

The impact of nature-based interventions on the wellbeing of vulnerable adults.

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Table of contents

Acknowledgements	2
Table of contents	3
List of figures	7
List of tables	8
List of abbreviations.....	9
Abstract.....	12
Chapter 1. Thesis overview	14
Chapter 2. Literature review	16
2.1 Background introduction.....	16
2.2 Mental health and wellbeing.....	16
2.2.1 Terminology, definitions, prevalence and cost of mental ill-health	16
2.2.2 Models of mental health and wellbeing	20
2.2.3 Vulnerable populations and health inequalities	23
2.2.4 Mental health treatment options	26
2.3 Nature, mental health and wellbeing.....	29
2.3.1 Psycho-evolutionary theories for Human-nature wellbeing	31
2.3.2 Nature connection and wellbeing.....	33
2.3.3 Experiencing Nature Connection.....	35
2.4 Nature-Based Interventions (NBIs), types and evidence of outcomes	36
2.5 Possible mechanisms for the impact of NBIs on wellbeing.....	44

2.6 Dose, frequency and duration of NBI	48
2.6.1 Single dose of NBI	48
2.6.2 Frequency and duration of NBI	49
2.7 Wider values to society	50
2.8 Enablers, barriers and gaps	51
2.9 Summary of literature review and research aim/questions	54
Chapter 3. Methods	56
3.1 The ontological and epistemological position of the researcher – pragmatist	56
3.2 NBI Provider, intervention and role of researcher	58
3.3 Study 1 and study 2 methods	61
3.3.1 Overall Study Design	61
3.3.2 Study 1 Quantitative Survey	62
3.3.2.1 Study 1 Participants and Recruitment Strategy	62
3.3.2.2 Study 1 Procedure	64
3.3.2.3 Standardised Questionnaire Measures	67
3.3.2.4 Study 1 Data Analysis	68
3.3.3 Study 2 Qualitative Data Collection	68
3.3.3.1 Study 2 Participants and recruitment	68
3.3.3.2 Study 2 Procedure	69
3.3.3.3 Study 2 Data Analysis	70
Chapter 4. Results	73
4.1 Study 1 Results	73

4.1.1 Study 1: Participants	73
4.1.2 Study 1: Wellbeing.....	74
4.1.3 Study 1: Nature Connection	75
4.1.4 Study 1: Predictors of Wellbeing	77
4.2 Study 2 Results	77
4.2.1 Study 2: Participants	77
4.2.2 Study 2: Six Themes	78
4.2.3 Theme one: Enhanced social interaction within the NBI.....	79
4.2.4 Theme two: Feeling calm, free and closer to nature through increased interaction and immersion within the natural environment	83
4.2.5 Theme three: Enjoyment from being active and appreciation of the benefits of physical activity	87
4.2.6 Theme four: Improvement in lifestyle behaviours.....	91
4.2.7 Theme five: Enhanced positive affect, emotions, confidence and self-esteem ...	94
4.2.8 Theme six: More positive about the future, increased hope, pride and state of empowerment.....	98
Chapter 5. Discussion	101
5.1 Study 1 discussion	101
5.2 Study 2 discussion	104
5.2.1 Mechanism one - Social interaction	105
5.2.2 Mechanism two - Interaction with natural environment	106
5.2.3 Mechanism three - Physical activity.....	110
5.2.4 Mechanism four - Behavioural gains	111

5.2.5 Mechanism five - Self-esteem, confidence and emotional experience.....	113
5.2.6 Mechanism six - Empowerment.....	115
5.2.7 External and internal underpinning mechanisms and conceptualisation of process	117
5.3 Interpretation of combined findings.....	120
5.4 Strengths and limitations of the research	123
5.5 Future research directions	126
5.6 Wider Implications.....	129
5.7 Conclusion	130
Chapter 6. References.....	133
Chapter 7. Appendix.....	251
1 Green Light Trust (GLT) Theory of Change model.....	251
2 Short Warwick-Edinburgh Well-being Scale (SWEMWBS).....	252
3 Study 2 Interview script/questions	253
4 TIDieR checklist for GLT intervention	258
5 UK-based NBIs: wellbeing comparisons	259
6 UK-based NBIs: wellbeing comparisons	260
7 Study 2 theme generation process examples.....	261

List of figures

Figure 1: A model describing how the set of actions operates to enhance wellbeing (Aked et al, 2008). Source: NEF Five Ways to Wellbeing Report, p:17.	22
Figure 2: CONSORT flow diagram for participant engagement (study 1).....	64
Figure 3: NBIG and WLCG survey completion points and process	66
Figure 4: Mean±SD SWEMWBS scores pre and post intervention for NBIG and WLCG. * indicates a significance difference from pre-NBI (p <.001).....	75
Figure 5: Mean±SD NCI scores pre and post intervention for NBIG and WLCG. * indicates a significance difference from pre-NBI (p <.001).....	76
Figure 6: External (blue) and internal (pink) NBI mechanisms.	118
Figure 7: Conceptualised process of mechanisms.	119

List of tables

Table 1: Participants gender/age by group.....	73
Table 2: Other mental health support received by participants, by % of group	74
Table 3: Study 2 participant pseudonym and demographic.....	78
Table 4: UK-based NBIs: wellbeing comparisons	259
Table 5: NBIs: nature connectedness comparisons.....	260

List of abbreviations

AI	Artificial Intelligence
APP	Adult Participant Profile
ARM	Applied Research and Methods
ART	Attention Restoration Theory
BAME	Black, Asian and Minority Ethnic
BP	Blood Pressure
CAM	Complementary and Alternative Medicine
CBT	Cognitive Behavioural Therapy
CMT	Compassionate Mind Training
DBT	Dialectical Behaviour Therapy
EAA	Environment of Evolutionary Adaptedness
ENE	Engaging/Engagement with Natural Environments
FWW	Five Ways to Wellbeing
GDP	Gross Domestic Product
GP	General Practitioner
GLT	Green Light Trust
GSP	Green Social Prescribing
HDRS	Health Data Research Service
HLE	Healthy Life Expectancy
HR	Heart Rate
INS	Inclusion of Nature in Self
KPI	Key Performance Indicator
LGA	Local Government Authority

LNRT	Local Nature Recovery Strategy/ies
LS/H	Life Satisfaction/Happiness
MIH	Mental Ill Health
MYCaW®	Measure Yourself Concerns and Wellbeing
NBI	Nature-Based Intervention
NBIG	Nature-Based Intervention Group
NC	Nature Connectedness
NCD	Non-communicable Diseases
NCI	Nature Connection Index
NEF	New Economics Foundation
NHC	Neighbourhood Health Centre
NHS	National Health Service (UK)
NR	Nature Relatedness
NSFT	Norfolk and Suffolk NHS Trust
ONS	Office for National Statistics (UK)
OWB	Objective Wellbeing
PCN	Primary Care Networks
PET	Psychoevolutionary Theory
PIS	Participant Information Sheet
PTSD	Post-traumatic Stress Disorder
RCT	Randomised Control Trial
RQ	Research Question
RSPB	Royal Society for the Protection of Birds
SAD	Stress Anxiety (and/or) Depression

SCC	Suffolk County Council (UK)
SEND	Special Educational Needs and Disabilities
SP	Social Prescribing
SROI	Social Return on Investment
SRT	Stress Recovery Theory
SSRI	Selective Serotonin Reuptake Inhibitor
STH	Social and Therapeutic Horticulture
SWB	Subjective Wellbeing
SWEMWBS	Short Warwick-Edinburgh Mental Wellbeing Scale
TF-CBT	Trauma-focused Cognitive Behavioural Therapy
TG	Treatment Gap
UPC	Universal Personalised Care
WEMWBS	The Warwick-Edinburgh Mental Wellbeing Scale
WHO	World Health Organisation
WLCG	Waiting List Control Group
WT	Wilderness Therapy
WWT	Wildfowl and Wetlands Trust

Abstract

Following years of austerity, slow economic growth and continued strain from the wake of the Covid-19 pandemic, there remain major challenges facing the National Health Service (NHS) in the UK. There are declines in levels of wellbeing and increasing numbers of people unable to work due to mental ill-health (MIH). There has been increasing interest in the integration of Social Prescribing (SP) to access non-clinical support services and support cost reduction of repeat prescriptions and GP visits. Studies have attempted to understand and quantify the benefits of a variety of non-clinical options, including Nature-Based Interventions (NBIs). There are key areas of uncertainty around NBIs including standardisation of practice, long-term outcomes and the mechanisms for how nature exposure and interaction translates into wellbeing improvements. This research addresses some of these areas of uncertainty by providing evidence of the wellbeing and nature connection (NC) benefits of participating in woodland-based mixed-type NBIs, and identifying the potential underpinning mechanisms for wellbeing changes. Such areas of uncertainty negatively impact the overall perception and optimal use of NBIs, and the implementation of and referral to NBIs. Therefore, work to decrease areas of uncertainty will assist in achieving a clearer understanding of the benefits of NBIs and how they can best be utilised by providers, healthcare professionals and the general public.

This research utilised a sequential mixed-method design with both quantitative and qualitative approaches. This research recruited vulnerable adults referred to a NBI provider, including those who participated in a NBI and those who were placed on the waiting list for a NBI. Study 1 quantitatively assessed the wellbeing and NC of vulnerable adults (n=100) via standardised questionnaires. These were

administered both before and after participating in a 12-week NBI or a 12-week waiting list control group (WLCG). Study 2 involved face-to-face semi-structured interviews conducted with 10 NBI participants. Interviews explored mechanisms underpinning NBI wellbeing changes reported in Study 1. Participants of the NBIs (NBIG), but not the WLCG, reported significant improvements in wellbeing ($p < .001$) and NC ($p < .001$). Six themes were identified through thematic analysis, which mapped over to the suggested mechanisms underpinning wellbeing changes: (1) Social interaction, (2) Interaction with natural environment, (3) Physical activity, (4) Behavioural gains, (5) Self-esteem, confidence and emotional experience, and (6) Empowerment. Mechanisms were classified as external (1-3) and internal (4-6), with a conceptualisation of the potential process of the mechanisms.

For most NBI participants, their accumulated experience from the NBI led to feelings of having taken control of their life; a sense of owning their improvements and achievements, and self-belief in their capacity to continue these into the future. Together, these two studies provide an indication of NBI outcomes and mechanisms underpinning a successful NBI. The findings should assist in reassuring referrers on the impacts of NBIs and provide a deeper explanation of the outcomes participants may expect. Overall, the findings indicate that structured NBI programmes could be beneficial in supporting mental health treatment and recovery of vulnerable adults, representing important implications for both public health policy and practice. The research supports the integration of NBIs within healthcare referral pathways as an adjunct to conventional mental health care approaches. This has potential to reduce demand on overstretched NHS services, enhance recovery and self-efficacy among vulnerable adults, and contribute to a more sustainable, preventative model of community mental health provision.

Chapter 1. Thesis overview

The introduction will set the scene for the thesis, exploring wellbeing and mental health in the UK. Chapter 2 will provide further information on evidence-base, gaps in current research and justifications for this study. In the UK, the NHS faces economic pressures, an aging population and increasing scope of services (Khan, 2023; NHS England, 2025c). Government-set targets, such as for GP/specialist and operation waiting times, have regularly been missed and there remains inconsistent provision across health boards, including a range of services, such as elective surgery, contracted-out to private treatment providers (Department of Health and Social Care, 2025; Warner and Zaranko, 2024; Goodair, 2023).

There is an acute increase in mental ill-health (MIH) across all age groups (ONS, 2024c), resulting in a rise in the number of people unable to work (Mental Health UK, 2024). This increases the burden faced by the population and state, straining support services, increasing social-benefit payments, reducing productivity and taxable income, and has resulted in an increase in prescribed medications (Naser et al, 2022; Ghinea, 2024).

With these pressures on the NHS, it has become more urgent to explore more efficient ways to combat poor wellbeing and MIH, and encourage and promote behaviours and activities that support wellbeing. Government and NHS policies and action plans reflect a growing interest in Social Prescribing (SP) pathways for non-clinical interventions (Morris et al, 2022) in the drive towards minimising the costs of repeat prescriptions and GP visits. Such interventions, including Nature-Based Interventions (NBIs), need to be shown to be an effective option if they are to become utilised more widely. Therefore, it is imperative there is increased

understanding of NBI outcomes to assist and support funding for NBI providers, better inform GPs and other referrers, and reassure participants of the potential benefits of the interventions.

Chapter 2 will review existing literature and current knowledge within the scope of this research on NBIs. Chapter 3 will introduce the NBI provider for this research, discuss the position and role of the researcher, present the multi-study, the featured NBIs and methodology, analysis and results. Chapter 4 will present the results from the multi-study and build on existing evidence with new research on woodland-based mixed-type NBIs through the two studies. Study 1 will quantify the effectiveness of NBIs at improving the wellbeing of vulnerable adults, and the effect of NBI participation on nature connection (NC), compared to a waiting list control group (WLCCG). Study 2 will explore and seek to identify and understand the underpinning mechanisms fundamental to wellbeing changes from the NBIs. Chapter 5 will discuss and interpret the results of the studies and explore potential implications of the research and consider directions for further research. This thesis aims to provide rigorous and evidence-based information on NBIs, potentially enabling providers, referrers and participants to make more information-based decisions.

Chapter 2. Literature review

2.1 Background introduction

This narrative literature review will discuss definitions and terminology regarding mental health and wellbeing, and consider the current state of adult mental health and wellbeing in the UK, particularly amongst vulnerable populations. The review will report statistics and the impact of MIH and personal wellbeing from a global and UK perspective, to provide context. The review will also explore why, with a growing treatment gap (TG), alternative solutions to complement existing health services is a public health priority. This review will synthesise and critique the existing literature examining the effectiveness of NBIs for supporting positive wellbeing and mental health, including outcomes of NBIs, equity of access to NBIs, and primary beneficiaries of NBIs, particularly in vulnerable adults. It will also consider the role of NC in NBIs, and to what extent NC may influence wellbeing. This review will conclude by highlighting the limitations of current knowledge of NBIs, identifying evidence gaps and justifying the rationale for the thesis aims.

2.2 Mental health and wellbeing

2.2.1 Terminology, definitions, prevalence and cost of mental ill-health

There is much debate over the most appropriate terms to refer to mental health concerns. The World Health Organisation (WHO) (2020) define health as *“a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”* Mental health is a key component of health and is defined as:

“a state of mental wellbeing that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community”

(WHO, 2022).

By contrast, wellbeing is *“not merely as the absence of disease but as a state where [one] can achieve their full potential in terms of physical and mental health.”* (WHO, 2025).

Wellbeing is multi-faceted; affected by an individual's physical and mental health and therefore influences the individual's experience and outcomes of health conditions, thereby reflecting health, wellness and happiness (Jarden and Roache, 2023; NHS England, 2022c; Bautista et al, 2023). Mental ill-health (MIH) may occur when an individual is unable to maintain a state of mental health (WHO, 2022). The term MIH is therefore used in thesis as an umbrella term to describe mental health concerns, diagnosed mental illness, or states harming wellbeing, cognition, behaviour or emotional control (Everymind, 2026; Haslam and Baes, 2024).

In England, 20.2% of adults experienced MIH between March 2023 and July 2024, with 1.2m waiting for community mental health services, such as talking therapies and crisis support (Morris et al, 2025; House of Commons Committee of Public Accounts, 2023). In 2023, 21.5% of adults rated anxiety high, up from 19.5% over five years (ONS, 2024c). Whilst 75% of referrals to talking therapies for anxiety and depression in England accessed services within 6 weeks, 5% wait longer than 18 weeks for access (NHS England, 2025d).

As part of the NHS Long Term Plan, Universal Personalised Care (UPC) was launched in 2019 with the aim of supporting 2.5m people by 2024, by increasing

patient autonomy and connection to local health support (NHS England, 2019). This target was achieved, but despite the potential for UPC to effectively utilise localised services, provision remains inconsistent regionally, exacerbating pressures on the NHS (Personalised Care Institute, 2024). The Independent Investigation of the National Health Service in England report (Darzi, 2024) stated the NHS is in 'serious trouble'. In response, the Labour government announced a 10-year health plan, reinforcing its commitment to UPC and care for MIH, promising more funding, GPs, NHS App-enabled appointments, stronger community healthcare, and reduced inequality (UK Gov, 2024, 2025).

NHS pressures and policy shifts, such as UPC and the 10-year plan, drive greater reliance on third-sector organisations (Dutton et al, 2023). Calls to Samaritans rose from 1m in 2020 to 3.3m in 2023, mirroring suicide increases (Samaritans, 2020, 2024; ONS, 2024a). Collaboration between the NHS and the third sector has the potential to provide a range of benefits, be more flexible and responsive across a range of personalised care needs and provision gaps, but is hindered by varying availability and access (Dutton et al, 2023; Rahal et al, 2024; Newbigging et al, 2020, Johnson et al, 2023). In 2023/24, 20% of the workforce took MIH-related leave (MH UK, 2024), costing the economy £118bn annually (MHF, 2022; Frayman et al, 2024). England's MIH costs reached £330bn in 2022, with NHS spending £14bn on services (Baker, 2021; Centre for Mental Health, 2024).

Consensus on a single definition of wellbeing is lacking, as it is multifaceted and used across a range of disciplines, which impacts the ability to evidence its impact on public health and assess differences across populations (Pincus, 2024; Bautista et al, 2023). However, wellbeing can be broadly defined as "a state of positive feelings and meeting full potential" (Simons & Baldwin, 2021), with "mental and

emotional health, physical health and a healthy lifestyle” being key contributors (NHS England, 2023b).

The most recent data from the Office of National Statistics (ONS) (2023b), using the ‘ONS4’ survey questions, show that multiple measures for personal wellbeing has declined. Life satisfaction has decreased from 7.54 out of 10 in year-ending March 2022 to 7.45 in year-ending March 2023; happiness has decreased from 7.77 to 7.73 over the same period. Both life-satisfaction and happiness are influenced by MIH (Land et al, 2012; Lombardo et al, 2018). The life satisfaction and happiness scores are the lowest in the UK for a decade, except for life satisfaction during Covid-19 lockdowns (7.39) (ONS, 2023b); scores were lower in mixed (6.94), black (7.14) and other ethnic groups (7.22).

Hedonic and eudaimonic wellbeing differ from each other but both contribute to overall wellbeing (Disabato et al, 2015); hedonic wellbeing emphasises autonomy, pleasure and life satisfaction (Joshani et al, 2020; Henderson et al, 2013), and eudaimonic wellbeing focuses on meaning, reflection, and virtuous choices, also partly shaped by culture, supporting mood regulation and resilience to aging and inequality (Niemiec, 2014; van Halem et al, 2024; Ryff, 2017; Tov, 2018). Wellbeing can also be considered subjective or objective. Subjective Wellbeing (SWB) encompasses life satisfaction, happiness and positive affect, overlapping with both hedonic and eudaimonic wellbeing (Diener, 1984; Joshani & Jovanović, 2021). Objective Wellbeing (OWB) reflects life needs—health, safety, environment—and is often linked to economic wellbeing (Voukelatou et al, 2020; Grashof, 2025). Increased SWB and OWB have been associated with better health (Hou et al, 2025).

The various types and components of wellbeing all impact overall wellbeing, which may fluctuate even when MIH persists (Gautam et al, 2024), however higher wellbeing lowers the risk of mental health disorders (Santini et al, 2022). Disorders, such as depression and anxiety, may be defined as:

“a syndrome characterized by clinically significant disturbance in an individual's cognition, emotion regulation, or behaviour that reflects a dysfunction in the psychological, biological, or development processes underlying mental functioning”

(Stein et al, 2021).

Positive psychological wellbeing means absence of these and presence of positive factors, such as positive emotions and relationships, autonomy, purpose in life and personal growth (Adler et al, 2017; Dhanabhakym and Sarath, 2023). Wellbeing is primarily psychological (Pincus, 2024) and central to mental health, which WHO defines as “a state of mental wellbeing enabling people to cope, realize abilities, learn, work and contribute” (WHO, 2022).

2.2.2 Models of mental health and wellbeing

Ryff (1989) proposed a six-factor model of psychological wellbeing, identifying 6 key dimensions for optimum wellbeing: self-acceptance, personal growth, purpose in life, environmental mastery, autonomy, and positive relations with others. All 6 factors are presented as being significant for wellbeing, however subsequent research has suggested not all the factors are equal contributors to wellbeing, with autonomy and positive relations having a relatively lower correlation to general wellbeing (Abbott et al, 2009). The validity of the six-factor model has been questioned due to criticism that the six factors are not distinct dimensions due to the high degree

of overlap and inter-correlations, especially between the first four factors (Springer and Hauser, 2006).

Seligman (2011) viewed wellbeing more than purely subjective and identified five elements: Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment (PERMA model), all presented as equally important to overall wellbeing. Positive emotions such as joy and feeling interested are important for mental resilience and overall wellbeing. Engagement recognises the importance of being immersed in an enjoyable, potentially skilful activity. Relationships reflect the significance of having positive and strong family, friend and community connections. Meaning relates to having a sense of purpose, and accomplishment leads to satisfaction through achieving goals. The PERMA model can be considered as being able to predict levels of SWB and provide more nuanced understanding of wellbeing and that the five components are both distinct from each other and interconnected (Merritt et al, 2023). Criticism of PERMA includes the view that it does not consider how existential suffering may negate wellbeing levels across the five elements (Wong et al, 2021).

The Hierarchical Structure of Well-Being model (Gallagher et al, 2009) sought to integrate three correlating factors of wellbeing (eudaimonic, hedonic and social wellbeing), with a total of 14 elements of wellbeing incorporated into these, to provide a comprehensive wellbeing model. The elements are positive affect, negative affect, and life satisfaction (hedonic/subjective wellbeing), autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance (Eudaimonic/psychological wellbeing), social acceptance, social actualisation, social coherence, social contribution, and social interaction

(social wellbeing). Further elements of wellbeing continue to be theorised, including the effect genetics may have on wellbeing (Bjørndal et al, 2023), and developing technology could be utilised in future research to help to further understand wellbeing (Bartels et al, 2022).

The Five Ways to Wellbeing (FWW) model is an approach to wellbeing devised by Aked et al (2008). This identified five actions that can be taken by individuals to improve wellbeing, including connecting with people, being physically active, taking notice, learning/discovering and giving/being generous (Figure 1).

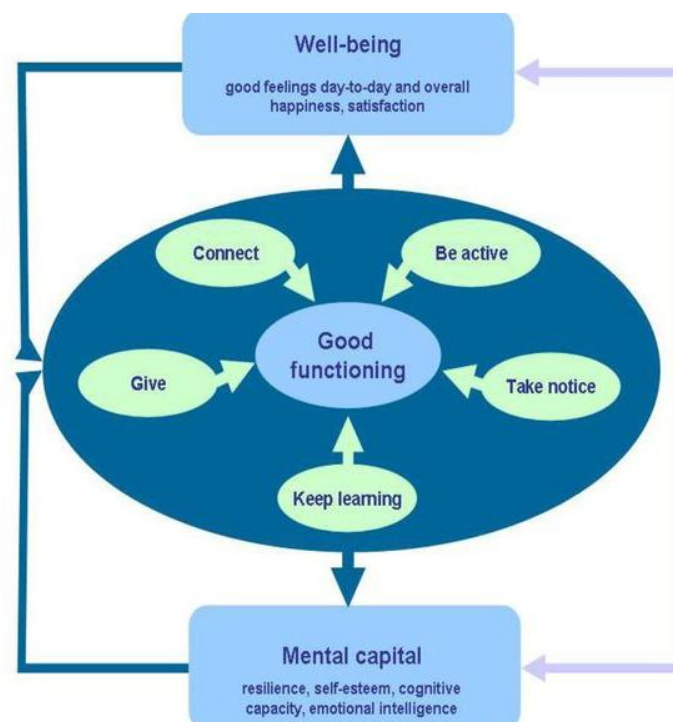


Figure 1: A model describing how the set of actions operates to enhance wellbeing (Aked et al, 2008). Source: NEF Five Ways to Wellbeing Report, p:17.

The FWW, promoted as a tool for improving collective and individual adult social care wellbeing interventions (The New Economics Foundation, 2011), has been embedded into healthcare by NHS Trusts and other organisations through incorporation into patient care initiatives. Performance of each of the FWW has

been associated with enhanced mental health, potential reduction in out-patient visits and considered a useful framework for reporting key elements of wellbeing (Prydz et al, 2024; Mahoney-Davis et al, 2017; Gilliver, 2021; Ng et al, 2015; Farrier et al, 2017). Stadler et al (2023) found that participants often engage in the FWW subconsciously and without direction to satisfy their needs, such as forming work/social relationships. The study surmises that more conscious practice of the FWW may increase benefit. Criticism exists surrounding how effectively FWW has been promoted, its suitability for specific populations, such as individuals with learning difficulties, due to a lack of research across such populations, being oversimplistic and not recognising the strong interconnectivity of the five separate elements (Sharma et al, 2024; Mahoney-Davis et al, 2016; Gilliver, 2021).

Wellbeing models often have a degree of alignment and commonality, such as purpose, personal growth, positive relations/social interaction, and positive feelings. There are also significant differences in the make-up of the models, possibly reflecting the multi-faceted nature of wellbeing and cross-section of disciplines these models may be applied to.

2.2.3 Vulnerable populations and health inequalities

This section will consider health inequalities in vulnerable adults and the impact this has on their wellbeing and mental health. Definitions of vulnerable adult vary across UK sectors but largely refer to being “less able to care for or protect oneself” (HMICFRS, 2024), although the term may be controversial when applied more broadly (Langmann, 2023; Sanchini et al, 2022). Vulnerable populations typically experience reduced control over their health and disproportionate levels of ill-health (Dyg et al, 2020; Limanté and Tereškinas, 2022; Bleich et al, 2012;

Diderichsen et al, 2018). These groups include people with poor health, low income, youth, women, older adults, unemployed, ethnic minorities, LGBTQ+, disabled, and abuse victims (NHS England, 2024c; Kirkbride et al, 2024; Chambers et al, 2018; Public Health England, 2022).

Health inequalities are defined as “*systematic, avoidable and unfair differences*” in outcomes and access to care (McCartney et al, 2019), with the above groups potentially experiencing a range of health inequalities. Women’s MIH worsened during the pandemic, are more likely to be victims of domestic abuse and violence against women increased 37% since 2018 (Sun et al, 2023; ONS, 2024d; College of Policing, 2024). Loneliness linked to aging affected 4m people in the UK and is associated with depression and anxiety (Campaign to End Loneliness, 2023; Age UK, 2016). The Black, Asian and minority ethnic (BAME) population in the UK experience higher risks of discrimination and MIH (Bamford et al, 2021; Dykxhoorn et al, 2024; Memon et al, 2016; Alam et al, 2024). During a 12-month period, 52% of LGBTQ+ individuals experienced depression compared to 10% of the general population (Stonewall, 2018) and there are higher rates of MIH among transgender and non-binary groups (Watkinson et al, 2024). Neurodivergent people face higher MIH risk and poorer healthcare due to communication barriers (Radey et al, 2024; Loizou et al, 2024).

Health inequality is one metric used for assessing deprivation in England (Ministry of Housing, Communities and Local Government, 2025), where 61% of local authorities contain at least one deprived neighbourhood (UK Government, 2019). People living in deprived areas are more likely to experience lower life expectancy and MIH (Holdroyd et al, 2022; Binder and Coad, 2014; Clark et al, 2013; Thomson et al,

2023; Woo and Zhang, 2020; Wilson and Finch, 2021; Kirkbride et al, 2024).

Despite government levelling-up targets to reduce regional gaps in Healthy Life Expectancy (HLE), by improving wellbeing in every area of the UK by 2030 (UK Government, 2022), health gaps continue to widen and those living in deprived areas are spending more of their life in poorer health (ONS, 2024b; Marmot et al, 2020; Munford et al, 2023).

Inequalities in access to the natural environment further exacerbate health disparities, as those living in higher income areas typically have greater availability of green space, characterised by presence of vegetation (Buckland and Pojani, 2023; Breen et al, 2023, Geneshka et al, 2021). Nature views, and accessing nature, improves wellbeing during times of personal crisis (Garrido-Cumbrera et al, 2022), particularly for more socio-economically deprived groups (Wheeler et al, 2012; Flowers et al, 2016; Mitchell and Popham, 2008; White et al, 2023). Health inequalities can therefore be compounded for vulnerable populations. The Covid-19 pandemic worsened health inequalities, with vulnerable populations experiencing higher levels of MIH (Spencer et al, 2022; Sun et al, 2023; Montero-Marin et al, 2023; Zaninotto et al, 2022; Häfliger et al, 2023; Thorpe and Gutman, 2022).

Inequality in access to mental health services, greater in deprived areas, means a lack of available services often prompts people to independently explore alternative treatments and pathways (Lowther-Payne et al, 2023). Access to private health provision may on occasion help to fill the TG but is too expensive for many and simply increases inequality (Devaja, 2023). Groups most at risk include those with MIH, women, low-income individuals and rural residents (HM Gov, 2023b; Pickering

et al, 2023). The susceptibility of many vulnerable groups in the UK is further compounded by intersectionality issues, belonging to more than one vulnerable or disadvantaged group, increasing negative experiences and creating greater barriers to healthcare (Al-Hindi, 2025; Silra et al, 2023; Fulcher et al, 2023; Moreno-Agostino et al, 2023).

2.2.4 Mental health treatment options

There is a range of potential treatments for MIH, including medication, talking therapies and targeted interventions. After workforce expenditure, medicines are the NHS's second highest cost, representing over 7% of the Healthcare services budget and exceeding GP and Primary Care costs (NHS England, 2024a; NHS, 2020). In addition, medicines contribute 20% of the NHS carbon footprint (NHS England, 2022b), with health care generating 4–5% of global greenhouse emissions (Tennison et al, 2021). It is also important to recognise the physical manifestations, increased risk of physical disease and treatment costs associated with MIH (Haslam and Baes, 2024; Fiorillo et al, 2023). The NHS spent £9.59bn on primary care medicines in 2022–23 (NHSBSA, 2023a); even small reductions in medication-use can scale to significant NHS-wide carbon savings.

A range of MIH medications exist, each with side effects such as headaches, nausea and insomnia. Antidepressants treat depression, anxiety, panic attacks and PTSD. In 2022–23, £240m was spent on antidepressants (NHSBSA, 2023a), considered effective for severe depression, but with possible withdrawal symptoms, such as numbing of fatigue and weight gain (Kendrick, 2020; Horowitz and Wilcock, 2022). Prescription of antidepressants rose 3.94% in England over the period 2023/24–2024/5 (NHSBSA, 2025), with long-term use contributing to the increase. Mood

stabilisers such as lithium treat bipolar disorder, depression and self-harm (Alda, 2016), though its mechanism remains poorly understood (Lähteenvuo et al, 2023; Volkmann et al, 2020). Medication can ease symptoms but may not address root causes. Other MIH treatments include talking therapies (TT), complementary and alternative medicine (CAM), and social prescribing (SP) pathways.

TTs include Cognitive Behavioural Therapy (CBT), Dialectical Behaviour Therapy (DBT), and counselling. The NHS received 1.83m TT referrals in 2023–24, up 4% from 2022–23 (NHS, 2024d). Waiting lists in September 2025 consisted of 6.24m people, a median waiting time to start treatment of 13.4 weeks, with significant regional variation (British Medical Association, 2025; Mind, 2024). Most first appointments occur within six weeks but also vary regionally (NHS, 2024a; Digital NHS UK, 2024). TT requires commitment and may trigger negative effects such as resurfacing memories, sleep issues and stress (Strauss et al, 2021). Only 49.8% of people with clinical depression or anxiety, completing a course of TT in January 2024, were deemed as clinically recovered, considered to no longer be a 'clinical case', determined by patient-reported outcome measures (PROMs), such as the Patient Health Questionnaire-9 (PHQ-9) for depression (NHS, 2024b; NHS England, 2025). People with long-term conditions fare worse (Seaton et al, 2022), and recovery rates are lower among vulnerable groups (NHS England Digital, 2022). Medication and TT show similar effectiveness for moderate-to-severe MIH (Gartlehner et al, 2015); combining both may improve quality of life and remission speed (Rajkumar, 2024; Dunlop, 2016; Kamenov et al, 2017) but is costly (Cuijpers et al, 2020).

SP, part of Universal Personalised Care (UPC), embeds Link Workers in Primary Care Networks (PCNs) to connect patients with community-based non-clinical

support. All PCNs must provide SP if beneficial, to be decided between the GP/referrer, patient and link worker (NHS England, 2024b). Link Workers direct individuals to local community-based services that provide practical, social and health support. However, regional variations exist, referral pathways can be weak, and referrals often occur via self-referral or community groups, with uptake is stronger where GP trust is higher (Reinhardt et al, 2023; Pescheny et al, 2018; NASP, 2022; Munro & Dayson, 2025).

There remains insufficient evidence overall for the effectiveness of SP pathways, despite some interventions, such as those involving art, exercise or nature, having been shown as potentially effective in improving wellbeing, perceived health, social connectedness, and reducing anxiety (Woodall et al, 2018; NASP, 2024a; Evers et al, 2024; Office for Health Improvement and Disparities, 2022). SP may also carry lower carbon costs, offer greater holistic support, and provide timely help during relapse (Maughan et al, 2015; Moffatt et al, 2017). Evidence suggests interventions through SP pathways can reduce GP visits and NHS expenditure, and close TGs (Blodgett et al, 2022; Kellezi et al, 2019). However, robust research and investment in voluntary/community providers are needed, including to support providers achieve full-cost funding and gain capacity for outcome evidence, thereby increasing knowledge/choice around suitable provision (Sheaf et al, 2024; Bu et al, 2024; The Lancet (Editorial), 2025). The holistic nature of SP interventions complicates standardization and measurement of unmet-need and dropout rates (Husk et al, 2019; Polley et al, 2022).

Nature's role in wellbeing is increasingly recognised (Bird, 2021). In 2021, Green Social Prescribing (GSP) launched to embed GSP pathways into communities, increase guidance to GPs/referrers, reduce NHS demand and improve wellbeing

through benefits associated with exposure to nature (The Green Social Prescribing Project, 2023). Between April 2021–March 2023, 8,339 people were referred, showing significant MIH improvements and leading to recommendations to embed GSP in anxiety and depression pathways (NASP, 2024b). However, provision remains uneven and limited regionally in types of available intervention (Grantham & Whaley, 2023).

2.3 Nature, mental health and wellbeing

By the 2050s, half of the world's population will live in large cities (Pincetl, 2017). Urban environments raise stress (Sadeghpour et al, 2024) and reduce both quantity and quality of natural experiences (Shanahan et al, 2019). Declining biodiversity undermines livelihoods and wellbeing, impacting clean air and water, regulation of climate, cultural values, and connections to the natural world (Dasgupta, 2021; Sathvara et al, 2024). Research has identified a myriad of health and wellbeing benefits associated with nature exposure and interaction. 'Nature' is a challenging term to define, with disagreement over what constitutes nature, how humans/human-constructs should be considered part of the definition, can be subjective and differs across study-areas (Ducarme and Couvet, 2020; Luque-Lora et al, 2022). One very broad definition of nature is offered by Ducarme and Couvet (2020):

“The whole of material reality, considered as independent of human activity and history”.

However, this separates humans, and human activity, from the rest of 'reality'. Any environment, particularly in the UK, felt to be 'natural' is likely to have been human-influenced to some degree, such as historically-managed woodlands. The concept of nature in relation to wellbeing interventions should recognise humans as part of nature, and human activity as influential on natural environments. It is also necessary to differentiate between human-built and urban environments, and greener or wilder environments (Yao et al, 2021). Nature in respect of NBIs typically refers to "*physical features and processes of nonhuman origin that people ordinarily can perceive, including the 'living nature' of flora and fauna*" (Hartig et al, 2014). Such environments can range from wilderness and woodland to parkland and may also include water bodies (Coventry et al, 2021).

Although 70% of GPs would like to prescribe nature (Woodland Trust, 2024), the UK is ranked among the most nature-depleted countries in the world, with only 7% of UK woodlands in good ecological condition (Burns et al, 2023). Natural spaces, including in and around urban areas, provide cleaner air, promote health, activity, social and mindful activities, and improve immune system functioning (van den Bosch, 2024; Henderson et al, 2024; WHO, 2021; Johansson et al, 2024b). Habitation in proximity to green space is linked to lower antidepressant use (Stenfors et al, 2024; Marselle et al, 2020), lower obesity, better sleep, and higher wellbeing (Zhang et al, 2024; Martin et al, 2023; Shin et al, 2020; Hazlehurst et al, 2022; Phillips et al, 2023). Living close to concentrated clusters of trees has been associated with lower mortality rates (Chi et al, 2025); nature exposure can reduce heart rate (HR) and depression, while increasing relaxation and positive feelings (Mayer et al, 2009; van den Bosch, 2015; Hansen et al, 2017; Ikei et al,

2017; Cheng, 2024). Nature contact benefits short-term emotions and cognition, helping manage acute and chronic stress (Collado et al, 2017; McMahan & Estes, 2015), enhances long-term stress resilience, supports disease prevention brief exposure can raise self-esteem (Elliott et al, 2023; White et al, 2023; Barton and Pretty, 2010).

Inequalities (see also 2.2.3) exist in nature access. Approximately one-third of people in the UK visit nature once a week or less, however those on lower-income have less access to nature and make fewer visits (Hunter et al, 2022; WWF, 2024; Birch et al, 2020; Bock et al, 2024). Approximately one-quarter of the population lack private gardens associated with better health (Fields in Trust, 2024; Natural England, 2023; de Bell et al, 2020;). Vulnerable individuals may feel unsafe in some natural spaces; female runners are likely to modify their behaviour due to anxiety/fear of harassment (Skilton et al, 2024; Brockschmidt and Wadey, 2021). Just one hour/week spent in nature may have the potential to close the wellbeing gap and community-based nature interventions may help reduce inequalities in nature-access (Garrett et al, 2023; NHS England, 2023a; Fian et al, 2023; Boyd et al, 2018; Mughal et al, 2022).

2.3.1 Psycho-evolutionary theories for Human-nature wellbeing

Multiple theories have attempted to explain the nature-wellbeing relationship. Psycho-evolutionary theories (PET) propose that humans evolved in natural environments and so experience less mental stress there (Ulrich et al, 1991; Ewert and Chang, 2018). For example, eyes instinctively seek greenery over concrete, reducing anxiety, restoring energy, and improving wellbeing (Fleming et al, 2024). Plutchik's psycho-evolutionary theory of emotion suggests emotions evolved, within

the natural environment, as survival mechanisms which underlie personality traits and psychiatric diagnoses (Plutchik, 1982; 1988). While influential, it has been criticised as simplistic, limited in emotional scope, and neglectful of societal and cultural impacts (Mason & Capitano, 2016; Al-Shawaf et al, 2015

Wilson's Biophilia hypothesis argues humans have an inherent, genetic predisposition to connect with nature, making it central to culture and wellbeing, while disconnection may increase MIH (Wilson, 1984; Schiebel et al, 2022). Lived experience shapes which environments feel most restorative (Haga et al, 2016), with recent research suggesting the desire for frequent nature contact is partly genetic (Chang et al, 2022; Jimenez et al, 2021). Whilst studies have often found broad support for biophilia, it has also been criticised as vague and untestable (Schiebel et al, 2022; Woods and Knuth, 2023).

Stress Recovery Theory (SRT) and Attention Restoration Theory (ART) expand on biophilia. SRT proposes natural rather than built environments restore psychological and physiological emotional state, allowing recovery from high stress or arousal, including anxiety (Ulrich et al, 1991). SRT describes that humans, when exposed to stress and stressful spaces, are predisposed to seek a calmer, more natural environment that promotes positive emotions and allows the body to recharge energy used during the stressful period. Studies show exposure to nature lowers HR, even when simply viewed (Honold et al, 2015; Benz et al, 2022). However, this does not apply universally, as some people find nature to be stressful, due to a fear of nature (biophobia) and concerns about personal hygiene and safety (Mammola et al, 2025).

Pleasant natural cues, such as petrichor, may also stem from evolutionary survival mechanisms (Neff, 2018; Garbeva et al, 2023). Stress recovery is strongest where water, diverse plants, or undulating ground are present (Huang et al, 2021). Whilst evidence for Biophilia and SRT is broadly supported, the role of nature in stress reduction may only have a small to medium effect (Gaekwad et al, 2023).

ART (Kaplan & Kaplan, 1989) argues that directed attention is tiring, but natural environments restore cognition through “soft fascination.” Reduced mental effort enables reflection, unlike hard fascination from daily tasks. Nature exposure supports memory, attention, and cognitive control (Schertz & Berman, 2019). Defining directed attention and clarifying ART’s mechanisms remain unresolved (Ohly et al, 2016; Stevenson et al, 2018; Yannick & Dewitte, 2018; Neilson et al, 2019). Soft fascination relies on the participants being comfortable around nature and not being distracted or in fear of the environment. Advances in neuroscience/technology support ART, identifying potential neural pathways that support soft fascination (Basu et al, 2018; Piedimonte et al, 2025; McDonnell & Strayer, 2024). However, PETs remain more challenging to test than physical evolution, raising questions of validity (Burke, 2014).

2.3.2 Nature connection and wellbeing

NC describes an individual’s emotional bond with the natural world (Mayer and Frantz, 2004). NC goes beyond visiting nature, requiring deeper immersion. It enhances perceived value of nature, pro-environmental behaviours, and latent wellbeing effects (Alcock et al, 2025; DeVille et al, 2021; Richardson and McEwan, 2018; Liu et al, 2022; Whitburn et al, 2020; Natural England, 2020; Butler et al, 2024). Research consistently shows physical and mental connection with nature

improves health, reduces stress and anxiety, and supports eudaimonic wellbeing, personal growth, and psychological connection (Barragan-Jason et al, 2023; Pritchard et al, 2020; Chang et al, 2024; Richardson et al, 2022). How people interact with nature shapes the benefits; paying close attention to natural objects fosters stronger connections with others as well as nature (Passmore and Holder, 2016).

NC has declined globally for over 200 years, with recent technologies deepening the separation (Soga and Gaston, 2023; Barragan-Jason et al, 2023; Richardson, 2025; Schultz, 2002). The UK ranks 59th of 65 countries for NC (Swami et al, 2024), potentially reflecting that individuals from wealthier countries with large urban areas are less likely to be connected to nature (Kleespies et al, 2023), whilst cultural norms such as consumerism can also weaken NC (Oh et al, 2021; Liu et al, 2024). An individual's experience of NC can subsequently impact their children's NC, relationships, behaviours and wellbeing (Chen et al, 2024). NC spikes in childhood, declines in adolescence, before rising again in adulthood (Keith et al, 2021); notable since NC improves body appreciation (Liu et al, 2024). However, nature access and experiences in childhood strongly influence lifelong NC and wellbeing (Barrable et al, 2024; Friedman et al, 2022). Access to nature can increase NC even when stress occurs from being in an unfamiliar environment (Ward Thompson et al, 2019), suggesting initiatives to facilitate access to nature would have the potential to redress NC levels.

Evidence shows strong correlations between NC and wellbeing, with some studies showing NC is positively associated with wellbeing (Jimenez et al, 2021; Richardson et al, 2021b). Liu et al (2022) suggested that contact with nature is responsible for approximately one-third of this association. However, understanding of the

causation and mechanics of the relationship between NC and wellbeing remains limited (Capaldi et al, 2014; Jimenez et al, 2021). The demonstrated benefits, alongside theories such as ART and SRT, continue to drive research into the mechanisms behind NC.

2.3.3 Experiencing Nature Connection

To achieve NC, five pathways have been suggested (Richardson et al, 2020a; Richardson et al, 2021a): sensory contact, emotion, meaning, beauty, and compassion. Seeing beauty in nature can be subjective, the degree of NC and wellbeing experienced is moderated by the individual's perception of its beauty (Zhang et al, 2014). Other senses may allow deeper interaction with nature. Tactile experiences, such as stroking moss, are fundamental to the experience of nature and potentially able to reduce pain (Franco et al, 2017; Oschman et al, 2015). The olfactory pathway accesses the aromas of nature, regulating stress responses, influencing emotions, promoting relaxation, enhancing well-being and potentially decreasing depression (Taufer et al, 2025; Bratman et al, 2024; Kadohisa, 2013). Through evolution, humans associate pleasant smells with beneficial outcomes (Juran et al, 2023). Natural sounds, such as birdsong and flowing water, are pleasant/calming, decreasing heightened alert from the sympathetic nervous system towards a more relaxing parasympathetic activation (van Praag et al, 2017; Buston et al, 2021; Smalley et al, 2022), supporting SRT, and to an extent, ART.

Emotions felt from nature include curiosity, joy, wonder, creativity and awe; provoking emotion regulation and improved mood (Vitale and Bonaiuto, 2024; Joye and Bolderdijk, 2015). Conversely, a deep feeling of closeness to nature,

and related pro-environmental behaviours, may increase 'eco-anxiety', anxiety towards the state of the environment (Davis and Gatersleben, 2013). However, the level of eco-anxiety can be reduced by interaction with social groups, pro-environmental actions and NC (Cosh et al, 2024; Baudon and Jachens, 2021). There are three elements key to NC, cognitive (feeling part of nature), affective (feeling of care towards nature) and behavioural (the urge to protect nature) (Schultz, 2002), potentially all found in NBIs.

2.4 Nature-Based Interventions (NBIs), types and evidence of outcomes

NBIs can be defined as programmes, activities or strategies intended to engage people in nature with the specific objective of enhancing health and wellbeing (Shanahan et al, 2019; Shrestha et al, 2025; Robinson and Breed, 2019; Harrison et al, 2023; Owens and Bunce, 2022). Some wellbeing interventions utilise nature to a limited extent, such as outdoor photography (Struthers et al, 2024; Barnes and Passmore, 2024; Moula et al, 2022). However, this study will focus on NBIs with increased nature immersion; monitored and supported intervention programmes that incorporate nature interaction with the objective of improving wellbeing. These take many forms, utilising urban or rural green spaces, blue spaces (natural spaces with water bodies), or a combination. Examples may include, social and therapeutic horticulture (STH), care farming, forest bathing, nature walks, mindfulness in nature, wilderness therapy (WT), bushcraft, nature conservation and woodland-based activities. Categorising NBIs in terms of content can be challenging as there may be cross-over in activities, variations in provision content and type of natural environment present.

A range of social, physiological and psychological wellbeing benefits have been associated with NBIs (Martin et al, 2024; Pretty and Barton, 2020; Johansson et al, 2024b; Pretty et al, 2006; Smyth et al, 2022; Rogerson et al, 2020). For individuals with lower wellbeing, there can be proportionately higher wellbeing increases through increased motivation from enjoyable activities within immersive NBIs (Hug et al, 2009; Lahart et al, 2019; Wood et al, 2023). This section looks more broadly at NBI outcomes across three systematic reviews and meta-analyses, Coventry et al (2021), Nguyen et al (2023) and Catissi et al (2024), and presents evidence for some specific NBI-types aimed at improving adult wellbeing.

Coventry et al synthesised 50 studies (2019-2020), including 32% randomised control trials (RCTs), Nguyen et al reviewed 92 studies (2019-2021), including 28 in the meta-analysis, 72% which were RCTs, excluding studies without control groups. Catissi et al reviewed 12 studies (2012-2022) focussing on adults aged 60 years and over, 83% of which were RCTs. Collectively, they reviewed studies from Asia, Europe, USA and Australia, including STH, gardening, crafting, and woodland-based activities and combined modalities, such as woodland walks/mindfulness. Whilst not the focus of this thesis, given the interaction between mental and physical health, it is note-worthy that some studies recorded physiological outcomes, such as BP and blood lipids, finding some limited beneficial outcomes, mediated by activity intensity and duration. Catissi et al found improved sleep to be an outcome, associated with reduced diastolic BP (Blodgett et al, 2024), finding evidence that NBIs improved mental health more than physical health. All three reviews found decreases in SAD. Catissi et al and Coventry et al both reported a decrease in negative affect and an increase in positive affect.

Based on the findings, recommendations included optimal NBI-durations (see also 2.6) of 12-13 weeks. Immersive forest-based therapy produced many mental health benefits over a period of 4-8 weeks; STH produced similar benefits over 12 or more weeks. Exercise-based outdoor interventions were particularly beneficial in reducing depression over a period of 8-12 weeks (Coventry et al). Catissi et al found quality was at least as important as the quantity, but generally more time spent engaging with the NBI was better.

The were unable to determine common mechanisms for the outcomes (see also 2.5) or identify which NBI-types were most effective overall. This may be because the studies utilised varying scales and methods to record and assess different outcomes. There was little differentiation between the degree of nature engagement, those with formal support from professional staff and scarce information on the quality of nature utilised. The reviews likely reflect the benefits of NBIs in the target countries, mostly high income, many of which were European. This potentially makes the studies and reviews more easily comparable but may be unrepresentative on a global scale.

Some NBI-types have less direct relevance to this thesis due to their modality, for example care farming and WT. However, care farming, involving horticulture and farm animals, has been shown to have the potential to help decrease depression and anxiety, and enhance nature awareness (Gorman and Cacciatore, 2020; Cacciatore et al, 2020; Harrison et al, 2023; Murray et al, 2019). Care farming also has the potential to be utilised in more rural areas where traditional mental health services are less well-served (Artz and Davis, 2017). WTs, often targeted at teenagers/young adults, aim to encourage social interaction and develop confidence through achieving goals, such as improved teamwork (Mohan et al, 2022). WTs tend to be immersive, including activities such as kayaking and bushcraft, some elements

of which can be found in other NBIs, helping to take participants away from prior distractions of their daily lives (Tucker et al, 2023). Benefits associated with WT include decreases in problem behaviours and substance abuse, and increased wellbeing and self-esteem (Overbey et al, 2021), however WT may under-utilise nature and the benefits of greater NC (Reese et al, 2018; Garrett et al, 2021).

The remainder of this section will focus on NBIs that are more directly relevant to this thesis. Forest bathing, *shinrin yoku*, originated in Japan and involves slowly walking through a forest, practising calmness, appreciating nature, using all the senses and often incorporating other activities such as meditation or yoga. More psychological than physiological benefits are associated with forest bathing, particularly for those with depression or anxiety (Siah et al, 2023; Furuyashiki et al, 2019; Quan et al, 2024; Lee et al, 2011). Forest bathing facilitates ways to wellbeing such as connecting, being active and taking notice, increasing introspection and mindfulness (Szitás et al, 2024). The forest environment helps to activate the relaxation response in the pre-frontal cortex, facilitating a more focused, relaxed state (Song et al, 2020; McEwan et al, 2021).

Forested environments are not easily accessible to all in the UK and ancient woodland is often on private land (Ramblers, 2024). Trips to forests and woodlands increased following the pandemic (Forestry England, 2023), and both Forestry England (2024) and the National Trust (2024) promote the concept of forest bathing. Benefits of forest bathing have been shown to last for 7-30 days (Li, 2022), but it is an activity that needs to be participated in on a regular basis to sustain longer-lasting benefits (Kotera et al, 2020). It is challenging to compare or replicate forest bathing outcomes universally due to differences between types of forest and tree species, varying types and

concentrations of phytoncides (antimicrobial substances often associated with increased wellbeing), flora density, undergrowth and visual impact (Kim et al, 2021; Li, 2010). Specific mechanisms for outcomes remain unclear (Siah et al, 2023) and traditional forest bathing has been criticised for lacking structured and customised/tailored activities appropriate for different cultures, regions and environment (Leão et al, 2025). When combined with TTs, forest bathing may have potential to decrease depression, improve sleep, and increase NC (Shin et al, 2012; McEwan et al, 2021). However, it is unclear whether improvements are due to the TT, the environment or mixture of both, or the longer-term impact on the participants.

STH is a structured, usually person-centred, intervention with a therapeutic practitioner. In either urban or rural settings, STH involves trained staff utilising horticultural practices to support participants to improve their mental health and wellbeing (Therapeutic Horticulture Stakeholder Group, 2024). STHs can facilitate MIH recovery through social interactions, personal responsibilities and learning opportunities, and represent potential benefits and value to the community, such as increased food availability and transformation of the landscape (Armstrong et al, 2023; Hardman et al, 2023; Pimentel et al, 2024; Hume et al, 2022; Berg et al, 2023).

Longer-term engagement has been shown to produce significant increases in wellbeing for adults with MIH, such as decreased depressive and anxiety, and increased cognition, social functioning, wellbeing, quality of life and hope for the future (Wood et al, 2025; Wood et al, 2022a; Kuo et al, 2025; Panțiru et al, 2024).

STH is often used for specific groups, for example the physical elements of STH have the potential to help adults aged 60 and over to gain fitness and lose weight, whilst also experiencing lower stress and diet improvement (Yun et al, 2024; Harrison et al,

2023). A study of adults with dementia (Scott et al, 2022) found that STH can offset some psychosocial effects of dementia, enhance concentration and memory, and reduce anxiety, with holistic benefits such as access to fresh air, sunshine, and exercise, and communal gardens offer access to social partners. For institutionalised chronic schizophrenic adults, STH showed potential to help decrease depression and anxiety in (Mourão et al, 2021). Incorporating both indoor and outdoor activities (gardens rather than park/public spaces) have been found to be favourable, as they can be more controlled/less likely to be distracting due to factors such as weather and noise, and encourage use of the five senses (Sachs et al, 2024; Lu et al, 2023. Kuo et al, 2025). Further rigorous research is needed on long-term effects of horticultural therapy, and to compare STH against other MIH treatments, to better understand STH and maximise effectiveness across MIH-types (Armstrong et al, 2023; Wood et al, 2025; Mourão et al, 2021; Panțiru et al, 2024).

Whilst nature walks, rambling and hiking are popular past-times, trained staff are required to deliver person-centred support outcomes if they are to be classed as NBIs. Walking-based NBIs provide opportunities to be active, and some psychological benefits may come through social interaction, but greater wellbeing increases are likely when walking in areas with more greenery and increased nature contact (Legrand et al, 2022, Ahmadu et al, 2021). An adventurous-mindset during nature walks can contribute to improved mental health and may equip individuals with a greater ability to handle stressful situations (Boudreau et al, 2022).

Nature-walks can incorporate less physically challenging activities, such as meditation and mindfulness, allowing for more soft attention and therefore a greater disengagement from stress (Djernis et al, 2019). Mindful walks in both parkland and urban areas have been found to improve sleep quality (Ma et al, 2023), but these

more passive, cognitive walks were not shown to increase feelings of NC. A more expansive landscape means nature walks may be better facilitated, offering opportunities to appreciate nature, identify species, explore the environment and encourage the more adventurous mindset, helping to further decrease SAD (Siah et al, 2023; Furuyashiki et al, 2019; Djernis et al, 2019; Wheeler et al, 2012; Gascon et al, 2017; Maund et al, 2019; Greco et al, 2023). However, these types of environments may be less accessible and safety concerns in more remote spaces may limit their participation (Ward et al, 2023; Gladwell et al, 2013).

Nature conservation and woodland management activities can also be appropriate activities for NBIs. The current lack of effective woodland management contributing to lower biodiversity (Forestry Commission, 2023; Forestry Commission, 2020; Smart et al, 2024), provides a need/opportunity for NBI groups to take part in meaningful activities to support wellbeing and the environment (Johansson et al, 2022; Smyth et al, 2022). Such activities have been associated with increased biodiversity, such as meadow restoration, and facilitating a sense of purpose and achievement (Beesley et al, 2025), (Sila et al, 2023; Jones et al, 2022). They can promote more positive attitudes/behaviour, increase social interaction, facilitate learning and improve health and wellbeing, including life satisfaction (Šorytė et al, 2023; Obeng et al, 2023; Shanahan et al, 2019; Pretty and Barton, 2020; Smyth et al, 2022). Access to larger landscapes with diverse habitats, such as forest, meadow, wetland and hedgerow, provides greater potential to experience a wider range of activities, nature and species (Hackett et al, 2024). However, these landscapes are less abundant in urban areas and access often restricted in rural areas of England (Beal et al, 2025).

WT, conservation and forest-bathing are some examples of when NBIs may utilise woodland. The woodland environment adds to a feeling of being remote, offering a greater sense of being away from daily stresses, an escape (Birch et al, 2020; Owens and Bunce, 2022; Tambyah et al, 2022), and provides opportunity and resources for both mindful and physical activities (Pretty and Barton, 2020; Gittins et al, 2023a). Woodland-based NBIs have been shown to promote positive attitudes and behaviour, increased social interaction, and improved health and wellbeing, (Leão et al, 2025; Šorytė et al, 2023; Obeng et al, 2023; Shanahan et al, 2019; Pretty and Barton, 2020). They have also been associated with lower HR/BP, decrease in fatigue levels and stress, and increased introspection/mindfulness, mood improvement and NC (Szitás et al, 2024; Siah et al, 2023; Furuyashiki et al, 2019; Quan et al, 2024; Lee et al, 2011; McEwan et al, 2021; Catissi et al, 2024).

Woodland-based NBIs provide an opportunity to observe changes in nature, allow immersion in, and reconnection to, nature and support increased enjoyment, motivation, physical performance and overall wellbeing (Hug et al, 2009; Lahart et al, 2019; Gladwell et al, 2013; Gray et al, 2023). Woodland-based NBIs have been found to positively affect perceptions of woodland environments and facilitate an increased use of woodlands for leisure following NBIs (Gittins et al, 2023). A diverse range of woodland activities may also contribute to increased facilitation of the 3 elements of NC (cognitive, affective and behavioural) and support the 5 pathways to NC (Richardson et al, 2021a; Gittins et al, 2023a, Liu et al, 2022).

Nature conservation, woodland management and environmental activities may also be combined into a mixed-activity NBI, with other elements described above, such as nature walks, mindfulness, bushcraft and horticulture. NBIs that are not confined to a single activity-type have the potential to encourage a diverse range of participants

to reconnect with nature and experience more factors associated with wellbeing (Sands et al, 2023; Isham et al, 2025; Shrestha, 2025; Leão et al, 2025). Utilising mixed-activities can take advantage of all the associated outcomes of each activity, including increased social interaction/bonding, reduced stress and social isolation, improved self-esteem and feelings of self-worth, increased confidence, improved learning processes and skill base and increases in NC (Chawla, 2022; Maund et al, 2019; Richardson et al, 2020b; Jong et al, 2022; Djernis et al, 2021; Ibes et al, 2020; Garza-Terán et al, 2022; Lengieza and Aviste, 2025). In addition, incorporating personalised activities will potentially amplify each set of outcomes (Silva et al, 2023; Siah et al, 2023; Reese et al, 2018). Hence, there may be large potential for combining woodland-based interventions with mixed-activities NBIs. Despite the many potential benefits, there is little available evidence on specific, structured, mixed-activity woodland-based NBIs and it is difficult to make comparisons as the activities and environment are likely to feature many variations.

2.5 Possible mechanisms for the impact of NBIs on wellbeing

Despite a range of literature demonstrating the potential benefits of NBIs, the underpinning mechanisms remain unclear. Some underpinning or causal mechanisms have been suggested to explain the mental health and wellbeing benefits arising from NBIs, including nature and NC, evolutionary theories (see section 2.3.1), social connections, physical activity, purpose and achievement, and staff support and guidance (Sila et al, 2023; Jones et al, 2022). This section will discuss and critique some of these suggested mechanisms.

One potential mechanism is exposure to natural environments. The natural environment may create a framework allowing for choice, variation and different

opportunities compared with indoor environments (Johansson et al, 2022). Whilst there is general agreement that natural environments are associated with a range of potential health benefits (Silva et al, 2022; Jimenez, 2021), there is less known about how this may work as a possible mechanism and how different factors, such as flora and air quality, may contribute. Exposure to negative air ions, produced by types of flora and increased by rain/sea, has the potential to benefit health by changing amino acid metabolism, which can increase anti-inflammation and antioxidation, promote energy production and improve cardiac function (Jiang et al, 2018; Xiao et al, 2023; Liu et al, 2022). Conifer and broad-leaved trees emit different types of phytoncides, such as monoterpenes and, particularly in summer, these are easily transferred to people walking in the forest (Bach et al, 2020; Sumitomo et al; 2015). Exposure to phytoncides, have been shown to improve mood, reduce BP and aid the immune system with increased natural killer (NK) cell activity (Peterfalvi et al, 2021; Li et al, 2009). Sunlight and being outdoors allows for increased absorption of Vitamin D, which is essential for health and a deficiency is associated with MIH and cardiovascular disease (Oliver et al, 2023). The combination of such factors, and natural sights and sounds, may promote a healthier physiological/psychological state when visiting nature, potentially contributing to one central pathway of improved immune function, and therefore a host of health outcomes, including decreased anxiety, depression, musculoskeletal complaints and respiratory disease (Kuo, 2015).

NC has been cited both as a mechanism and a mediator for more effective outcomes, and NBIs can promote NC through immersion in nature (Coventry et al, 2021; Richardson, 2019; Martin et al, 2020; Gibbs et al, 2022). Cleary et al (2017) pointed to Self-Determination Theory (SDT) (Deci and Ryan, 1985) to suggest NC as a mechanism to promote eudaimonic wellbeing. SDT is a theory

of human motivation and personality emphasising the role of intrinsic motivation and the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. These psychological needs may be met within nature through engagement motivated by intrinsic pleasure or value, thereby satisfying autonomy, increasing wellbeing, and bringing belonging and peace (Lee et al, 2021; Yang et al, 2022; Johansson et al, 2022).

One common aspect of NBIs is the presence of other people. Social anxiety and lack of self-confidence in a social setting may act as an initial barrier (Burrell et al, 2024), but interacting with others who are experiencing similar challenges and learning from others' experience can be a positive factor within NBIs (Johansson et al, 2022). Social connection through NBIs has been suggested as a mechanism for achieving an increased sense of belonging and improved wellbeing (Lesser et al, 2024; Timko Olson et al, 2023; Maas et al; 2009), especially during NBIs lasting 3 to 12 months (Sachs et al, 2024). Social interaction also improves social confidence and self-worth during NBIs across age ranges (Bhatti et al, 2020; Richardson et al, 2020b; Wood et al; 2025), suggesting initial social anxiety may improve through NBI engagement and enhanced social connections.

Varying degrees of physical activity are inherent in most NBIs and the range of associated health benefits (Struthers et al, 2024; Silva et al, 2024; Ma et al, 2024) support this as a potential mechanism. Activity in nature causes increased levels of neurotransmitters, including endorphins, increases oxygen supply to the brain, and improves emotion regulation (Vitale and Bonaiuto, 2024). It may also decrease neural activity in the subgenual prefrontal cortex occurs, reducing patterns of self-referential thought associated with depression (Bratman et al, 2015), and directing attention away

from causes of stress (Gritzka et al, 2020). Meaningful and purposeful physical activity, such as conservation and horticulture, is likely to increase an individual's motivation to be active, support feelings of purpose and self-confidence, and strengthen social interactions and trust (Sachs et al, 2024; Johansson et al, 2022; Shrestha et al, 2025; Shanahan et al, 2019; Teig et al., 2009). Personal achievement can be gained through a variety of actions, such as increasing plant and animal habitat and diversity (Alaimo et al, 2023; Dyg et al, 2019; Husk et al, 2016).

The role of professional support staff within participant-centred, structured NBIs is also often reported as a key factor in creating an environment conducive to NBI effectiveness, facilitating wellbeing and feelings of self-worth (Harrod et al, 2024; Birch et al, 2020). Effective NBI leaders can help individuals to overcome nature-anxiety, try new activities, encourage NC pathways, increase pro-environmental behaviours, and ensure the achievement of goals are conscious for the participant (Johansson et al, 2024a; Pocock et al, 2023; Whitburn et al, 2020; Wright et al, 2024; Schell et al, 2012). A combination of staff can be utilised, such as staff with specific NBI knowledge and mental health staff, potentially supplemented by knowledgeable and/or empathetic volunteers, to create a supportive environment and structured intervention to optimise NBI outcomes (Wood et al, 2022b; O'Brien, 2018; Silva et al, 2023). Whilst there is broad agreement that professional support staff, tailored goal-setting and relevant purposeful activities increase NBI effectiveness, there is less agreement over whether these constitute underpinning mechanisms.

There is evidence to suggest interconnected factors combine to act as one underpinning mechanism. For example, Coventry et al (2021) suggest nature/NC combines with experiencing a NBI in a group setting to become a mechanism. Other studies have attributed nature/NC combined with performing physical, meaningful

activities with others as a mechanism for increased wellbeing outcomes (Howarth et al, 2020; Silva et al, 2023; Kuo, 2015; Wong, 2024; Zhang et al, 2021).

There is therefore some agreement on several factors that may interact and inform NBI outcomes, but less uniform agreement on what constitutes an underpinning mechanism for a specific NBI-type or whether there is a one-size-fits-all NBI. Nor is there consensus on the extent to which each potential mechanism may contribute to outcomes for specific populations or individuals.

2.6 Dose, frequency and duration of NBI

Increased understanding of how NBIs impact wellbeing will assist in more effective prescribing of outcome-specific NBIs. Funding is finite, so knowledge of optimal duration and frequency will support providers to increase the effectiveness of the provision.

2.6.1 Single dose of NBI

Various NBI forms differ greatly in content, physical intensities, duration and frequency. Whilst a short, sharp 10-30 minute exposure to nature may be enough to initially lower feelings of depression and decrease BP, the effects are fleeting (Bettmann et al, 2024; Shanahan et al, 2016) and studies finding decreases in stress from a one-hour forest walk, and decreased rumination from 90-minute walks (Sudimac et al, 2022; Bratman, 2015) fail to address how long the effects last. Short-term benefits from brief nature exposure may support an individual's initial engagement with a NBI, but longer exposure should increase the benefits (Barton and Pretty, 2010). Improved health and wellbeing have been evidenced from 2-hour NBI sessions (Shanahan et al, 2016) and may plateau after 5 hours (White et al, 2019). Lu et al (2023) found 100-500 minutes provided

the most effective stress reduction during STH NBIs, balancing optimal attentiveness with outcomes. This may suggest that the optimal duration for a single NBI session is 5 hours, dependent on activity type, level or required immersion and population ability. Different types of NBI have different targeted outcomes and work best at different intensities and durations, therefore it may be unlikely there will be a one-size fits all solution (Lovell et al, 2019). In addition, the overall efficacy of NBIs can depend on many factors such as types and quality of environment, contact and activities (Silva et al, 2023).

2.6.2 Frequency and duration of NBI

In terms of frequency of the NBI sessions, one session/week is likely to correspond with improved health and wellbeing, and greater social cohesion (Shanahan et al, 2016; White et al, 2019). The frequency of NBIs may be affected by intensity of the activity, the physical/mental recovery period required, and the participant's ability to attend. Optimal frequency for an NBI is an essential variable that is currently lacking adequate research (Kaleta et al, 2025). The total duration of NBIs also varies; effective wellbeing increases may be outcomes from NBIs running from 8-12 weeks (Coventry et al, 2021), or for 3-12 months for enhanced social connection benefits (Sachs et al, 2024).

It is not well established whether duration and frequency impact the longevity of the outcomes. Silva et al (2023) suggested benefits accrued during the NBI will stay with the participant in the short-term but faded over time if nature-based interactions are not continued. Higher levels of wellbeing and NC have been found to persist over 30 days following a mixed-type NBI, but NC decreased over a period of 3 months following the end of a forest bathing intervention, with more

research needed to understand longer-term wellbeing, NC and behaviour outcomes (Leão et al; 2025; Polley et al, 2023; Silva et al, 2023; McEwan et al, 2021). Maintaining NC is important to longer-term wellbeing benefits and NBIs need to promote and facilitate continued and sustained behaviour change and time in nature (Holland et al, 2023). Regarding frequency and duration of NBIs, most agreement comes with what is not understood. This is largely due to the heterogeneity of NBIs and it is accepted that more evidence is required to better understand optimal 'doses' of NBI, factoring-in the efficacy of the intervention (Shrestha et al, 2025, Leão et al, 2025; Kaleta et al, 2025) and how the NBI can support behaviour change (Irvine et al, 2024). The optimal 'dose' may depend on many factors such as intended outcomes, baseline level of the participant, intensity of the activities, extrinsic factors such as weather and environment, attendance rates and suitability of the NBI for a specific individual's needs. The ability of an individual to embed elements from the NBI into their own lifestyle may also be fundamental to achieving longer-term outcomes.

2.7 Wider values to society

There are potential financial benefits to society from individuals gaining positive longer-term wellbeing outcomes from NBIs. NBIs have shown potential to offer potential financial benefit through decreased reliance on other health and social care services and enabling individuals to increase their motivation to be able to manage their own wellbeing (Wood et al, 2022b; Tierney et al, 2020; Grellier et al, 2024). The Social Return on Investment (SROI) of investment in NBIs has been forecast to be anywhere between £2.42 to £6.70 in the UK, for every £1 invested, based on monetised outcomes of physical activity, self-efficacy, and social trust (Haywood et al, 2024; Whiteley et al, 2022; Hartfiel et al,

2023). Combining NBIs with wider societal outcomes, such as integrating wellbeing outcomes with conservation can help achieve further benefits to society and increase cost-effectiveness (Murage et al, 2025).

2.8 Enablers, barriers and gaps

Enablers have been reported that may maximise participation in NBIs, such as clean air and biodiversity (Nejade et al, 2022), but these need to be effectively communicated. Benefits of NBIs, such as positive emotions, person-centred approach, and optimising the therapeutic element of the environment, should also be highlighted when promoting and referring to NBIs (Elliott et al, 2021; Harrod et al, 2024). There is demand for NBIs but referral systems, and the process of application, are inconsistent across the UK (Garside et al, 2020). Whilst GPs and other referrers may be increasingly positive towards NBIs (Fixsen and Barrett, 2022), access to availability, information and evidence on the effectiveness of specific NBIs are not always simple and forthcoming (Santoni et al, 2019; Simpson et al, 2021; Harrison et al, 2023). This can be due to a range of factors such as a lack of knowledge of how to refer, lack of patient feedback following referrals (Department of Health and Social Care, 2023), and evidence remains too limited, with available evidence often poorly communicated to service users, practitioners, and policymakers (de Bell et al, 2024).

There is a lack of overall connectivity and long-term strategy planning, due to low and inconsistent funding to third sector NBI providers (Pescheny et al, 2018). Growth in the number of NBIs need to be matched by more investment, along with more evidence of how NBIs best fit into health policies to ensure NBIs best support health

as well as aiding nature recovery (Gittines et al, 2023; Shrestha et al, 2025; Garside et al, 2023).

Whilst NBIs offer variety, there are inconsistencies in provision across the UK and no single directory for local NBI provision or specific conditions targeted by the NBIs (Santoni et al, 2019). There may also be practical barriers, such as being unable to reach a provision due to distance and lack of transport, especially in rural areas (Simpson et al, 2021), and cost of travel. Many other potential barriers have been identified, such as deterioration of mental health, social-anxiety, disbelief in the effectiveness of NBIs (Burrell et al, 2024), and low self-esteem (Simpson et al, 2021). NBIs are not typically included in medical research (Polley and Sabey, 2022), with priority given to more traditional medical approaches (Wood et al, 2024), hindering NBI referral and uptake. Further research in areas where current gaps in knowledge exist may help to improve this situation (Gray et al, 2023). A broader evidence base is required to synthesise results after accounting for regional, contextual and population diversity to enable appropriate tailoring of interventions (Sachs et al, 2024; Shrestha et al, 2025; Yang et al, 2023).

There is a lack of studies utilising control groups, (Struthers et al, 2024; Yang et al, 2023), which limits causal inference and understanding (Catissi et al, 2024; Schell et al, 2012; Silva et al, 2023; Harper et al, 2021). Control groups inform evidence-based practice, potentially capture important subgroups, including vulnerable participants, across specific activities that may experience larger benefits from NBIs, and may also assist in identifying active elements and mechanisms of NBIs (Catissi et al, 2024; Struthers et al, 2024; Coventry et al, 2021; Silva et al, 2023; Lamont &

Hinson, 2024). This would help with targeting specific types of NBIs at certain populations, making it easier for GPs/Link workers to prescribe appropriate pathways to access NBIs (Quan et al, 2024; Choi et al, 2023; Dohle et al, 2025).

Reviews have identified a lack of quality, rigour and inconsistency in outcome measures as hindering current knowledge and understanding of NBI outcomes (Yang et al, 2023, Struthers et al, 2024). Increased standardisation of key terms, and agreement on 'NBI' definitions would enable more accurate comparisons of NBIs and outcomes (Harrison et al, 2023). However, this area of research is still exploratory and has not yet adopted the same methodological standards applied in medical research. (Jessen et al, 2024). NBI research often lacks clear and comprehensive information about the natural settings and intervention structure and content (Wilkie and Davinson, 2021; Shanahan et al, 2019; Shrestha et al, 2025). More measures should be regularly tracked over extended time periods, to establish the medium to long-term effects of NBIs, optimal durations and frequencies for specific NBI (Wood et al, 2022a; Yang et al, 2023; Silva et al, 2023).

More robust research is required to further understand the underpinning mechanisms influencing the effectiveness of NBIs and how the mechanisms interact for optimum effectiveness and wellbeing gains (Zhang et al, 2021; Shanahan et al, 2019; Kondo et al, 2020; Harrison et al, 2023; Gray et al, 2023; Leão et al, 2023; Yang et al, 2023). Better understanding of these mechanisms would support the validation, implementation and wider promotion of NBIs (Owens and Bunce, 2022).

Despite evidence linking NC with increased wellbeing and conservation-centred behaviours (DeVille et al, 2021; Richardson and McEwan, 2018; Martin et al, 2020; Liu et al, 2022; Whitburn et al, 2020; Natural England, 2020; Butler et al, 2024), there

is limited research that engaging in conservation activities, or mixed-type woodland-based NBIs, can increase NC. There is also little evidence on the nature of the relationship between wellbeing and NC (Capaldi et al, 2014). Evidence of the wellbeing outcomes from woodland-based NBIs is sparse, especially in vulnerable adults, partly reflecting restricted availability and access of these environments (Gittins et al, 2023).

A more coherent and standardised body of evidence, with greater understanding of the mechanisms, would strengthen referral pathways and shape policy-making around the utilisation of green spaces for mental health promotion (Sandhu et al, 2022; Wood et al, 2023; NASP, 2023). This would increase confidence among bodies such as Defra and the Department of Health and Social Care to integrate NBIs into public health strategies and clinical practice (Garside et al, 2020; Struthers et al, 2024; Masterton et al, 2020).

2.9 Summary of literature review and research aim/questions

There is growing interest in NBIs as a pathway to improve wellbeing and to be integrated in healthcare as a treatment option for MIH. Benefits derived from NBIs are varied and numerous, including benefits to individuals' physical, mental and social health, and potentially long-term financial savings to society. Despite the broad and varied range of possible NBIs and providers, availability, choice, awareness and knowledge of services across the UK is inconsistent. Gaps in the research and inconsistent provision compounds efforts to effectively promote NBIs to public health/medical professionals, link workers and the public. Research to support specific outcomes from particular NBI-types remains insufficient, lacking in control groups, and with rigour and detail required to aid

future research. Key underpinning mechanisms need to be identified to inform intervention design, to enable more tailored and focused NBI provision, and continued evidence is required to further understand links between NC and wellbeing.

Based on, and informed by, conclusions from this literature review, the aim of this thesis is to analyse the effects of NBIs on wellbeing of vulnerable adults and gain a deeper understanding of the complexity of the underlying mechanisms specifically present in woodland-based mixed-type NBIs. To provide a robust analysis, this study will adopt a mixed methods approach, utilise a waiting list control group, and record wellbeing and NC measurements at baseline and post-NBI.

The overall research aims/questions addressed in the proceeding multi-study chapter are as follows:

Study 1 will quantitatively analyse the effects of NBIs on wellbeing and NC in vulnerable adults with MIH and low levels of wellbeing, compared to a control group.

The primary research question (RQ) is-

Do NBIs improve wellbeing in vulnerable adults? We hypothesise that wellbeing scores for participants will increase more following the NBI than for the control group.

Two further research questions include (i) do NBIs affect NC, and (ii) what is the relationship between NC and wellbeing?

Associated hypotheses state that participation in NBIs will positively influence NC more so than in the control group and there will be a positive correlation between NC and wellbeing.

Study 2 (qualitative) aims to explore and understand what underpins participants' changes in wellbeing, to provide insights into potential underpinning mechanisms.

Chapter 3. Methods

This chapter will describe the ontological & epistemological position of the researcher, the NBI provider, NBI, researcher's role and position, and the methodologies adopted for the multi-study design.

3.1 The ontological and epistemological position of the researcher – pragmatist

A researcher's ontological position has the potential to influence a study, from choosing the research topic, RQs, and methods, through to understanding how historical, cultural, and philosophical contexts influence knowledge claims and certainty about results (Gillespie et al, 2024; Al-Ababneh, 2020; Rahman, 2023). The researcher's over-arching ontological and epistemological stance through this research is that of pragmatist, supporting the connection of the research outcomes to real-world applications, and prioritising practical usefulness over abstract, philosophical or ideological debates. A pragmatic epistemological position focuses on what works best for the RQ and is conducive to choice and adaptability of methods and approaches (Kaushik and Walsh, 2019). However, the researcher needs to question whether a pragmatic approach is suited to the entire research. From an ontological perspective, realism has value for utilising quantitative data, aligning with the assumption that one single reality exists and can be measured (Irfan et al, 2021). Constructivism with qualitative data aligns with the understanding of social constructs, lived experiences and subjective meanings, rather than one single reality (Tenny et al, 2022). However, pragmatism can employ elements of both realism and constructivism to accommodate quantitative,

qualitative and mixed-methods without compromise, and accepts different realities may exist (Kaushik and Walsh, 2019; Morgan, 2014).

Pragmatism allows more flexibility in the interpretation of qualitative data, enabling a richer and deeper response to interview questions, providing a flexible choice of research methods to focus on objective and subjective elements of the RQ(s), but with the caveat that there may be different versions of reality experienced by individual research participants (Ahmed and Ahmed, 2014; Slevitch, 2011; Shan, 2022; Gillespie et al, 2024; Frankel Pratt, 2016; Kaushik and Walsh, 2019).

Pragmatism prioritises empirical evidence and observable changes whilst considering theoretical underpinnings and concepts (Capps, 2023).

Pragmatism faces some potential specific limitations, which may include potential biases arising from unblinded treatment; interventions that already exist as part of standard care may mean patients are aware of the treatment-type they are receiving. This can introduce potential biases arising from patient self-assessment due to the Hawthorne effect, as participants may change their behaviour as they know they are being observed (Sedgwick and Greenwood, 2015), discussed further in relation to this research in section 5.4. Reflexivity will be supported by the researcher continually reflecting on their own potential biases/assumptions to minimize any influence on the research process and findings. It is hoped that by articulating the epistemological and ontological position of the researcher, there may be a clearer understanding of the philosophical foundations of the research and help to ensure that the methods and findings align with the researcher's assumptions about reality and knowledge.

3.2 NBI Provider, intervention and role of researcher

This section provides information on the geographic region and the NBI of focus for this study, conforming to the [TIDieR](#) (template for intervention description and replication) checklist and guide (see appendix 4), and the role of the researcher.

Norfolk and Suffolk contain a mix of urban and rural environments and range of socioeconomic areas. Over 20% of neighbourhoods in Great Yarmouth and Norwich are among the 10% most deprived nationally, also lacking sustainable access to nature (Norfolk Biodiversity Partnership, 2020). Deprivation in Suffolk has been increasing since 2007, with 22 neighbourhoods in the 10% of most deprived English areas (SCC, 2019) and increasing polarisation between the least and most deprived (Suffolk Community Foundation, 2020). Therefore, vulnerable adults in these urban and rural areas have particular need for wellbeing services provided by third sector organisations, and woodland-based mixed-activity NBIs have strong potential to form part of this provision. This section provides information on Green Light Trust (GLT), the NBI provider for this research.

GLT provide nature-based support for vulnerable children and adults, including NBIs for adults with MIH. Adults referred to GLT are reported to have lower life satisfaction and happiness than average for the UK population (Pretty and Barton, 2020). The majority of GLT participants therefore fall into the 'vulnerable' category (see section 2.2.3). GLT runs interventions across nine woodland sites. All sites were included in the research (3 in Norfolk and 6 in Suffolk). Referrers, and participants self-referring, access the intervention via the GLT website, are assessed for eligibility and added to a waiting list.

Each adult NBI is a group-programme, reflecting the optimal duration of 12-weeks (Coventry et al, 2021, Bragg et al, 2017), with attendance one day per week - 10am to 3pm. Groups are mixed in terms of gender, age, and reason for referral, and have a maximum of 12 participants in each cohort. The NBIs are led by at least two GLT staff, trained in delivering a range of activities, with previous experience of supporting vulnerable participants and in working with participants/referrers to identify appropriate personalised targets. Attendance is monitored and recorded electronically.

The NBIs are mixed-type and woodland-based, consisting of activities for personal and group involvement. Each day-session consists of a mixture of activities, such as conservation projects/woodland management, bushcraft, arts/crafts, green woodworking, mindfulness/relaxation activities, and nature walks. Activities vary depending on site location and season, and factors such as weather, resource availability, staff expertise, and participants' preferences and targets. All GLT sites have the main 'camp' and activity area in mixed deciduous and coniferous woodland, which varies in size and species dependant on the site. Some sites have a continuation of mixed woodland, whilst other sites incorporate estate gardens, broadland/wetland, coast/heathland, meadow or a mix of these.

The one-day/week sessions are designed to build and progress participants over 12-weeks to support confidence and wellbeing, through gaining knowledge and skills. Instruction is provided at the start of the NBI, and supported throughout the NBI, along with developmental support. A session usually begins with a 'welcome circle' to give participants an opportunity to voice any concerns or wishes for the day, and the session ends with a 'group reflection', with participants encouraged to

communicate their feelings about the day, what went well, what they achieved, and what they would like to improve/do in future sessions. Sessional feedback from individuals are recorded by a member of GLT staff, who also provides written feedback on the participant's achievements. Adherence, or engagement in the intervention is monitored and continually assessed by GLT staff, and support provided as required.

The researcher, along with undertaking a Masters by Research, is a full-time employee at GLT. The role includes planning and delivering NBIs, and other woodland-based wellbeing and education sessions, for GLT participants across sites. This includes setting targets with, and for, the participants, to support and facilitate wellbeing, education and progression, and recording the progress and achievements of the participants. Whilst the research and job role are separate, the dual roles supported the researcher in gaining access to NBI sites, recruit participants to the study, access course material and, where applicable and ethical, participant information.

However, the dual-role means there is the potential for conflicts of interest to arise. There may be an expectation of greater evidence of success as the researcher is also employed by the provider. Therefore, transparency and rigour are of utmost importance. As an employee of GLT, the researcher witnesses real-life evidence of successful NBI outcomes and is responsible for gathering and recording (non-scientific) evidence of outcomes as part of the GLT role. Hence, the researcher has professional interest in accurately quantifying wellbeing outcomes from the NBIs. True and accurate representations of the underpinning mechanisms are important to the researcher to support optimal future NBI provision.

The researcher acknowledges that unconscious bias in data interpretation may be present in various forms such as confirmation bias and anchoring bias, that may compromise the integrity of studies. Confirmation bias, a tendency to seek out and/or interpret data that may confirm a pre-existing belief or hypothesis, may discount evidence that contradicts it and lead to poor decision-making and flaws in the conclusion (Bhadoria et al, 2024). The researcher will therefore prioritise rigour in the research methods, regularly question assumptions and share progress, and debate, with the Research Supervision team.

Selection bias will be less of a factor as the specific inclusion criteria will be developed and the researcher will seek to invite all eligible GLT NBI participants to participate in the research. Participants may feel pressure to enrol in the study or respond favourably if they perceive the researcher as a representative of the charity rather than an independent investigator, so it will be important to show transparency about the dual-role and rigorously mitigate potential conflicts of interest. To further mitigate unconscious bias, the researcher will seek to focus objectively on the data, using data-driven decisions and using standard data analysis techniques and procedures to identify patterns and trends. The researcher realises the importance of questioning their own opinions/assumptions and to seek out evidence to support or refute them through critical thinking.

3.3 Study 1 and study 2 methods

3.3.1 Overall Study Design

The research was a sequential mixed-method design to gain quantitative data from questionnaires (Study 1) and qualitative data from interviews (Study 2). The mixed-methods approach, combining qualitative and quantitative approaches in a

single research project, allowed for a broader and deeper exploration of the data to answer the RQs (Wasti et al, 2022; Ivankova et al, 2006). Study 1 was a non-randomised between-subjects design with two conditions. The quantitative applied research and methods for Study 1 (see subsection 3.3.2) and qualitative methods for Study 2 (see subsection 3.3.3) are described separately. The researcher had access to secondary data which the GLT participants had consented to share, including participant demographics (gender and age). Ethical approval (Ethics application ETH2223-1724) was granted by the University of Essex Ethics Sub Committee 2.

3.3.2 Study 1 Quantitative Survey

3.3.2.1 Study 1 Participants and Recruitment Strategy

Participants (n=100), were aged between 18 and 72 years, mean age 43 (\pm 15) years, and allocated to either the NBI group (NBIG) (n=69) or the waiting list control group (WLCG) (n=31). Eligible participants who enrolled on their allocated course were invited to join the NBIG. If no place was available on a course at a location close enough to the individual, GLT placed them on a waiting list. These participants were invited to join the WLCG, and also included any participants who delayed their start. The study included 29 males, 38 females and 2 'other' (NBIG), and 17 males and 14 females (WLCG) (see 4.1.1 for a further detailed breakdown).

The NBIG participants attended 29 separate NBI courses, across 9 sites (3 in Norfolk and 6 in Suffolk), commencing between August 2023 and February 2024. All participants resided in the UK, and had been referred through their GP, social worker, support worker or other professional, or via a self-referral

route. Eligible participants had to be 18 years or older and not previously have attended a GLT NBI. Participants were allocated to either NBIG or WLCG depending on whether there was a GLT NBI starting in their area within the subsequent 12 weeks.

It was important to identify any potential ethical issues related to the multi-study, particularly in relation to allocating participants to either group, and ensuring individuals were able to access the intervention. To mitigate ethical issues, individuals allocated to the WLCG were informed that they remained on the waiting list, for placement on the next available NBI. If a placement became available, and was accepted, during the period of the research, the individual had the opportunity to swap research groups, ie move from WLCG to NBIG. The Consort flow diagram below shows participant engagement.

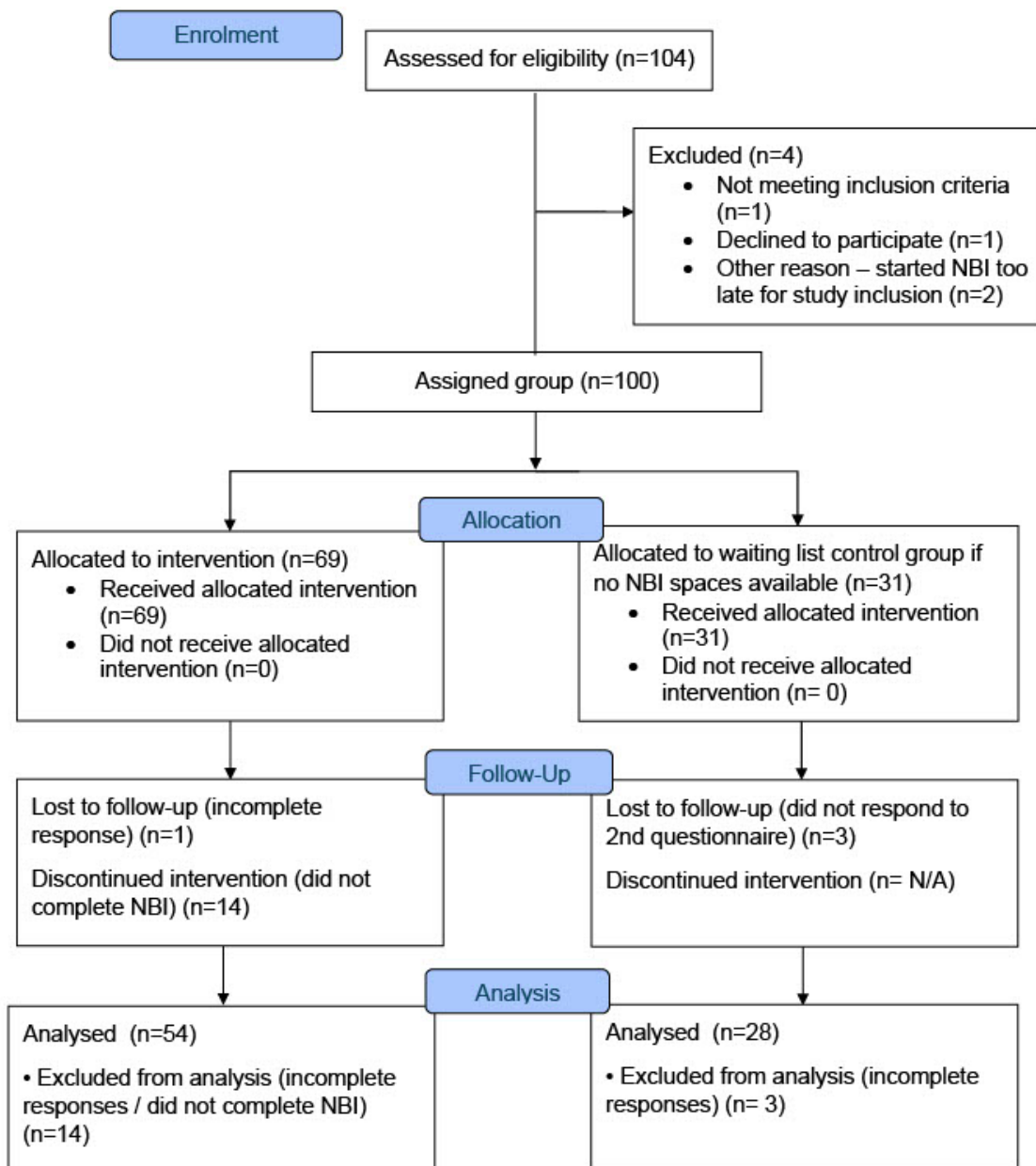


Figure 2: CONSORT flow diagram for participant engagement (study 1).

3.3.2.2 Study 1 Procedure

Upon confirmation of GLT NBI suitability (aged 18 years or over and able to attend a NBI site independently or with GLT transport), service-users complete an Adult Participant Profile (APP) form, including consent for their data to be

used by third parties and for research purposes. The information gathered at this stage, stored on GLT's Data Management System ('Beacon'), included demographic information and was therefore available as secondary data.

Individuals accepting the offer of GLT provision were assigned to a NBI course and site appropriate to availability and location. The researcher contacted eligible GLT service-users by email, inviting them to participate in the research by following a link. The link took them to a Qualtrics survey which introduced the individual to the research, included a 'Participant Information Sheet' (PIS) and 'Consent Form', and gave them the option to participate in the research. The consent obtained electronically via Qualtrics, was downloaded and stored in the Universities secure cloud (Box). Only participants who provided consent took part in the research, see below: Figure 3: NBIG and WLCG survey completion points and process.

Participants in both the NBIG and WLCG completed surveys at baseline and after 12 weeks/post-NBI. The baseline questionnaire was identical for both NBIG and WLCG, allowing for a participant to be moved between initially allocated groups, for example from the NBIG to the WLCG if for any reason they did not start the NBI. Two participants moved from NBIG to WLCG and one participant moved from WLCG to NBIG. Both questionnaires asked participants to complete the short form Warwick Edinburgh mental wellbeing scale (appendix 3) (Richardson et al, 2019, Koushede et al, 2019; Ng Fat et al, 2017, Stewart-Brown et al, 2009), and Nature Connection Index (Richardson et al, 2019). All participants were asked what, if any, other wellbeing support they were receiving. In instances where the exact type of other support was unclear, the researcher used the information on the GLT system (Beacon) to clarify the support service

and categorise the support-type. The researcher assigned code numbers to each participant. Upon completion of the NBI (NBIG), or 12 weeks after the first questionnaire (WLCG), the researcher e-mailed the participants with a link to a second questionnaire. Participants in the NBIG were also asked whether they were interested in participating in an interview as part of the research (study 2).

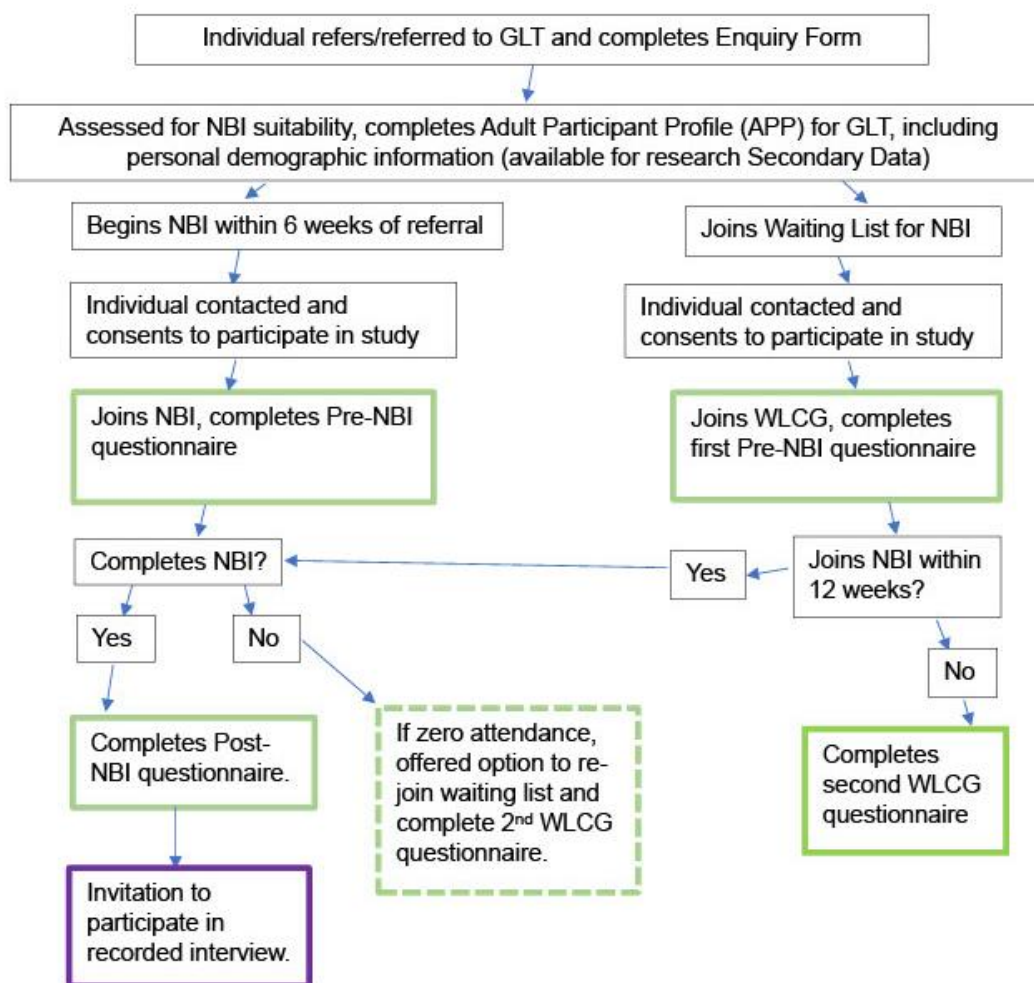


Figure 3: NBIG and WLCG survey completion points and process

3.3.2.3 Standardised Questionnaire Measures

Wellbeing was assessed using the Short-form Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS), a 7-item positively worded scale commonly used to assess wellbeing in the population (Tennant et al., 2007). SWEMWBS has five response categories, from one (none of the time) to five (all of the time) which are summed to give a score from 7 to 35, with a higher score representing better wellbeing. Prior to analysis, the raw score was transformed to a metric score, using a conversion table provided by SWEMWBS authors (Stewart-Brown et al. 2009). The scale has a Cronbach alpha score of 0.90 (Tennant et al. 2007) or 0.84 (Ng Fat et al, 2017), indicating very good reliability. For this sample, the Cronbach alpha across the wellbeing timepoints was 0.90. The norm for a UK adult is 23.5 ± 3.9 and can be categorized as 'low' 7.00–19.3, 'medium' 20.0–27.0 and 'high' 28.1–35 (Ng Fat et al, 2017). 15% of the UK population can be expected to have a score above 27.4 and 15% to have a score below 19.6, and with data taken from 2010-2013, it was found that males (16 years +) had a mean score of 23.67 ± 3.92 and females had a mean score of 23.59 ± 3.99 (Ng Fat et al, 2017). A change in SWEMWBS score of between 1 and 3 meets the threshold to be considered a meaningful change.

Nature connectedness was assessed using the Nature Connection Index (NCI), a 6-item measure examining the extent to which a person feels connected with the natural environment. Participants respond on a 7-point scale from 'completely disagree' to 'completely agree', with a weighted points index used to indicate the importance of each item and summed to calculate the NCI score. The weighted score ranges between 0-100, with higher scores indicating higher connectedness to nature. The NCI scale is reliable, valid and has high internal consistency (α

=0.92) (Richardson et al, 2019). The norm for a UK adult is 61.16 ± 27.88 , the norm for females is 64.21 ± 27.36 and for males is 57.96 ± 28.08 (Richardson et al, 2019). The scale has a Cronbach alpha score of 0.92 (Richardson et al, 2019). For this sample, the Cronbach alpha across the NCI timepoints was 0.89.

3.3.2.4 Study 1 Data Analysis

Data analysis was conducted with SPSS v29 and significance set at a P value of 0.05. Data was checked for any erroneous figures and missing information, and normality tests were conducted to explore the distribution of wellbeing and NC data. Independent t-tests were conducted to compare wellbeing and NC scores of the NBIG and WLCG at baseline, with subsequent mixed ANOVAs used to explore differences in changes in wellbeing and NC over time between the groups. Follow-up paired samples t-tests were used to analyse changes in wellbeing and NC for both NBIG and WLCG.

A series of one-sample t-tests compared wellbeing and NCI scores for both NBIG and WLCG groups, at both time points to UK normative values. Multiple regression was used to determine to what extent age and gender predicted changes in wellbeing and NC.

3.3.3 Study 2 Qualitative Data Collection

3.3.3.1 Study 2 Participants and recruitment

Participants who had indicated a willingness to participate in the interviews were contacted prior to their final NBI session to confirm their agreement to participate. Study 2 participants therefore comprised of NBIG participants from Study 1 who had recently (within the three weeks preceding the interviews)

completed a GLT NBI, of which 24 participants indicated a willingness to participate in the interviews. Factors such as location/travel, work/other commitments and ability of the participant/researcher to attend a specific GLT site on a mutually convenient date meant 10 participants could be interviewed within the timescale of November 2023 to May 2024. Participants from different sites and courses were prioritised to provide a larger representation of experiences, cross-section of delivery staff, seasons, weather and environment.

3.3.3.2 Study 2 Procedure

Study 2 comprised individual semi-structured interviews conducted in person at one of the GLT sites, post-completion of the NBI. The interviews explored participant motivation for attending the NBI, how their wellbeing changed, what they felt contributed to this change, and the role of NC (see Appendix: 3. Study 2 Interview script/questions). Interviews were conducted between the final session of the NBI and up to 3 weeks after. All interviews took place at the same GLT site that the participant attended their NBI. The semi-structured interviews were conducted and recorded in-person, on site, with a mean average duration of 43 minutes (ranging from 27 minutes to 71 minutes). Interview consent was re-confirmed verbally at the beginning of the recorded interviews. Participants were reminded of the purpose of the research and given the opportunity to stop/pause the interview, ask any questions, and withdraw their consent at any time. The nature/NC questions asked the participant how they perceived the role of nature in their NBI experience, if their view of, or connection with, nature had changed during the NBI and what their future relationship with nature might look like. This was an opportunity to explore what the participants

perceived as underpinning any changes in their wellbeing and NC and add context and understanding of how the NBI has affected their life, plans and aspirations. All questions were asked to all interview participants, except when the participant had already answered a separate question whilst responding to another question. All questions were open and participants were often asked to expand upon or explain their response.

The transcriptions were made by the researcher from the audio files and stored securely, using Box. All interview data was anonymised prior to analysis to ensure anonymity of data and all potentially identifying information was removed from transcripts. Once transcription was complete and the transcripts had been checked, audio files were destroyed. On completion of the project, anonymised interview transcripts were archived in the UK Data Service to support future research. After ten years, electronic consent data and transcripts will be destroyed.

3.3.3.3 Study 2 Data Analysis

An inductive qualitative approach was used, starting with an examination of the data produced, to identify patterns and themes. Interview transcripts were subjected to thematic analysis in accordance with the 6-stage protocol developed by Braun and Clarke (2006). Thematic analysis allowed for exploration of individual perspectives, identification of similarities and differences within the dataset, and for identifying unexpected findings.

Data familiarisation was achieved through conducting the interviews, the process of manual transcription of the interviews and during the subsequent process of coding the data. NVivo (v14) was used to generate initial codes into a framework. Codes

and a coding framework were developed and produced through exploration of the data and codes. Initial generation of the codes had the potential, and some tendency, to be deductive and partially aligned to the content of specific questions. The process was started three times before the researcher was satisfied that the codes were more inductive. The process allowed for an element of recognition of existing theory associated with a deductive process, in combination with a more inductive process (Fife and Gossner, 2024), facilitating resulting codes, and subsequently the themes, to emerge directly from the raw data, thereby minimizing potential bias, and assisted in cross-checking the codes remained contextualised. Initial themes were explored by grouping the codes together where some commonalities were found. All themes were reviewed before being defined and named.

The themes were re-visited several weeks later, all text was re-read, codes re-checked, some codes were re-named and, in some cases, re-coded with new 'parent' and 'children' names. The dual role of the researcher, as a NBI-deliverer and the researcher leading the interviews, transcription and analysis, enabled a more nuanced and contextual comprehension of the data (once the data had been split into short phrases). For example, once codes were identified and taken from interview text, they may lose contextual meaning. The dual-role allowed the researcher to recognise the original meaning and context of code, particularly when related to specific experiences or activities present within the NBI.

In addition to utilising NVivo, other complementary forms of data synthesis were employed to assist in the categorising of codes and creation of themes, based on the NVivo codes, such as colour-coded tables in Word documents and spider-diagrams on flip-chart paper (see appendix 7). A return to deductive elements of the analysis

were utilised at the final stages, to check the codes and emerging categories were relevant to the RQs. The final six themes evolved from these processes. This process resulted in greater differentiation between the themes, allowing for clearer definitions and naming. The analysis was then at an appropriate stage to enable the reporting of findings.

Chapter 4. Results

4.1 Study 1 Results

4.1.1 Study 1: Participants

The sample size was n=100, 52 females, 46 males and 2 other, from NBIs at all sites across Norfolk and Suffolk (Table 1). All participated in their NBI between the Summer of 2023 and Spring 2024.

Table 1: Participants gender/age by group

	Male		Female		'Other'		Total
	Number (%)	Mean±SD age (range)	Number (%)	Mean±SD age (range)	Number (%)	Mean±SD age (range)	
NBIG	29 (42)	43.3±15.1 (20-71)	38 (55)	43.4±15.5 (18-72)	2 (3)	26.0±11.3 (18-34)	69
WLCG	17 (55)	44.5±12.2 (23-70)	14 (45)	40.1±16.0 (18-67)	0 (0)	N/A	31
Total	46 (46)	43.8±14.0 (20-71)	52 (52)	42.5±15.6 (18-72)	2 (2)	26.0±11.3 (18-34)	100

The majority of participants were accessing other support for MIH (Table 2). However, approximately 29% of the NBIG were receiving no other support, in contrast with approximately 7% of the WLCG. The highest NBI drop-out rate occurred for those with no other mental health support, and only non-clinical mental health support.

Table 2: Other mental health support received by participants, by % of group

	Pre-NBI/baseline		Post-NBI/12 weeks	
	NBIG %	WLCG %	NBIG %	WLCG %
No other mental health support	28.9	9.7	27.8	7.1
Medication only	8.7	16.1	11.1	17.9
Non-clinical only	17.4	25.8	9.3*	21.4
Talking therapy only	1.4	0	1.9	0
Medication and non-clinical support	27.5	29	33.3	32.1
Medication and talking therapy	8.7	16.1	9.3	17.9
Non-clinical and talking therapy	7.2	3.2	7.4	3.6

* figure includes one participant who completed the NBI but submitted incomplete questionnaire responses

4.1.2 Study 1: Wellbeing

The pre-NBI wellbeing score for all participants combined was 17.99 ± 4.05 . An independent t-test revealed no significant differences between pre-NBI wellbeing scores in the NBIG and WLCG ($t(97) = 0.43$, $p = 0.344$), with the NBIG having a slightly higher score than the WCLG (Figure 4). A one-samples t-test revealed that the pre-wellbeing score for the NBIG ($t(67) = -11.500$, $p < .001$) and WCLG ($t(30) = -7.162$, $p < .001$) were both significantly lower than the UK normative value of 23.5 ± 3.9 (Ng Fat et al, 2017).

Mixed ANOVA revealed a statistically significant interaction of time and group ($F(1, 79) = 13.694, p < .001; \eta p^2 = 0.148$) on wellbeing scores. Follow-up paired samples t-tests for the NBIG and WLCG separately revealed a statistically significant increase in wellbeing in the NBIG ($t(52) = -5.45, p < .001$) and no statistically significant change in wellbeing in the WLCG ($t(27) = 0.309, p = 0.380$). The average scores in both the NBI ($t(53) = -4.489, p < .001$) and WLCG ($t(27) = -6.600, p < .001$) remained below the UK normative value after 12 weeks; however, scores in the NBIG moved to the 'average' category, whilst scores in the WLCG remained in the 'low' category (Figure 4).

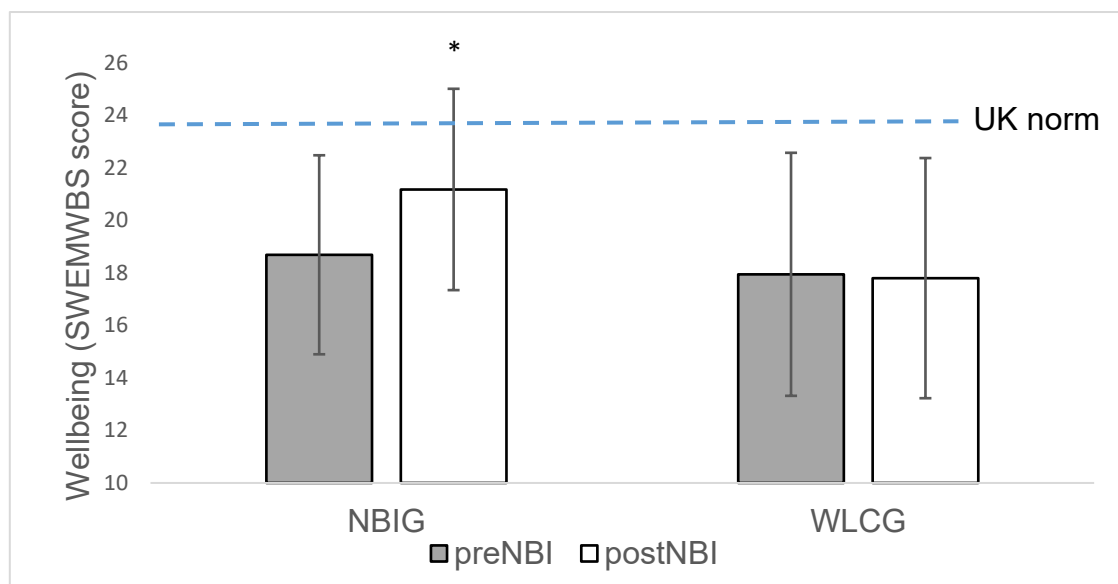


Figure 4: Mean \pm SD SWEMWBS scores pre and post intervention for NBIG and WLCG. * indicates a significance difference from pre-NBI ($p < .001$).

4.1.3 Study 1: Nature Connection

The pre-NBI NCI score for all participants combined was 55.66 ± 25.06 . An independent t-test revealed no significant differences between pre-NBI NCI scores in the NBIG and WLCG ($t(98) = 0.115, p = 0.956$), with the NBIG having a

slightly higher score than the WCLG (Figure 5). A one-samples t-test revealed that the pre-NCI score for the NBIG ($t(53) = -4.489, p < .001$) and WCLG, ($t(27) = -6.600, p < .001$) were both significantly lower than the UK normative value of 61.16 ± 27.88 (Richardson et al, 2019).

Mixed ANOVA revealed a statistically significant interaction of time and group ($F(1, 80) = 4.625, p = 0.035; \eta p^2 = 0.055$) on NC. Follow-up paired samples t-tests for the NBIG and WCLG separately revealed a statistically significant increase in NC in the NBIG ($t(53) = -4.45, p < .001$) and no statistically significant change in NC in the WCLG ($t(27) = -0.58, p = 0.28$). After 12 weeks, the average NC scores in the NBIG, ($t(53) = 3.25, p = .002$) increased above the UK normative value and the average scores for the WCLG ($t(27) = -1.102, p = 0.280$) remained below the UK normative value (Figure 5).

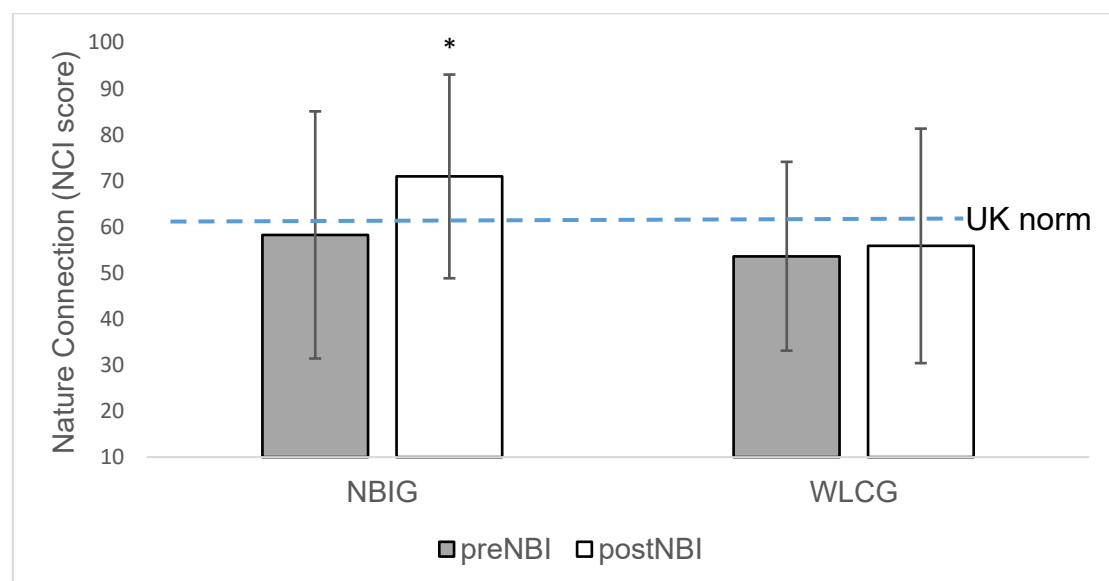


Figure 5: Mean \pm SD NCI scores pre and post intervention for NBIG and WCLG. * indicates a significance difference from pre-NBI ($p < .001$).

4.1.4 Study 1: Predictors of Wellbeing

Multiple regression explored the extent to which the intervention group, change in NC, age, and gender predicted the change in wellbeing. The model significantly predicted 20.5% of the variance in the change in wellbeing scores ($F(3,47)= 4.041, p=.012$). NCI Change ($\beta=.052; p=.015$) and Gender ($\beta=-2.043; p=.021$) significantly predicted wellbeing change, accounting for 10.69% and 9.61% of the variance in SWEMWBS change respectively. Each additional one-unit improvement in the NCI score was associated with a 0.052 unit increase in wellbeing. Additionally, being female was associated with an additional 2.04 improvement in the wellbeing score.

4.2 Study 2 Results

4.2.1 Study 2: Participants

The sample size was $n=10$, seven females and three males, age range 22-64 years, mean age 49 ± 12 years, from NBIs at five sites across Norfolk and Suffolk. One of the individuals participated in their NBI during the Summer/Autumn of 2023, one in Autumn/Winter 2023-4, four in Winter 2023-4 and four in Winter/Spring 2023-4.

For the purpose of context, and with regard to ethics and data protection, the 10 participants have been given pseudonyms.

Table 3: Study 2 participant pseudonym and demographic

Pseudonym	Gender	Age group
Louise	Female	40-50
Kelly	Female	40-50
Sean	Male	50-60
Keith	Male	30-40
Jason	Male	50-60
Helen	Female	20-30
Barbara	Female	50-60
Kate	Female	60-70
Camille	Female	50-60
Francesca	Female	50-60

4.2.2 Study 2: Six Themes

Study 2 aimed to explore and understand what underpins participants' changes in wellbeing. Six themes were identified through the thematic analysis: (1) Enhanced social interaction within the NBI, (2) Feeling calm, free and closer to nature through increased interaction and immersion within the natural environment, (3) Enjoyment from being active and appreciation of the benefits of physical activity, (4) Improvement in lifestyle behaviours, (5) Enhanced positive affect, emotions, confidence and self-esteem, and (6) More positive about the future, increased hope, pride and state of empowerment.

Themes one to three reflect the participants' response to elements of the NBI; the social aspects, the natural environment and being active. Themes four to six reflect

changes experienced by participants, internal responses, related holistically to the NBI. They are linked to the accumulation and intercepting of the first three themes and are more variable due to individual's unique experience of the NBI.

4.2.3 Theme one: Enhanced social interaction within the NBI

This theme reflects the importance of NBI participants feeling socially comfortable and supported in the NBI environment. All participants referred to social aspects as a factor in their positive experience of the NBI. This theme includes decreases in social anxiety and isolation, increases in belonging and feeling valued, and being in a supportive environment. The natural environment was recognised as conducive to the social interactions.

All participants reported improvements in social skills and social confidence through social interaction within the NBI environment. However, most participants reported social anxiety as being a major challenge for them when attending the first session. Social anxiety often continued during the first few NBI sessions, but participants felt the NBI offered opportunities and support to reduce social anxiety over the duration of the intervention.

"I don't have that [social anxiety] anymore. But the first few weeks were very difficult."

- Kelly

Six of the ten participants reported feeling socially isolated prior to the NBI and was a reason for them to attend the NBI. Several participants reported feeling less social isolation, through the opportunity to re-engage with people and re-develop social skills during the NBI. Some participants reported gaining friends on the NBI who they have started to meet with socially.

Anxiety reduced as participants started to feel accepted and at ease in the environment. Expressions of feeling safe were common; that it was a place where the participants could be themselves and they felt valued and comfortable.

"I was terrified the first day, ...but ...I've realised that it's a safe space and I can talk".

- Sean

"I like the feeling of safety, emotional safety within the camp. And the support that you get from the other members." - Kelly

Anxiety often took the form of an initial fear of not being accepted by other members of the NBI, but participants subsequently reported that they felt accepted and encouraged, not judged by other participants and experienced a sense of belonging.

"Feeling like I belong here... accepted. I think just being with other people in this beautiful environment has made me feel so much less lonely." - Francesca

Some participants expressed surprise that other people would like them or accept and value them.

"I think it just gave me a different perspective on people because [I thought] people were scary, people aren't going to be nice to me. And so, coming here and realising that people are going to be nice to me and I can feel comfortable around people, I'm not gonna be judged, I'm not gonna be criticised. I [realised] oh, there are nice people. And it was really good to have that shift in my thinking. I thought I'd be laughed at and people think I'm stupid, but I've got over that since I've been here." -

Sean

All participants expressed positive thoughts towards their fellow NBI members, enjoying the company of others in the group irrespective of whether social

interactions were motivational in their own reasons for attending the NBI. Most participants reported positivity within the group as an important factor in feeling more confident around their peers. All participants commented on fellow participants/GLT staff being supportive and positive, often describing them as 'nice', 'lovely', 'empathetic', 'understanding', 'non-judgmental'. Participants linked this shared understanding or empathy of MIH to their own feelings of acceptance and achievement.

"One of the things I like about the group is that you can talk about stuff and you meet their eyes and you just know that they know, they get it, you know, and that's great." -

Kelly

Many participants reported it was important for their wellbeing that they did not feel forced to interact with other people; that they had the choice of what they did, when they did it and who they talked to. Group tasks in the NBI were recognised as constructive and motivational ways to facilitate interactions, but choice allowed the participants to have social interaction on their terms, as and when they felt comfortable, whilst also having the option to have personal time. Some participants commented on being accepted whether they wanted to interact with the group or be left alone at times. One participant, a carer, commented on feeling more energised due to not being expected to perform a specific task or assist someone, but feeling good when helping because they choose to do it.

"I naturally will gravitate to just helping. But the fact here that it's not expected and very much appreciated, that's made all the difference and the buzz you get from helping somebody when they didn't ask or you weren't expected to do it, it gives a different type of energy, definitely." - Camille

This safe and supportive environment allowed for reciprocation, with other participants also feeling they gained self-esteem and happiness from being able to support, help and be kind to others. Upon reflection during the interviews, the participants often started to place more emphasis on how the NBI facilitated opportunities to give to others and the associated positive effects on wellbeing.

“I’ve seen some of the younger ones struggling ... So, some of the tricks that my dad had taught me when doing woodworking stuff, I showed him how to do that. That wasn’t only just good for me. It was good for him. It just made me feel like I had something to offer.” - Francesca

“It feels good to help other people and to support other people and, as well, like having other people do that for me.” - Sean

Some participants felt they did not have much to offer but began to realise there were many opportunities to help others with NBI activities; that they could be more useful than they thought. One young adult participant found this liberating:

“My family is wonderful and they’ve always taken care of me. But now ... both my parents are struggling with different illnesses and stuff and it’s helping me realise the I can help more than I thought I could. I guess I kind of I was stagnant and I thought, ‘What can I do? I’m useless’. But coming here and making a drink [for others], ... if I’m at home I can make [Mum] a drink. And, and that becomes a habit.” - Barbara

Several participants described how their increased confidence in social interactions has also extended into other areas of their lives, such as being able to go out more and become involved in other activities.

“I speak to my friends and my family a lot more, ... I guess I reach out more to my friends and [visit] my grandparents [more]. I couldn't have done that before.” -

Barbara

Participants felt that the social and natural environment combined to create a positive and supportive place to be. The natural environment represented a neutral and calming space away from outside pressures and expectations, conducive to positive social interaction. It was also appreciated that there were genuine opportunities to help nature and future participants by taking part in conservation tasks and making improvements to the camp.

“The conservation work we've done, the coppicing, but also with the RSPB ... it feels good to be doing something good, and that makes me feel better about myself too.” -

Barbara

The NBI environment and people therefore presented a space for the participants to be themselves, feel at ease and engage more freely with the opportunities on offer.

4.2.4 Theme two: Feeling calm, free and closer to nature through increased interaction and immersion within the natural environment

All participants reported how they felt some sense of ease with being in the natural environment, which increased further once they also felt able to comfortably and positively interact socially. The natural environment was instrumental in reducing social barriers and anxiety. Most participants reported having achieved a personal inner-calm and peaceful feeling, due to being physically away from causes of stress and responsibilities, distractions and sensory white noise, like ‘you're stepping away from the day-to-day world’ (Louise). This allowed for a mental re-set, to be quiet, more present, and in a safe place. The journey to the NBI, often a bus or

taxi, followed by a walk through the woods to the NBI camp, acted as positive trigger, enabling a feeling of escape and entering a different reality.

“I come here and my heart rate drops, become calmer. I just come walking into the woods knowing it's going to be a good day.” - Kate

Eight of the ten participants described a feeling of being submersed in nature on the NBI, using at least one of the following descriptors: calming, relaxing, peaceful, tranquil, therapeutic. A place where they didn't 'over-think' or feel stress and can just be. Of the other two participants, one stated that they found it more relaxing than being at home and felt free, and the other said it felt like the outside world was left behind them. This is consistent with participants' descriptions of feeling comfortable with social interactions in the natural environment, as described in theme one.

Most participants reported feelings of belonging in, or comfortable with, and connected to, nature and the natural environment. Participants often specifically described how nature increased, or even caused, their feelings of calm. They alluded to utilising their senses, such as seeing the trees, patterns of leaves against the sky, sounds of wind in the trees and birdsong. The sights, sounds and smells made it feel like a natural place for them to be, which helped participants to feel calm and relaxed.

“Sniffing balsam [fir tree needles and freshly cut logs] is also quite, that, that smell really makes me feel calm ... those kind of things like the smells and stuff ... I suppose it's because it is natural to us. It would be our natural habitat, you know, going back.” - Louise

There were constant opportunities to interact more closely with nature, whether during physically demanding or more passive activities. Working with wood, hands on, felt natural and increased feelings of connection with the surrounding nature.

“Turning a fallen tree into something is really, yeah, really enjoyable and connected.

Planting the trees. That’s helped connection.” - Kate

Participants acknowledge the physical space, which allowed for space to be alone in, the freedom to be, and to explore. Most participants reported appreciation of not being, or feeling, isolated, but having the choice when and whether to engage with others or be alone, in the knowledge there is company and support close by, linking back to the previous theme. The expanse of the natural environment accommodated this, in contrast to being surrounded by four walls. Participants expressed feeling free, not claustrophobic, enjoying finding new things, the freedom to walk around at their own pace and investigate their surroundings. In some cases, this also inspired them to go for walks and explore their environment on non-NBI days.

“I’m going to set Fridays aside to go back to what I call my exploring walks.” - Kate

The feelings of freedom to spend some time alone or around others, to sit and enjoy nature or to explore, whether searching under nearby logs or going for longer nature walks, are consistently reported by the participants to be instrumental in their enjoyment of both the social aspects and the natural environment. Many participants reported these freedoms and choice as also enhancing their feelings of self-awareness and awareness of the natural environment. Participants commonly reported feelings of appreciation, and increasing recognition, of beauty in the wildlife

and surroundings, noticing changes in nature every week, buds and flowers, leaves returning, and being energised.

There was often recognition that they had become less connected with nature over time and felt the desire to re-connect, remembering positive feelings they had as a child when around nature. There was increasing realisation that humans are not separate from nature. Nature helped participants to notice and appreciate more of their surroundings, for example, the changing seasons, spring growth and different wildlife present, prompting them to value small positives, gain a new perspective and to re-frame their lives.

“I wouldn't pay attention if I was out and about outside [in] the winter months or when it's colder or dreary and grey outside, and I would... think, oh, look all the leaves on the ground, they're all crispy and dead, looks barren. And I think it made me feel like, oh, everything else is feeling a bit terrible as well at the moment. But then I start to pay more attention and you'd see like, oh, buds on the trees, 'Any fungi?'... And it's like there's life!” - Barbara

Gaining knowledge was not an initial motivation for participants to start the NBI. However, many participants noted how interested they became in aspects of the natural environment and were surprised by how much they were interested in learning more. For some, it was a revelation that they are able to learn, having previously doubted their intellectual ability, realising they do have the ability if the environment is suitable and they are interested.

“It's physical. You can touch it and yeah, you learn because it's immersive, completely immersive.” - Camille

Sean felt he enjoyed learning progressively more about nature and it helped them realise:

“We are part of nature and you know we are not separate from it, and humans kind of separate themselves from that. But I do feel more like part of nature.”

Participants frequently linked nature to senses of belonging, belonging in the woodland environment and in the social group.

“Then nature is really... absolutely fundamental to this. It adds an element of acceptance.” - Kate

The participants therefore felt the natural environment was a key contributing factor in the enhanced social interaction described in theme one. It was a source of calmness, an enabler of feelings of freedom and exploration, and supported empathy towards nature, the environment, and each other, and self-acceptance.

4.2.5 Theme three: Enjoyment from being active and appreciation of the benefits of physical activity

All participants referred to benefits they noticed from being more physically active during the NBI. For many, physical activity and fitness was not the primary motivation for attending the NBI, but most participants reported physical activity to be welcome, enjoyable and beneficial.

Some degree of physical activity was required, with the minimum requirement being that of walking to and from the NBI site, a distance ranging from approximately 100m to 700m each way, in addition to any activity during the session. However, this was an opportunity for participants to ease themselves into the session.

“First of all, even just walking up to camp in the mornings, there’s that nice, little gentle walk I take, normally with a few of our participants, but it’s a nice way to get settled before I even get into camp.” - Barbara

Where appropriate, participants were encouraged to participate in a broad range of activities but had choice of which activities they felt able to engage with and to what intensity. Activity options and differentiation were applied appropriately. Kate enjoyed trying different types of physical activities:

“In like, in your 60s, you might walk or dance or something, but you don’t leap and balance on logs anymore so I think I’ll be putting [a ‘lava’ balance trail] in my garden.”

Physical activities were described as useful for staying busy and having a focus, as well as enjoyable, fun and rewarding, such as felling a tree, splitting logs, wood carving and building dead hedges.

“Actually the active part is more important than I realised. The dead-hedging I really enjoyed, and even just the chopping wood and all that. That’s something fun. Gets me moving.” - Barbara

One participant felt they probably would not have continued the NBI if there had not been nature walks.

“Even if there was nothing to do here and we just sat round a campfire and went for a walk in the beautiful surroundings, I would still have come here every week”. -

Francesca

Participants often felt that the walks helped to stimulate their interest, creating a desire to discover and learn more. During the NBI, many participants developed interests in plants, fungi, birds and insects, and they utilised the walks to search out

such nature, with the sense of exploring and discovering a motivating factor for the walks. Regardless of motivation-type, participants found they walked further than they thought they would. Several participants found the NBI had re-ignited their enjoyment of walks, or motivated them to participate in more, and longer, nature-based walks during the NBI.

“It's made me think more about how I'm spending my time physically before, during and after the day that I spend here. It's enabled me to stop seeing walking as something that's gonna be arduous and painful and detrimental.” - Camille

Barbara alluded to the walks being nice because they were an opportunity to look for interesting things and learn, be active, and be sociable. Many of the activities required teamwork or social interaction, linking to theme one, commented on by some as being beneficial to group cohesion and bonding, enabling the activity to be more enjoyable. Several participants also identified the combination of physical and social activity, and the natural environment, linking to themes one and two, as particularly key to their enjoyment.

“The most valuable.... being with big mix of people, but being active with them because the activities draw you together. And bashing things, chopping, bashing and putting things on fire has been really excellent. It has all got to blend in with each other. You can't really take anything away. It wouldn't work in the classroom. It's got to be outside”. - Kate

Some participants found the NBI tiring at first, but usually in a 'good way'. Physical improvements experienced included feelings of increased stamina, quicker recovery from physical exertion and higher energy levels. Many participants reported that they had observed weekly improvements in basic physical ability, feeling they had

higher levels of stamina for daily tasks and a general feeling of being fitter. They noticed they were able to walk further, or over a longer duration, or even have better balance, due to the 'lava trail' (a trail of logs, tree trunks and wooden stepping stones to balance on and traverse).

"We walked down to the beach and stuff like that, you know, and these walks get further, further away and I'm learning how to cope with that" - Helen

Louise, a ME sufferer, had previously been bed-bound and described their physical improvements to be "hugely beneficial" and felt there were more holistic benefits than just going to the gym:

"When my mental health takes a dip, my physical health also takes a dip. [I've been] able to gradually build up my activity levels as I go through."

Most participants recognised that physically active tasks were rewarding, both in terms of achieving something positive for themselves and worthwhile for the environment. Francesca had been "shut in my house day in, day out for years" due to fibromyalgia and was "was absolutely knackered the first few weeks". However, they recognised their achievement of getting through the NBI-sessions without having to take a rest or "sit down and watch the telly and have a cup of tea".

"When I when I first came here, I wasn't doing much so when you're at home on your own every single day, you are just sitting around. [The NBI] does make you feel good and even just the walking around, you know, that's it's good for you." - Sean

Barbara recognised that participating in woodland management and conservation activities were even more rewarding because they had a wider, pro-environmental purpose. Many participants reported going through a process of re-evaluating what exercise or physical activity can involve. Louise expressed the view that being active

in nature can be effective exercise, and also has psychological wellbeing advantages that simply going to a gym does not have.

“Learning woodwork skills and all that....that's physical as well. But yeah, yeah, it's just nice to be active. It does help a lot really.” - Jason

Camille also recognised improvements in health and routine from being active on the NBI, inspiring them to pursue future employment in the outdoors. Physical activity during the NBI was therefore considered to be highly beneficial to general fitness and wellbeing, and the range of activities contributed to engagement and combined to optimise the impact of themes one and two.

“I suppose, seeing myself coming out and reconnecting and being more active and seeing what's around me, allows me to view myself or even people as something that's just a part of nature that you can't separate.” - Barbara

Participants recognised that after some physical work, they felt more justified in rewarding themselves with an enjoyable, relaxing and mindful break, such as lying in a hammock and staring at the tree canopy against the sky. Some participants have taken confidence in their physical ability, and satisfaction in successfully engaging in new activities. They gained inspiration from the NBI and nature, becoming more adventurous in the physical activities they participate in away from the NBI, reporting positive changes in their lifestyle behaviours on days between the NBI sessions.

4.2.6 Theme four: Improvement in lifestyle behaviours

As introduced in section 4.2.2, themes four to six reflect changes experienced by participants, related holistically to the NBI and linked to the intercepting of the

previous three themes. Theme four represents positive changes in lifestyle and behaviour that developed over the course of the NBI, linking strongly to elements of the previous three themes. However, theme four represents a distinct shift from improvements participants experienced during their NBI sessions, to participants extending the positive behaviours across the rest of their week. Several participants referred to instances whereby the NBI had helped them develop a more physically and psychologically healthy routine through the week, reflecting an increasingly healthier lifestyle.

Some participants had applied increased interest in physical activity and nature to spending more time outdoors, in their own gardens, creating more habitat and even planning to build a 'lava trail', emphasising the links to themes two and three.

Recognising the benefits they experienced during NBI-days, several participants have started to explore footpaths in their locality, having longer dog walks or being more confident to try off-road footpaths. This was often in combination with nature interest, species identification and foraging, with nature interest referred to as serving as a motivator and stimulator to increase the durations of the activities. Kelly and Camille were amongst those who enjoyed going for longer nature-focused walks on non-NBI days, and plans to continue this.

Other positive behaviour changes included more regular meal-times and sleep patterns, supporting wellbeing. Barbara felt that, especially with being autistic, a positive routine was important:

“Sleep has improved since being outside and more active. Sleeping earlier and getting up much earlier now so. It's made a big difference.”

Most participants described noticing other changes they linked to the physical activity and healthy elements of the NBI. This included reducing bad habits, being more health-focused, feeling more energetic, losing weight (body fat), and being inspired and re-gaining the confidence to, for example, start cycling again. Many participants also expressed how they have come to realise that aspects of their lives are interactional and that a variety of lifestyle changes can positively influence their wellbeing.

“I feel like the more things you do, you realise there's other things that come with it.

So, like when you make something, then you get that sense of achievement, accomplishment. And I didn't even think about that until I started making things. And then I realised, Oh my God, this was nice. And you feel proud of yourself.” - Sean

They noted, for example, how being physically active and eating a nutritious lunch during the NBI, and experiencing a better quality of sleep on the night following the NBI, combined to improve their wellbeing. They reported that this gave them the reason and motivation to make positive changes at home on other days.

“I can't go home and not sleep and skip meals and do all this and expect myself to be kind of a functioning being. Waking up at a proper time and feel calmer and more motivated for the day ahead. I'm more stable. I'm not kind of having really emotional outbursts anymore.” - Barbara

Participants acknowledged feeling better as a result of the one-NBI day each week and that it could impact other days of the week.

“Knowing that I'll have at least one good day in the week makes it easier to get through the other days.” - Kate

This recognition and experience of rewarding and enjoyable activity, nutritional lunch, improved sleep and increased energy often motivated participants to replicate elements of the NBI on other days, prompting personal agency, positive behaviours and lifestyle changes during the rest of the week.

4.2.7 Theme five: Enhanced positive affect, emotions, confidence and self-esteem

Theme five encompasses enhanced positive affect, the increased senses of confidence, self-esteem, achievement, value, feelings of joy and happiness, and a reduction in feelings of SAD. Some participants joined the NBI specifically to increase their confidence and self-esteem, and/or decrease their anxiety and depression, however many of the other participants also reported these benefits. Several participants reported they were aiming to return to employment in the medium to long-term, often citing a lack of confidence and self-esteem as both a barrier to returning to employment and exacerbated by not being in employment. Themes one to four reflect some of the confidence increases in specific personal achievements/tasks such as interacting with other people or completing projects. Theme five recognises that these increased senses of confidence, self-esteem and self-worth begin to be felt more holistically by the participant, facilitating positive emotions and decreasing negative feelings.

Eight of the ten participants identified increases in confidence and/or self-esteem to a feeling of being useful, increased feelings of having value and having something to offer others, thereby improving their wellbeing. The NBI offered opportunities to support each other in a variety of ways. Louise felt “*most valued... and appreciated*” when able to help others, by just making a cup of tea for other participants. Many

participants expressed surprise that they were able to support others through words and action.

“It’s increased my self-esteem, which wasn’t something I was thinking about when I joined. I’ve realised there are things I can give.” - Barbara

Participants attributed a strengthened sense of self-worth and value to achievements that also helped other people or supported nature, such as helping to construct items like saw-horses, benches, wood stores and dead hedges.

“It just made me feel like I had something to offer. Over the course I have noticed the difference in everybody else as well as myself. The confidence that everybody else has. Their confidences have grown.” - Francesca

There was a sense of pride in what they were leaving behind to benefit nature and future NBI participants. Camille enjoyed being with *“a group of passionate people who are trying to make the world a better place and feeling that I’m a part of it.”*

The sense of confidence, self-esteem, achievement and value combined to support increased feelings of happiness. All participants stated they had experienced positive emotion during the NBI, with most participants reporting increased happiness and enjoyment, during the sessions.

“[I’ve] been happy to be on the course because I really love the woodwork and you know, as I say, it’s good to be out here with the group. I thoroughly enjoyed my time here”. - Jason

Happiness and enjoyment also extended into other areas of their lives, through increased activity and socialisation.

“[My family would] definitely say I’m happier.” - Helen

The natural environment supported and magnified the positive feelings and emotions. Participants often linked their increased comfort in social interactions in conjunction with the presence of the perceived neutral and calming nature of the natural environment, with feeling able to 'be themselves'. This helped to enable participants to foster a sense of value and purpose, freedom to enjoy their experiences and to be able to express their positive emotions. Enjoyment and joy were expressed by many other participants, on a range of experiences, such as in relation to nature (Jason and Kate), from the peace and quiet, and being able to help others (Louise), from interaction with others, of nature and learning new things (Kate).

"This has helped me get my own personality [back] and just remind myself that I am an individual, a person that's allowed to have needs, that's allowed to enjoy things without guilt attached to it, or to even remember that I enjoy things." - Kate

Strong emotive feelings were regularly expressed by all participants. All ten participants used the word 'love' in describing their experiences, for example, Louise described how they "loved" being on the NBI and "loved" learning new skills, in contrast to feeling anxiety prior to the NBI. Many other similarly strong, positive emotive words were used throughout the interviews; Kate stated, "It was blooming excellent!" and Camille feeling "like I'm on a natural high every time."

In addition to increases in confidence, self-esteem, happiness and other positive emotions, there were reported reductions in feelings of SAD. Participants reflected on links between lacking confidence or self-esteem and heightened feelings of SAD. Nine of the ten participants identified decreases in SAD during the NBI. Anxiety was commonly described as an issue by participants. The anxiety varied between

participants, including social anxiety and anxiety over being judged about medical conditions or ability. However, all participants who raised anxiety as an issue experienced reduced anxiety on the NBI, which positively impacted their life beyond the NBI.

“I had really bad anxiety and if I left the house I couldn't go even go like a minute down the road by myself, the music [through headphones] was a way to block things off, so I wouldn't have time to catastrophise... Now I prefer not to. I prefer to hear kind of bird song, anything. And it's actually much nicer. I think I'd like to enjoy that rather than blocking it out.” - Barbara

Some participants identified actions as useful for coping with stress. These also included listening to birdsong and other nature sounds, as well as, for example picking up a piece of wood and starting to whittle, enjoying the fresh air, and their mind being occupied by something positive and constructive. Similar aspects of the NBI were also identified as increasing calm, being more in the present, and being less anxious and depressed, resulting in improved feelings of wellbeing.

“Some days I wake up and I feel... feel really down. But I know that as soon as I'm here I'm gonna start to feel better and I have done every single time.” - Keith

Theme five therefore reflects interactions of all previous themes, the accumulative effects of increasingly positive feelings experienced by the participants during the course of the NBI.

4.2.8 Theme six: More positive about the future, increased hope, pride and state of empowerment

Theme six reflects changes experienced by participants, related holistically to the NBI experience, pertaining to their increased focus on, and positivity for, their future. The overall experience of the NBI were reported to lead to feelings of increased hope, pride, sense of control, self-determination and empowerment.

Participants alluded to a strong sense of unashamed pride in, and ownership of, their achievements and progress.

"I'm so glad [I started the NBI]. It's probably one of the best things I've done for myself, especially in my, like, recovery journey. It's, it's been such a big thing." -

Sean

There was recognition of unexpected outcomes and interconnections, related to their actions and achievements; the accumulation of experiences portrayed in the first five themes. Most participants had not joined the NBI to discover new interests or hidden talents, or to experience positive feelings from completing activities such as wood carving, building stools or creating nature habitats. However, many found joy in such activities and satisfaction from completing them. As self-esteem and pride started to increase from completing one activity, so there was increased motivation to replicate and improve and/or try a different activity.

"When you make something, then you get that sense of achievement, accomplishment. And you feel proud of yourself." - Kelly

There is a feeling among the participants that they have chosen this pathway to support their recovery and are happy with the pathway and their progress.

“I’ve gone through the worst time of my life recently, [but] for the last few years, I haven’t tried to kill myself. So that shows you that I am going down a path which I’m happy with. A lot of it is nature and a lot of it is taking part in things like this.” - Keith

Feeling ownership of achievements and control over their actions has allowed participants to believe they can take their experiences into broader areas of their life and future. They feel they can now focus on other areas of their life, such as hobbies and interests, lifestyle, relationships and career with renewed positivity and purpose. Some participants became active in social groups, enjoying both learning and passing on their knowledge. Some participants discovered they do have the capability to attend interventions, and engage and complete them, giving them more confidence to attend other support groups. Some participants felt that, following the NBI and becoming more active, they were able to manage their wellbeing more independently and no longer require additional wellbeing support. Kelly felt they are now in a better place emotionally and that their old-self is coming back. One participant felt the NBI has helped them learn about life, what they can control and work to improve on, and what is out of their control. Another participant began the NBI being scared about making a mistake during a camp task, such as fire-lighting or spoon-making, but realised they can learn from their mistakes, without feeling embarrassed or ‘furious’ with themselves, and take that attitude into the rest of their life.

All participants strongly indicated they were more hopeful about their future, pointing to the accumulation of benefits accrued, as described in the previous themes. One felt they are “no longer living in a bubble”, and are now able to go out, communicate and enjoy life. Another describes that self-harm and suicidal tendencies have reduced.

“I see a future where I’m more helpful to society. At some points I have been more a hindrance to society. I spent years masking and pretending that everything’s ok and now I don’t mask. I am going down a path which I’m happy with.” - Keith

Some participants have made plans for their futures and already put the plans into action, denoting significant steps forward. Although one participant is looking forward to joining a choir, there is a nature-bias towards most of the intended progressions. These include attending further NBIs to keep learning and gain more skills, re-train as a gardener, and volunteering with a forest school. One participant reported that their increased confidence, a positive “shift in my thinking” about people, and a desire to work in nature were reasons why they were able to volunteer at a local charity’s allotment, and then also gain employment at a garden centre. They felt that talking therapy had been helping, but the NBI enabled them to get out of the house and ‘test’ themselves in the outside world. Without the NBI, they don’t think they could have taken the step into volunteering and then employment.

“I’m so glad [I started the NBI]. It’s probably one of the best things I’ve done for myself, especially in my, like, recovery journey. It’s, it’s been such a big thing.” - Sean

Empowerment with personal agency is an accumulation of all participant experiences during the NBI.

“It actually made me realise I’ve got a lot more going for me than I remembered. And that’s empowering”. - Kate

Therefore, feeling more positive about the future, increased hope, pride and state of empowerment is not about feeling that wellbeing is improving, but the feeling of control over wellbeing and the perception that this can be taken forward and give direction and ownership in future endeavours.

Chapter 5. Discussion

This chapter discusses and interprets the findings from both studies independently and collectively, including implications of the research, suggestions for future research and conclusion.

5.1 Study 1 discussion

This section discusses the key findings from study 1, interpreting them in relation to the chapter 2 literature and other studies. A wider discussion combining both studies is in section 5.4. The aim of study one was to quantitatively analyse the effects of NBIs on wellbeing of vulnerable adults, and to answer the RQs. The primary RQ was ‘do NBIs improve wellbeing in vulnerable adults?’ and the first hypothesis was that wellbeing scores for participants will increase more following the NBI than for the control group.

The first key finding is that improvement in wellbeing was greater in the NBIG than in the WLCG. The baseline mean SWEMWBS score for all study participants (17.99 ± 4.05), and the NBIG (18.69 ± 3.79), indicates the cohort’s mean wellbeing fell within the low category and within the lowest 15% in the UK population (<19.6) (University of Warwick, 2024). The mean score for the NBIG following the NBI fell into the average category (21.18 ± 3.83). These results strengthen evidence that NBIs improve wellbeing (Shanahan et al, 2019; Struthers et al, 2024; Leão et al, 2025; Coventry et al, 2021; Catissi et al, 2024), further expand the evidence with the utilisation of the control group, lacking in much research, and provide specific evidence on woodland interventions.

Direct comparisons to other studies remain difficult due to differing populations, baseline wellbeing, duration, NBI content, location, and measures used. Evidence on the impact of a range of NBIs on wellbeing has demonstrated increases of 6.7%-30.7% (Appendix 5), which are broadly in line with the findings of this study where there was a 13.3% increase. However, these studies included a range of different intervention types, durations and metrics, for example the study finding 30.7% magnitude of wellbeing increase had a 26-week duration. Study 1 findings are consistent with other UK-based NBI studies (Rogerson et al, 2020; 2022; Gittins et al, 2023a; Maund et al, 2019) and align with evidence of shifts from low to average wellbeing (Wood et al, 2022a; Smyth et al, 2022). Results also support limited research on mixed-type NBIs (Leão et al, 2025) and align with previous research on GLT woodland-based mixed-type NBI cohorts (Barton and Pretty, 2010).

The findings do not specify which aspects of wellbeing were most affected. Given the short timeframe, hedonic wellbeing, linked to pleasure, happiness, and life satisfaction, may be more strongly reflected (Joshanloo et al, 2020; Henderson et al, 2013). The findings may also reflect SWB being dominant as it aligns with how individuals are feeling about their wellbeing, as opposed to specific OWB-related factors such as health and income. This may be important because hedonic wellbeing is more closely linked to short-term happiness, however, SWB has been linked to longer-term wellbeing outcomes (Zaninotto and Steptoe, 2019).

The second finding supports the hypothesis that vulnerable adults' participation in NBIs positively influences NC, with NC significantly increased in NBIG but not WLCG, aligning with research linking nature engagement with wellbeing and NC (Silva et al, 2023; Richardson et al, 2020a; Jong et al, 2022; Richardson and McEwan, 2018), and strong links between NC to wellbeing restoration (Pritchard et

al, 2020; Cleary et al, 2017). This study shows significant NC increases within 12 weeks, even with only one day/week of exposure.

Evidence on the impact of a range of NBIs on NC has demonstrated increases of 5.9%-23.7% (Appendix 6), mostly lower than the findings for Study 1 (21.8% increase). The studies included a range of different intervention types and natural environment and durations, reflected in the range of NC magnitude increase. However, duration only does not appear to be a strong factor, the intervention showing 23.7% increase only had a 5-day duration (Keenan et al, 2021).

NBIs performed in a range of natural environments may all have the potential to increase NC. Whilst many types of regular nature exposure have been found to increase NC (Sheffield et al, 2022), findings suggest greater immersion in a natural environment (Barton et al, 2016) and a mixture of environments, such as coast and mountains, (Keenan et al, 2021) have the potential to produce fast and significant increases in NC. Study 1 contributes by showing NC increases occur in woodland-based mixed-type NBIs, despite differing group dynamics, activities, and woodland types/time of year.

The third finding supports a positive association between NC and wellbeing, with additional one-unit improvement in the NCI score associated with a 0.052 unit increase in wellbeing. This aligns with previous research highlighting NC as a possible mechanism through which NBIs exert psychological benefits (Coventry et al, 2021; Richardson, 2019; Martin et al, 2020; Gibbs et al, 2022). Gender also significantly predicted wellbeing change. Being female was associated with an additional 2.04 improvement in the wellbeing score. This suggests potential gender differences in responsiveness to the NBI, or in the broader factors shaping wellbeing

trajectories. Such findings warrant further exploration, as they may reflect gendered patterns with, or sensitivity to, nature-based or socially oriented activities. The findings also support existing evidence that time in woodland can produce significant reductions in anxiety for females (Yang et al, 2024). This adds to the importance of facilitating woodland areas that females can feel safe in accessing (Colley et al, 2022).

While causality remains unclear, the existence of NC increases during the NBI, may suggest not just hedonic wellbeing factors, but also the influence of eudaimonic wellbeing, which has been associated with NC, and therefore potentially longer-lasting benefits (Pritchard et al, 2020; Martin et al, 2020). Study 1 supports, builds on, and extends existing evidence, showing woodland-based mixed-type NBIs benefit both wellbeing and NC in vulnerable adults. Future research should focus on enhancing understanding of the mechanisms and contextual factors underlying these associations.

5.2 Study 2 discussion

This section discusses the key findings from study 2, interpreting them in relation to the literature reviewed in chapter 2 and comparison with other studies, theories, models and mechanisms. A broader discussion of the combined findings from studies 1 and 2 will follow in section 5.4. Study 2 builds on Study 1, which showed that NBIs positively influenced participant wellbeing and NC. Study 2 aimed to explore and understand what underpins participants' changes in wellbeing, to provide insights into potential underpinning mechanisms.

Quantitative analysis identified six themes from the interviews (4.2.2). The six themes have been mapped onto six mechanisms, proposed here as underpinning

the wellbeing increases found in Study 1. The six underpinning mechanisms support understanding of why and how mixed-type NBIs succeed in enhancing wellbeing.

5.2.1 Mechanism one - Social interaction

Social interaction during the NBI involved group activities and opportunities for knowledge-sharing and giving, linked to increased happiness (Helliwell et al, 2025). Elements of social wellbeing in the Hierarchical Structure of Well-Being model (Gallagher et al, 2009) (section 2.2.2), were evident throughout the NBI. Participants had the opportunity to interact with others during the NBI and felt able to contribute socially through NBI activities and discussions. Participants gained feelings of social acceptance through validation of their opinions in a supportive environment, and through their contribution to group tasks. Their contribution, teamwork and shared experiences enabled social coherence, combining to achieve a level of social actualisation and increasing their overall social wellbeing.

Participation enabled adults of all ages to experience group belonging, overcome social fears or isolation, and achieve gains such as confidence, belonging, and self-worth (Bhatti et al, 2020; Richardson et al, 2020a; Wood et al, 2025; Sachs et al, 2024). These findings reinforce existing research that highlights the social aspects of NBIs as mechanistic (see section 2.5) in reducing isolation, lowering anxiety and depression, and improving wellbeing (Tunçgenç et al, 2023; Martino et al, 2015; Gittens et al, 2023; Lesser et al, 2024; Timko Olson et al, 2023; Maas et al, 2009; Aked et al, 2008; Wood et al, 2025; Legrand et al, 2022).

The interview findings support evidence around wellbeing increases through overcoming social barriers which may be present prior to the NBI. These social barriers include social isolation, potentially due to rural isolation, lack of transport

opportunities or availability of social groups, and also barriers related to a social confidence or social anxiety (Simpson et al, 2021; Burrell et al, 2024). This was mitigated by GLT facilitating attendance through regular communications and transport as required. Social anxiety was reported by many participants to be an initial challenge in both the decision to leave their home to attend each session and in engaging with other people once at the intervention.

Interacting with other participants, and NBI staff, is valuable for NBI participants (Johansson et al, 2022; Duff, 2011). The interaction provides opportunities to spend time with others who are facing similar challenges, increasing feelings of empathy and gaining from sharing experiences, (Joschko et al, 2023). GLT staff facilitated interaction through group discussion, reflective circles, group activity and allowance for personal time/space as required. This mechanism therefore supports and reflects other existing literature (Wickramaratne et al, 2022; Holt-Lunstad, 2024; Johansson et al, 2022; Lesser et al, 2024; Timko Olson et al, 2023; Gallagher et al, 2009), emphasising social wellbeing as a key factor in overall wellbeing.

5.2.2 Mechanism two - Interaction with natural environment

The NBI sites were considered neutral environments, away from personal status markers and daily stress, potentially reducing social anxiety (Haugan, 2023). Interaction with the natural environment began as participants entered the woodland. Although some faced minor accessibility challenges, the walk itself encouraged escapism and relief from daily worries (Johansson et al, 2022). Participants became immersed in nature enroute to the NBI camp and reported feelings of increased energy and wellbeing entering the woodland. This interaction fostered calm and

ease around new people, supporting engagement in activities, curiosity and pro-social behaviours (Ng et al, 2023; Büssing, 2021).

These findings broadly align with Oh et al's (2020) proposed 6-step model (stimulation, acceptance, purification, insight, recharging, and change). Participants recognised that being cut off from nature in daily life negatively affected wellbeing and reported an inherent predisposition to benefit from immersion in it. They reported initial stimulation when entering the woodland, a sense of comfort and peace. Participants also described a greater appreciation for nature, 'acceptance', and reduced stress, 'purification', develop through the NBI. They also expressed an ability to reflect on their feelings and emotions, also facilitated by a daily reflection circle, 'insight', and reported feeling increased energy from the NBI, all combining to support potential positive life changes.

These findings also lend support to SDT, where psychological needs met in nature enhance wellbeing (Lee et al, 2021; Cleary et al, 2017; Yang et al, 2022). SDT suggests certain innate human needs: autonomy, competence and relatedness. Autonomy was present in the NBIs, the participant had made a choice to attend the NBI and could exercise choice over the degree to which they interacted with nature and what activities in nature they took part in. They all gained competence in new activities in nature and gained knowledge about the natural environment.

Participants could also exercise choice in when to interact with others, 'relatedness'. The meeting of these needs, according to SDT and reflected in the NBIs, enabled greater intrinsic motivation, particularly autonomous motivation from enjoyment of being in nature, and psychological wellbeing.

Interaction with the natural environment facilitated senses of freedom, a fundamental belonging, and calm, broadly supporting Wilson's Biophilia hypothesis (1984) and theories such as SRT and ART, where nature fosters restoration and reduces cognitive fatigue (Ulrich et al, 1991; Patrik et al, 2021; Kaplan and Kaplan, 1989; Sullivan and Li, 2021; Crossan and Salmoni, 2019). Birdsong, for instance, was described as calming and linked to perceived safety (Stobbe et al, 2022). Specific activities such as nature walks and greenwood-working were associated with stress reduction. While evolutionary theories face challenges in empirical testing (Burke, 2014; Liu et al, 2024; Joye and Dewitte, 2018), these findings broadly support them in real-world NBIs, by reflecting participants' feeling for a need to connect, or re-connect, with nature.

Participants described feeling closer to and more comfortable in nature, and calmer and less stressed in the natural environment, supporting established links between NC and wellbeing (Coventry et al, 2021; Richardson, 2019; Martin et al, 2020; Gibbs et al, 2022). Immersion and quality interactions with nature during the NBI, not just time spent in nature, has been suggested as key to NC (Richardson et al, 2021a). Seasonal and site variations produced different experiences, yet participants consistently described tranquillity. Nature provided opportunities to reconnect participants with early-life memories of being in nature, sharing fond memories, enhancing both social and nature connection, linking to nostalgic and nurturing relationships with nature found to enhance NC (Vainio et al, 2025).

Interview responses appear to add further strength to the theory that NC increases the perception of the value of nature and pro-environmental behaviours (DeVille et al, 2021; Richardson and McEwan, 2018). The NC element of NBIs has been

suggested as a facilitator for improved personal reflection (Johansson et al, 2022), and the interview findings support this through participants' testimony. The five pathways to NC (Richardson et al, 2020a) were evident throughout the NBI, supporting the five pathways concept and NC being an active element in the NBI. NC has been shown to encourage social and altruistic tendencies across demographics (Goldy and Piff, 2020; Pereira and Forster, 2015; Henderson et al, 2024), and these tendencies were evident in study 2. Several participants reported that they came to realise they had something to give to others in the NBI, and they could contribute to the group, for example (bush)craft skills, knowledge of nature, emotional support or just making a cup of tea, which made them feel good. The bi-directional nature of altruism and wellbeing (Rhoads and Marsh, 2023), may support increases in life-satisfaction and positive emotions such as happiness, calm and inspiration (Curry et al, 2018; Buchanan and Bardi, 2010; Fryburg, 2021).

These first two mechanisms, interacting socially and within nature, support arguments for multi-causality, and interconnected causes for the outcomes in a natural environment (Harper et al, 2021; Mei et al, 2024). Studies have shown that there is an increase in oxytocin production when in nature, a hormone associated with increased trust and sociability (Grahn et al, 2021; Kosfeld et al, 2005). The immersion afforded by NBIs aligns with Leão et al's (2023) multisensory integration model and Masterton et al's (2020) realist-informed intervention framework, where nature, self and social elements interact. However, Study 2 findings do not disconnect individual and social self into separate themes, perhaps due to the social and team-work elements that are fundamental within the featured NBIs. These findings support previous research that identified nature as mechanistic to wellbeing outcomes (Coventry et al, 2021; Richardson, 2019; Martin et al, 2020; Gibbs et al,

2022; Johansson et al, 2022; Silva et al, 2022; Jimenez, 2021; Jiang et al, 2018; Xiao et al, 2023; Kuo, 2015), and identifies that interaction with nature supported other mechanisms, such as enabling social interaction through specific group and individual activities.

5.2.3 Mechanism three - Physical activity

Social factors are often highlighted as therapeutic mechanisms in NBIs, with the natural environment credited for wellbeing gains. Evidence on the specific role of physical activity on wellbeing during NBIs is less well-known, with research typically limited to physiological metrics such as HR and BP (2.4). Although this study did not directly assess such measures, participants reported perceived physical health improvements due to physical activity during the NBI, supporting research showing NBIs increase physical activity and associated health benefits (Nguyen et al, 2023; Struthers et al, 2024). Being physically active is linked to improved wellbeing and mitigates negative effects of low social connection through enhanced social and psychological health (Heckel et al, 2023; Biddle and Ekkekakis, 2005; Benedyk et al, 2024).

Physical activity was not usually the main reason for attending, though many participants expressed a wish to improve their activity levels and required encouragement to begin or persist. Staff guidance, motivation and activity differentiation were seen as critical, echoing previous findings that knowledgeable facilitation enhances outcomes (Birch et al, 2020; Pocock et al, 2023; Johansson et al, 2024a; Wood et al, 2022b; O'Brien, 2018; Silva et al, 2023). This was further supported by participant-led targets, developed with GLT staff prior to the NBI, and mostly necessitating some degree of physical activity. Personalised targets have

been shown to encourage motivation and enhance self-esteem, wellbeing and conscious achievement (Schell et al, 2012; Wright et al, 2024; Huppert, 2009; MacLeod et al, 2008; Sachs et al, 2022).

Physical activity was frequently linked to feelings of achievement. Social encouragement and support, and engagement with purposeful, nature-related tasks helped participants build confidence in their physical ability. This often manifested in motivation to engage further and repeat or enhance their achievements, aligning with, and exemplifying, motivation-achievement cycles as proposed by Vu et al (2022). The variety and adaptability of activities allowed gentle progression and sustained engagement, with many involving direct interaction with nature, reinforcing the interconnectedness of people and environment, and supporting NC (Leão et al, 2023).

Participants valued both physically demanding tasks, such as log splitting, and more passive activities like sit-spots. Natural spaces to escape stress and opportunities for those over 60 years to participate in more passive nature-activities have both been associated with wellbeing gains (Johansson et al, 2022; Heród et al, 2024). However, we found both older and younger adults also benefited from engaging in a spectrum of physically demanding and passive outdoor activities, reporting wellbeing gains and increased NC.

5.2.4 Mechanism four - Behavioural gains

Some NBIs have been shown to be successful when aiming to modify a specific behaviour, such as increasing social or nature connections (Shanahan et al, 2019). In study 2, participants reported a wide range of behavioural gains, both during NBI days and throughout the rest of the week; many of these were

unintended but meaningful outcomes, including reframing their week. Interviews revealed some participants adopted more structured daily routines during the week, which then necessitated more regular meal-times. Whilst studies have suggested that NBIs, particularly STH, may encourage healthier food choices (Langlois and Chandon; 2024), this study can only reflect participants' improved awareness of the importance of regular meals appropriate to their daily routines.

Participants also alluded to, and described, implementing healthier patterns of behaviour such as increased physical and social activity, and more regular sleep patterns, aligning with other research findings that NBIs can support sleep quality, with potentially restorative qualities (Catissi et al, 2024; Scott et al, 2021; Vandekerckhove and Wang, 2017). The enhanced daily structure was instigated by the need to prepare, and recover from, the NBI-day, but participants also realised they felt better as a result. This prompted continuation during the week, with increasing awareness of the benefits of making healthy choices and providing further motivation. These incidental lifestyle changes resulted in participants feeling more energetic and capable in daily tasks, alongside perceptions of strength and stamina gains; outcomes previously associated with outdoor activity and woodland environments (Sharma-Brymer et al, 2015; Ryan et al, 2010; Noseworthy et al, 2023; Brito et al, 2024; McEwan et al, 2023).

Overall, participants reframed health as both achievable and rewarding, with positive psychological benefits. They recognised the interconnectedness of different lifestyle behaviours and how these changes collectively enhanced their wellbeing. For some, this also extended into a wider pro-environmental appreciation, consistent with findings from other NBI studies (DeVillie et al, 2021; Richardson and McEwan, 2018). These behavioural gains were part of a continual loop, feeding back into participant

performance within the NBI and helping to optimise outcomes. Whilst improved sleep and daily routines have been documented in previous mixed-activity NBI research (Catissi et al, 2024; Mahindru et al, 2023), this thesis highlights how such behavioural gains can be seen as mechanistic, helping to underpin NBI outcomes. This suggests that there may be wider benefits still to explore and a raft of potential unintentional outcomes associated with NBIs.

5.2.5 Mechanism five - Self-esteem, confidence and emotional experience

Increases in positive affect has been linked to outcomes from outdoor walking and other NBIs (Trammell et al, 2024; Silva et al, 2023; Maund et al, 2019; Overbey et al, 2021). However, such improvements in self-esteem and confidence, and increased positive emotions are proposed not purely as an outcome but as an active, underpinning mechanism within NBIs, significantly interconnecting and forming a cycle with the other mechanisms. Confidence gains in specific areas, such as in a social context or task completion, have been noted in association with the previous mechanisms. Additionally, interviewees reported self-esteem, confidence and emotional experiences in a wider context were progressively developed throughout the NBI. Participants described these feelings as rewards for their own actions, motivating further engagement with activities and with other participants.

Senses of achievement have been reported to be enhanced through purposeful activity (Sachs et al, 2024; Johansson et al, 2022) and informal learning (Jenkins and Mostafa, 2015; Ferguson and Merga, 2021). The first two mechanisms, social interaction and interaction with natural environment, showed how increases in self-esteem and confidence began to provide early opportunities for achievement.

Participants connected senses of purpose and achievement with their increases in

self-esteem and confidence, echoing studies highlighting these as drivers of motivation and social interaction within NBIs (Sachs et al, 2024; Johansson et al, 2022; Teig et al, 2009; Coventry et al, 2021; Sila et al, 2023; Jones et al, 2022).

Participants reported transferring increased self-esteem and confidence into their daily lives and future aspirations, consistent with findings from Gittins et al (2023) and Shanahan et al (2019). These benefits often extended to lifestyle and career planning, frequently linked with a growing interest in nature and feelings of hope for the future. Confidence and self-esteem were reinforced by continued positive experiences, illustrating the interconnected nature of mechanisms and their overlap with behavioural gains and empowerment (5.2.6). Participants subjectively described reductions in feelings of SAD (4.2.7), consistent with outcomes from forest bathing (Siah et al, 2023; Furuyashiki et al, 2019) and time in nature (Djernis et al, 2019; Wheeler et al, 2012). These reductions may have contributed to the enhanced positive emotions, in line with research suggesting that NC facilitates positive affect (Kennan et al, 2021; Vitale and Bonaiuto, 2024).

Positive emotions such as enjoyment and happiness were universally reported, supporting previous findings with GLT participants showing increases in life satisfaction and happiness (Pretty and Barton, 2020). While many models and mechanisms emphasise behaviour, cognition, or social factors, emotions such as joy and happiness emerged here as central to wellbeing outcomes. This resonates with Leão et al's (2023) multisensory integration model which highlights how emotional and aesthetic experiences can reshape the context for other components—for example, happiness from social acceptance or appreciation of natural beauty motivating further participation. Analysis from interviewees clearly identifies this

positive affect as a necessary mechanism for optimising NBI effectiveness and underpinning increases in wellbeing.

5.2.6 Mechanism six - Empowerment

This mechanism encompasses internal changes in the participant that act to give the participant a sense of self-worth, ownership of successes and achievements and control and personal agency over their destiny. These feelings associated with empowerment, increased and built gradually during the NBI. Hope and the perceived ability to be able to take control of their life was subsequently felt by participants. Aspects such as feeling valued and hopeful about the future align with benefits noted in other NBI studies (Richardson et al, 2020b; Harrod et al, 2024).

For some participants, empowerment enabled moving forward without further support, while others felt better positioned to engage in future interventions.

Empowerment is less commonly explored in NBI research but is implicit in Oh et al's (2020) 6-step model of nature-based therapy process, where stress reduction leads to insight, change in thought, improved autonomy, and ultimately recharging and self-realisation. While these steps were evident in the findings of the interviews, the participants' real-world experiences were more complex, interwoven, and variable.

Empowerment has been linked to self-efficacy, where safe experimentation during NBIs translates to wider life contexts (Pálsdóttir et al, 2014). The feeling of empowerment expressed by interviewees, and their intent to move forward in their lives, suggests the positive behaviours and outcomes may have longevity, consistent with Gittins et al (2023a). Whilst Study 1 could not strongly identify aspects of wellbeing most impacted (5.1), Study 2 supports suggested increases in hedonic wellbeing and SWB as interview responses reported instances of pleasure,

happiness and feelings of wellbeing. Study 2 analysis also suggested a more eudaimonic increase in wellbeing, through increased participation in meaningful activities, linking to the nature interaction and physical activity mechanisms. This allowed for heightened feelings of purpose, self-actualization and personal growth contributing to empowerment. That positive wellbeing was sustained on non-NBI-days, and fundamental behavioural changes and pro-environmental views were developed may suggest elements of eudaimonic wellbeing (van Halem et al, 2024; Niemiec, 2014; Ryff, 2017) were also responsible for overall wellbeing increases. This aligns with the Hierarchical Structure of Well-Being model, which identifies autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance as components of eudaimonic wellbeing (Gallagher et al, 2009). This is important because it is further evidence of longevity of the wellbeing increases, and that the participants may have the awareness and motivation to self-administer. This also supports the suggestion that NC increases may have contributed to an increase in eudaimonic wellbeing as well as hedonic wellbeing (Pritchard et al, 2020; Martin et al, 2020) (5.1).

Although feelings of empowerment may not have been possible without elements from other mechanisms, such as increased self-esteem, confidence and achievement, empowerment is a distinctly separate mechanism which is more forward-looking; with the belief in a more hopeful and positive future. It is the large degree of interconnectivity of this, and the other identified mechanisms, and the conceptualisation of the process described below (5.2.7), that may be the most insightful aspect of these findings, contributing to increased understanding of the underpinning mechanisms of woodland-based, mixed-type NBIs.

5.2.7 External and internal underpinning mechanisms and conceptualisation of process

This research identifies six interconnected mechanisms, with two main distinctions. Social interaction, interaction with the natural environment, and physical activity are external mechanisms, inherent through the setting, people, and activities of the NBI, and impacting all participants. Behavioural gains, self-esteem, confidence and emotional experience, and empowerment are internal mechanisms, arising as individual responses to the external elements. The internal mechanisms do not necessarily occur in parallel with the external mechanisms, developing gradually before becoming more sustained over the course of the NBI. Every participant experienced the NBI in a unique and personal way, so their journeys through the NBI were not equal. However, these mechanisms impacted all participants; the six mechanisms are reciprocal and interdependent, together shaping overall wellbeing outcomes. Figure 6 shows the six mechanisms categorised as external and internal.

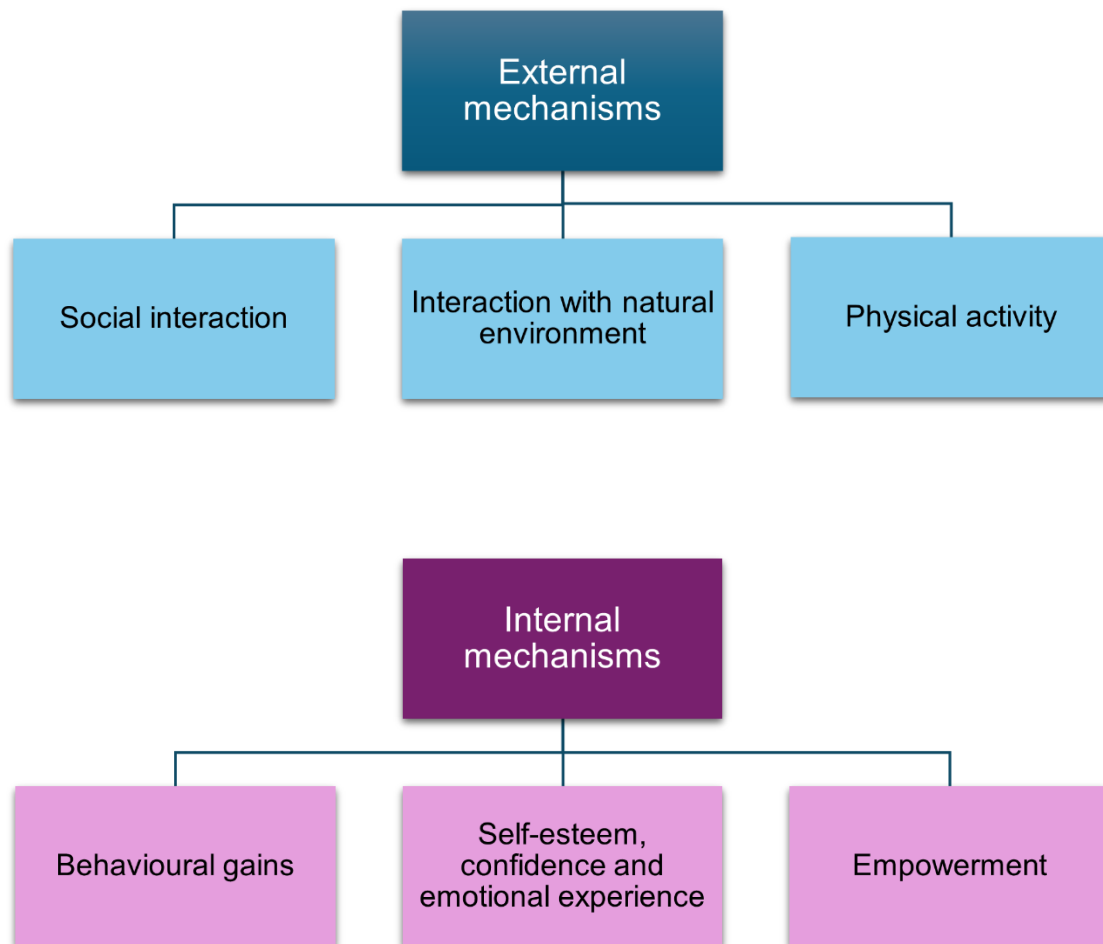


Figure 6: External and internal NBI mechanisms.

Although six distinct mechanisms emerged from the thematic analysis, their interactions make a linear account difficult. Figure 7 summarises the suggested key stages of the NBI experience based on the thesis findings. The mechanisms active at each suggested stage are shown in Figure 7. The key feedback loops are shown, which may differ in strength/amplification over time and by individual.

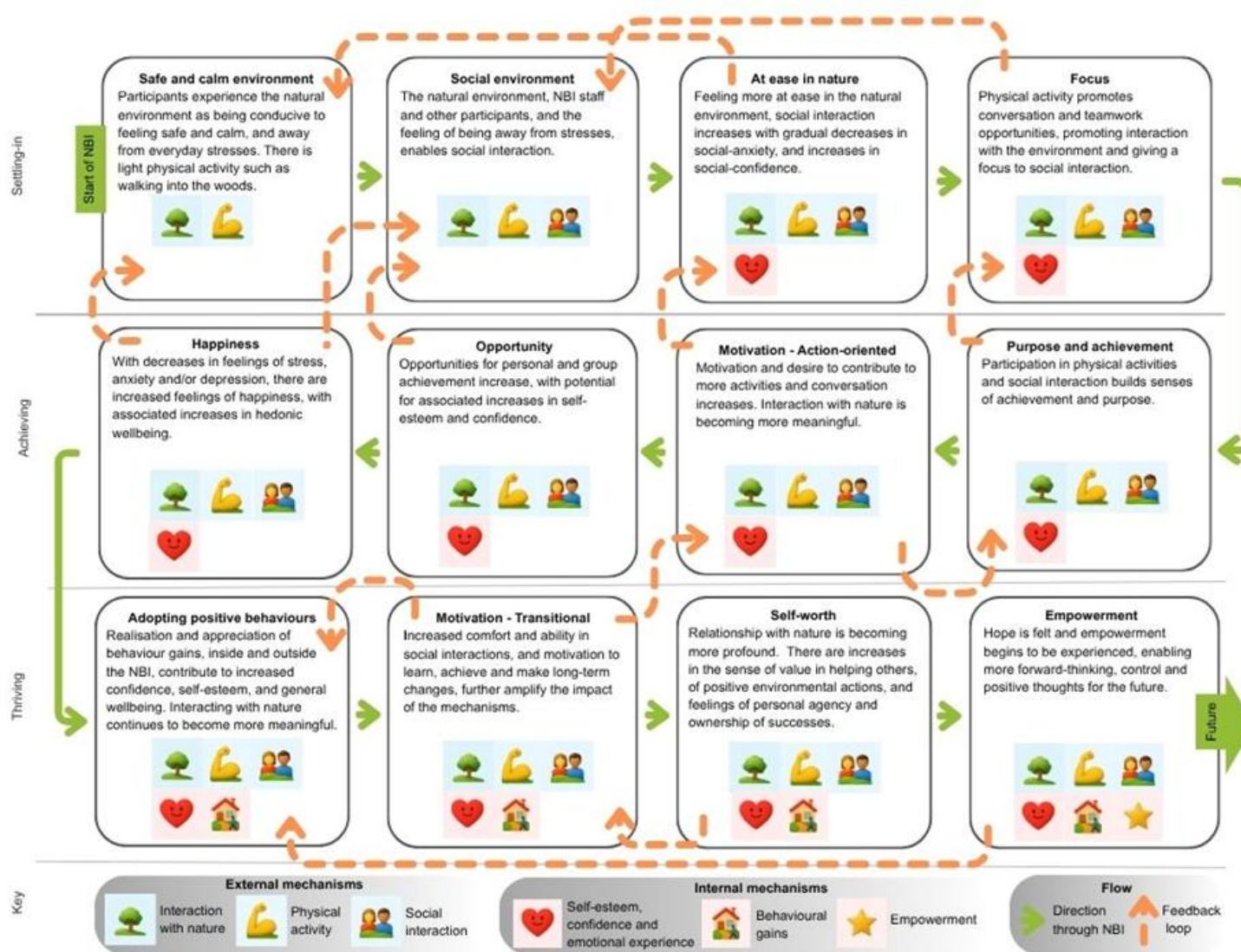


Figure 7: Conceptualised process of mechanisms.

The figure above is unable to convey the large extent of mechanism interconnection and individual variations. While all mechanisms may operate throughout, the first five collectively foster empowerment, increasing value, purpose, positivity, and control over life direction.

5.3 Interpretation of combined findings

Together, the findings from study 1 and 2 demonstrated that woodland-based mixed-type NBIs improve wellbeing and NC, underpinned by the above 6 mechanisms. Together, the two studies find some support for existing wellbeing-related models and theories. Meaning and self-worth reported in Study 2 aligns with Ryff's (1989) six-factor model of psychological wellbeing (2.2.2), suggesting there were increases in eudaimonic wellbeing. The social interaction, interaction with natural environment and physical activity, such as conservation and woodland management, combined to contribute to Ryff's six factors (Self-Acceptance, Positive Relations with Others, Autonomy, Environmental Mastery, Purpose in Life, and Personal Growth). These elements have also been found in other studies (Gittins et al, 2023a; Rogerson et al, 2020; Leão et al, 2025; Wood et al, 2022b, 2025; Smyth et al, 2022), and encompass social, hedonic and eudaimonic wellbeing factors outlined in the Hierarchical Structure of Well-Being model (Gallagher et al, 2009). Study 1 and 2 findings combined also support Seligman's (2011) PERMA model, that nurturing positive emotions, engagement, relationships, meaning and accomplishment leads to increased wellbeing, beyond purely decreasing negative experiences. The NBI, through the six mechanisms, allowed escape from everyday negative experiences and replaced them with the opportunity to build positive affect.

Study 1 and 2 combined also finds some support for psycho-evolutionary theories (2.3.1). The NBI mechanisms allowed focus on positive emotions, such as joy, trust, anticipation and acceptance. Interview testimony supports that combinations of these positive emotions occurred, for example, joy experienced during a NBI session, mixed with anticipation for the next session, may have combined to create more complex feelings such as excitement, linking to Plutchik's (1982) psycho-evolutionary theory of emotion. This thesis identifies that interacting with the natural environment is mechanistic to wellbeing and NC increases, supporting Wilson's Biophilia hypothesis, that humans possess an innate tendency to seek connections with nature. Interview testimony referred many times to feeling calmer and more positive in the natural environment, linking to SRT (Ulrich et al, 1991), and of feeling away from stress and more relaxed, linking to ART (Kaplan and Kaplan, 1989). The medium-density of the woodland environment was immersive but not overwhelming, a feeling also reported by Leão et al (2025), offering escape, neutrality and reduced stress, also found by Shanahan et al (2016). Other studies have found that reflection, mindfulness, and walks, all present in the NBI, foster benefits such as reduced depression/anxiety, social connection, adventurousness, introspection, and stress resilience (Siah et al, 2023; Sztítás et al, 2024; Boudreau et al, 2022; Legrand et al, 2022). Study 2 also found all FWW (Aked et al, 2008), connect with others, be active, take notice, keep learning, and give to others, were all supported through the mechanisms and NBI.

It has been reported that there is no strong evidence about whether particular NBIs are more beneficial for particular populations (Harrison et al, 2023), that there may be differing NBI mechanisms for male and female participants (Wood et al, 2022a), with males generally gaining quicker benefits from STH, and that women are more

likely to feel higher levels of NC and prefer outdoor environments (Rosa et al; 2020). This research suggests the NBIs were beneficial in increasing wellbeing for vulnerable adults across a range of ages and conditions, however it cannot be stated whether the wellbeing increases occurred at similar rates during the NBI.

The wellbeing increase identified in Study 1, and the potential for the mechanisms of Study 2 to exist, can be partly attributed to the design of the NBI. The woodland environment, its size and variety of activities contribute to benefits such as improved environmental awareness, social interaction, and health found in prior studies on mixed-type NBIs (Šorytė et al, 2023; Obeng et al, 2023; Shanahan et al, 2019; Pretty & Barton, 2020; Remme et al, 2021). The NBI provider supported participant attendance from a wide geographical area through assisting with transport. Making attendance more convenient potentially increases participant motivation to attend regularly (Calogiuri and Elliott; 2017). Some interviewees felt they could, and already had, identified areas closer to them that offered opportunities to continue engaging with nature beyond the NBI.

The structure of the NBI allowed for personalised activities. This supports achievement and self-esteem (Jong et al, 2022), increases participants' motivation to overcome challenges and driving wellbeing gains (Sachs et al, 2022; Pincus, 2024), in addition to addressing the original, specific reason for referral (Wood et al, 2022b). NBI duration supported Coventry et al (2021), showing positive affect over 12 weeks. Participants became comfortable with setting, peers, staff, and activities, while repeating and developing favoured activities, forming bonds, and experiencing seasonal change. Weekly five-hour sessions fit around commitments yet provided long, immersive exposure, aligning with prior evidence on optimal session length (Barton & Pretty, 2010; White et al, 2019, 2023; Shanahan et al, 2016).

These NBI characteristics therefore optimised the six underpinning mechanisms that produced wellbeing and NC improvements in study 1 and additional personal outcomes in study 2. The mechanisms were complex and interconnected, but they provide insight into how and why the NBI was effective.

5.4 Strengths and limitations of the research

These findings of this thesis provide further evidence of NBI wellbeing outcomes for vulnerable adults across age and gender, with various forms of MIH. This thesis enhances understanding of mechanisms specific to woodland-based mixed-type NBIs. Previous studies have called for more control trials in NBI research (Catissi et al, 2024; Coventry et al, 2021). Study 1 contributes by incorporating a waiting list control group, comparable to the NBIG, strengthening validity and showing such designs are feasible.

However, there are limitations to consider. Most NBI studies show moderate–high risk of bias in participant selection (Harrison et al, 2023). It is unclear whether Study 1/2 participants were representative; they may have chosen the NBI due to a predisposition towards to nature. The sampling cannot be considered entirely random as some individuals, potentially those with lowest wellbeing or self-esteem, may have declined the invitation to take part in the study.

Research uptake cannot be confirmed; the number of individuals contacted is unknown due to multiple GLT staff assisting in sharing information about the research, verbally or by email. Full capacity (12 participants) across each of the 29 NBIs, with the target of 50% of the places allocated to the eligible new NBI participants, would equate to 174 potential recruits. However, the average participant number per NBI was 8, meaning there were likely to have

been a maximum of 116 potential NBIG participants. Therefore, 69 NBIG participants represents over two thirds of the eligible participants likely to have been reached. Uptake was proportionally lower for WLCG, potentially due to less face-to-face contact, but strong compared to clinical trials (Williams et al, 2021). All participants had 'reached out' for support, so enrolment itself may have improved wellbeing, affecting baseline and follow-up scores.

The total sample size (n=100) for Study 1 exceeded expectations, which is noteworthy considering various limitations of time imposed by the researcher's dual role, the available suitable participants, nature of the participants' mental health, and available time-frame. Study 1 participant drop out was 15%, lower than the 20–30% expected for MIH (Smyth et al, 2022; Bouchard et al, 2022). The researcher's dual-role (3.2) may have influenced this through personalised communication, reminders, and signposting. Confounding variables, such as MIH, negative NBI experience and on-going therapy, may also have affected attendance and outcomes.

To reduce bias and maximise multiple perspectives/demographics, Study 2 prioritised interviews from all NBI sites. All participants chose in-person interviews over online options, possibly due to limited internet access or discomfort with technology. In-person interviews enabled observation of body language, emotional support, and consistency. Some selection bias is possible, as those with stronger positive experiences may have been more willing to volunteer.

The dual-role of the researcher meant there was potential for bias. The researcher had no prior views on potential mechanism(s). The researcher, from experience with GLT, had awareness of increased nature interest from participants when walking through woodland, often prompting participants an interested in weekly changes in nature. The researcher had no pre-existing opinions on underpinning mechanisms and was open to evidence-based findings. A potential drawback associated with the adopted pragmatic approach may mean the researcher relied on experience of woodland-based NBIs at the expense of following fundamental research principles, allowing potential biases to exist when conducting or evaluating the research (Hampson and McKinley; 2023). It was important for the researcher to accept that research findings may not apply universally, for example, to all NBIs, populations, or outcome-types.

Anchoring bias had the potential to occur during the interview process, however this was mitigated by following standard procedures such as open-ended research questions, transparency, neutral language with participants during interviews, and adhering to accepted thematic analysis protocol (see 3.3.3.3). This process was further aided by re-starting the coding/categorising on three separate occasions with reflection in-between.

There was potential for the Hawthorne Effect in both groups. To be deemed more suitable for future NBI provision, WLCG participants could have overstated their NC in Study 1 pre-NBI questionnaires or reported lower wellbeing to show urgency. Through the referral process, site introductions and research participation, WLCG participants may have gained interest in nature or modified their behaviours, influencing their NC and wellbeing scores. NBIG participants may have exaggerated

positive Study 1 outcomes in the post-NBI questionnaire to avoid appearing unsuccessful, or to please the GLT staff/researcher. They may also have believed responses could affect future NBI access.

It remains unclear which NBIs and formats are most effective (Coventry et al, 2021). This research applies to woodland-based mixed-type NBIs but may not apply to other NBIs or populations. NBI effects may be greater for those with lower wellbeing (Smyth et al, 2022), limiting generalisability. Findings cannot confirm whether the six mechanisms identified apply across NBI-types. Much existing research reflects high-income European contexts, not global populations. These findings too, cannot necessarily be considered as globally representative. Wellbeing assessments were not carried out at interval(s) during the NBI, so it is not clear if this is the optimal duration, and longevity of the changes post-NBI are unknown. Similarly, these NBIs cannot reflect or predict what changes would have occurred with alternative session frequency or session duration times.

5.5 Future research directions

This section outlines directions for future research that would add to the current body of evidence and reduce gaps in NBI knowledge. The range of the mechanisms identified suggest that adopting interdisciplinary and systems-level approaches to future research would help to recognise the interconnectedness of environmental, social, and health systems, assisting in increased holistic understanding. Advancing theoretical integration between frameworks such as ART, SRT, and SDT may provide a more comprehensive explanation of how cognitive, affective, and motivational processes interact within NBIs, to inform intervention design.

Associations between nature and wellbeing are evident from a range of studies and research should focus on further understanding these associations to improve classification of outcomes and comparisons between NBIs/populations. The variation of NBI-types, scales, and assessment methods, make comparisons and identification of mechanisms difficult (Coventry, 2021). Consistent terminology and standardisation in the use of frameworks, such as CONSORT or TIDieR, and using both subjective and objective indicators of wellbeing, physical activity, and nature exposure would aid future research, enhancing transparency, reliability, comparability and replicability (Rodríguez-Violante, 2024; Katyayan, 2025). Using artificial intelligence (AI) in future research, to gather and synthesis data, has great potential if access is open to high quality data sets (Noble et al, 2024; Katyayan, 2025), and the effectiveness will be enhanced by greater standardisation of data sets (Lu et al, 2024). Other advances in technology may assist research to integrate psychophysiological measures, such as cortisol levels, heart rate variability and neuroimaging, with self-reported and behavioural data to build multidimensional models of how nature exposure influences mental health. Incorporating digital technologies, such as wearables, GPS tracking and ecological momentary assessment, may also provide richer, real-time insights into how individuals engage with natural environments, minimising recall bias and enhancing the accuracy of data. This may also assist in further understanding and quantifying additional outcomes, such as sleep and other lifestyle behaviours.

Further research into the NC/wellbeing relationship, especially across other NBI-types, would be valuable for gaining a more detailed understanding of the association between NC and wellbeing and potentially more effective utilisation of NC in interventions. Most Study 2 participants stated intent to continue nature

engagement. Whilst woodland-based NBIs have been shown to sustain wellbeing/NC benefits up to 30 days post-intervention (Leão et al, 2025; Kotera et al, 2020), this thesis cannot state how long wellbeing, NC or behaviour gains persisted post-NBI. Future research should explore long-term outcomes across NBI-types and longitudinal designs should assess wellbeing/NC changes at multiple time-points post-NBI, for example 3,6 and 12 months, to help determine the potential preventative value of NBIs within public health frameworks.

Future research is required to establish whether targeted interventions by group or MIH-type, mixed-group NBIs, or universal pathways are most effective. The GLT NBI supports effective dose/duration with a 60-hour/12-week format, but further research is needed across NBI-types and range of natural environments to determine optimum frequency/duration. Pressure to attend an NBI may reduce intrinsic motivation and increase anxiety (Tester-Jones et al, 2020), but for others, it may provide the motivation needed, therefore understanding inclusivity and equity of access to NBIs, and barriers and facilitators to participation are important for optimising NBI engagement. Research should also investigate availability of natural environments, equity of UK woodland access and opportunities for individuals to self-administer NBI elements to sustain wellbeing.

To support the scaling-up and policy integration of NBIs, future research should include economic evaluations assessing cost-effectiveness and return on investment. Social return on investment (SROI) analysis should be utilised to quantify potential healthcare savings, productivity gains, and social value outcomes associated with reduced mental ill health.

5.6 Wider Implications

Evidence on NBI mechanisms and outcomes can support GPs/link workers in prescribing NBIs more confidently within care pathways. Providers should note elements such as woodland setting, duration and person-centred delivery, to optimise outcomes, and assess whether environments can support varied activities that support NC. These findings contribute to a wider understanding of how NBIs impact wellbeing, with implications for informing Public Health policy at National and local levels, shaping the commissioning of health and wellbeing services by driving more informed decisions and promoting health equity. These findings add to research providing Defra/Department of Health and Social Care with evidence to advocate and fund NBIs within health strategies and clinical practice, supporting the '10-year health plan for England' and 'Plan for change' (UK Government, 2025) aim to shift more care from hospitals to the community. This may enable further third sector utilisation and integration, which to-date has been limited (Johnson et al, 2023).

Society must re-evaluate its relationship with nature to ensure equitable access and recognise environmental value in health policy. NBI research strengthens the case for restoring and maintaining ecosystems, aligning with the EU Nature Restoration Law (2024), the UK's Nature Recovery Network (2020/2024), and the Environmental Improvement Plan (2023). These findings support the importance of the UN Sustainable Development Goals, particularly aligning with 'Goal 3', good health and wellbeing, 'Goal 10', reduced inequalities, and 'Goal 15', protect, restore and promote ecosystems (United Nations, 2015). NBIs can play a role in broader societal nature-based solutions by improving health and, for example, enhancing

conservation opportunities, thereby providing simultaneous 'human wellbeing, ecosystem services and resilience and biodiversity benefits' (United Nations Environment Programme, 2022).

This study is an example that validation through control groups is possible when researching NBI outcomes and that cooperation between academic institutions and third sector providers can be valuable to both parties, with potential benefits to wider society. These findings support methodology that utilises qualitative methods to compliment quantitative data, provide a deeper, more nuanced understanding of the participants' experiences, addressing a significant gap in the literature. The broad range of study participants' age, background and MIH-type may suggest that a one-size-fits-all NBI could be possible. In summary, these findings reinforce existing knowledge, and offer new insights and evidence, that supports NBI providers, referrers and healthcare professionals. The findings also further highlight the importance of promoting strategies that value and enhance natural environments, for the wellbeing of people as well as the planet.

5.7 Conclusion

This thesis set out to identify the NBI mechanisms responsible for wellbeing increases in vulnerable adults and address the knowledge gaps in woodland-based NBIs, NC/wellbeing association and lack of studies utilising control groups. Study 1 found that woodland-based, mixed-activity NBIs have a positive and significant effect on NC and can improve wellbeing (from low to medium levels) over a 12-week period across age, gender and types of MIH. The use of a control group was key to achieving valid results, increased causal inference and confidence in the conclusions, contributing valuable knowledge around outcomes of woodland-based,

mixed-activity NBIs. Study 2 identified six interconnected mechanisms, categorised into external and internal. The three external mechanisms (social interaction; interaction with natural environment; physical activity) were inherent within the NBI and promoted the efficacy of the three internal mechanisms. The internal mechanisms (behavioural gains; self-esteem, confidence and emotional experience; empowerment) were not purely outcomes from the external mechanisms, but actively and profoundly mechanistic in the wellbeing outcome, feeding back into the mechanics of the NBI. The complex interconnections of the mechanisms are challenging to describe or visualise, and vary depending upon individual experiences of the NBI, however this thesis offered a conceptual process to assist in the understanding of the pathway. In addition, Study 2 findings provide insight into how individuals experience greater NC and environmental awareness, with the desire to continue to experience nature in their lives.

These findings will help providers and referrers to targeted NBIs through increased understanding of underpinning mechanisms. It will also assist those engaged in commissioning health and wellbeing services to make more informed decisions and promote health equity. This thesis emphasises the need for equity of access, and quality of, natural environments for wellbeing, relevant to current and future environmental and societal strategies, and the recognition of the environmental value in health policy, at national and local levels. To offer more equitable NBI provision and nature-access to support pre-emptive and self-administering of nature for wellbeing. NBIs may not just be interventions; the evidence suggests they have the potential to be catalysts for more sustained wellbeing, stronger NC, and healthier individuals and societies. The thesis suggests future research directions to support effective, personalised referral pathways, including standardised agreement on key

terms/definitions, NBI impact on specific populations, rate of increase and longevity of wellbeing/NC outcomes, and SROI/economic evaluations.

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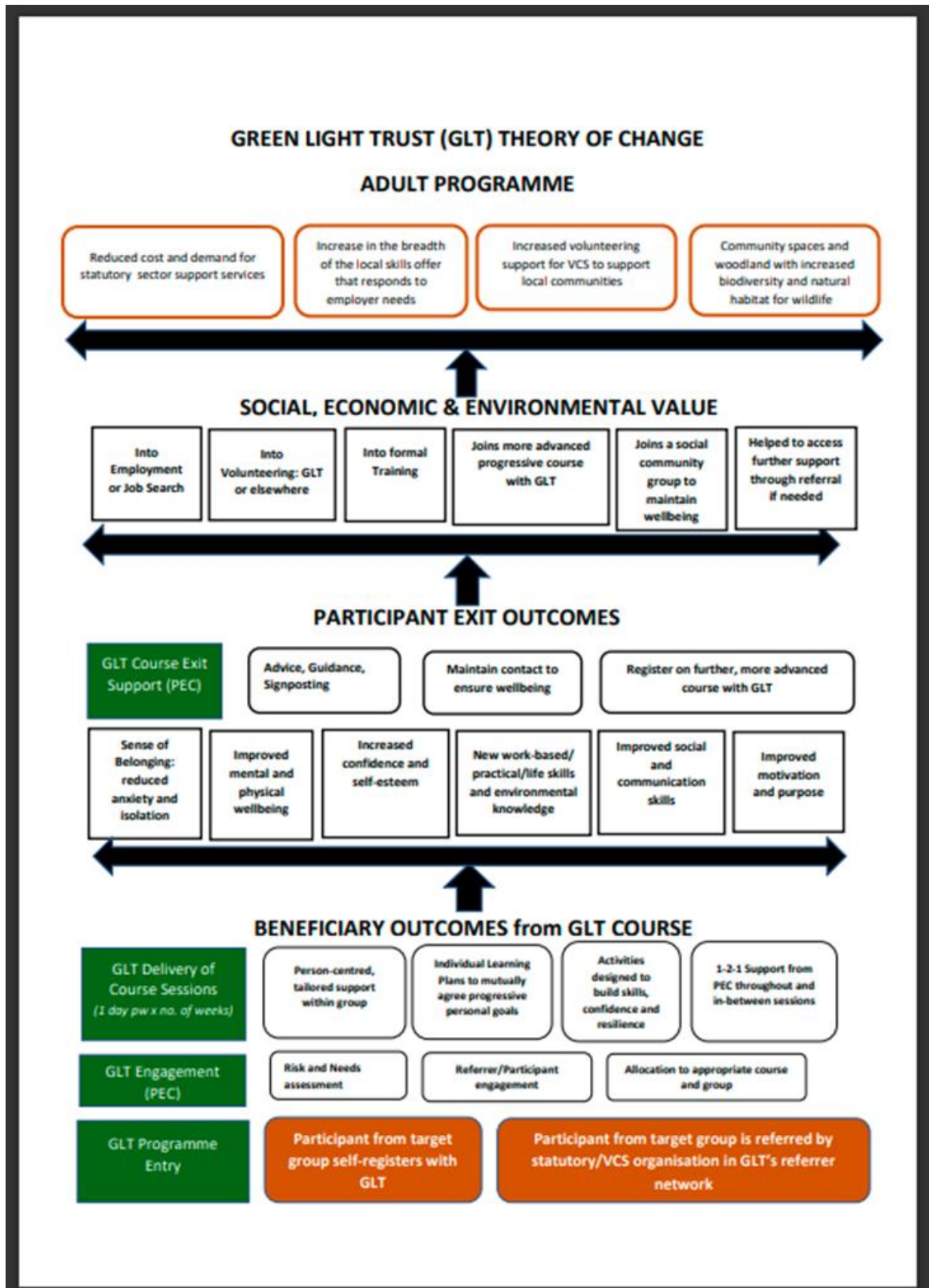
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Chapter 7. Appendix

1 Green Light Trust (GLT) Theory of Change model



2 Short Warwick-Edinburgh Well-being Scale (SWEMWBS)

The Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS)

Below are some statements about feelings and thoughts.
Please tick the box that best describes your experience of
each over the last 2 weeks

STATEMENTS	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	1	2	3	4	5
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5

"Short Warwick Edinburgh Mental Well-Being Scale (SWEMWBS)
© NHS Health Scotland, University of Warwick and University of Edinburgh, 2008, all rights reserved."

3 Study 2 Interview script/questions

Interviewee Code	
Date / Time / Location	/ /

Hello _____.

Thank you for your support of this research so far and for agreeing to this interview.

The purpose of the interview is to find out more about your experiences of the Greenlight Trust 12-week programme and the data from the research will be valuable in shaping future programmes offered by Greenlight Trust, as well as for use academically as part of a study into Nature and Wellbeing, in conjunction with the University of Essex.

The interview will be recorded so a transcript can be produced afterwards. The transcript and audio recording will be saved in a secure electronic cloud for 10 years.

Your name and personal details will not be attached to the recording or transcript.

You are free to stop the interview at any time and you are free to withdraw your consent at any time.

You don't have to answer any questions and you can have a break whenever you need. Are you happy to continue?

Have you got any questions before I start recording?

I'll now start the audio recording.

I'm now recording. Thank you for taking part in this interview.

Please confirm you've received a copy of the Participant Information Sheet and consented to be interviewed.

(Wait for reply)

Please confirm you understand that you're free to stop the interview at any time, you are free to withdraw your consent at any time, you don't have to answer any questions and you can have a break whenever you need.

(Wait for reply)

Thank you. If you see me making any notes, they are merely prompts for me!

(Comfort question)

Q1 Can you tell me about anything you particularly enjoyed about the programme?

(Wellbeing scores – RQ: How and why has the Wellbeing of NBI participants changed and what do the participants perceive the reasons to be?)

Q2 How do you think the programme has affected your wellbeing?

Q3 From the answers you gave on your questionnaires, your wellbeing changed _____*(describe wellbeing change)*_____, what are your thoughts on these changes?

(Ranking of Five ways to wellbeing - Connect, Be Active, Take Notice, Keep Learning, Give.)

(Impact of the NBI on each of the five ways to wellbeing, including how the participant is likely to develop these).

Q4 In the last questionnaire, you were asked to rank Five Ways to Wellbeing (Connect, Be Active, Take Notice, Keep Learning, Give) – you placed _____ at the top, how do you feel about this and why is it important to you?

Q5 Can you comment on the other four (*remind what they are and go through them in rank order*), and whether you gained much in these areas from the programme and whether they are particularly important to you?

Q6 How do you feel this factors/these factors have helped you and your wellbeing?

Q7 Do you think you have stayed on the course if only (*the top ranked factor*) had been met and if so, why?

Q8 Do you think you would have stayed on the course if (*the top ranked factor*) had NOT been met and if so, why?

(More general)

Q9 Your original reason for joining the programme was (*insert here*), has that reason changed? Please explain.

Q10 What do you think was most valuable to you about the programme? (*compare this with Q1 and other answers*)

(Re Nature connectedness/RQ: To what extent has Nature Connection affected the participants' Wellbeing?)

Q11 How do you think being around nature played a role in the programme and your wellbeing?

Q12 In your previous questionnaires, your feeling of connection to nature changed (*describe the change/scores*) - can you describe how you feel more or less connected or feel differently about nature? Can you give any examples?

Q13 Do you think you'll continue to engage with nature in some way? If so, how? How often? What might stop you?

(How NBI has affected the participant in a practical sense and what they have enjoyed and what was valuable - It will be interesting to find out if these answers are similar to each other and also if they correspond to the 5 Ways.)

Thank you. Going Forward...

(Add context and further understanding of how the NBI has affected their life, plans and aspirations)

Q14 How, if at all, do you think the programme has helped you and your life practically?

Q16 Is there anything you would change about the programme? If so, what and why?

(This may reinforce the 5 Ways or highlight a missing need.)

Q17 What further support do you think you need, or want, to help you move forward?

(This may identify similar factors or show they have now progressed and require different support.)

Possible Question as appropriate – You said you were also receiving Wellbeing support from (xxxx), can you describe how you're benefiting from that?

(Final Question)

Q18 Is there anything you would like to tell me that I haven't asked?

(Close the session)

Thank you for your time and sharing your experience.

Your words will be transcribed and data analysed, along with data from other participants, however as previously stated, all data is anonymised so you can't be identified. The information from this research will help us to better understand how Wellbeing and Nature-Connectedness are affected during Greenlight Trust (and similar) programmes.

4 TIDieR checklist for GLT intervention

Item no.	Item	Section (page number)
1	Name of the intervention	3.2 (58)
2	Rationale, theory, goal essential for the intervention	3.2 (58-59)
3	Materials used in the intervention	3.2 (59-60)
4	Procedure – descriptions of the procedure/activities used in the intervention	3.2 (58-60), 3.3.3.2 (64-66)
5	The expertise/background of the individual providing the intervention	3.2 (58-60)
6	Modes of delivery (ie face-to-face and in a group)	3.2 (58-60)
7	Types of locations	3.2 (58-60)
8	Number of times the intervention was delivered, number of sessions, duration.	3.2 (58-60)
9	Why, when and how the intervention was tailored/personalised	3.5 (68-69)
10	Was the intervention changed during the course, and if so how?	3.4 (66-7), 3.5 (67-69)
11	Planned intervention adherence - was it assessed? If so, how and by whom? Any strategies used to maintain or improve adherence?	3.4 (66-7)
12	Actual intervention adherence - was it assessed? If so, what was the extent to which the intervention was delivered as planned?	3.4 (66-7)

5 UK-based NBIs: wellbeing comparisons

Table 4: UK-based NBIs: wellbeing comparisons

Study	Type of NBI	Duration (weeks)	Magnitude of wellbeing increase (%)
Study 1	Mixed	12	13.3
Rogerson et al, 2020	Project B: community gardening	12	13.0
Rogerson et al, 2020	Project E: mixed green community activities (whole sample)	26	15.6
Rogerson et al, 2020	Project E: mixed green community activities (low wellbeing sample)	26	30.7
Gittins et al, 2023a	Mixed (woodland)	4–12	6.7
Maund et al, 2019	Mixed (wetland)	6	10.8

6 UK-based NBIs: wellbeing comparisons

Table 5: NBIs: nature connectedness comparisons

Study	Type of NBI	Location	Duration	Magnitude (% increase)
Study 1	Mixed	UK	12 weeks	21.8
Richardson and McEwan 2018	'30 Days Wild'	UK	30 days	13.3
Richardson et al, 2016	'30 Days Wild'	UK	30 days	12.4
Keenan et al, 2021	Nature walks	Ireland	5 days	23.7
Down et al, 2021	Residential Outdoor Expedition	Australia	3 days	5.9
Warber et al, 2015	Wilderness camp	USA	4 weeks	8.3
Barton et al, 2016	Wilderness expedition	South Africa and Scotland	5-11 days	19.1

7 Study 2 theme generation process examples

MS Word tables

Social improvements, inc social belonging	Physical and behavioural wellbeing improvements	Psychological wellbeing (increased wellness) inc decreased anxiety / depression	Psychological wellbeing (at peace) inc calm, peace and belonging in / connecting with nature	Psychological wellbeing (self-improvement) inc hope/plans for future, purpose, achievements, routine, self-improvement, enjoying learning
Social improvements	Gains from increased PA	Happier home life	Peace in nature	Other positive progressions
Give	Enduring emotional and behavioural positives	Reduced anxiety	Natural environment and NC	Opportunities due to gains in confidence...
Connect with others	Have a routine	Increased confidence or self-esteem	Calm or relaxed feelings	New interests or return to past interests
	Be active	Other feelings and emotions about the NBI	Away from stress and isolation	Employment and volunteering
		Decreased stress	Take notice of self and surroundings	Keep learning and new experiences
		Decreased depression		Achievements on NBI

Safe and supportive environment inc freedom to choose / encouragement	Natural environment and wide space inc self-awareness and environmental awareness, freedom to learn / explore	Self-empowerment (inc being able to own the benefits and into other areas of life and into the future)		<i>Enablers as well as benefits?</i>
Staff support	Peace in nature	Have a routine		Reduced anxiety
Social improvements	Natural environment and NC	Enduring emotional and behavioural positives		Increased confidence or self-esteem
Give	Gains from increased PA	Happier home life		Decreased stress
Connect with others	Be active	Other positive progressions		Decreased depression
Other feelings and emotions about the NBI	Calm or relaxed feelings	Opportunities due to gains in confidence...		
Away from stress and isolation	Take notice of self and surroundings	New interests or return to past interests		
		Employment and volunteering		
	Keep learning and new experiences			
		Achievements on NBI		

