardson (2013) argued that both hedonism and eudaimonia contribute to overall well-being and that these notions of happiness are relevant to this research. Research has shown a link between feelings of happiness and well-being and immersion in nature (Pritchard *et al.*, 2019). As such, theories of nature connectedness offer a useful lens to understand how immersion in natural darkness produces such feelings.

Nature connectedness and the biophilia hypothesis

Relevant to nature connectedness theory is the biophilia hypothesis (Kellert and Wilson, 1995), which states that humans have an evolutionary innate desire to be close to non-human living entities and natural habitats, as the human mind, body and senses evolved under bio-centric, not manmade or engineered factors (Barton *et al.*, 2016). Urban development, such as the

industrial revolution and rapid technological advances are recent in evolutionary terms and humans as a species are still "*biologically programmed to respond to a variety of environmental cues and natural stimuli*" (Barton *et al.,* 2016, pp. 17), so our inherent affinity for the natural world continues to be instrumental to well-being. Although the biophilia hypothesis focuses on landscapes and ecosystems, it is argued here that the night sky is the most universal natural environment that humankind has evolved with and one we have a strong affinity for.

Nature connectedness is a psychological construct that describes how people feel psychologically and emotionally close to nature and how they incorporate the natural world into their sense of identity (Lengieza and Aviste, 2025). Although nature connectedness is not attributed to a single figure, Ulrich et al. (1991), leading scholars in this field, studied measurable health impacts of nature in healthcare settings and proposed that natural environments evoke positive emotions and alleviate psychological stress. They proposed a Stress Reduction Theory (SRT) to explain the beneficial outcomes of exposure to natural environments on human psychological responses. Similarly, Kaplan and Kaplan's (1989) Attention Restoration Theory (ART) stated that spending time in nature restores attention and cognitive function and combats mental fatigue (Kaplan, 1995). These theories on nature connectedness support the view that immersive natural environments can promote cognitive restoration, reduce stress and fatigue, and evoke positive emotional responses. Nature connectedness is subjective and varies among individuals, but it encompasses deep thoughts, feelings, and experiences with nature that go beyond simple or passive contact. The most apparent way to experience nature is in outdoor settings, but it can include indirect experiences, such as enjoying images of nature in photography and art (Barton *et al.,* 2016). The ways people connect with nature include engaging the senses, perceiving beauty, evoking positive emotions, and developing a deep sense of meaning and compassion (Lengieza and Aviste, 2025). This theoretical underpinning of how natural environments positively impact human well-being will be applied within the context of dark sky engagement in a national park and dark sky reserve in the UK.

Pritchard *et al*. (2019) explored, through a meta-analysis, how nature connectedness relates to an individual's subjective sense of their relationship with the natural world. They discovered that those who are more connected to nature have greater eudaimonic well-being and higher levels of self-reported personal growth (Pritchard *et al.,* 2019). They argued that connecting with nature has a significant impact on deep levels of happiness, fulfilment and personal development. Similarly, in a study of hedonic and eudaimonic behaviours, Henderson, Knight and Richardson (2013) found that hedonic behaviours increased positive emotions and reduced negative emotions, such as stress, whereas eudaimonic behaviours led to greater meaning in life and

elevated experiences. This study indicated that hedonic and eudaimonic behaviours both contribute to well-being, but in different ways. This new research explores how engagement with dark skies has the potential to build deeper connections to nature and contribute to well-being.

Well-being frameworks

A basic understanding of human requirements is Maslow's (1943) Hierarchy of Needs (Figure 2):

Figure 2: Hierarchy of Needs. Source: Maslow (1943)

It is argued that, based on Maslow's Hierarchy of Needs (1943), human desire is to strive towards a positive state of well-being through a series of levels. Maslow's (1943) theory puts self-actualisation as the highest life goal, championing a eudaimonic perspective. Although this theory of human need is an important consideration, it is necessary to apply a more specific theory of well-being to this research. Theories of well-being, such as Ryan and Deci's (2000) Self-Determination Theory (SDT), state that well-being depends on satisfaction of three psychological needs: autonomy, competence, and relatedness. In a similar vein, six psychological scales of well-being were defined by Ryff (1989) as autonomy, environmental mastery, personal growth, positive relations with others, purpose in life and self-acceptance. She argued that when balanced, these factors contribute to an individual's sense of contentment and happiness.

Although important considerations, Seligman's (2011) PERMA model of well-being was preferred (Figure 3).

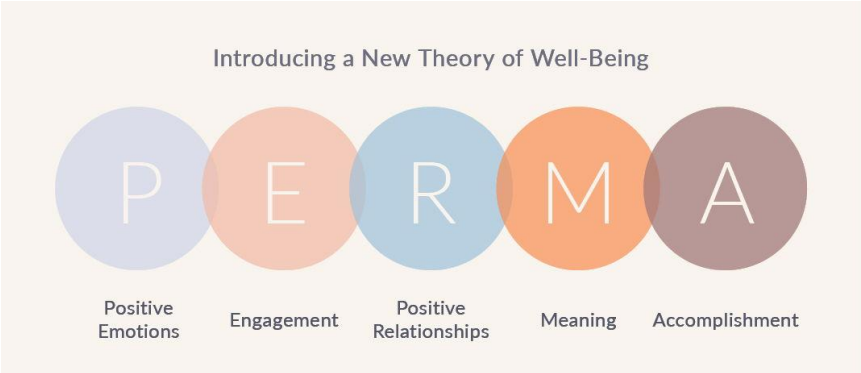

Figure 3: Visualisation of Seligman's (2011) PERMA model of well-being. Image credit: PositivePsychology.com

Figure 3 presents 5 key dimensions of well-being in the PERMA model (Seligman, 2011):

- **Positive emotions** such as joy, gratitude, love
- **Engagement** includes being immersed in activities utilising skills and strengths
- **Relationships** which are positive create meaningful bonds with others
- **Meaning** achieving a sense of purpose and belonging
- **Accomplishment** demonstrating competence and achieving goals

This multi-dimensional framework for understanding contributors to well-being, developed by Seligman (2011), a leading figure in positive psychology, focuses on flourishing. In this research, the five elements of Seligman's (2011) PERMA model (Positive emotions; Engagement, Relationships, Meaning and Accomplishment) will help identify participants' sensations and experiences with dark skies, to explore how nature connectedness produces eudaimonic sensations of well-being.

A unique interpretation of these theories on nature and well-being in a dark skies context is shown in Figure 4 which brings together humans' innate affinity for natural environments, nature connectedness and eudaimonia, and the PERMA model well-being framework (Seligman, 2011).

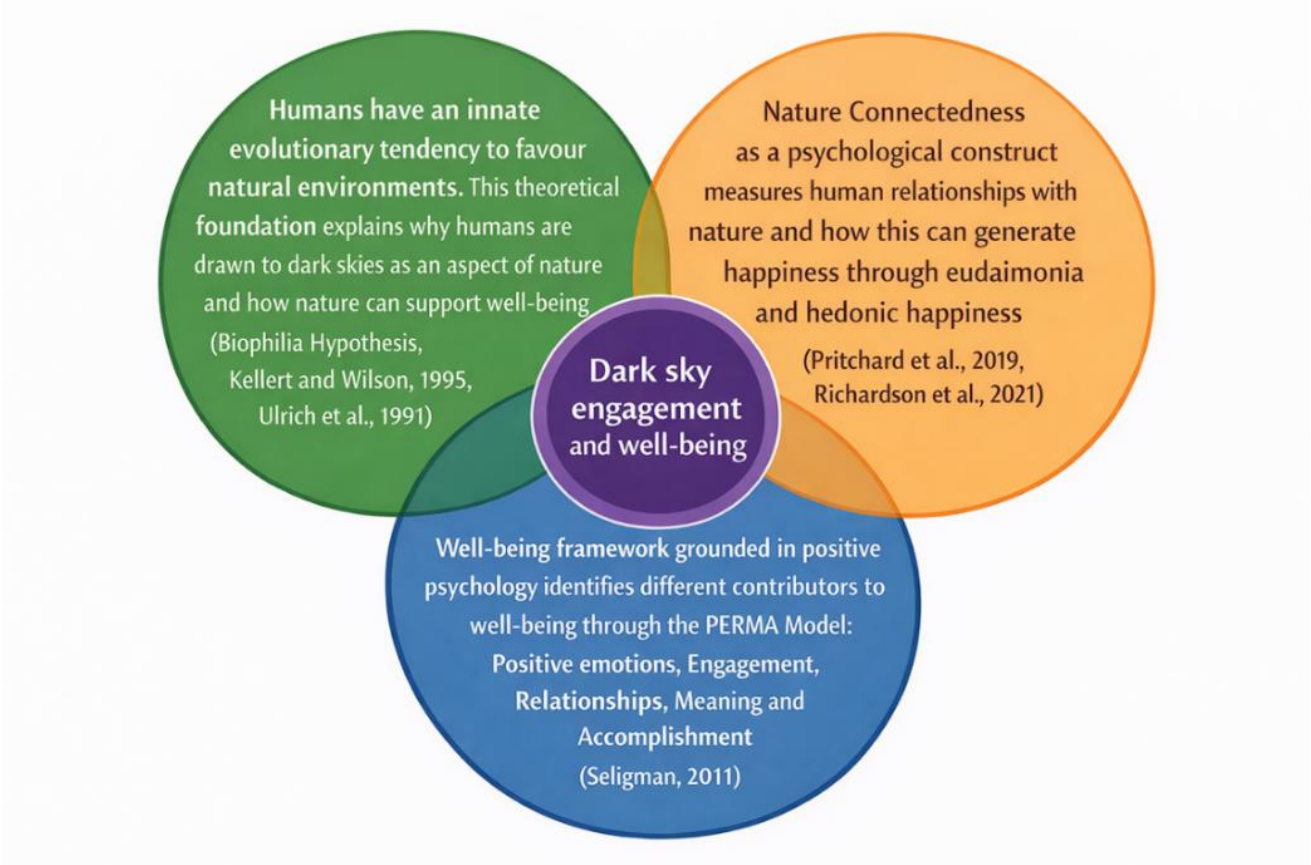

Figure 4: Interpretation of theories on nature and well-being in a dark skies context (Author's own)

This interpretation offers a unique perspective to understand, within the context of dark skies, human innate desire to connect to nature and how sensations of well-being are expressed. Figure 5 below extends this further by presenting a new conceptual framework to demonstrate what nature, in the context of dark sky engagement, does for human well-being. It will be used to show how nature connectedness produces sensations that generate feelings of well-being.

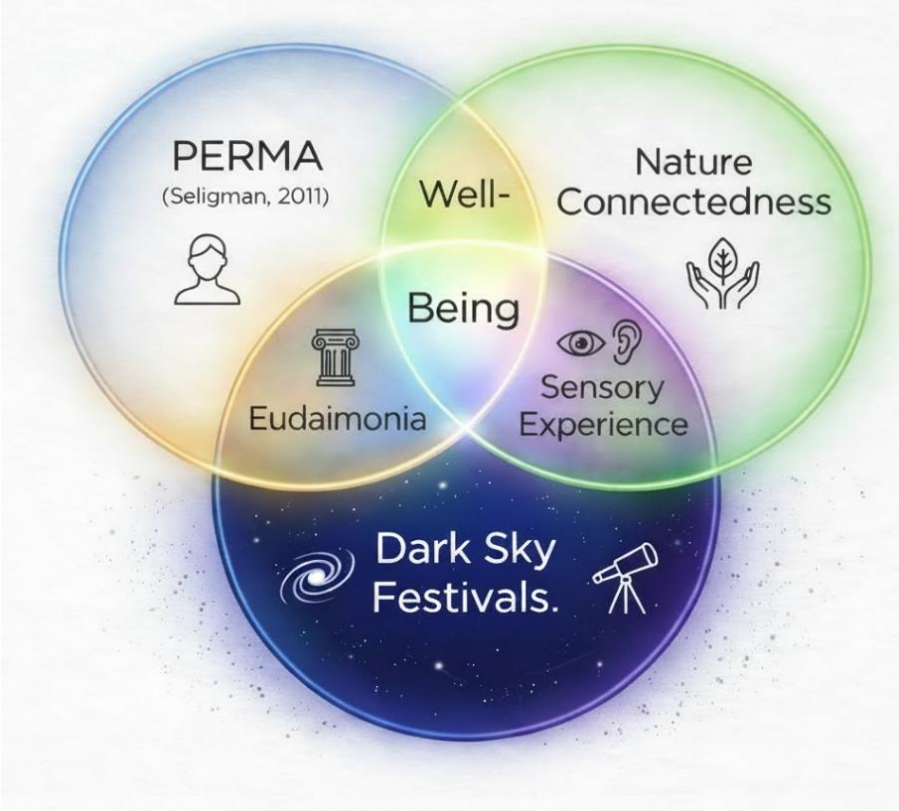

Figure 5: Conceptual framework linking the PERMA model, nature connectedness and dark sky festivals (Author's own)

Each of the three areas adds value and strength to the novel theoretical approach taken in this research, helping to explain participants' engagement and experiences with dark skies and nocturnal biodiversity during dark sky festivals, as well as the resultant positive emotional responses that generate sensations of well-being. These key areas of underpinning theory work together to create an innovative new lens to explain how engaging with dark skies can increase nature connectedness and evoke positive sensations, which enhance psychological well-being. Exploring connections to dark skies, through the application of nature connectedness theory and eudaimonia, demonstrates that sensations of well-being and happiness are produced, and the PERMA model (Seligman, 2011) breaks down how well-being manifests in different ways within a dark sky setting through positive emotions, engagement, relationships, meaning and accomplishment.

The research gap

The literature review identified a significant gap that this study will address. Current research has focused on the extent of light pollution and sky glow (Davies and Smyth, 2018; Falchi *et al.*, 2016; Kyba *et al*., 2023), the detrimental effects of light pollution on ecology and biodiversity (Longcore and Rich, 2004), health risks of artificial light (Chepesiuk, 2009), detrimental emotional impacts of mourning the loss of dark skies (Venkatesan and Barentine, 2023) and astronomy as a sustainable development option for rural economies (Gankhuu *et al*., 2023; Barbosa *et al*., 2022). However, rather than focusing on the detrimental impacts of light pollution or the threat of losing dark skies, this study embraces natural darkness for its potential benefits to well-being, addressing a gap previously identified by Bjelajac, Đerčan and Kovačić (2021).

In addition, most of the literature on the role of nature and natural environments for well-being was daylight, ground and green-centred (Bratman, Hamilton and Daily, 2012; Capaldi, Dopko and Zelenski, 2014; Pritchard *et al.*, 2019; Richardson *et al.*, 2021), rather than focused on the role of natural darkness as an aspect of nature and its potential for well-being (Bjelajac, Đerčan and Kovačić, 2021), suggesting more research is needed on human interactions with natural nighttime environments. Therefore, this study will bridge this gap.

Similarly, some UK studies on nature and well-being statistically analysed large sample sizes via surveys, such as Richardson *et al*. (2021), who conducted a UK-based study on n=2,000+ respondents and found simple moments with nature to be effective for well-being, but did not study well-being and nature in the context of dark skies. In contrast, this study will gather rich personal narratives rather than develop a consensus.

Bell *et al.* (2014) was the first known study of its kind to conceptualise stargazing as a dark sky nature activity, focusing on exploring the potential well-being benefits, but this new study extends this further by incorporating other dark sky nature activities, including night-sky-themed art workshops and night walks. This research, therefore, fills a gap by providing new insights into engagement with nature in national parks, specifically within the context of dark sky festivals.

The literature provided empirical evidence of dark sky engagement from the USA (Collison and Poe, 2013; Derrien and Stokowski, 2020), Africa (Jacobs, Du Preez and Fairer-Wessels, 2020) and parts of Europe, such as Portugal (Barbosa *et al.*, 2022), but UK-specific case studies were limited (Richardson *et al*., 2021; Farkić, Filep and Taylor, 2020; Hall, Paddison and Jones, 2025; Marr, 2024).

Hvengaard and Banack's (2024) Canadian festival research was based on visitor experience and behaviour change rather than well-being, so not UK or well-being centred. Similarly, recent dark sky festival research within the NYMNP by Hall, Paddison and Jones (2025) was focused on

regenerative tourism practices rather than well-being. The research follows a creative short film (Burns, Hall and Paddison, 2024) to explore community engagement in dark skies in the NYMNP and why conserving this dark sky reserve through public engagement programmes is vital not only for the preservation of dark skies but also for the promotion and practice of well-being.

This research, based in the North York Moors National Park (NYMNP) in the United Kingdom (UK), is conducted in one of only 25 internationally recognised dark sky reserves; therefore, the geographical setting is conducive to this research. It is the first known study of its kind to investigate well-being in the context of dark sky festival events through a novel theoretical approach that draws on theories across the social sciences, including psychology and public health, geography, and environmental studies, contributing a new understanding of the human experience of dark sky places. The positive psychology perspective, using Seligman's (2011) PERMA model of well-being, offers a new and exciting conceptual link between related fields of study on well-being in a dark-skies context. The novel theoretical approach integrates nature connectedness theory and utilises the PERMA model (Seligman, 2011) to identify sensations that generate feelings of eudaimonic well-being.

There is an identified research gap on exploring key stakeholder perceptions and experiences when engaging with dark skies through festivals within a UK national park and dark sky reserve. As such, this study through its exploratory design will generate new empirical insight to better understand how engaging with the night sky can help people achieve a positive sense of well-being and makes a significant contribution to existing limited research on dark sky engagement in a post-pandemic world.

Introducing the North York Moors as an international dark sky reserve

The darkest regions in the world are organised into six categories; International Dark Sky Communities; International Dark Sky Parks; International Dark Sky Reserves; International Dark Sky Sanctuaries; Urban Night Sky Places; Dark Sky Friendly; Developments of Distinction (DarkSky, 2025). An International Dark Sky Reserve must have a brightness of no more than 20 magnitudes per square arcsecond and be on public or private land of at least 700 km2. It includes a core area that meets the minimum criteria, as well as a peripheral area that supports the preservation of the core's darkness (DarkSky, 2025).

The North York Moors achieved national park status on 28 November 1952 and is one of 15 such protected areas in the UK covering 1,436km between Scarborough, Thirsk and Teesside (National Parks UK, 2026). A landscape richly steeped in cultural heritage with stunning purple heather moorland, quaint rural villages, woodland and dramatic coastlines, with tourism a significant income stream, particularly during the summer months. Following a successful application,

NYMNP became an international dark sky reserve in 2020 and together with the Yorkshire Dales is one of only seven across the UK and one of only 24 in the world. The dark sky reserve covers the entire national park, an area of 3,615km^2 (North York Moors, 2025).

The NYMNP Authority and Trust have engaged the public with astronomy-related events for over 30 years, when Dalby Forest began public night-watches in 1993, and eight years later Sir Patrick Moore opened the woodland's first public observatory (NYMNP, 2025). On a clear night on the moors, it is possible to see the Milky Way, the nearest galaxy Andromeda, thousands of stars, the craters on our moon, planets, constellations, comets, satellites and other unique astronomical events (NYMNP, 2025). Around 2,000 stars can be seen on nights without cloud cover (DarkSky, 2025). The community is a diverse mix of visitors, residents and local businesses and some rural villages in the reserve have already received recognition as 'dark sky friendly' villages, such as Hawnby, for adhering to strict policies on the appropriate use of lighting, which minimise upward light emission and reduce interference with night-sky observation (NYMNP, 2025).

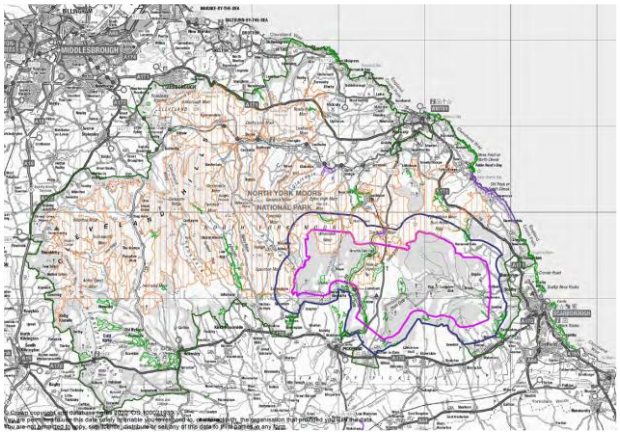

Figure 6: Dark sky zone: Image Credit North York Moors International Dark Sky Reserve Application, September 2020

Figure 6 shows the boundaries of the NYMNP (green) along with the core (purple) and critical buffer zone (blue).

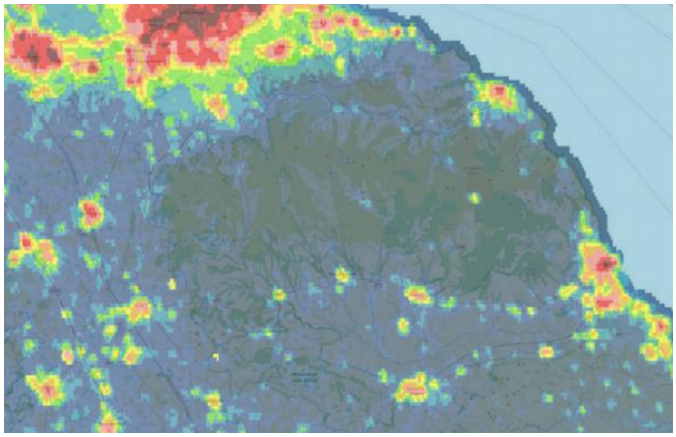

Figure 7: Light imagery of the North York Moors National Park. Image credit: https://www.lightpollutionmap.info

Figure 7 shows light imagery of the North York Moors and the core dark sky protected zone with a small cluster at Fylingdales Royal Air Force base and light pollution in the North from Middlesbrough and Teesside.

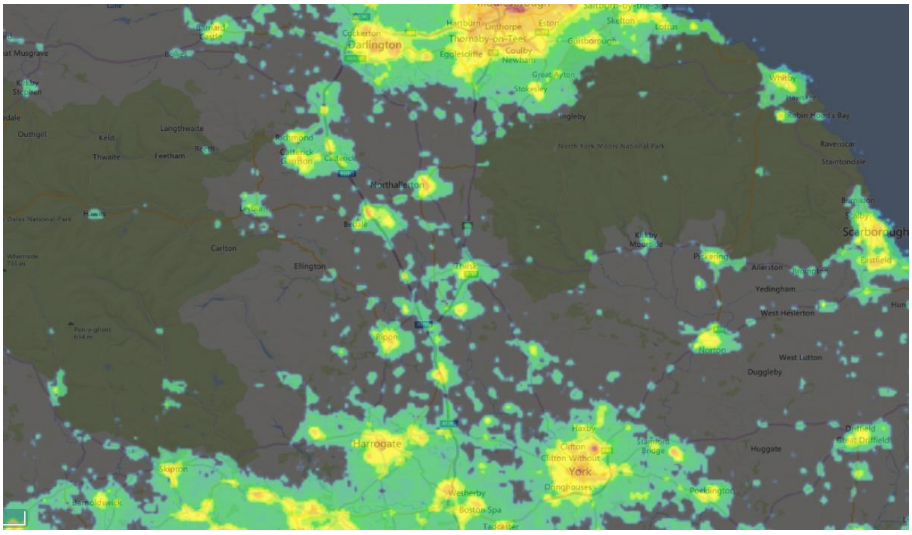

Figure 8: Light imagery of the dark sky reserve of the North York Moors and Yorkshire Dales. Image credit: https://www.lightpollutionmap.info

Light imagery mapping of the NYMNP and the Yorkshire Dales National Park, together forming the International Dark Sky Reserve, highlights light-pollution clusters in nearby urban areas (Figure 8). There is concern that the corridor between the A1 and A19 is narrowing, and that light pollution in this area between the NYMNP and the Yorkshire Dales could pose a serious risk to nocturnal connectivity for wildlife. This was a key reason for the first Northern England Dark Skies Alliance (NEDSA) conference, held at Ampleforth Abbey in November 2025, and was designed to formalise the alliance between protected landscapes in the North of England (NYMNP, 2025).

Dark sky festivals in the national park

The NYMNP has six key public engagement areas, which cover why dark skies are important: 1) Culture and Mindfulness; 2) Education; 3) Wildlife; 4) Rural Economy; 5) Energy Usage; 6) Human Health (NYMNP, 2025). The Dark Sky Festival programme in the North York Moors International Dark Sky Reserve is an important aspect of its public outreach, and the festivals contribute to development in all areas. This research addresses 1), 2) and 6) of the public engagement areas on why dark skies are important. Dark sky ‘fringe’ festivals take place annually in October, and ‘main’ dark sky festivals take place in February each year. Both coincide with school half-term breaks, benefiting families. The festivals attract people locally, regionally, nationally and internationally, and events run at various dates, times of day and locations within the reserve, with variable ticket prices from free to approximately £100 per person and the dark sky festivals aim to increase awareness and enjoyment of the night sky and provide a boost to local businesses

during the tourism off-peak shoulder season (NYMNP, 2025). Most events are organised and delivered by local businesses and advertised centrally.

2025: A celebratory year marking the 10th anniversary of the dark sky festival

In October 2024, the NYMNP Dark Sky Reserve celebrated its fifth Dark Sky 'fringe' festival, and in February 2025, its tenth Dark Sky 'main' festival. A range of events, led mainly by local businesses, formed the festival programme and offered choice for engaging with the night sky through stargazing, night treks, coastal ghost tours, night navigation, guest speaker talks, astrophotography classes, owl experiences, fine dining and craft workshops (NYMNP, 2025).

Chapter 3 Methodology

This chapter justifies methodological choices based on the layers of the research onion (Saunders, Lewis and Thornhill, 2019). These are explored from the outer philosophy layer, working towards the central core of data collection and analysis (Figure 9):

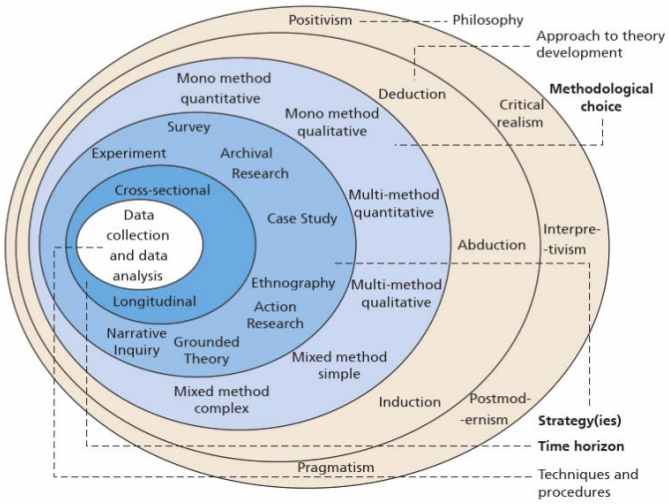

Figure 9: The Research Onion (Saunders, Lewis and Thornhill, 2019, p. 174)

Research philosophy: Interpretivism

The research philosophy is a set of beliefs about how knowledge is created and understood, and it shapes how research is designed, gathered and analysed (Seuring, Stella and Stella, 2021). Positivism relates to facts and measurable quantitative data, realism indicates that reality exists independently but is observed indirectly, and pragmatism has measurable features and applies practical solutions (Saunders, Lewis and Thornhill, 2019). The philosophy most suited to this research is a constructivist, interpretivist philosophy, which concerns how people subjectively make sense of their experiences and construct their own understanding and knowledge of the world through experience, reflection, and social interaction (Savin-Baden and Major, 2023). This research is people-centred and will capture personal narratives, enabling the researcher to interpret how individuals make sense of their own experiences when engaging with dark skies. Interpretivism is a research approach commonly used in sociology that focuses on understanding the subjective meanings and experiences of individuals within their social context (Blair, 2018; Derrien and Stokowski, 2020).

A theoretical framework, or lens, is a perspective used to understand, explain and interpret research. The main theoretical lens used in this research is nature connectedness, based on the belief that a positive connection with dark skies rests on an active connection with nature. The

research philosophy is that nature is a positive resource for well-being, and that dark skies are an aspect of nature that can contribute to this, and to explore how this occurs.

Research approach: Inductive

The approach to theory development used in this research is not deductive, as this tests whether a theory is true or false (Seuring, Stella and Stella, 2021). It is not abductive which uses theory and observation. Instead, the research approach was inductive, as data were collected first through the researcher's embodiment in the research setting (Farkić, Filep and Taylor, 2020), without preconceived ideas. The research design is exploratory, aiming to discover how participants experience, interpret, and envision dark skies. The inductive orientation will generate context-specific insight and identify patterns and interpret these in line with the aim and objectives (Creswell and Creswell, 2022). This approach was chosen as the research focuses on researcher reflexivity to understand people's perceptions and lived experiences of dark skies and then seeks to identify key well-being themes through patterns emerging from data analysis. There is a critical reflection on the knowledge produced and the researcher's role in knowledge production (Braun and Clarke, 2013). The reader can evaluate the researcher's subjectivity and interpretation of the data, and plausibility is used to demonstrate quality rather than categorical truth (Savin-Baden and Major, 2023).

Methodological choice: multi-method qualitative

A multi-method approach was chosen because multiple types of qualitative data will be used. The research design included field observations via a reflexive journal, used to record participants' non-verbal attitudes and behaviours as well as their verbal responses. Multimodal methods applied in this research included the creative use of video, audio, and photography during field observation, walking interviews, participatory methods, and semi-structured interviews.

Research strategy: Ethnography

The strategy adopted to guide the data collection and analysis process was ethnography, defined as a qualitative research method that involves an in-depth study of the behaviours, language, and actions of a social group in their natural settings (Creswell and Creswell, 2022). It included participant observation in the field during dark sky festival events and semi-structured interviews. The methodological approach was to explore, through the gathering of qualitative data, why people engage with dark skies in the North York Moors International Dark Sky Reserve and how this experience makes them feel, thereby indicating an impact on well-being. The research used intuitive inquiry, defined by Anderson (2019) as an in-depth reflective process of interpretation.

This was achieved by working through the 5 cycles of intuitive enquiry to identify the research topic, collect data, and analyse and interpret the results, guided by the researcher's intuition (Anderson, 2019). This process helped to reflect on and interpret perceptions, thoughts, experiences and feelings of those connecting with dark skies. Considering the significant role of the senses when engaging with dark skies, it was important to apply a sensory ethnography approach.

Sensory ethnography

The research methodology applied sensory ethnography, a developing field of practice that emphasises connections between environment, mind, and body and is fundamentally shaped by four elements: experience, perception, knowing, and practice (Pink, 2015). It is often applied to research projects involving human participants and practical activity, and, as an approach, is interdisciplinary and under-explored in dark sky tourism research (Hall, Paddison and Jones, 2025; Pink, 2015). Essentially, sensory ethnography involves doing ethnography through the senses; sight, sound, smell, touch, taste and embodied movement, and explores how sensory experiences shape meaning, identity and culture, going further than verbal data (Hall, Paddison and Jones, 2025). It enables the researcher to engage with participants in the field to explore rich sensory experiences and better understand engagement through embodiment, extending beyond cognitive or linguistic levels. This approach involves the researcher taking a participant-observer role to engage intensely with participants environments and practices, which enables strong connections with participants social and environmental experiences (Pink, 2015). Central to this ethnographic methodology is openness to multiple ways of knowing and reflection on new knowledge pathways (Pink, 2015). This method invites new insight into other people's worlds to better understand engagement through shared practice and activities: *"Doing sensory ethnography entails taking a series of conceptual and practical steps that allow the researcher to re-think both established and new participatory and collaborative ethnographic research techniques in terms of sensory perception, categories, meanings and values, ways of knowing and practices"* (Pink, 2015, p. 7).

Pink's (2015) sensory ethnography approach extends Ingold's (2000) work on how people actively engage with and make sense of the world around them. Ingold (2000) argued that the ethnographer is part of the environment they are researching, acknowledging interconnected aspects of mind, body, nature and culture, and highlighted the importance of movement, environment and human and non-human beings in shaping knowledge (Ingold, 2000). However, there is a debate within sensory anthropology between Ingold's (2000) approach and that of Howes (2003), who studied culture through the senses and argued that sensory engagement

within space and place shapes human meaning. This debate highlights the complexities of understanding human experience and the importance of the interplay between perception, embodiment and culture. It is important to acknowledge that theories of space, place and environmental experiences are critical to human geography (Pink, 2015) and that sensory ethnography is applied to more richly explore humans' interaction with landscape. The link between perception, place, knowing, memory and imagination is also significant, with the ethnographer seeking to discover other people's worlds in ways similar to how they are known by those people, to better understand how they experience, remember and imagine (Pink, 2015). This approach, therefore, puts the ethnographer at the heart of the social and sensory environment experienced by people. Participant sensory experiences were prioritised during the research process and while collaborating in the field (Paddison, Jones and Hall, 2025). Therefore, combining sensory ethnography with nature connectedness theory and a well-being framework brings a novel approach to exploring personal experience in the NYMNP dark sky reserve. Taking a sensory approach, the emotions evoked by engaging with dark skies will be explored through observation and personal narratives. Ethnography will critically explore how people see, hear, feel and move in the natural nightscape of the NYMNP to connect with dark skies and how this can positively impact sensations of well-being. The researcher argues that this has the potential to demonstrate that dark sky festivals can act as a powerful resource to help people feel positive and connect to nature. As highlighted by Pink (2015) sensory ethnography is important as emotional, non-verbal and sentient experiences can often be overlooked, ignored or forgotten and taking this approach will help the researcher to explore how participants engage senses and identify what participants feel and experience. This will enable the researcher to explore in depth non-verbal sensations, particularly changes in sight, sound, touch, and embodiment when participants connect with nature and dark skies, and to interpret how sensing this connection fosters well-being.

There is limited peer-reviewed research that applies a sensory ethnographic methodology to dark sky festivals, specifically to explore participants' experiences and impacts on well-being. Hall, Paddison and Jones (2025) applied an emplaced sensory ethnography approach to their research during the February 2024 dark sky festival in the NYMNP dark sky protected zone. However, rather than well-being, their research focused on regenerative tourism practices and emphasised that although research is limited on how sustainable outcomes can be achieved through dark sky festivals, immersive learning and sensory experiences could drive change for regenerative tourism practices in dark sky protected zones. In addition, Marr's (2024) research in the Galloway Forest Dark Sky Park brought together cultural geography, embodiment and participative

methods such as sound recording, photography, and autoethnographic walking to map sociocultural values and the experiential dimensions of the night landscape: a kind of sensory ethnography of dark sky communities; however, it was not festival-specific.

This new research will explore how feeling connected to the cosmos through dark sky festivals in the Dark Sky Reserve enables people to connect with the nocturnal environment. Sensory ethnography is therefore vital to better understand the role of the senses in human experience and how this influences perceptions, behaviours and interactions when engaging with dark skies. Pink's (2015) sensory ethnography was applied throughout fieldwork and reflexive analysis. This enabled the researcher to critically analyse participant sensory experiences in relation to dark skies, how these evoked new emotional responses and how, in turn, these help participants connect better to dark skies and the resultant impact on well-being. The role of the senses, in particular sight, sound, touch and bodily movement, was explored in detail to identify how the participants build a connection with dark skies in new and different ways. The interview process enabled delving into rich personal narratives to gather participants' perceptions, experiences, and reflections on their personal dark sky connection and thoughts on well-being.

Time frame

A longitudinal study monitoring change over time was not conducive to this study, given time constraints. Therefore, a cross-sectional timeframe was chosen with data collection well positioned to coincide with the tenth anniversary of the dark sky ‘main’ festival and the fifth anniversary of the dark sky ‘fringe’ festival. The cross-sectional design is suitable for exploratory research that aims to identify patterns and experiences within a defined period (Creswell and Creswell, 2022).

Data collection and analysis

The empirical material presented in this research was collected during the North York Moors dark sky festival events in October 2024 and February 2025. The researcher attended 12 events as part of the dark sky festival public engagement programme, including night walks, sedentary stargazing at nature hubs, an indoor presentation, an online presentation and craft workshops at the following locations within the North York Moors International Dark Sky Reserve: Ampleforth Abbey, Dalby Forest, Danby Lodge, Sutton Bank Visitor Centre and Welburn. Observations were recorded in the researcher's reflexive journal, along with photographs and a series of semi-structured interviews, most of which took place online via Microsoft Teams, chosen for flexibility, convenience, and confidentiality. As part of fieldwork, NYMNP visitor centres and gift shops were explored to note the presence of dark sky-related products within the reserve’s visitor hubs.

The research was grounded in reflexive analysis, which takes account of the experiences of both participants and the researcher throughout the research process (Creswell and Creswell, 2022). Eight semi-structured interviews took place remotely via Microsoft Teams (approx. 45 minutes each), with transcripts automatically generated, saved, and corrected for misinterpretation errors. A further four participants were interviewed in person, where notes were handwritten. Therefore, a total of twelve interviews were conducted, and in the analysis that follows, they are referred to as 'I' for Interview, followed by the interview number (I-1 to I-12). Notes within the researcher's reflexive journal were referenced using the format: field note, date. There was representation across all community groups. As shown in Table 1, participants included visitors, residents, local businesses, and a public official, representing a range of voices and perspectives.

Table 1: List of participants (Author's own)

Interviewee number	Description
I1	Visitor
I2	Visitor
I3	Resident and Local Business
I4	Resident and Public Official
I5	Visitor
I6	Visitor
I7	Resident and Local Business
I8	Visitor
I9	Resident and Local Business
I10	Visitor
I11	Visitor
I12	Visitor

Population and sampling

The research focused on those currently engaging with dark skies in the NYMNP and how this connection can positively impact well-being. Therefore, purposeful sampling was selected, dependent on participant availability and willingness to be interviewed. The aim was not to form a consensus but to explore individual voices and experiences about engaging with dark skies. A participant information sheet and consent form were signed by each participant prior to the interview. Interview questions served as a basic structure and were designed to be open-ended, giving participants prompts for discussion, the freedom to explain their answers, and the ability to divert off course if relevant. There was an opportunity for further expansion or clarification of points through two-way dialogue between the participant and the researcher. Triangulation of data sources ensured reliability and trustworthiness, achieving the core aim within qualitative research standards of credibility, transferability, dependability, and confirmability (Sparkes and Smith, 2014; Derrien and Stokowski, 2020).

Interview questions covered the following areas:

1. Context setting on community group(s) (visitor, resident, local business, public official)
2. Views and personal experiences of light pollution and personal interest in dark skies
3. Previous dark sky event engagement and how connected they feel to dark skies
4. Dark skies and well-being
5. Changes in sensory perceptions in the dark
6. Optional questions on night walking and creative artistic outlets when engaging with dark skies
7. Barriers to access for dark sky events
8. Relationship between dark skies and nature
9. Thoughts on future engagement with dark sky events and any key messages prior to close of interview

All questions were optional, and there was an opportunity at the end for the participant to ask questions. After data collection, software Nvivo15 was used, based on Braun and Clarke's (2006) six-step data analysis process (Figure 10):

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Figure 10: Phases of thematic analysis. Source: Braun and Clarke (2006, pg. 87)

Thematic analysis

Thematic analysis was used to identify, analyse and report on patterns within the qualitative data. It is important to note that well-being themes were not chosen prior to data being collected. Instead, using a grounded approach, the data indicated key well-being themes which will be presented and discussed in the main analysis section. Emergent well-being codes related to positive emotions evoked during dark sky engagement and nature experiences were created manually by cross-referencing data from field notes, semi-structured interviews, photography, and videography. An inductive approach categorised the data to identify well-being themes that emerged naturally without the need for a pre-existing framework (Skjott Linneberg and Korsgaard, 2019). These themes will be addressed in the discussion and supported with participant quotes,

photographs and field observations recorded in the researcher's reflexive journal. The emerging well-being themes will be linked to nature connection theory and Seligman's (2011) PERMA model of well-being. Analysis of the data was conducted in stages over several months, reading transcripts and reflexive journal field observations notes multiple times for familiarity. Transcripts, interview notes, and photographs were uploaded to NVivo15, and were assigned codes (first-order concepts). The codes helped the researcher identify second-order categories and aggregate well-being themes.

Ethical considerations

This research strictly adhered to ethical guidelines to protect participants' rights and privacy and the researcher's safety. Ethical approval was granted by the York St John University ethics committee prior to the research, and the researcher obtained consent from each event leader in advance. Prior to each event, dark sky event leaders carried out risk assessments. Dark sky event leaders briefed visitors about the research at the start of each event to secure informed consent for observation and photography. Data collection in the field was an opt-out approach, with the researcher explaining the purpose of the research at the beginning of each event and giving participants the right to withdraw. Prior to interviews, participants were given information on the purpose of the research, and written consent was obtained prior to interview. The research design enabled participants to openly express their thoughts and feelings about the dark skies connection, with a focus on well-being, as communicated to participants ahead of the interview. Participation was entirely voluntary, and individuals had the right to withdraw without a reason or to seek further information from the researcher or the School Ethics Chair. To ensure researcher safety and to capture observations in the field, the researcher always carried a mobile phone. Participants were not asked for sensitive demographic information, such as age, gender, religious views, or home postcode. Participants were anonymised, and in line with the methodology used by Derrien and Stokowski (2020), in excerpts from the raw data, verbatim remarks by participants during interviews were followed by the interviewee number (I-#). In line with qualitative research trustworthiness, credibility and reliability were of paramount importance throughout the process (Seuring, Stella and Stella, 2021).

Data storage and retention

Data was held in the University's password-protected OneDrive folder, in line with the General Data Protection Regulation (GDPR) requirements and University data protection policies, to ensure it was collected, stored, handled, and analysed safely and securely.

Essential fieldwork kit

During fieldwork the main resources used were a headtorch, warm coat, journal, pen and a pair of walking shoes as illustrated in Figure 11.

Figure 11: Muddy walking boots, notebook, pen and headtorch

This chapter outlined the methodology and justified the use of interpretivism and qualitative, multi-method approaches to field observation and interviews. It addressed the importance of sensory ethnography to capture non-verbal behaviours and ethical considerations to ensure safety of participants and researcher.

Chapter 4 Results and Discussion

The findings are presented thematically and linked to the research aim and objectives regarding dark skies, nature connection, and well-being. Field observation and interview data is drawn on to explore how applying sensory ethnography helped understand the role of the senses in dark sky connection. Grounded in nature connectedness, it applies Seligman's (2011) positive psychology PERMA model to identify sensations that generate feelings of well-being. Pink's (2015) sensory ethnography was applied throughout fieldwork and the reflexive analysis, which enabled the researcher to critically analyse participant sensory experiences with dark skies, how these evoked new emotional responses and how, in turn, these help participants connect better to dark skies and resultant impact on well-being. The role of the senses, in particular sight, sound, touch and bodily movement, was explored, to identify how the participants build connection with dark skies in new and different ways. The interview stage delved into rich personal narratives to gather perceptions, experiences, thoughts and reflections on personal dark sky connection and well-being.

Emerging well-being themes

Interpretivist analysis is presented in five areas (A-E). These aggregate themes were identified as contributors to a positive sense of well-being when engaging with and connecting to dark skies in the NYMNP Dark Sky Reserve. They are divided into separate sections, beginning with a summary, emotions produced, and key indicators of Seligman's (2011) PERMA model for well-being:

A. **Changes in sensory perceptions trigger curiosity, imagination and creativity**
B. **Practice of mindfulness and slowing down to observe natural darkness**
C. **Mood boosting experiences evoke wonder and awe**
D. **Sense of community and place promote individual and collective empowerment**
E. **Childhood interest in space and positive family influences**

Each well-being will be explored with supporting empirical evidence. The researcher used this data to explore how engaging the senses, verbal and non-verbal, helped to identify what participants were feeling, sensing and experiencing. The researcher critically evaluated how sensing the environment differently through lesser-used senses of reduced vision, amplified sound, deep listening, sense of touch, or feeling, and embodied movement helped participants feel more connected to dark skies. The researcher then explored how this connection helped participants to feel a greater sense of well-being. It is important to note that dimensions of well-being are interrelated with inevitable overlap. The division into distinct well-being themes

enabled a systematic discussion. It is emphasised that well-being themes were not pre-determined; instead, a grounded approach was taken, which enabled the data to speak of emergent well-being themes.

A. Change in sensory perceptions in the dark trigger curiosity, imagination and creativity

Summary: Changes in sensory perceptions at night, in particular reduced sight, amplified sound and deep listening, together with the sense of touch spark curiosity and imagination. Therapeutic art is a medium for creativity, self-expression and sense of accomplishment with dark skies and nature an inspiration for artwork.

Emotions: Curiosity, imagination, creativity, sense of achievement

PERMA model indicators: Positive emotions, Engagement, Accomplishment

This theme explores changes in sensory perception at night. Applying a sensory ethnography approach enabled the researcher to observe, walk and be with participants (Pink, 2015) during dark sky events (Hall, Paddison and Jones, 2025). The discussion explores new sensory skills and practices that enabled participants to better connect with the night landscape through immersive sensory experiences, in particular, engaging lesser-used senses such as reduced vision, amplified sound, deep listening, and touch. Non-verbal and verbal communication helped the researcher identify what participants were feeling, experiencing and sensing when connecting with dark skies and how this interaction positively contributed to their well-being.

Reduced night vision

One of the most notable sensory changes when submerged in natural darkness is reduced vision, enabling other senses to be utilised (Morris, 2011; Blair, 2018). The reduction of natural light from daylight to dusk heightened awareness of participants' immediate environment and changed the way shapes and textures were viewed and interpreted (fieldnote, 29 October 2024). Participants used sense of touch in reduced vision to feel around for obstacles and help them become more in tune with their natural environment and therefore build a better connection; *"When it's dark outside and quiet, I think you kind of connect to nature more. I can't really describe it but your senses are more in tuned with your natural environment....I feel that the darkness it brings calm and quiet" (I-5)*. The darkness allowed for a better connection to nature as the participant felt their senses more in tune, resulting in feelings of calm and peace. This participant also explained the atmosphere at night can offer more than in the day; *"I think at night time there's just more to offer, more things to connect to and see, you know, it's just more atmospheric"*. They perceived the

atmosphere in the dark and the sensory experience as an elevated experience and an important aspect of engaging with nature; "I *don't think people appreciate nature if you first of all hate the winter and you shy away from it, you know you're kind of missing out so many things but when it's dark, you see the stars shimmering. .... And it's like an atmospheric environment, which you don't really experience unless you make the effort to enjoy it..... I think most important aspect is the sensual bits of dark skies*."

Reduced vision at night helped participants feel excited and challenged in a fun way; "*The fact that we couldn't really see things, I thought that was a really fun challenge" (I-2)*. When describing the feeling of being immersed in natural darkness this participant used the analogy of a background static and the heightened feeling this created in their head: *"I find that once you're immersed in the dark and you haven't got any light, you I feel like there's a heightened feeling, but it feels like it's almost like there's a background static almost. It's like a static that sort of sits behind here in your head is the way I feel is like"* (I-2). This suggested the participant felt a powerful new sensation when engaging with dark skies and spoke with excitement and enthusiasm when describing this feeling.

Observation in the field demonstrated that it is sometimes more about what you imagine to be there with participants looking around them in reduced vision, listening to the rustle of leaves, and hearing the screech from a nearby tawny owl (fieldnote, 29 October 2024). Participant I-8 described this sensation of imagining what is around as different and interesting: *"It was such a different experience and it's just it's so interesting to think about kind of what's going on around us"*. Reduced vision therefore created an opportunity for different sensations compared to in the day and this change in sensory perception was described as a sensory revolution by I-12 and a way of recognising how nature should feel and that without manmade noise you can hear the sounds of nature such as the wind and birds: *"I do feel that some people do have a bit of a sensory revolution in a weird way because they're like, oh, this is how nature feels. There isn't the constant sound of a generator or so on .... this is how it should feel. You've just got the wind and then, you know, I know it sounds cliche. You can stand there and you can just like, close your eyes, take a couple of deep breaths and you can, like, I can feel the wind. It's coming from this direction. There's a bird behind me over there and it's lovely. And you can get that at night a little bit easier because you're....yeah, not gonna have to close your eyes"*. This evidenced an increased awareness of the feelings and sounds of nature around this participant through changes in their senses, which built new connection to nature around them. This links Hall, Paddison and Jones (2025) who found that participants engaging with dark skies during festival events experienced heightened awareness of their surroundings and could connect more deeply with other senses,

for example touching rain on leaves, and listening to the sound of a nearby steam whilst immersed in their immediate environment (Hall, Paddison and Jones, 2025).

The way that participants described natural darkness demonstrated that they felt positive about the sensory change, using words like; excited, challenged, curious and ultimately felt more connected to nature around them in natural darkness (fieldnote, 29 October, 2024). This relates to the study of slow adventure, including stargazing, characterised by the gentle passage of time and the creation of meaningful moments during immersive, guided experiences that enabled participants to forge a closer connection with nature (Farkić, Filep and Taylor, 2020). The implications of this are deeper and more meaningful contact with nature, strengthening the bond with the natural world and evoking positive emotions which contribute to well-being.

Night walking

Whilst walking with participants during dark sky events (Figure 12), it was often necessary to cautiously avoid tree branches overhead, protruding tree roots, or undulating ground underfoot, and keep sight of permissible pathways. This invited the formation of new connections with the environment, with participants and researcher using their hands to feel around and avoid head-height branches, communicating to others in the group and walking at a slow, steady pace (fieldnote, 29 October 2024). This links with Hall, Paddison and Jones's (2025) research on regenerative tourism during dark sky festivals, and how interactions with nature, such as night walking, create opportunities for new moments and sensations with nature in unfamiliar surroundings, helping establish new connections between participants and the environment.

Figure 12: Researcher walking with participants at night, Sutton Bank

This heightened sensory experience of walking at night was described by I-4 as a sensory awakening which made them feel good: *"I always feel great after a walk. I suppose night walking, it just it awakens your senses as well as well as your body more than walking at daytime"*. This participant compared day and night walking and indicated that walking at night is a more awakening sensory experience. Similarly, I-8 described night walking as a positive contributor to their mental health and described night walking as special; *"I find going on walks is really good*

for my mental health. I find it really nice to sort of be out and about and connect to nature. So I think as much as you can do this as possible is great…. there's such a special thing about walking at night." This provides new evidence on nature connection and well-being to support the findings of Bell *et al.* (2014) who found that those who noticed wildlife whilst stargazing felt more of a connection to nature.

It was found that participants considered night walking to be a more significant contributor to their mental health and well-being than a physical health benefit. This could partly be due to the leisurely pace of some of the night walks (fieldnote, 29 October 2024) and evidenced by I-2; *"What we were doing was quite a leisurely walk….so I mean, it's probably….good for your physical health, but I think I think there's more of a stress on mental health for that one, being it's quite methodical in a way like you really have to engage with your body and your mind."* Being described as a methodological process in this way was interesting as it implied that night walking helped this participant connect body and mind. Similarly, I-7 spoke about the importance of walking for their mental health as it creates a mood boost; *"I think physically I'm pretty fit anyway, but I think the biggest thing is the mental health…I think well, physically, I mean it's brilliant, isn't it? And it keeps you fit. Mentally, again, I think it just boosts that sense of wow, and you're doing something you're doing something different. You're doing something out of the ordinary. which has a huge boost".* It is argued that even simple, fleeting nature connections such as this can provide happiness (Richardson *et al.*, 2021), and that this provides evidence of hedonic pleasures through the generation of positive, feel-good emotions.

Several participants mentioned night walking as a good way to improve mental health and the heightened sensory experience compared to a daytime walk. This aligns with the findings of Hall, Paddison and Jones (2025) that darkness heightened participants' awareness of their surroundings. It was recognised by 1-5 that nighttime brought a sense of peace; *"I do find at night times it's more sensual, more peaceful….so I prefer the dark because it's more sensual, yeah"*. Reflecting on their own perceived benefit of night walking became a reminder to participant I-8 to commit more time to night walks and connecting with nature; *"It is just thinking about, I suppose, reminding ourselves to take time for ourselves and take time for nature as well. So having that opportunity is reminding me that I need to go out and about and have lots more walks in the evenings."* The importance of night walking in generating positive connections with nature among participants was also found by Hall, Paddison and Jones (2025).

Use of red lighting

In natural darkness, where vision is reduced, red lighting was used at dark sky events rather than white lighting, as it is considered better for human night vision and less disruptive to nocturnal animals, which may be startled by the dazzle of brighter lights. Red lights were used on headtorches and in fixed positions on signage and along pathways to guide participants and frame central areas, such as nature hubs at Dalby Forest and Sutton Bank (Figures 13 and 14):

Figure 13: Red lights to guide participants to stargazing event, Dalby Forest

Figure 14: Red lighting at Dalby Forest stargazing hub, February 2025

The dark sky nature hub at Sutton Bank was appreciated by I-12 for its amphitheatre design, guarding against light pollution from nearby moving cars: *"It had a nice little almost amphitheatre you can stand in and it almost cuts out any like car lights that are around".* Red lights and headtorches were often switched off to enable human night vision to work more effectively, and this allowed better viewing of stars in the sky, so participants could connect and explore the cosmos overhead (fieldnote, 24 February, 2025). Participants were comfortable to occasionally switch off red lights and headtorches to observe dark skies and when listening for nocturnal wildlife such as bats and owls (fieldnote, 29 October, 2024). The implications of this were a greater awareness and appreciation amongst participants of wildlife that could be nearby and the development of new sensory experiences in darkness listening for sounds of nature.

Ultraviolet lights to illuminate

Ultraviolet (UV) lighting was observed twice, on a night walk around the woodland grounds of Danby Lodge and also at a neon painting workshop at Sutton Bank. During the woodland walk,

participants wore head torches and high-visibility jackets for safety, and the group leader shone a UV light on living and non-living entities, including fungi growing on trees, owl pellets on the ground, beetles on plants, and a snake skin in a clear plastic bag. This created excitement and interest among the group to observe different flora and fauna illuminated under darkness and explore luminescent properties of natural entities (fieldnote, 30 October 2024). Participants were drawn to take a closer look at these living and non-living beings and took photographs to capture nature in a different way compared to in daylight (fieldnote, 30 October 2024; Figures 15-19). Colours observed using the UV lighting exercise at Danby Lodge included shades of red, purple, pink, white and blue, which participants described as 'beautiful' (fieldnote, 30 October 2024). It is argued that this helped them develop new visual interpretations of nature, fostering curiosity and excitement in new sensory experiences. This demonstrates that nature connectedness produced positive emotions, a key component of Seligman's (2011) PERMA model. These non-verbal experiences and behaviours may have been missed if a sensory ethnographic approach (Pink, 2015) had not been applied.

Figure 15: UV light shone on woodland

Figure 16: UV light illuminating fungi on the ground

Figure 17: Red and UV lighting illuminating trees and fungi

Figure 18: Participant taking photograph of fungi on tree, Danby Lodge

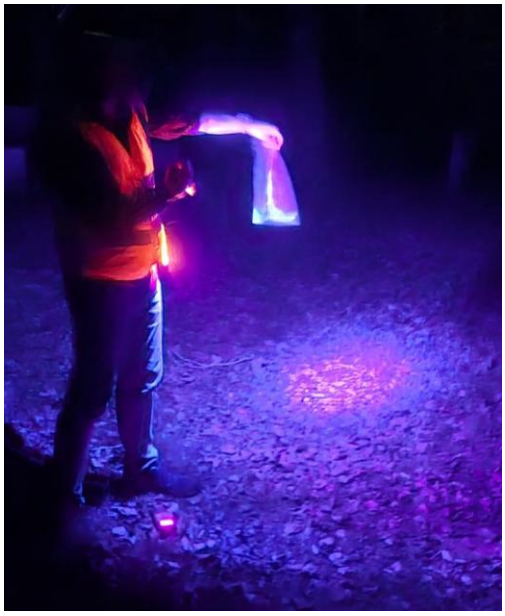

Figure 19: Snake skin in a clear plastic bag illuminated with a UV light

UV lights to explore flora and fauna in the woodland at night were used alongside bat detectors, which picked up the clicking sounds of bats. Participants were engaged in listening for these sounds and were excited to hear them, with one participant describing this experience as 'awesome' (fieldnote, 30 October 2024).

UV lights and bat detectors were described by I-4 as a fantastic way of offering new sensory experiences to children who may never have connected with night time in this way before, due to living in urban light polluted areas outside the national park and dark sky reserve: *"There's a walk in the dark with UV lights and bat detectors, we get the telescopes out…we….. look at the stars, we learn about the stars. And a lot of these children have never been off their estate let alone to a national park in the darkness where it gets pitch black and you know the wonder by a lot of them, it's really eye opening."* This implied that facilitated dark sky events run in national parks, particularly those using UV lights, bat detectors and telescopes, offer exciting and new opportunities for children living in urban areas who would not ordinarily see dark skies to connect with nature in this new and exciting way. It was found to create a sense of wonder, a positive emotion, one of the PERMA elements, that supports well-being and along with awe, a key driver for happiness (Keltner, 2023).

Field observation during a neon painting workshop found dark skies artwork was generated in new ways using UV lighting. At this dark sky themed art workshop, which took place in daylight during the festival, participants sat next to windows facing outwards towards the natural environment (Figures 20 and 21):

Figure 20: Neon painting workshop, Sutton Bank

Figure 21: Participants facing windows looking out to the natural environment

At the start of the workshop, black paper was handed out, along with a colour palette of neon paints. Participants were given freedom to choose their own subject to paint, but it was found that the majority found nature an inspiration for their art; space, flowers, mountains, lakes, feathers and natural shapes (fieldnote, 16 February 2025). It is argued that this suggests nature not only provides a relaxed setting for creative practice but is a preferred choice of subject for artwork. After participants completed two paintings each, these were placed on a central table, the group gathered, and the window blinds were closed to shield the room from daylight. A UV light was used to illuminate the pictures, and at this moment the participants reacted positively to the new visual change in the paintings, which became more vibrant, colourful and bold (fieldnote; Figures 22 and 23):

Figure 22: UV light illuminating neon artwork

Participant expressed that they enjoyed the freedom to choose their own subjects, having a few hours to relax and paint, and experienced a memorable moment at the end of the workshop, seeing their pictures lit up with UV lighting surrounded by darkness. This relates to the Accomplishment element of Seligman's PERMA model and ties with Ryan and Deci's (2000) Self

Determination Theory (SDT) which suggests autonomy and competence are key to psychological needs for well-being.

Figure 23: Neon painting with UV lighting

Participants described the experience as ‘relaxing’ and ‘proud’ of their work, which they took away with them (fieldnote, 16 February 2025; Figure 25).

Figure 24: Planning of artwork on black paper

Figure 25: Participant taking home their artwork at the end of the workshop

Data gathered at this workshop (see Figures 24 and 25) will be revisited later when discussing use of art during the dark sky festival for creativity, self-expression, and therapeutic purposes.

Amplified sound and deep listening

In the dark, another sense that changes significantly alongside reduced vision is sound. The researcher joined a walk at Sutton Bank led by a sound artist who creates relaxing nature

soundscapes. The purpose of the sound walk was to enable participants to listen deeply, intently, and purposefully to nature around them and to connect at a deeper level, beyond merely hearing a sound without paying full attention (fieldnote, 29 October 2024). A microphone and a set of headphones were attached to a tree to enable participants to fine-tune their hearing and listen to the tree's unique micro-sounds and movements. This enabled participants to focus on their hearing and practise deep listening in a nighttime environment and explore new sensory experiences in the dark. The gently paced night walk incorporated pauses to listen, enabling participants to become aware of their surroundings and of how sound interacts with their bodies at a physical level (fieldnote, 29 October 2024). The sound exercise was inspired by the work of Pauline Oliveros, an experimental sound practitioner and composer, and her three core pillars of deep listening, movement and dreaming (The Pauline Oliveros Trust, 2020). This helped participants to engage their deep listening skills using amplified sound in the dark, becoming aware of the immediate and more distant acoustic environment, and sparking their imagination, as noted by I-2; "*I think your sound is heightened....it's all about, like, how much more your imagination starts firing. Seeing other people sort of having their own sensory experiences is quite cool as well. You know, everyone's different and how they can experience it is different*". This participant recognised the individuality of sensory experiences through sound, implying that it is subjective, unique and deeply personal.

Silent walking enabled participants and the researcher to experience new embodied experiences at night, becoming more aware of movement, night vision capabilities and amplified sound, giving them new and unfamiliar sensory experiences, which did not necessarily need to be vocalised despite being experienced together (fieldnote, 29 October 2024). The sensory ethnographic approach used in this research relates to McGhie (2024) practice-based research project at Kielder Observatory that incorporated sound trails within darkness.

When reflecting on sensory perceptions at night, and in particular sound, participant I-6 described that without a strong visual sense, other senses had to work harder and this made it a heightened, mysterious and thrilling experience; *"I think everything's heightened obviously because it's dark and you can't see where you're going, and you're listening more acutely. I'm a very visual person, actually, so it's quite interesting for me because it heightens everything else that I normally don't take any notice of. I have to really work hard with, like sound.... I'm really into what I can see. So I think, yeah, I think it changes my sensory perception on that level ... because it's dark and it's a bit mysterious, it makes it a thrilling experience as well as opposed to like when you're in broad daylight, there's something quite exciting.....if you can overcome that fear and see what you can explore." (I-6)*. This evidenced the conceptual framework presented earlier (Figure

5) and how changes in sensory perceptions in the dark evoke positive feelings, including thrills and excitement, compared to daylight, which generate sensations of well-being through these new experiences. The opportunity to explore the night through dark sky festivals forms new sensory experiences and feelings of eudaimonia.

It was recognised that sound, as well as amplified, can be muffled in the dark; *"It's like your hearing goes up a little bit because then you can you hear like a conversation that's happening at the other side of the group…but only muffled slightly." (I-2).* Working on lesser-used senses in darkness, such as hearing, made participants more aware of the depth and intensity of sound.

Sense of touch

Participants used touch to feel around for branches, tree roots and uneven ground, particularly whilst walking. This created opportunities for new connections with nature compared to the day, when vision is better. On a dark sky walk at Sutton Bank, the researcher joined participants on a viewing platform where, in the day, this is a location to look far into the horizon and not necessarily focus on nature in the immediate vicinity. The researcher observed two participants on the viewing platform studying textured green moss growing on a nearby tree, which they observed, touched and described as 'beautiful' (fieldnote, 29 October 2024; Figures 26 and 27).

Figure 26: Sutton Bank viewing platform at night

Figure 27: Tree moss in spotlight, observed from Sutton Bank viewing platform

It is feasible that the two participants would not have noticed the green, textured moss on this tree during the day, but the headtorch's spotlight and surrounding darkness drew attention to this aspect of nature and encouraged interaction through touch. The two participants demonstrated appreciation of its natural texture and colour (fieldnote, 29 October 2024). Touching the moss at night deepened the connection with the tree through tactile sensation. This made the participants notice natural colours and textures and feel positive about the connection, evoking positive emotions and therefore contributing to well-being. This supports the theory that immersion in dark, natural environments is good for well-being, as it helps people notice and appreciate natural forms, textures, shapes, and colours that might otherwise go unnoticed. This finding relates to Bell *et al.* (2014), who discovered that those who noticed wildlife whilst stargazing felt most connected to dark skies. It also relates to the biophilia hypothesis (Kellert and Wilson, 1995), who argued that humans have an innate desire to be close to living entities. The conceptual framework (Figure 5) shows that nature connection, in the context of dark sky engagement, promotes well-being.

Curiosity and imagination

Curiosity can often be sparked through creativity (Schutte and Maloff, 2022; Zainal and Newman, 2023) and curiosity was recognised by participants as a factor in good mental health; *"Curiosity is a really good measure of mental health and well-being. If you're curious about the world…and I think the dark skies are a gorgeous opportunity that you wouldn't normally get to do, something out of the ordinary. That sparks curiosity because there's lots you can take away from a dark sky event..... like mythology around the dark or night creatures, that kind of, you know, folklore. So I think and that as a whole improves my well-being and the family's well-being because it keeps us engaged. It keeps us interactive. It keeps us having interesting conversations and being curious about the world around us and sharing something which I think is really important" (I-6).* This participant's view of curiosity during dark skies engagement was that it provides an opportunity for out-of-the-ordinary experiences, interactions, and conversations with family, which they saw as beneficial to well-being. These beneficial outcomes of curiosity and creative interventions align with Schutte and Maloff's (2022) meta-analysis on the influence of curiosity on life satisfaction, engagement, and good mental health.

Participants linked curiosity to childhood feelings of wonder and implied that adults need to reconnect with curiosity: *"Adults needed to reconnect with that whole sense of curiosity and wonder…I feel that there's already so much out there for children in terms of connection to awe and wonder and curiosity. I don't think there's anything for adults" (I-7).* Field observation indicated that dark sky events did attract adults, which provides a way for them to reconnect with

curiosity (fieldnote, 24 February 2025). Participant I-2 explained that engaging with dark skies helped their imagination and to feel more playful; *"It's all about, like, how much more your imagination starts firing.... my imagination goes .... I just love it. It's like a really fun way of engaging with being more playful, the sort of feeling a bit more like what it was like as a child"*. This excitement was shared by participant I-4: *"It's exciting doing something you don't ordinarily do.....going out in a big coat, you know, to look at a comet or to look at, you know, things that you don't see sort of day-to-day .... it captures....people's imagination."* These feelings relate to the theories of happiness and eudaimonic well-being introduced earlier in relation to nature connectedness (Pritchard *et al*., 2019), and it is argued that the simple pleasures of playfulness, fun and a sense of imagination generated by being in the dark contribute to an individual's subjective sense of their relationship with the natural world. It is argued that individuals who are more connected to nature when engaging with dark skies experience eudaimonic well-being. This indicated that connecting with nature has a significant impact on deeper levels of happiness, fulfilment and personal development as found by Pritchard *et al*. (2019).

Engaging with dark skies was described as a way of evoking feelings of childhood; "*I think what's happened for us adults is that we get so caught in responsibility and like we've got to take life seriously, it's got to be like this. We've kind of got stuck in those routines and we've forgotten how to be curious about life, curious about the universe, curious about, you know, the micro as well as the macro side of life....you know, the universe. It's not just....looking at a wonderful seascape or a mountain .... It's also the universe and I think it's incredibly important*" (I-7). This implied dark sky engagement can be a catalyst for curiosity in all scales of life. This relates to the theory of eudaimonia and deeper levels of meaning, as this participant was seeing life from a perspective of the universe and mentioned natural forms such as mountains and seascapes, showing a link between nature experience and a sense of meaning.

Other ways participants explored a sense of curiosity during dark sky festivals included looking at a space rock with a little light, surrounded by darkness (Figure 28):

Figure 28: Space rock in spotlight

Telescopes and binoculars were used during stargazing events to observe deep space. Upon arrival at the Sutton Bank nature hub, the researcher and participants witnessed a rare comet with the naked eye and through binoculars. This made participants feel excited and grateful to have seen a special astronomical event in the evening sky (fieldnote, 19 October 2024). This links with the positive emotions of gratitude and joy within Seligman's (2011) PERMA model. Similarly, the use of telescopes set up by event leaders at a dark sky festival event in Dalby Forest enabled participants to explore space with equipment they would not ordinarily use at home. With the naked eye, only a fraction of the star clusters forming the seven sisters constellation (Pleiades) could be seen compared to looking at the same area of the night sky through a telescope. This increase in the ability to see stars through the telescope was described as 'incredible' (fieldnote, 24 February 2025). The findings that dark sky engagement enabled special moments of happiness and joy links with Henderson, Knight and Richardson (2013) research on hedonic and eudaimonic behaviours as pathways to well-being, being a predictor of flourishing and a way of reducing stress. It also relates to Piccininni *et al*. (2018) survey of exposure to outdoor environments as a protective factor for mental health, highlighting the importance of natural spaces such as dark skies for psychological well-being.

Participants enjoyed learning about constellations in the night sky (Figure 29). The researcher observed participants encountering a wide variety of celestial objects, both with the naked eye and using binoculars and telescopes, including planets, stars and constellations, comets, nebulae, moving satellites and aeroplanes, galaxies, including our own, the Milky Way, and nearby Andromeda, craters on the moon, Saturn's rings and the North Star, a key for navigation.

Figure 29: Stargazing at Dalby Forest with Orion overhead. Image credit: Astrodog

Constellations

Dark sky leaders at stargazing events often used a green laser to highlight and navigate constellations (fieldnote, 14 February 2025). Use of the laser pen relied on a clear sky and enabled participants to pinpoint exactly where to look and gain knowledge about navigating the night sky. This enabled participants to gain knowledge to use beyond the event when observing the night sky independently.

Where cloudy conditions prevented a clear view of the night sky and where events had both indoor and outdoor components, constellations were explored on a screen, together as a group. During indoor presentations, technology such as a laptop, a projector, and the Stellarium app was used to help participants visualise constellations and their representations in Greek mythology or as animals (fieldnote, 14 February 2025). Observation indicated that participants were excited to see constellations interpreted this way by verbal expressions of 'wow' and non-verbal behaviours of listening intently (fieldnote, 14 February 2025). Non-verbal behaviours could have been missed if a sensory ethnography approach had not been used.

Participant I-11 explained that one of the main reasons they engaged with dark skies was fascination with constellations' mythology: "I have an interest in constellations as *a marker of mythology. So I enjoy like a lot of ancient texts about how like where they came like where they got their pictures from. The stories that are behind them....I find that really interesting. So that was sort of like my main motivation to go along*."

Figure 30: Constellations represented as animals during an indoor presentation

Constellation presentations were used at a dark sky festival events at Danby Lodge where they were represented as animals (Figure 30) and as ancient Greek beings (Figure 31):

Figure 31: Visualisation of constellations, Danby Lodge

Constellations were explored at Danby Lodge using a dome light to show how they rotate in the night sky (Figure 32). Participants appeared interested in this new way of learning about constellation patterns (fieldnote, 30 October 2024). This links with Gankhuu *et al*. (2023) exploration of how astronomy may be a useful tool for mental health and well-being and findings of Bjelajac, Đerčan and Kovačić (2021) on the interconnected roles of natural darkness and technology for astrotourism and well-being.

Figure 32: Dome light showing constellation rotation

Imagination was a focus during indoor presentations, when participants were shown photographs from Mars (Figure 33):

Figure 33: Image taken from Mars, shared at an indoor presentation

Participant I-9 described how a child they had previously spoken to had imagined being on another planet, using the sensation of cold to imagine being there. They then explained how someone they knew felt closer to her late father when connecting with the night sky. This

evidenced the emotional connections people can form with dark skies and how they can help them remember and connect with lost loved ones.

Art for creativity, self-expression and therapeutic qualities

Field observation found art was used to engage participants with dark skies and enabled them to make subjective, personal interpretations of darkness and creatively express their thoughts and feelings (fieldnote 14 Nov, 2024). This contrasts with the perspective of space as a complex scientific topic; *"I think there's so many ways that we can that we can connect to nature through and connect to dark skies through arts" (I-8)*. The researcher argues that the use of art in the festival programme enables creative engagement with the dark skies of the NYMNP dark sky reserve. It offers a space for personal interpretation of dark skies and a way to learn and build on existing artistic techniques and practices to represent nighttime textures, colours and shapes artistically, helping people connect with darkness through art and positively impact well-being through skill development, accomplishment and pride. This links with the findings of Henderson, Knight and Richardson (2013) on hedonic and eudaimonic behaviours and well-being. Painting two starry night landscapes at a watercolour workshop, new techniques such as the use of scrunched clingfilm to create tree and leaf textures were learnt by participants who had never previously used this material for this effect and were thrilled to have learnt a new painting technique (fieldnote, 14 November 2024, Figures 34 and 35). It is argued that the acquisition of new skills is a contributor to hedonic happiness, or simple pleasures, and the generation of positive emotions as indicated by Seligman's (2011) PERMA model for well-being as participants felt a sense of pride in their work and development of new skills, leading to emotions of happiness, achievement and accomplishment. Development of technical skills has been shown to lead to personal growth (Bell *et al.*, 2014).

Figure 34: Dark skies art workshop signage

Figure 35: Watercolour nightscapes

Linked to Maslow's Hierarchy of Needs (1943), participant I-3 mentioned the term 'self-actualisation' in reference to the sense of achievement when painting dark sky landscapes. This, the process of realising one's full potential, is evidence that engaging with dark skies through the arts can help participants to achieve the higher levels of human need through accomplishment, one of the key elements of Seligman's (2011) PERMA model, which positively impacts their sense of well-being. This participant explained that representing the night through paint is an interesting technical challenge and that a palette of purples, greens, pinks, blues and black and white can help visually interpret night-scape colours (fieldnote, 14 November 2024 and Figures 36 and 37). The watercolour paintings were all different, uniquely created by each participant, but all incorporated natural shapes and entities such as plants, lakes, mountains, stars and the moon. It is argued this helped them develop meaningful connections with nature and improve their psychological closeness (Lengieza and Aviste, 2025) and this provides evidence of the conceptual framework (Figure 5) and how nature connectedness, in the context of dark sky engagement, produces PERMA (Seligman, 2011) sensations that generate feelings of well-being. One participant had not painted in around 50 years, was delighted to be producing artwork after such a long time, and shared their desire to repeat the experience soon (fieldnote, 14 November 2024).

Figure 36: Nightscapes using watercolour

Figure 37: More nightscapes using watercolour

As explored earlier, UV lighting was used at a neon painting dark sky festival workshop with brightly coloured neon paints used on black paper, and participants were inspired by nature, including planets and mountains (Figures 38 and 39):

Figure 38: Neon painting of planets

Figure 39: Mountains and moon with neon paints

The process of painting at dark sky events was described by participants as 'mindful' and 'meditative' (fieldnote, 16 February 2025). Individuals focused on their own interpretation of nature, rather than creating a masterpiece; *"It's not so much about producing an amazing piece of art at the end of it. It's more about learning to observe properly and engage with the natural world as much as it is producing an accurate picture" (I-6).* The researcher joined a felt planet workshop at Sutton Bank Visitor Centre. This sustainable craft, primarily aimed at children but open to all, used sustainably sourced local materials, including wool and foraged branches, which provided a connection to local heritage (Figures 40 – 44).

Figure 40: Signage for felt planet workshop

Figure 41: Felt planet advertising board

New techniques were learnt by wetting and binding white wool, shaping it into circles, and then overlaying it with coloured wool to represent planets, the moon and the sun in our solar system.

These were attached to a string and hung from a woodland branch as a decoration for participants to take home. All materials were provided, and new skills were learned. Participants took time to create their solar systems, and the activity was described as 'relaxing', 'therapeutic' and 'calming' (fieldnote, 15 February 2025).

Figure 42: Attaching planets to form a hanging decoration

Figure 43: Shaping the wool planets

Figure 44: Finished solar system hanging decoration

Astrophotography

There was evidence of amateur astrophotography during the dark sky festival events, including the creation of star-trail images using slow-capture lenses (fieldnote, 24 February 2025). Participants described using astrophotography to capture the moment as part of memory-making, rather than to pursue professional images for framing or selling. This finding can be compared with McGhie's (2024) practice-based research project at Kielder Observatory in the Northumberland International Dark Sky Park, which also used a sensory-oriented approach, including photography, to explore sensory experiences of darkness.

The researcher did not find evidence of participants using the written word, for example, poetry or story writing, or other creative writing practices to engage with dark skies as part of the festival programme, but this could have been due to not attending events with this focus. However, one participant indicated they are challenged to find words that can describe the feeling of dark sky engagement; *I feel like the feeling is just so innate that I can't find the words for it, even to like explore around it"* (I-2). This indicated the participant was more comfortable engaging in non-written dark sky activities.

Participants noticed changes in sensory perception when connecting with dark skies, particularly reduced vision, reduced red and UV lighting, embodied experiences during gentle walking, amplified sound, deep listening, and heightened sense of touch. These sensory experiences enabled participants to feel new connections with nature and dark skies, feeling for branches and roots, noticing texture of moss, envisaging what was around them and triggering positive emotional responses of excitement, imagination and curiosity, which contribute to sensations of well-being as broken down through Seligman's (2011) PERMA model (Positive emotions, Engagement, Relationships, Meaning, Accomplishment). Learning about constellations and engaging through art practices such as watercolour, neon painting, feltwork, and amateur astrophotography promoted a sense of accomplishment and pride. Creative art enabled participants to explore new connections to nature and dark skies, develop skills, and support personal interpretation of dark skies. The link between art and science regarding dark skies was outlined in Chapter 2 (Morris, 2011; McGhie, 2024), and the incorporation of art into the festival appeared to be a popular way to engage participants with what is often perceived as a traditionally scientific, complex topic. Participants' sensory experiences in darkness were linked with Seligman's (2011) PERMA model, in particular, Positive emotions, Engagement and Accomplishment.

B. Practice mindfulness and slowing down to observe natural darkness

Summary: Engaging with dark skies is a way of practising mindfulness, being in the present, noticing nature and natural cycles and forgetting everyday worries
Emotions: Tranquillity, calm and comfort
PERMA model indicators: Positive emotions, Engagement, Meaning

This theme explores how dark sky events enabled participants to practice mindfulness, slow down, and connect more deeply with nature, mind, and body, thereby enhancing their well-being. Mindfulness "involves paying attention to what is going on inside and outside ourselves, moment by moment" (NHS, 2025) and is regarded as a useful practice to enjoy being in the present, as

opposed to focusing on the past or future, both of which can cause stress and anxiety. Participant I-2 described the benefit of engaging with dark skies as a way of temporarily sidelining everyday worries; "*It's easy to sort of carry the day with you. You know, it's good just to try and leave it to one side as much as possible, just for a little bit anyway*." This was reiterated by I-6*; "It takes you out of your own head and worrying thoughts and feelings because you're engaged in the moment. I mean, it's a bit like mindfulness, isn't it?" .....It keeps you in the present and in the moment, and I think that's really good for us. We spend a lot of time... kind of lost in our worrying thoughts and feelings or ruminating about things... it brings you out of that and very much engaged in the world around you, which I think is good for your well-being*" (I-6). This finding aligns with Berto (2014), who found that natural environments can help people cope with stress and mental fatigue caused by everyday worries. It indicated that dark sky engagement diverted participants' attention away from intrusive thoughts by encouraging engagement with the immediate environment, thereby positively impacting their well-being.

It was evident that participants appreciated taking time in the evening to observe the natural cycle of light to dark and to notice living and non-living entities around them during evening events, such as vegetation, the breeze, and leaves rustling (fieldnote, 29 October 2024). During a night walk at Sutton Bank, mindfulness activities were incorporated at the start, with the group forming a circle, raising their arms towards the sky, and practising deep breathing (fieldnote, 29 October 2024). This supports the nature connection theories outlined earlier (ART and SRT) and adds further empirical evidence to Ohly *et al.* (2016) findings that natural environments promote calm and provide restorative benefits.

Attending dark sky events was described as a mindful, calm space to explore the world; "*It's just about people connecting through various means .... just essentially it comes down to sort of having a mindful, quiet, gentle space to explore the world*" (I-8). This was similar to another participant; "*The benefits are being able to sort of slow down and reconnect with yourself...so for your mental health, I think that's a real plus*" (I-2). This participant saw dark sky events as a way of people joining together, becoming more mindful of our spaces and seeing their beauty; **"***It's like a really positive thing to bring people together and a way to, like, calm down and be more mindful of our spaces and see the beauty in them. That was something I was really attracted to".* This supports the findings of Coventry et al. (2021), who found that nature-based interventions were effective in improving mood and reducing anxiety, highlighting a positive correlation between nature activities and better mental health. It draws similarities with Gallaway (2010) research on how people express natural beauty as passive pleasures as opposed to explicitly

expressing the importance of dark skies. This suggests a stronger intent is required to articulate the benefits they can bring to well-being.

A significant aspect of the mindfulness theme was participants' realisation of their perspective on their individual place as a small component of the world and the wider universe. Participants often drew comparisons between their individual lives and the enormity of the universe; "*Sometimes you need to realise we're just a little spit of dust essentially in the middle of a huge cosmic thing ..... everything kind of doesn't really matter..like that guy watched me drop a drink. It doesn't matter in the grand scheme of things. You know, if you look up at the sky kind of thing, you know, we're just this little spit and....I think some people do need to be reminded that we're not that important in the grand scheme of things" (I-12).* This self-realisation of feeling small when connecting to dark skies helped this participant feel less worried about their own problems and be in the present and another described this as helping them feel alive; "*...the mind also changes in that instead of like thinking about future or past, you're immediately in the present moment so all the worries that you've had, they've just disappeared because you're so incredibly present and when that happens, it's kind of slightly exciting, slightly scary at the same time, but you just feel alive. You feel alive*" (I-7).

It is argued that dark sky engagement can be an awakening or grounding sensory experience, helping participants see their place within a much larger system, thereby scaling down individual worries. Similarly, another participant described planet Earth as a 'blob' and a 'rock' and pondered how peaceful the stars and planets appear in the sky, which made them question negative things happening on planet Earth when space is enormous yet calm; "*Earth's like a little blob in space. It's a little ball that floats around yeah and there's thousands of planets and stars or billions. And yet on this one planet, so much death, racism, you know, hatred, wars, you know, just all these horrible things are happening. And you think why can't we just be peaceful, you know, just floating around on this rock we are on the same rock, we are all in the same boat. We float around the sun and the sun floats around obviously the black hole in the middle of the Milky Way. And why can't we just get on with life and enjoy it, you know?*" (I-5). It is argued that engaging with dark skies offered participants an escape from life's worries and enabled them to gain perspective on themselves in comparison to the planet, the universe, and beyond. This relates to the Ryff scales of psychological well-being, in particular, the aspects of purpose in life and self-acceptance (Ryff, 1989) and the 'Meaning' element in the PERMA model (Seligman, 2011).

It was found that some participants viewed humankind as tenders or gardeners of the natural world and they had developed a sense of nurturing responsibility towards nature; "*I'm a big believer in like humans, as we're sort of like gardeners, we're here to tend and look after....we kind*

of have a responsibility to try and preserve those things and hopefully, you know, not just preserve them, but like they can flourish" (I-2). It is argued that this provided a stronger connection with nature, as participants felt they had a role in looking after the planet and therefore a desire to engage and build meaningful connections through dark skies, which in turn benefited their well-being through caring emotions.

Dark sky events provided mindfulness tools for participants to utilise within their own everyday lives; "*I think basically we're giving people a way in to experiencing something they possibly don't normally do, and also giving them more information and tools as to how they can do it for themselves. So the stuff that we do, it's not just a straightforward night walk…they're also learning mindfulness tools as well*" (I-7). This is important, as it supports the view that mindfulness is embedded in dark sky activities during festival events in the reserve, and that these can equip participants with mindfulness tools to use beyond the events. It was also indicated by another participant that the way some dark sky events are positioned as ambient and meditative was one of the reasons they were enthusiastic about engaging with dark skies; *"The way that I try to make them is to have them be ambient and meditative. And I guess mindful. So I think in that way it's trying to encourage this sense of slowing down and paying more attention to the little details and in that way you can engage with the landscapes that you experience in your day-to-day life a bit closer and a bit more. Yeah, closer and more intentional…..it's like a really positive thing to bring people together and a way to, like, calm down and be more mindful of our spaces and see the beauty in them. That was something I was really attracted to" (I-2).* Paying attention to small details, slowing down, and engaging with landscapes and darkness more intentionally were described here as a very positive way of seeing their beauty and this way of connecting with nature produced sensations that generate feelings of well-being in Seligman's (2011) PERMA model especially positive emotions of joy, engagement and sense of meaning.

Tranquillity and calm

Related to mindfulness were feelings of tranquillity and calm expressed by participants when engaging with dark skies; "*Engaging in the night sky benefited me a lot…. It brings a sense of calm" (I-9).* This participant continued to explain that the night sky brings a sense of comfort when they can feel lonely*; "The night sky brings comfort to me……planet earth can feel lonely*". This indicated that engaging with dark skies reduced their loneliness and brought calm. This was apparent when speaking with another participant who appreciated the peacefulness of space, and they drew a comparison between this and global conflicts and pressures on Earth, ranging from wars to the insignificance of work stresses; "*When you look at the cosmos, you see all these weird planets and stars. Yeah. And it's all very peaceful. They've been there for billions of years…..*

And it kind of opens your eyes to what's around us and why and where did it come from? Why is it there? Why do we exist? ....it makes you think about life on Earth, how hectic it is, you know, with all of the killing, the wars... the stresses from work, when you look at the cosmos, it's peaceful. You think why? Why is life on Earth so hectic? But then you think, well, is my timesheet for work really that important? Because if I don't do the timesheet, the cosmos will still be there. Nothing really changes. Yeah. The pressures are kind of put on to you on Earth by obviously a job... I don't know family members or whatever....and when you look at the cosmos, it kind of makes you realise how peaceful nature is" (I-5). For this participant engaging with the night sky brought perspective, calm and contrast to complexities and stresses of life on Earth. They also drew comparisons in noise levels between seasons; "*Summertime, you know, the sun's out people having barbecues, there's noise, right...there's cars about, people drinking outside pubs, you know, it's more chaotic where I think winter is reserved for people that make the effort to go and enjoy it*." This implied the participant felt the colder, darker months required more effort but had more to offer than the louder, busier months of summer. This aligns with findings from Farkić, Filep, and Taylor (2020) on stargazing and its contribution to well-being through quieter, slower group activities.

Connecting with dark skies was therefore beneficial to well-being as it brought participants a sense of comfort and calm; "*Taking an hour out of your day at nighttime, especially, I think, just to sort of reconnect with yourself. I think that plays a huge part in sort of trying to foster that sense of tranquillity and peace*" (I-2). This sense of calm was expressed by another participant: "*I find it very calming. I could not tell you why I think it's just I enjoy being in the dark, but I find it really calm, especially on like a slightly breezy night and just having that slight breeze over you. I love that to pieces, but like I said, I wish I could do it more*" (I-11). It is argued that engagement with nature-based activities in the context of dark skies contributed to participants experiencing hedonic and eudaimonic behaviours through positive emotions such as joy and reduced negative emotions such as stress, giving a sense of meaning. As found by Henderson, Knight and Richardson (2013), these emotions can positively impact well-being.

When describing how it feels to be connected to dark skies participant I-12 used an analogy of feeling a feeling zen, a term associated with meditation and mindfulness; "*You can get that sort of Zen....without realising you've gone Zen. Yeah. Yeah, it's accidental Zen*." This implies that a meditative state is not necessarily the purpose but an effect of connection with dark skies. This suggests dark skies can have a mesmerising and calming effect on humans. This ties with Derrien and Stokowski's (2020) study on the role of imaginaries and symbolism in dark sky engagement.

Observing and appreciating the natural rhythms

A significant way participants connected with dark skies was through observation and respect for the light-to-dark cycle: *"We have day, and we have night, so they should be held in equal measure.. it's a time when we're asleep usually, but there's all sorts of life that's happening at that time anyway...and I think we just need to be more mindful of what's going on beyond our own experience that we're having...We're so used to now being on screens and all of that.....I think there's something really deep inside of us that we need to notice the changes in light and time of day...for our circadian rhythm and things like that, it's really quite important to our health and well-being" (I-2).* It was acknowledged that artificial light, such as from screens, can limit the experience of natural darkness and that this affects circadian rhythms and, therefore, impacts well-being.

Engaging with dark skies helped recognise the purpose of natural cycles for rest to aid well-being; *"I think engaging with dark skies, it's part of, like, respecting that the world isn't just for us there's a whole range of species that live here and we're sharing it and I think it's recognising that I think like in past times before electricity and everything would have, we'd have lived much more to the rhythm life cycles of nature, but we've divorced that we're pushing ourselves all the time so we can keep going into the night, whereas actually. I think dark is a special time when you we should be resting. ....we're forcing ourselves out of our natural rhythms all the time. And that's not good for our mental health or our well-being. So there's something about connecting back into the natural rhythms and just being gentle with ourselves. And I think, yeah, the dark skies are important for that and important for wildlife, it does a lot of damage to disrupt their cycle as well" (I-6).* This participant emphasised the loss of our connection with darkness over time and how important it is to re-establish this cycle to help humans and wildlife reconnect with natural rhythms*; "It's good to be dark at night, you know, that nighttime is nighttime. And I think we've lost....we're really disconnected from nature and it's good to rebuild that back" (I-6).*

It was recognised that the instinct to connect with the night ties with heritage "*We've always looked up at the stars as a species. We've always been looking up and I think the idea of us losing that ability to look up and wonder what's up there or come up with stories of what's up there, or just have for general sort of wanting to learn is if we lose that ability, it's a bit, I think, something that's missing in the world at the moment is the fact that we are losing sight of the sky*" (I-6). This was stated as one of the reasons this participant wanted to engage with dark skies to prevent loss of this heritage.

Figure 45: Moon craters seen through telescope at Sutton Bank. Image credit Prof Brendan Paddison

This theme has described how dark sky engagement can be a way for participants to practice mindfulness, slow down, reconnect mind and body, and actively observe natural cycles such as the transition from light to dark. Therefore, connecting with dark skies was found to provide participants with a perspective on their place within the wider universe and reduce everyday worries. This evoked feelings of calm and tranquillity, as well as nurturing instincts towards Earth. The evidence is most closely linked with Seligman's (2011) PERMA model indicators: Positive emotions, Engagement and Meaning.

C. Mood boosting experiences evoke wonder and awe

Summary: Engaging with dark skies offers mood-boosting opportunities through wonder and awe
Emotions: Amazement, wonder, awe, wow, hedonic and eudaimonic happiness
PERMA model indicators: Positive emotions

Wonder, awe and the creation of 'wow' moments

This theme draws on the sense of awe and wonder evidenced during dark sky engagement, which generated mood-boosting feelings in participants. The emotion of awe promotes happiness and better mental health by engaging five processes: changes in neurophysiology, reduced self-focus, increased relationality, improved social integration, and a heightened sense of meaning, life satisfaction, and resilience (Keltner, 2023). Awe is therefore argued to be a key emotion generated as part of dark sky engagement, which helps shift perspective on identity and improve well-being (Monroy and Keltner, 2022).

Engaging with dark skies was described as a way of escaping the mundane to experience 'wow' moments; *"I think more than anything, the overriding thing is for people to be able to escape the everyday, to move away from the mundane and to experience that wow factor ..... because it just makes you feel incredibly joyous....it's the well-being side of it because it can just make you feel absolutely amazing. Whether that's a night walk, whether you actually see stars or not, it makes you feel amazing and if more and more people can feel amazing, then I think, well, we're going to just be living in a much more beautiful world" (I-7)*. This participant felt that the world would

benefit from more people engaging with dark skies for well-being; *"...if you involve mindfulness, it's a massive mood booster. ....a feeling that stays with you for days afterwards. You just feel so well and wowed".* This supports Barnes and Passmore's (2024) research findings that night sky connections are positively correlated with a person's mental health and happiness, and also Coventry *et al. (*2021), who found a positive correlation between nature activities and better mental health. It adds further empirical research to the theory proposed by Ulrich *et al.* (1991) that nature has a positive mood effect. The findings continue the work of Bell *et al.* (2014), who found that exposure to natural nighttime environments, including stargazing, encouraged mindfulness, awe, reduced stress and enhanced mood, improving mental health.

Emotion of happiness

Happiness is a subjective yet positive emotional state of well-being, influenced by lived experiences, values, personality and culture. In exploring how dark sky engagement can help participants achieve a positive sense of well-being, it is important to refer to the levels of happiness experienced in hedonism, through simple pleasures and enjoyment and eudaimonic happiness achieved through deeper meaning, purpose and fulfilment. It is argued that both hedonic and eudaimonic happiness contribute to well-being and people need both to flourish (Henderson, Knight and Richardson, 2013) and dark sky events are a way for these feelings to be created: "*I absolutely love to go to these events. I think they're great, you know, and it's an opportunity to go out and say, look at the stars. It's just wonderful. I love it" (I-5).*

Participant I-8 described nature connection as beneficial to well-being as it offers the opportunity to take time for oneself and create joy; "*I think being out and about in nature generally has kind of proven to be really beneficial to people's well-being and just being able to connect to nature and particularly take time specifically to almost just be out and about and enjoy the space and take time for yourself. And I think dark skies events are really brilliant for that*".

Figure 46: View of the Milky Way, indoor presentation, Ampleforth Abbey

During indoor presentations (Figure 46), participants were wowed by space imagery, such as the Milky Way (fieldnote, 14 February 2025). Participants recognised the risk of light pollution preventing dark sky connection and the impact this could have on well-being: "*I think that we are*

in danger, especially as we get, you know, bigger sort of conurbations and so on. We're at a danger of like, losing our dark skies. And I think dark skies are massively important for us to connect with nature. I mean, we're losing that connection with our stars, with our planets because there's so much light pollution in our cities and our towns. And it means that you don't have that experience, that wow factor" (I-7). This raises an interesting proposition discussed by Capaldi, Dopko and Zelenski (2014): being with nature and feeling happy are connected, highlighting a correlation between nature connectedness and happiness, which was proposed in the conceptual framework (Figure 5). The majority of participants encountered were already engaging with dark skies, perhaps because of the well-being benefits they experienced, including both hedonic and eudaimonic sensations.

Seasonal Affective Disorder (SAD)

Two participants mentioned Seasonal Affective Disorder (SAD), where a lack of light in winter leads to low mood. For one participant who suffered personally with SAD, connecting with the dark skies helped them to cope due to the mood-boosting ability of dark skies: *"It's really been a massive mood booster. It's kind of helped deal with the whole seasonal affective disorder.....Certainly I noticed how it was massive mood boost and I just felt awe. That's what that's what it is awe and that just stayed with me for days and I no longer felt that you know the seasonal effective disorder anymore it....it just went." (I-7)*. Similarly, another participant explained how colleagues with SAD benefitted from dark sky engagement: *"There's a couple of people that I work with that have got the seasonal affective disorder and you know they really go into themselves when winter comes along and the hours change and they get quite sort of, you know, they look a bit lost and a bit bleak. And I think that going out on a dark sky event and seeing the natural world at night time and it's all still going on and there's actually more interactions I think that that can bring you know a little bit of a little bit of joy and more well-being to yourself, yeah"* (I-4). This suggests that those with SAD may benefit from connecting with dark skies, as it can evoke positive emotions such as joy to counteract the difficulty of mood changes in winter.

D. Sense of community and promote individual and collective empowerment

Summary: The community during dark sky events is valued and the sense of place in the dark sky reserve is felt, with a desire to preserve the environment and protect against light pollution
Emotions: Empowerment, sense of place
PERMA model indicators: Relationships, Engagement, Meaning

Community and place were identified as well-being themes, perhaps due to the social nature of dark sky festival events, bringing like-minded people together within the reserve to appreciate its special qualities. Most participants the researcher spoke to and observed in the field attended dark sky events with at least one other person, so they attended with some familiarity, but group interaction was an important element of dark sky events. Community and place link particularly with the 'Relationships' indicator of Seligman's (2011) PERMA model.

Community

There was a sense of a community at events such as standing together in circles at stargazing nature hubs (fieldnote, 19 October 2024), sitting in u-shaped formations at art workshops (fieldnote, 14 November 2024), walking in a group line and gathering on benches at the end of a night walk to share hot soup and a bread roll (fieldnote, 30 October 2024).

A recurrent theme was appreciation and enjoyment at exploring the night sky within the reserve as a group: "*There was this really strong sense of community, of people just enjoying the enjoying the same thing.... I'm quite curious about it all and I think that's why I was really drawn to the festival in general, was just to connect with other people who like, sort of saw this as a space for exploration*" (I-2). This participant expanded on sharing the experience with others, bringing people together in a way festivals intend: "*You connect with other people you share your experience, but ultimately, like those workshops, are about coming together as a group and sort of sharing it with one another if that makes sense. Which I think could be probably said for dark skies festivals in general. I mean, I guess that's what a festival is. It draws sort of like-minded people together*" (I-2).

Others stated that they enjoyed the safe space provided at dark sky events and sharing a passion for the night sky with others: "*I think it's sharing that passion and interest. It's having a safe place to engage with the natural sky……When you kind of go with a group, you have that kind of safety and the connection there, that actually it's something that we're all doing together and it's something that people wouldn't necessarily feel comfortable confident doing by themselves*" (I-6). This participant emphasised the attraction of events for their family: *"I think it's a really cool thing to do as a family…something out of the ordinary" (I-6)*. This is in line with findings by Hvengaard and Banack (2024) on high levels of visitor satisfaction at the Jasper Dark Sky Festival in Alberta, Canada.

This emerging theme of community ties with Morris' (2011) research on the merging of art, landscape and sensory perception at night, which placed emphasis on experiences which are often caused or shared by others (Morris, 2011). This signifies the importance of community

when engaging with dark skies and the significance of social interplay rather than focus on isolated personal narratives.

Although the sense of community was important for helping participants feel safe and comfortable to explore the night sky together, the feeling of community was sometimes described as temporary, lasting for the duration of the event: *"On the event regardless of like how tired I was and that sort of thing, there was still that sense of a little community happening, even if only a temporary one. We all just kind of had this pull towards each other of like, oh, we all like this thing. Even if we don't fully understand it, we all enjoy it" (I-11).* This connects with Kaplan and Kaplan's (1989) Attention Restoration Theory (ART) that stated time with nature can help combat mental fatigue (Kaplan, 1995).

The researcher did not find significant evidence of the formation of strong connections arising from participants meeting others at dark sky events; *"I don't really go to make friends because I do it for personal reasons, just to go to enjoy the experience" (I-5)* and "*It's definitely opportunity to build connections within the space because you do sort of have that time to spend with yourself or with other people as well in that..... I wouldn't say necessarily that I've been in contact with many people since the walk*." (I-8).

Despite this, there was evidence that participants appreciated a sense of temporary community; "*Even if you don't stay in contact with the people who come on to these sorts of workshops, it's the experience you have with them...stays with you. So yeah, I think that's been really positive and good*" (I-2). This implied that the lasting impression was the experience shared with others, which made participants feel positive and good, as they shared the experience as a group.

An interesting analogy of feeling the gravitational pull of other people was used by one participant to describe how it felt to have people around them whilst engaging with dark skies: *"I was very much aware of the people around me and like how close I was to them.....With the people, you can almost feel their gravity. Yeah, it's how do I put it....it's like you can feel the electricity of the other person....It's almost like you feel the gravitational pull of people... I'm trying to just try and put it into words, but it's like almost like everyone has their own little gravitational pull. And as when you're in a group of people in the dark, you can almost feel where everyone is almost like a sixth sense that we've kind of lost touch with as a species.....It's almost like there's a radius where you can feel that and anything outside of that radius, which usually a wild animal would be you're not aware of it*" (I-12). This was interesting, as this participant felt the presence of the other people around them more than any nearby wildlife. It was implied that this feeling is something we have lost touch with as a species. This ties with the 'Relationships' element of Seligman's (2011) PERMA model. The sense of togetherness which participants expressed was evident in

slow adventure and well-being work of Farkić, Filep and Taylor (2020) and the community work explored by Blair (2018).

Participants shared their appreciation for having other people's energy and perspectives around them as a way of feeling closer to dark skies: "*Just having that time that hour and a half in the darkness....it definitely brought me closer to the night sky. Like even if it was overcast, I still feel like this, you know, almost like palpable. There's a real energy about it I found, and I think sharing that with other people and kind of hearing reflections and things. It sort of makes you think, you know, you're hearing opinions from other people, you're introduced to new ways of thinking or thoughts that really it sort of plants questions in your mind, you know and then your sort of days later reverberating and things. So yeah, I think just to have being able to experience that with other people as much as with yourself. That's big and that kind of brings you closer to the darkness*" (I-2). It was apparent that this participant felt closer to the darkness by experiencing it with others who introduced new ways of thinking and opinions, which enabled reflection after the event. The rich personal narratives explored relate to Derrien and Stokowski (2020) qualitative interpretivist research on night skies viewed as unreachable spaces and the ways visitors therefore developed imaginaries and meaning through symbolic language and personal storytelling about dark skies.

Place

The special qualities of the NYMNP international dark sky reserve were evident both in field observation and during the interview stage. One participant expressed their longstanding passion for the moors right at the start of the interview: "*I have always loved the North York Moors*" (I-10). This reinforces the appreciation of place. This supports the perspective of Maller *et al.* (2008) that natural environments, such as parks, are positive health resources, vital for enabling humans to access and connect with nature. It is argued here that dark sky festival events run within the NYMNP weave together environment, health and society based on nature connection, and dark sky festivals celebrate nature connection through darkness, generating feelings of well-being.

A special sense of place was evident during field observation, participant interviews, during research of dark sky festivals advertising and by the presence of a range of dark sky products in the national park's visitor centres and gift shops at Sutton Bank and Danby Lodge. The dark sky festival programme attracted people through social media and regional news advertising. It appeared on the front page of the February 2025 edition of the 'HandyMag' distributed to over 27,000 Yorkshire households and was advertised as a telescope ice sculpture at the York Ice Sculpture Trail in February 2025 (Figures 47 and 48):

Figure 47: Handymag February 2025 advertising the dark sky festival

Figure 48: Ice telescope advertising the festival during York Ice Sculpture Trail, February 2025

During fieldwork, the researcher visited Sutton Bank and Danby Lodge visitor centres and found a range of dark sky themed products in the national park visitor centre shops with dedicated sections for space, such as children's cards, books and toys (Figure 49). There were books for adults on planets and stargazing (Figure 50) and night-time inspired paintings for sale by local artists (not pictured, fieldnote 30 October 2024). This created a presence of dark skies within visitor hubs, signifying a sense of place and identity in the reserve for observation and connection to dark skies.

Figure 49: Night sky products aimed at children in the North York Moors Visitor Centre shop

Figure 50: Dark sky books available in the Dalby Forest Visitor Centre Shop

The dark sky festival events provided a space for dark sky leaders to share educational messages and engage the community in learning about dark skies and ways to preserve them (Figure 51):

Figure 51: Leaflet on how to preserve dark skies. Image credit: NYMNP

Stargazing leaflets were given out to participants during dark sky events (Figure 52):

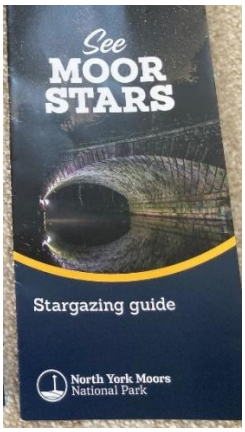

Figure 52: NYMNP Stargazing guide

Indoor presentations showing examples of dark sky-friendly lighting showed participants how different lighting choices impact visibility near buildings and towards dark skies above (Figures 53 and 54):

Figure 53: Poor lighting choices outspill light

Figure 54: Improved dark sky friendly lighting

It is argued that these conservation messages enabled a sense of both collective and individual empowerment, and the knowledge gained from these dark sky leaders was appreciated by participants: "*If you go to a dark skies event, usually somebody with some knowledge will explain*

something you don't know" (I-5). Field observation highlighted that dark sky events educated participants about the scale of light pollution and its impacts, as well as about dark skies and how to preserve them (Figure 55).

Figure 55: Light pollution mapping in the UK, indoor dark sky presentation

Field observation and interview data demonstrated that people appreciated educational elements of dark sky presentations, as they gained valuable information on light pollution and simple but effective examples of dark sky friendly lighting, helping them feel empowered to implement change locally at their homes (fieldnote, 14 February 2025). Participants also learnt the 5 key principles of effective dark skies lighting during indoor presentations at dark skies events (Figure 56):

Figure 56: Dark sky friendly lighting choices

Dark sky leaders used dark sky festival event presentations to provide participants with knowledge on biodiversity in the dark sky reserve including moths and bats, and explain the importance of moths for pollination within the NYMNP ecology (Figure 57):

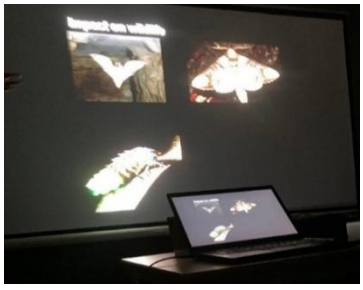

Figure 57: Raising awareness of moths for biodiversity

These educational conservation messages provided by dark sky event facilitators are relevant within the well-being theme of community and place because their knowledge and guidance

enabled particiapnts to gain information on the impact of lighting choices on human health and biodiversity, helping create empowerment with a sense of togetherness formed at the group based events to highlight individual and collective responsibililties. Field observation and interview data implied that individuals valued this information and would consider lighting changes for the benefit of viewing and connecting with dark skies and for biodiversity. This potential for dark sky activities to assist in regenerative tourism in dark sky zones relates to Hall, Paddison and Jones (2025) sensory ethnographic research within NYMNP and is also relevant to SDG 3, which promotes health and well-being within sustainable development (United Nations, 2026). The dark sky festival events taking place in the NYMNP during the shoulder season in October and February provide a way to continue engaging the community year-round (Mitchell and Gallaway, 2019; Rodrigues, Rodrigues and Peroff, 2015). Dark sky leaders at festival events helped to facilitate transfer of knowledge to participants, and it is argued that they have an important role in group cohesion, security and advocating well-being. In alignment with Farkić, Filep and Taylor's (2020) findings on the role of tour guides in guided immersive adventures such as stargazing "*In the slow adventure context, the guide's role is crucial. It is their responsibility to interpret, mediate and navigate people through unfamiliar wild spaces and negotiate harsh environments and, more importantly, to keep the group together and provide them with care*" (Farkić, Filep and Taylor's, 2020 pg. 2068). Therefore, it is argued that dark sky event leaders at festivals have a vital frontline role in promoting social involvement during small-group activities. These findings align with Marr's (2024) ethnographic research in Galloway Dark Sky Park, which affirmed dark sky protected zones as sites of socioecological interaction and cultural value for communities.

Some dark sky festival events included take-home resources; for example, a constellation dial making kit (Figure 58) and stargazing app Stellarium was promoted to participants at several events (fieldnote, 30 October 2024 and fieldnote, 17 February 2025, 24 February 2025, see Figure 59) so that participants could continue developing their connections with dark skies beyond the events. This theme has explored how a sense of community and place within the NYMNP has been created and facilitated with the support of dark sky leaders and being centred on small group based activities which enable participants to explore dark skies and nature in new ways to build deeper connections. The sense of empowerment creates sensations of well-being through the 'Relationships' and Engagement' elements of the PERMA model (Seligman, 2011).

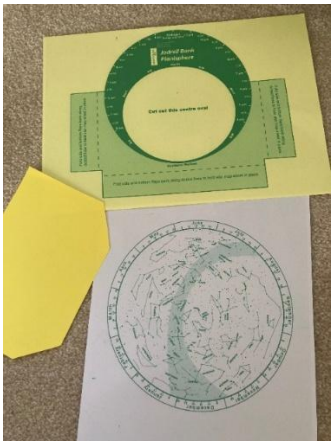

Figure 58: Constellation dial maker, given out at Danby Lodge

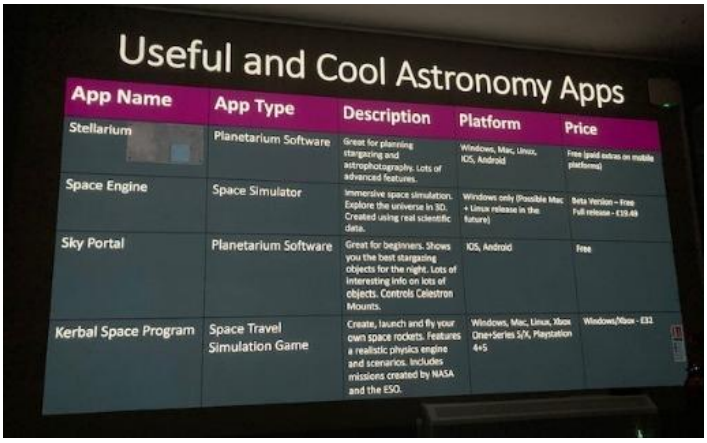

Figure 59: Astronomy apps provided at Ampleforth Abbey

E. Childhood interest in space and positive family influences

Summary: Childhood memories and interest in space and the natural world link closely with personal interest in dark skies during adulthood
Emotions: Sense of adventure and desire to explore nature
PERMA model indicators: Relationships, Meaning, Engagement

It was evident from individual narratives during interviews that an interest in dark skies often stemmed from a fascination with space and adventure as a child: *"My room when it was decorated had little stars and spacemen. I had the constellations of stars on the ceiling and stuff like that. Probably to replace the fact I couldn't see them outside.....I remember science saying there's two areas that mankind haven't explored, and that's the depths of the ocean and the depths of space. Well, I have a fear of deep water. So immediately I went for space"* (I-12). This participant brought a sense of space into their room through decoration, despite rarely seeing a starry night outside. The unexplored areas of the ocean and space created fascination at a young age. They continued; "*It's just rockets and stuff like that, being the kind of kid who is like big in engineering things. The ideas of rockets and stuff was quite enjoyed it. I feel that's probably where a lot of that came from really*." This finding links with Blair (2018), who found, through intuitive inquiry, also used in this research, that the night sky evoked nostalgic childhood memories, which helped strengthen claims made by the dark sky movement that dark skies can positively impact well-being (DarkSky, 2025).

It was found that positive family influences in engaging with dark skies sparked an interest in connecting with the natural world: "*My dad was always showing me anything in the natural world. And then of course, as soon as it gets dark, showing me anything that he knew about in the night*

in the night sky. He got a telescope and we attached the camera to it and I can remember getting a photo of Jupiter and like being able to see the weather on it because I could see that the spot on Jupiter and I could see the moons and I just it was blowing me mind that I could see weather on another planet and I was just thinking this is this is amazing. But then I noticed with his camera it was so much clearer and I was like, well, I needed a better camera. I needed a better telescope" (I-4). This implied that experiencing dark skies with family and using telescopes was something to enjoy together, and it created aspirations to continue improving their view of the night sky with better equipment.

A childhood passion for the natural world and family encouragement was a recurring theme: "*I have a wonder of the world. I'm interested in the whole of the natural environment, whether it's a dark sky or a light sky and everything that sort of lives there....iit was probably just a family encouragement. And my dad was always showing me things....it was maybe the one thing at school that I was that I was good at. ....if we ever did anything on nature or the natural world, I was always, you know, right at the top of the class"* (I-4).

There was a desire among participants to encourage their children to take an interest in the natural world away from technology and reduce screen use to benefit well-being: "*I love the area for a start, and my son is interested in planets and things. So it's one reason was to give him an experience, you know, something that's different. See some planets, see a comet rather than staying at home, you know, on the computer games, it gets him out to do something different, something constructive. And I think it opens your eyes as to, you know, what's around the planet. Yeah. People can kick a ball around or watch telly and they kind of focused on watching this box, aren't they? Whereas if you go to a dark skies event you are connecting with nature and you're connecting with the peace and quiet. You know the stars make you appreciate what's around the Earth" (I-5).* This indicated that dark sky engagement was viewed as good for family time and relationships, as a way to move away from reliance on screens for entertainment, and as a way to connect with nature in peace and quiet and observe what is around Earth.

A powerful memory of clear dark skies during a phosphorescent swimming experience in the Mediterranean left a huge impression on participant I-6, leading to their continued interest in dark skies into adulthood: "*It was pitch black, but your body was glowing in the water like this. The sea was lit up....almost like stars. And then that was reflected in the sky. Thousands and thousands. So it was just amazing...it's never going to leave me that memory. It was so huge"*. This positive and extraordinary experience of dark skies created a long-lasting association with the sensory thrill of dark skies. Participants' storytelling of dark sky experiences was also found by Blair (2018) in her research on the dark sky community on the Island of Sark. The data therefore

suggested that personal interest in the night sky can be linked to positive childhood memories and interest in space, and that family encouragement is an important factor.

This chapter, grounded in reflexive analysis, has highlighted and discussed the 5 key well-being themes identified. Figure 60 below demonstrates the link between dark skies engagement and the PERMA model of well-being (Seligman, 2011). Inevitably, there is overlap in well-being themes but it acts as a visual demonstration of how dark sky engagement evokes positive sensations that generate feelings of well-being.

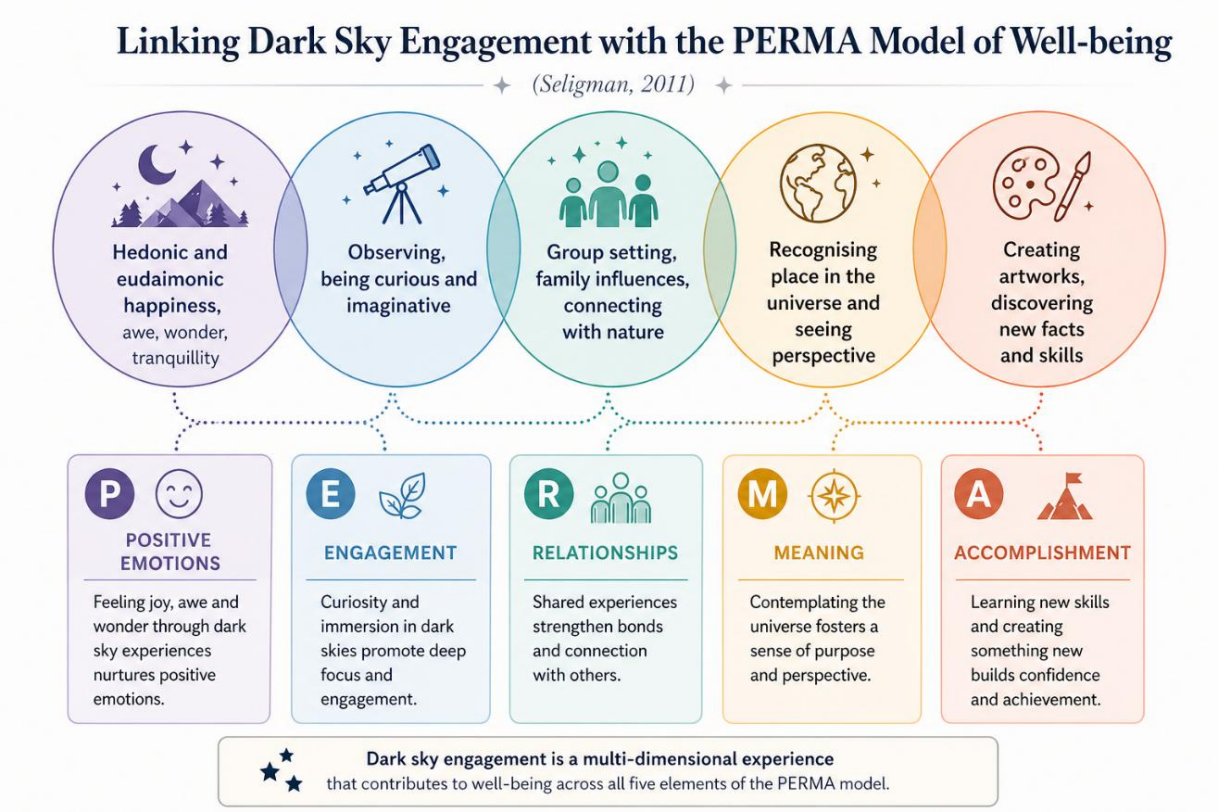

Figure 60: Linking dark sky engagement with the PERMA model for well-being (Seligman, 2011) Author's own

Figure 61, overleaf, visually maps the well-being themes identified during dark sky engagement. At the base is childhood interest in dark skies. Above this, the theoretical lens of nature connection is acknowledged. There is recognition for the sense of community and place within the NYMNP. Each of the four teal boxes shows themes identified: mood boosting emotions, mindfulness, changes in sensory perceptions and a sense of community and place, recognising the social setting of dark sky events and the unique qualities of the reserve.

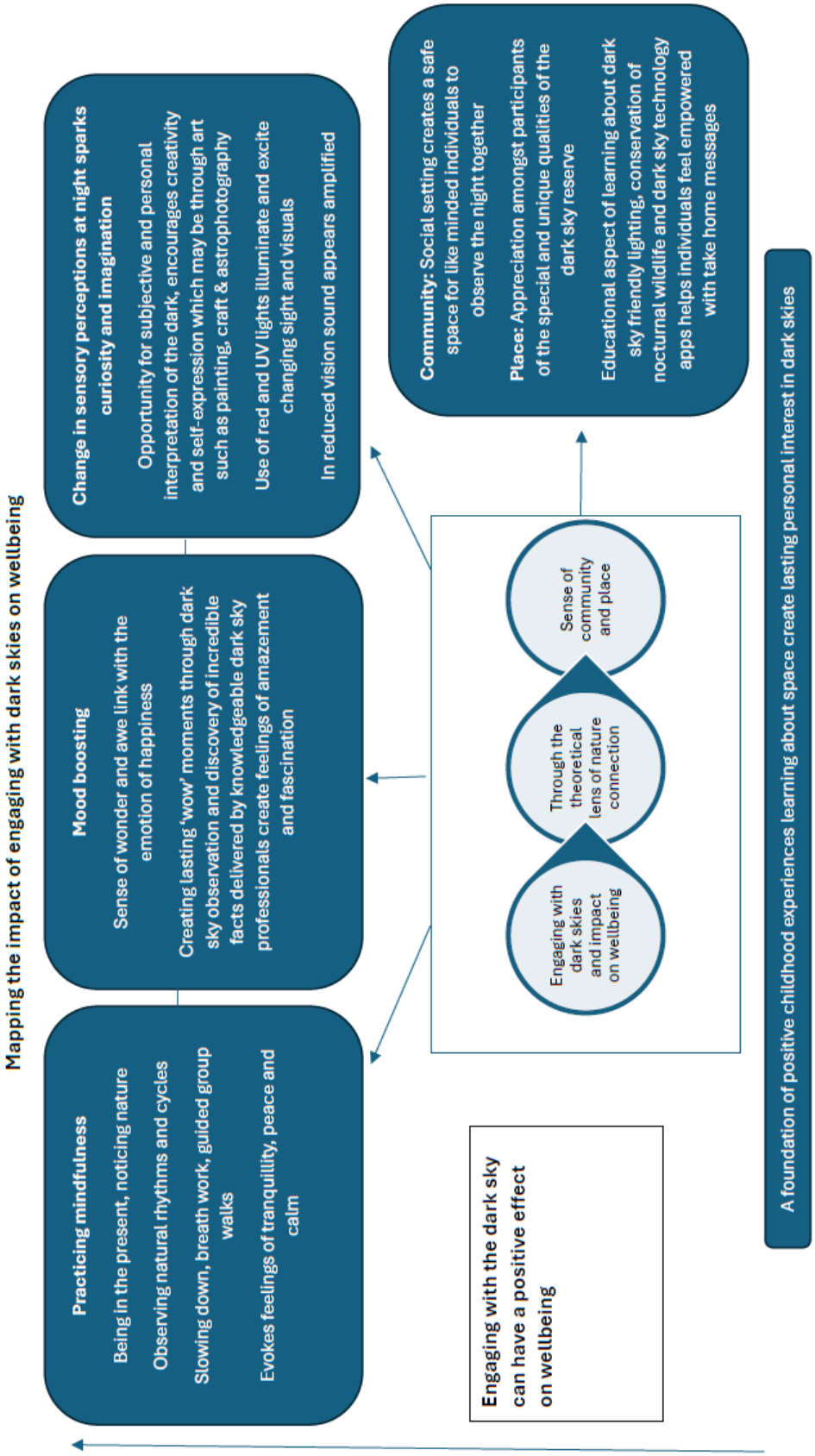

Figure 61: Mapping the well-being impact of dark sky engagement. Credit: Author's own

Chapter 5 Conclusion

This research provides new evidence and insight into the well-being benefits of festival-specific dark skies nature activities within a UK national park in a post-pandemic world.

The research gap was identified as a festival-specific empirical study in a UK national park and dark sky reserve, focusing on dark skies for well-being, using a novel approach of conceptually linking the biophilia hypothesis, nature connectedness, and hedonic and eudaimonic sensations, and breaking down how well-being manifests using Seligman's (2011) positive psychology PERMA model. The first objective to explore the impact of light pollution and the emergence of the dark sky movement in national parks in the context of nature connectedness and well-being has been met by a comprehensive review of existing literature in dark skies, nature connection and well-being, focused on community engagement in dark sky festivals in protected zones. This study explored different levels of happiness, a positive emotion linked to well-being, from simple pleasures of hedonism to a deeper sense of happiness and meaning through eudaimonia (Henderson, Knight and Richardson, 2013).

The overarching research aim was to explore how participants at dark sky festivals experience well-being in a UK national park through the lens of nature connectedness. This aim was achieved through field observation at dark sky festival events and rich personal narratives explored through interviews, which were used to identify five key well-being themes:

(A) Changes in sensory perceptions trigger curiosity, imagination and creativity
(B) Practice of mindfulness and slowing down to observe natural darkness
(C) Mood boosting experiences evoke feelings of wonder and awe
(D) Sense of community and place promote individual and collective empowerment
(E) Childhood interest in space and positive family influences

This research has therefore demonstrated that those who engage with dark skies can experience multi-faceted benefits to their sense of well-being. The NYMNP public engagement programme, delivered in one of only 25 international dark sky reserves in the world, provides a special opportunity for key stakeholders to forge new, exciting and deeper connections to dark skies through nature connectedness through curiosity, changes in sensory perceptions and creativity. These generated positive emotional responses in participants, including awe, wonder, tranquillity and accomplishment through new immersive experiences with nature to support well-being (Pritchard *et al.*, *2019;* Richardson *et al., 2021)* and the benefits of hedonic and eudaimonic behaviours on well-being (Henderson, Knight and Richardson, 2013).

The second objective, exploring, through a sensory ethnography approach, participants' experience of nature connectedness whilst engaging in dark sky festival events, was achieved by considering the role of the senses in engaging with dark skies. Taking a sensory ethnography approach was critical to explore how participants see, hear, feel and move in the natural nightscape of the NYMNP to connect with dark skies and how this can positively impact sensations of well-being. Participant observation in the field and in-depth interviews captured perceptions, behaviours, lived experiences and feelings in both verbal and non-verbal ways. It acknowledged the significant shift in sensory perceptions that darkness brings, including reduced vision, the use of red and UV lights, amplified hearing, and a focus on deep listening to tune into their surroundings through embodiment. Using sensory ethnography, recognised non-verbal behaviours such as excitement, awe, and happiness that could have been overlooked or ignored, and that would not have been captured by other methods, such as surveys. Engagement with dark skies through group-based activities in the reserve, led by dark sky advocates, fostered a sense of togetherness and enabled participants to spend valuable time with family and friends appreciating the reserve's special calming qualities and gaining knowledge. This is in line with Farkić, Filep and Taylor's (2020) study of facilitated slow adventures, such as stargazing.

Engagement with dark skies included pleasant hedonic well-being outcomes such as getting to know constellations in the sky, feeling the ground underfoot or branches in mid-air, illuminating natural entities with UV lights, feeling the wind, and hearing wildlife nearby. Eudaimonic well-being outcomes included participants developing new skills leading to accomplishment, pride and personal growth, and gaining a better sense of meaning and perspective on their lives within the wider universe. Exploring dark skies in new and different ways through the senses, embodiment and hedonic and eudaimonic sensations enabled participants to develop new, deeper and more meaningful connections with nature. This strengthens the existing evidence in the literature that being immersed in nature is good for well-being (Maller *et al.,* 2008), and the findings demonstrate that both hedonic and eudaimonic experiences can occur in participants at dark sky festivals, which can contribute to a sense of well-being.

The third objective, to identify how participants experience well-being through connecting with nature when engaging with dark skies, was achieved by implementing the PERMA model (Seligman, 2011), a positive psychology well-being framework. Breaking well-being contributors down into 5 key elements: Positive emotions, Engagement, Relationships, Meaning and Accomplishment enabled the researcher to identify and understand how sensations of well-being manifest in different ways. Dark sky engagement was found to be an instrument for participants to explore nature through curiosity, imagination and mindfulness. Dark sky

engagement supported participants in taking a physical and mental break from hectic lives and schedules, slowing down, being in the present moment, and seeing their lives in the perspective of planet Earth and the wider universe. By engaging with dark skies and noticing nature around them, participants were able to set aside everyday worries, listen to calming sounds, and observe the natural transition from light to darkness. This evoked wonder and awe, emotions strongly linked to happiness (Keltner, 2023). These findings contribute to existing literature on nature and well-being, providing new insight from a dark sky festival-specific context.

The integration of therapeutic art into dark sky festival events enabled participants to engage in creative practices, despite space being weighted towards scientific disciplines. The use of art enabled engagement through self-expression, creativity and personal interpretation of dark skies, leading to the development of new technical skills along with a sense of accomplishment and pride, contributing to well-being (Henderson, Knight and Richardson, 2013). Therefore, it is concluded that dark sky festival events in the NYMNP, as immersive sensory experiences, helped participants establish new connections with nature through art workshops based on the night sky, alongside more traditional methods such as night walks, sedentary stargazing and indoor presentations.

Engaging with dark skies was found to be both deeply personal, where people took from the experience what they wanted, but was a shared group experience. This supports the perspective of Maller *et al.* (2008) and Romagosa, Eagles and Lemieux (2015) that parks providing access to nature support well-being at both individual and community levels. Dark sky festivals in the reserve weave together a nature-based leisure activity with a sense of community and place for like-minded individuals to enjoy the structure of professionally led events. The sense of community was often viewed as temporary, a moment in time in which individuals gathered and shared an experience. This aligns with the findings of Farkić, Filep and Taylor (2020) on how outdoor guides facilitate tourists' well-being by enabling them to engage in slow-adventure experiences immersed in nature, with a sense of belonging within small social groups. Positive childhood memories or an interest in space, along with family role models, were found to link to dark sky interest and engagement in adulthood.

This research contributes to theoretical knowledge by developing a novel approach that integrates the biophilia hypothesis, the relationship between nature connectedness and hedonic and eudaimonic happiness, and a positive psychology well-being framework. This new way of looking at well-being in a dark sky setting provides a novel lens which could be applied to other community engagement projects in dark sky protected zones.

Contribution to practical contexts is now addressed. Importantly, this research challenges traditional preconceptions of national parks as a place to enjoy on a summer day. Engaging with dark skies in the NYMNP dark sky reserve offers an opportunity to be among natural darkness in a social environment, and the research has helped to form a better understanding of dark sky experiences within the reserve and how festival events can contribute to well-being. The research highlights the importance of the NYMNP dark skies public engagement programme, not just for dark sky preservation but also for individual and public health strategies to support well-being. The researcher argues that engagement with dark skies should be more prominently integrated into healthcare strategies, given the multitude of benefits it can bring to well-being. This conclusion further supports social prescribing, nature, and leisure-on-prescription initiatives as public health interventions for mental healthcare in non-clinical settings (NHS England, 2025). Finally, the fourth objective to make recommendations for further dark skies research beyond the scope of this paper is met below.

Recommendations

This study has provided a substantial contribution to the field of dark sky engagement for well-being, and specifically, the potential for the NYMNP dark sky festival public engagement programme to contribute to well-being. It opens a pathway to new and stimulating conversations on how voluntary dark sky engagement as a nature-based activity can positively influence the well-being of individuals and communities, and builds on the argument that national parks are an important health resource as well as areas for protection, conservation and regeneration of landscapes, habitats and biodiversity. This has implications for professionals and policymakers in the fields of healthcare, the environment, and sustainability, as well as for individuals seeking to enhance their psychological health and well-being by exploring new and exciting connections with dark skies and nature. The view that forming strong connections with dark skies as an aspect of nature is good for health and well-being that this study addresses is significant to disciplines including environmental studies, psychology, public health, tourism and leisure and is relevant to UN SDG 3 Health and Well-being (United Nations, 2026), vital for a more sustainable future (Farkić, Filep and Taylor, 2020). The dark sky reserve of the NYMNP offers a natural dark sky environment to build new and deeper connections with nature through a diverse array of festival events to cater for the new ethical consumer trend. The researcher argues that this demonstrates the potential for dark sky festivals to act as a powerful catalyst to help people forge new, stronger and deeper connections with nature through curiosity, creativity, tranquillity and the generating of positive emotions such as joy, gratitude, and wonder that support sense of well-being.

Based on the findings, the practical implications and recommendations are that the following actions are required for the continued development of dark sky festival public engagement programmes. Public engagement programmes of dark sky festivals should be actively promoted as a health resource for well-being (Maller *et al*., 2008; Romagosa, Eagles and Lemieux, 2015). The NYMNP dark sky public engagement programme is of benefit to those who use it and this provides a case of supporting their promotion and integration into healthcare and well-being strategies and policies. Environmental and health-based researchers and policymakers should consider how to forge meaningful connections with dark skies as an aspect of nature, and how this can evoke positive emotional responses to enhance well-being and contribute to the elements of Seligman's (2011) PERMA model (Positive emotions, Engagement, Relationships, Meaning and Accomplishment).

The research found that dark sky experiences as part of festival events are group-based social activities, yet personal and unique, dependent on individual engagement and perception. There is a strong sense of community and place within the NYMNP dark sky reserve during festival events, evidenced through the planning and delivery of sedentary activities and the unity of group walking. It is strongly recommended that engagement with dark skies take greater prominence in sustainable development goals and in conversations relating to the climate crisis and well-being. It is important to raise awareness of the benefits of dark skies for well-being, particularly among underrepresented groups who may never have connected with the night sky, and to discuss inequalities in sensory access to dark spaces. Outreach programmes could improve accessibility for marginalised groups, such as children, people with access issues, and people living in urban areas affected by light pollution, who may be less connected to dark skies. It is recommended that NYMNP continues to work with schools, dark sky activity leaders and local authorities to connect marginalised groups with dark skies. This would be an important step in bridging the gap between urban and rural areas and among different socio-economic groups, so more people can contribute positively to their well-being by engaging with dark skies.

Limitations

Despite its merits, it is important to recognise some limitations. Firstly, the cross-sectional design limited data collection to a narrow time window between October 2024 and February 2025. It is acknowledged that the geographical area was small and specific to the NYMNP, and it is important to recognise that the Yorkshire Dales is part of the international Dark Sky Reserve. This means the research is not fully representative and limited in place and time. However, collecting data only within the NYMNP ensured that this area was the study's primary focus. Given the wide and diverse events that form the dark sky festival programme, the researcher was only

able to attend a small proportion of them. However, this was due to the project's time constraints, and data collection was completed once saturation was reached. In addition, it is acknowledged that the sample size was small and reliant on self-selection for interview, which could be impacted by self-reporting bias and recall ability. The sample may not have been fully representative of key stakeholders' perceptions and behaviours, and may have been skewed by bias, as dark sky festivals tend to attract those already interested in and engaged with dark skies, both within and outside the reserve.

The main theoretical framework underpinning this research was humans' evolutionary tendency to favour natural environments (the biophilia hypothesis), nature connectedness and its links to feelings of eudaimonia, and Seligman's (2011) PERMA framework to break down how well-being manifests in different ways. Therefore, due to space constraints, it was not possible to address other theoretical lenses, including post-humanism and ecological justice. In addition, the decision to ground the research in positive psychology can be seen as one-sided or binary. In reality, positives and negatives coexist and are entwined; for example, a participant may enjoy attending festival events but dislike driving at night to reach them in remote locations. Sensory experience was a significant focus of this research, and not considering sensory issues such as sensory processing disorder (SPD) may have been a limitation, although there was no evidence of this in the empirical data. Finally, although this research contributes new knowledge on the role of dark skies for well-being, it did not aim to investigate or report on current nature-based and non-clinical interventions prescribed by healthcare professionals for those affected by mental health disorders.

Future research

It would be beneficial to conduct demographic studies to determine how engagement with dark skies for well-being varies among key stakeholders, including by gender, occupation, education, age, and socioeconomic background. The three main community groups of visitors, residents and local businesses could be studied individually or compared to investigate significant differences in perceptions and experiences of dark skies connection and resultant impacts on well-being. Quantitative data, such as surveys gathered from a larger population, could be categorised by stakeholder, though it is recognised that some participants may overlap across multiple community groups. Further research should incorporate quantifiable measures of dark sky connection such as utilization of the Night Sky Connectedness Index (Barnes and Passmore, 2024) and nature connection using the Connectedness to Nature Scale (CNS) (Mayer and McPherson Frantz, 2004) or the Inclusion of Nature in Self Scale (INS, Schultz, 2001; Richardson *et al*., 2021) or Biophilic Values (Kellert and Wilson, 1995).

If research were conducted on the distance travelled to dark sky festival events, this could help to determine the programme's geographical reach. Further research could incorporate religion and spirituality to investigate any links to well-being and mindfulness. It would be useful to incorporate dark sky festival events taking place within the Yorkshire Dales, as it is part of the same dark sky reserve as the NYMNP, and research could be extended to other dark sky places in the UK and abroad.

Future research should aim to take the learning from national parks into urban contexts, such as cities and study how local businesses, residents, and local authority planning departments could adopt dark sky festivals and responsible lighting to foster dark sky activism within cities, which could enhance the well-being of urban communities as well as reduce light pollution. In addition, it would be worthwhile to investigate the use of virtual reality in creating immersive dark sky experiences, perhaps focused on those unable to attend festival events due to accessibility issues, or conduct a comparative study of well-being impacts of natural stargazing versus simulated sky settings, including stationary and mobile planetariums. Similarly, the role of planetariums in community engagement in urban environments could be an interesting development in dark skies research and whether simulated skies could be a method of outreach for those currently not engaging with dark skies due to light pollution or lack of knowledge and understanding. Related to this, the impact of Sensory Processing Disorder (SPD) could be investigated in relation to the sensory experience of engagement with dark skies.

Further research should explore other theoretical lenses, such as posthumanism and ecological justice, to investigate biodiversity and conservation in dark sky places, spotlighting nocturnal species currently supported within these zones. Related to this is the potential for dark sky festival events to integrate citizen science through astronomy and ecology research. Further research could explore sustainability practices for dark sky festival events, such as strategies to minimise the environmental footprint of tourism activities in dark sky places like NYMNP.

Longitudinal studies on the impact of dark sky programmes on well-being and nature connection should be conducted to better understand the amount and type of dark sky engagement for optimal impact on well-being, and whether regular participation is essential for lasting impact, or whether sporadic engagement with dark skies is equally beneficial for well-being. The integration of specific health metrics into a new study would be beneficial, including physiological changes such as cortisol levels, cardiovascular changes, and sleep patterns, measured before, during, and after attending dark sky festival events. Understanding visitor experiences in this way would help better understand engagement with and connection to dark

skies as a journey of discovery, learning, and change beyond events. Similarly, it would be worthwhile to undertake behavioural studies to track whether participation in dark sky events leads to sustained environmental activism for dark sky protection. Further research could investigate dark sky friendly lighting in dark sky zones to provide evidence on whether this has any effect on crime rates, relevant to well-being of communities.

Finally, it would be worthwhile to research negative emotions and barriers to dark skies such as fear of the dark, mourning the loss of dark skies, safety concerns, in particular for vulnerable groups such as women, children and the elderly, dislike of night time driving, transport limitations, inaccessibility of remote areas for those with mobility issues, time and financial constraints and lack of awareness of dark skies festivals, especially for those living in light polluted areas. Studies in these areas could help identify barriers to accessing dark skies and may help mitigate access issues and support marginalised groups through outreach initiatives. There is an urgent need to address the urban-rural divide and highlight social justice issues affecting those living in light-polluted areas. Inequalities in sensory access to dark skies create a separation between urban and rural spaces in terms of natural nightscapes and, therefore, the potential benefits of dark sky engagement for human well-being.

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