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A Literary Review to Explore the Effectiveness of Shinrin-Yoku on Physiological and Psychological Stress, using Biological and Self-Reported Indicators

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Introduction

Throughout this Literature Review (LR), I shall explore the effectiveness of Shinrin-Yoku (SY) on physiological and psychological stress. With the advancement of technology and urban living, stress, defined as “mental, emotional, or physical strain or tension” (Collins, n.d, definition 2) is becoming a prevalent feature of today's society, with technostress becoming a present-day disease. Historically, humans have resided in nature, subsequently, effective methods of preventing and managing stress are fundamental for good health; the overwhelmingly beneficial, stress-reducing effects of SY are paramount in offering health promotion opportunities, for modern-day life.

As a trainee counsellor, I began researching SY effects on psychological stress; I found, however, greater quantities of literature examining physiological effects. Subsequently, I include both aspects; each demonstrates beneficial effects on stress levels; the greater the initial stress/depression levels, the more there is to be gained from SY. Although physiology may not seem important to counsellors, it is a measurement of our internal state and consequently significant. Accordingly, the effects of SY on both physical and mental stress are explored thereupon.

As I began researching, my main misunderstanding surrounded the many differing terms describing SY. Therefore, to understand more about the terminology and its

progression, see Appendix 1.1. Following Scholars examples, I will refer to SY, throughout this LR. I will begin by considering what SY is, along with a recapitulation of its history and an overview of why there is a growing desire to partake in this art. Secondly, I will review quantitative research regarding the effects of SY on physiological stress. Following on, there will be a review of the qualitative research surrounding the effects of SY on psychological stress. In conclusion, I will convey my sentiments on the research, along with suggestions for future research.

The Literature

Upon conducting my secondary analysis of primary research, I recognised substantial SY research has been generated. I read books and magazine articles, watched seminars and searched for peer-reviewed journals and articles on the Cheshire College South and West online library, Google Scholar and PubMed.

I found sufficient research has been published over the past ten years to satiate the assignment requirements. Many studies originate from Japan, with the United Kingdom (UK) publishing their first scientific research study paper of a *guided* Forest Bathing trip, in 2021. I have also included older research, for example, the world's first experiment to show the calming of the Prefrontal Cortex during SY (Park et al., 2007), as these feel prominent pieces. However, due to word count and focus, I was unable to include all research gathered (Appendix 1.3).

My research established studies overwhelmingly agree with each other; there are few contradictory pieces; no conflicts of interest were reported. Studies include predominantly males, of various ages, on *unguided* SY walks, of 15 minutes to 3 days. I was, however, surprised to discover minimal studies specified whether experimentations allowed conversation or not, yet caffeine, tobacco and alcohol were often strictly monitored; a possible suggestion for future research. The comparison to the studies, needed to clarify the results of SY, is always an urban walk. However, this alone increases bodily stress (urban experiments are carried out before the forest, to minimise the effects of the forest on urban results). Accordingly, I only discuss forest results. However, Egner et al. (2020) suggests it may be the lack of a stressor rather than nature itself, which is effective, whilst Joung et al. (2015) demonstrates forests are still more relaxing, even if the urban scenario is made less stressful, that is, if participants are not watched whilst physiological measurements are taken. Subsequently, this raises the question: What does literature tell us of what the art of SY is?

Question 1: What does the Literature tell us of what the art of Shinrin-yoku is?

What is SY?

Li (2018), a leading SY Professor, explains, *Shinrin* in Japanese meaning “forest” and *yoku* meaning “bath”, therefore bathing in the forest atmosphere, is a slow mindful walk through the forest; it is not a hike or run, “keeping your phone switched off ... come into the here and now” (Miyazaki, 2021, pg. 71). Selhub and Logan (2012) more broadly define SY as the absorption of the atmosphere of the forest via all five senses. Miyazaki (2021), together with Li (2012), suggests this

may be a morning, afternoon or full day, practised anywhere in the world, wherever there are trees, in any weather, and with any fitness level. Park et al. (2007) stipulates SY benefits all, regardless of background or age.

Among others, Lee et al (2014) and Miyazaki (2021) agree SY is the mindful absorption of the forest surroundings, whilst connecting via the conscious arousal of direct pathways (sight, sound, smell, touch and taste), with Li (2018b) suggesting, when opening our senses, we connect to the natural world, helping us to relax and think more clearly, by easing our stress and worries. Contrariwise, Egner et al. (2020) suggests a primary reason why humans relax in forests is based upon the leisure activity they carry out whilst there. Ultimately, Egner et al. (2020) adds it is only a small percentage of the population which associates nature, such as forests, with stressful conditions, for example, tree surgeons. This therefore suggests they may not benefit from the physiological and psychological stress reduction effects of SY, compared to those who experience the forest as a place of enjoyment.

What is the history of SY?

Literature research found Scholars, including Ochiai (2015) and Kobayashi (2018), cite SY as being founded in Japan by Tomohide Akiyama, the Director of the Japanese Forestry Agency. Beginning in 1982, as an intuitive-based practice, the “people of Japan were in need of healing through nature” (Li, 2018, pg. 58). Humans have perpetually known of the healing capacity of forests, with Japan's two main religions, Buddhism and Shinto, both regarding forests as the “realm of

the divine” (Li, 2018b, pg. 19). Miyazaki (2021) indicates the original notion of SY was “a marketing exercise to attract people to the beautiful forests of Japan” (pg. 8), which Li (2018) reinforces, suggesting the concept of SY was part of a movement to protect Japan’s forests; if individuals were inspired to frequent forests for health benefits, their desire would be to protect and care for them also.

Whilst SY began as an innate tradition for the Japanese, a more scientific way of viewing SY benefits began to emerge. Miyazaki (2021) explains in March 1990, on the Japanese island of Yakushima, he performs the first SY experimentation, investigating the physiological effects of SY on individuals during a forest walk. The stress-reducing results were determined by measuring the level of cortisol, a stress hormone found in saliva. However, there was little progress made in the decade following this experiment, regarding scientific and physiological data collection. Nonetheless, since 2000, the advancement of science has enabled brain and autonomic nervous activity to be measured, as each are reliable barometers of human body stress levels. Subsequently, the last decade has seen data assemble expeditiously, with findings being exceptionally promising. This data thence signifies the human body still perceives our home as being in nature, which is an important consideration, as the quantity of individuals moving to an urban environment increases yearly.

Why Japan?

During the introduction of his book, Li (2018) adduces “it is no surprise SY developed in Japan” (pg. 16); Japanese culture, philosophy and religion are shaped

by the country's vast forestry areas. Although Japan has one of the highest population densities on earth, Li (2018) cites it is also the greenest; two-thirds of Japan is covered by forest, making SY easily accessible. Kotte et al. (2019) further cites two species of tree as iconic to SY: the Japanese cedar, *Cryptomeria japonica* and the Hinoki Cypress, *Chamaecyparis obtuse*.

Masao Watanabe, an Emeritus Professor from the University of Tokyo, detailed in a 1974 edition of *Science*, the difference between how Japanese and Western people view nature; “In the West, Man stands opposed to nature, but in Japan, Man is part of nature” (as cited in Miyazaki, 2021, pg. 41). Miyazaki (2021) continues, suggesting the Japanese have time-honoured notions connecting nature to their emotions; the fall of cherry blossom is akin to sorrow, whilst an autumn evening often expresses loneliness.

Given Japan's affinity with forests, McEwan et al. (2021) cite Japan as a prominent SY figure; Japanese research is considerable. 2004 saw a total research budget of 470 million yen (£3.1 million), from the Japanese Government and over the past 15 years, have proceeded to manufacture the world's most state-of-the-art technology, to measure activity in the brain and autonomic nervous system, therefore contributing enormously to Japanese SY research. However, Kotte et al., (2019) proceeds to explain SY is now a global practice, in countries such as China, UK and Australia. Research is also coming from Taiwan (Tsao et al., 2018), Finland (Tsunetsugu et al., 2013) and Hungary (Peterfalvi, 2021), suggesting the knowledge and concept of SY is expanding internationally.

Why is SY required?

Miyazaki (2021) explains it is approximately seven million years ago, since our descendants began developing into the humans we know today, spending over 99.99% of their time residing in nature. Song et al. (2016) supports this view; our bodies are adapted to nature. During the introduction to her book, Gilbert (2019) advocates historically, humans have taken for granted the rewards of being outside; there was no justification needed as to why and how being outside was beneficial. However, now the amount of time spent outside deteriorates, humans are beginning to acknowledge the “need to be outside because we belong there” (pg. xii).

Whilst literature informs us of a human’s innate belonging in nature, a trend towards urban living has emerged. Miyazaki (2021) proposes, following the Industrial Revolution beginning 1760, only three-per-cent of the world's population lived in an urban area, increasing to 54% by 2016. Subsequently, the World Urbanization Projects (2014) envision this will reach 66%, by 2050, which Dan Pearson, designer of the ecological park at Tokachi Millenium Forest, Hokkaido, accedes; “people have become urban centric” (2020, 11.11). Miyazaki (2021) displays his concern, stating genes cannot modify as quickly as urbanisation develops, subsequently, humans are living in urban environments with bodies suiting the natural environment. Li (2018) supports this notion, suggesting although cities are innovative, residing there is stressful. The longer humans live in cities, the more stress accumulates, resulting in sickness: heart attacks, cancer and depression. Subsequently, stress is the health epidemic of the 21st Century. Hence, managing and reducing stress, for example via SY, is the greatest health challenge

ahead. Kotte et al. (2019) suggests the annual cycle of the forest teaches us the lesson of constancy of change; we too are part of the cycle. Those who “ignore their own rhythm” (pg. 405) and do not rest, will promptly become stressed.

Li (2018b) promotes these findings, detailing Europeans spend 90% of their time indoors, whilst Online Nation (2021) states when indoors, British adults average eight-hours and forty-one minutes a day on electronic devices, which researchers agree is akin to Nature Deficit Disorder (Gilbert, 2019; Song et al., 2020). American Psychologist Craig Brod (1984), coined the term “technostress”, to describe the present-day disease caused by the failure of coping with computer technology healthfully, which Li (2018) suggests can include continuously checking your phone. Simultaneously, Song et al. (2020) reports today's problems concurrent with technology include nomophobia, with symptoms including anxiety, depression and irritability (Li, 2018).

Inescapably, humans now live in a case of permanent stress; work-related stress being a prominent feature. Rising for five consecutive years, UK Government statistics show in 2019/20, approximately 828,000 people were affected, resulting in 17.9 million working days lost. Women were affected more than men, ages 25-34 most afflicted; 2,010 women per 100,000 workers (*Work-related stress, anxiety or depression statistics in Great Britain*, 2020). Miyazaki (2021) establishes whilst there is no Japanese word for *stress*, the English phrase used in lieu, stress is certainly experienced by the Japanese. Li (2018) agrees, stating *karoshi* (death from overwork), affects 23% of Japanese companies, with employees working over 80-hours overtime per month. Pressure to work extended

hours and be successful has increased over recent decades. Miyazaki (2021) also cites the modern-day computer technology advancement as intensifying stress, suggesting humans are “over-stimulated and stressed” (pg. 9), therefore making our bodies increasingly vulnerable to disease. Subsequently, when we encounter nature, such as forests, our bodies relax, which Miyazaki (2021), proposes as his “Back to Nature Theory” (pg. 23). Mencagli and Nieri (2019) convey this is the reason humans need contact with nature; SY is an antidote to stress.

Accordingly, regulation of modern-day stress is a significant health challenge (Li, 2018). Miyazaki (2021) therefore posits, whilst the simple action of forest walking may not seem exceptional, the stress-reduction benefits of SY really are. However, as the process cannot be described through words, “physiological indicators play an important role” (Lee et al., 2012, pg.1), explaining the methods of the relaxation effects. Thus, the effect of SY on physiological stress will now be reviewed.

Question 2: What does the Literature tell us about the effect of SY on Physiological Stress?

A note on the research

The LR will concentrate on the effect of SY on Pre-frontal Cortex, Stress Hormones, Heart Rate Variability, Blood Pressure and Natural Killer Cells. Due to the abundance of research available and word-count limits, the author is unable to include research relating to Heart Rate (HR), Noradrenaline and Dopamine. Whilst also responding positively to SY, this research is presented in Appendix 1.3.

Physiological Effects – Biological Indicators

Pre-frontal Cortex (PFC)

PFC brain activity, part of the Central Nervous System (CNS), decreases when we are relaxed (Miyazaki, 2021). Literature research identified the world's first PFC study (Park et al., 2007) examining the physiological effects of SY on cerebral activity; a study of 12 Japanese male students (22.8 +/- 1.4 years) during July (no environmental conditions confirmed). They concluded, following a 20-minute SY walk amongst oak trees, total hemoglobin concentration (t-Hb) in the left pre-frontal area was significantly lower ($p < 0.05$) after walking in the forest area, than the urban. This trend was also demonstrated prior to the SY walk; the t-Hb of those scheduled to visit the forest was significantly lower than those scheduled to visit the city. This therefore demonstrates relaxation of brain function and effective physiological stress reduction, both prior and during the SY experience. However, although t-Hb measurements could not be taken in bright situations, resulting in several measurement data not being obtained, physiological relaxation was displayed.

However, the author did not find additional PFC activity studies/results whilst *walking* in the forest. It is therefore difficult to validate the physiological effects based upon one piece of analysis, highlighting a gap in research.

Song et al. (2020) supports this sentiment also, highlighting evidence-based research on PFC activity “is limited” (pg. 6601), subsequently conducting their

slightly larger Japanese study of 29 women (21+/- 1.4 years) at five independent sites during August 2014 and August/September 2015. Participants mean height, weight, and Body Mass Index was recorded, along with environmental temperature, humidity and illuminance, increasing study thoroughness and reliability. The study identified sitting *viewing* a predominantly oak forest landscape for 15 minutes “sharply reduced oxygen hemoglobin (oxy-Hb) concentrations in the right area of the PFC” (pg. 8), during sunny weather. This consequently relates to physiological relaxation, implying *viewing* forests may be as beneficial to physiological stress as SY *walking*, exhibiting comparable PFC results for both genders and on both sides of the brain. However, participants viewing the forest whilst it was raining were excluded from providing results, therefore, possibly affecting the results' reliability.

However, whilst overwhelming evidence and unaltered trends over time display physiological relaxation for males and females walking in and viewing forests, study limitations were noted. Firstly, stimulation from differing external elements cannot be regulated during studies conducted in the forest. Further, all studies had small participant numbers, within similar ages and were homogenous groups. Participant height, weight and BMI were not always noted, and results were eliminated due to rain. Subsequently, obtaining results from SY trips conducted in all weathers would be valuable future research. Future studies involving older male, older female and older heterogenous groups, will also need consideration, along with participants health.

Furthermore, Song et al. (2020) highlights the element of exercise within the earlier Park et al. (2007) study as a limitation, suggesting walking consequently marks a shift in the activity of the left area of the PFC. Meanwhile, during their study, the element of exercise was not included due to the seated (*viewing*) nature, subsequently marking a shift in the activity of the right area of the PFC. Lastly, due to the five independent research sites, region-specific responses may have been demonstrated by Song et al. (2020). The impact of the type and volume of foliage, and forest location, would need to be considered for future research.

Stress Hormones

Adrenaline

Adrenaline, a hormone produced by the Endocrine System (ES), is released by the adrenal glands to help regulate stress (Bancos, 2022). Research of the literature found Li et al. (2008) conducted one of the first studies assessing the physiological effects of SY, measuring urinary adrenaline concentration, advising adrenaline increases with anticipation. The study concluded adrenaline levels significantly decreased in 13 female nurses (25-43 years) after a three-day/two-night Japanese SY trip, suggesting their stress levels had reduced. This trend continued to be supported by Li et al. (2011), who conducted a similar sized daytrip; 16 males (57 +/- 11.6 years), and Li et al. (2010); 12 males, (35-53 years), on a SY day trip; both studies evidence adrenaline decreasing, reiteratively demonstrating physiological relaxation across both sexes, age span and SY duration.

Cortisol

Cortisol, also produced by the ES, is released by the adrenal gland in times of stress (Kotte et al., 2018). As well as a tendency for the reduction of PFC activity and adrenaline, cortisol follows the same bearing, in response to SY. The earliest research, by Park et al. (2007), demonstrated male cortisol levels (22.8 +/- 1.4 years) reduced following a 20-minute SY forest walk. This trend continued; Li et al. (2010) found cortisol levels reduced in 12 males (ages 35-53) during a SY daytrip, whilst Park et al. (2011) and Lee et al. (2011) similarly established a reduction in males; 15.8% following a day trip, and noteworthy reductions following a three-day/two-night forest visit, respectively.

Furthermore, in their survey (15 males/five females, 20-33 years), Olafsdottir et al. (2020) assessed cortisol levels during a forest walk, walking on a gym treadmill and viewing nature on a television screen during a stressful examination period. Conceivably, whilst all methods may decrease cortisol levels, the forest *walk* group demonstrated “the largest decrease in cortisol levels” (pg. 265), supporting Wilders (1957) Law of Initial Value (LIV) (as cited in Lee et al., 2012; Song et al., 2015); the higher the initial (stress) level, the greater the response to function-depressing agents (SY). Therefore, the benefits are greater; the more stressed you are, the more there is to be gained than if you feel well. Gilbert (2019) concludes this cortisol reducing effect of SY is true in healthy adults, plus those with high BP, sleep problems and depression.

Heart Rate Variability (HRV)

Investigating the effect of SY, Miyazaki (2021) cites HRV as an accurate method of measuring ANS activity; previous methods of taking HR and BP only showed joint Parasympathetic and Sympathetic Nervous Activity (PSNA/SNA), whereas HRV allows individuation of the two, demonstrating “better results than other physiological measurements, such as salivary cortisol concentration” (Kobayashi et al., 2018, para. 3). The interval between heart beats manifests as two components: high-frequency (HF) PSNA, increasing signifying relaxation, and low-frequency (LF) SNA, increasing signifying stress (Li et al., 2007; Lee et al., 2012).

In summarising the results of a 15-minute SY walk, (485 Japanese males across 57 forests), Kobayashi et al. (2018) concluded HF was prominent; 65.2% displaying a positive response, representing autonomic relaxation, results echoed by Park et al., (2010); Lee et al., (2011/2014). Additionally, Song et al., (2013) established a 21.6% HF increase of 13 males during a winter walk in a Japanese urban forest, suggesting “urban parks have similar health benefits to natural environments” (pg.3), whilst evolutionary psychology suggests the forest environment “confers contentment” (Kobayashi et al., 2018, pg. 6). However, the remaining 34.8% demonstrated a negative response; increased LF, denoting stress, which may be described as Biophobia or Hylophobia (Li, 2018; McEwan et al., 2021), suggesting SY would not benefit them. Nevertheless, researchers are aware this study only includes young Japanese males and demographic and geographic factors would need considering in future research, along with the physiological reaction to the forest and biophobia.

Conversely, Yu et al. (2017), who studied 85 females/43 males (60 +/- 7.44 years) during a *guided* two-hour Taiwanese FT trip, discovered “a contrast at nonsignificant levels, namely a decrease in PSNA and an increase in SNA” (pg. 8), the reason for which is unclear. However, researchers cite either physical exercise or the attention being paid to the guide, as possible stressors. Although this LR is based upon *non-guided* trips, this research feels important, demonstrating beautifully the relaxing effects of practicing SY independently.

The Scholars are aware, nonetheless, of the limitations of working with this age group; failing habits and personality, whilst understanding the health benefits in local context is imperative; “the beneficial health effects derived from walking through a forest in Japan may differ from those derived from walking through a forest in Taiwan” due to “... forest type, environmental conditions, biodiversity, program content, and cultural background” (Yu et al., 2017, pg. 2). Therefore, future research conducted across a wider variety of locations/countries would be beneficial, whereby the influence of these variables can be further examined.

Blood Pressure (BP)

Kotte et al. (2019), who cites BP as an accurate method of measuring ANS activity, affirms Japanese incidences and mortality rates from hypertension are rising; 34.6% of Japanese males and 24.8% females had high BP in 2016. As such, stress may cause and/or heighten BP (Li & Kawada, 2014), whilst Ideno et al. (2017) suggests reducing BP will reduce mortality.

Despite these figures, Park et al. (2011) and Yu et al. (2017), agree short (15 mins – two-hours, n=420/128 respectively) SY trips reduce adult (45-86 years) male/female BP, whilst Ideno et al., (2017) found a reduction in children's BP also. The inaugural study assessing seasonal variations of SY was conducted in Hungary, finding the BP of 7 females and 5 males (25–63-years), following a two-hour SY walk reduced in both January and May, suggesting continual positive effects of SY, on BP (Peterfalvi et al., 2021). Additionally, Mao et al. (2012) established a 7-night Chinese SY trip, resulted in substantial BP reductions of 24 subjects (60-75 years, gender not specified) with diagnosed essential hyper-tension, compared to an urban group and their baseline level.

However, Horiuchi et al., (2013) identified during a small-scale study of 48-participants, BP substantially reduced amongst the aged, yet remained constant in young people, therefore offering contradictory findings, on the effects of SY on the young's physiological stress levels.

Furthermore, literature research revealed SY has a Physiological Adjustment Effect; Song et al., (2015) primarily identified this tendency. Miyazaki (2021) continues, suggesting SY has a differing effect on different people, reducing BP in those who begin with high BP, whilst increasing BP of those who begin with low BP, which was suspected of being an initial error in data, as not experienced in urban areas. This therefore makes SY invaluable; regulating to the individual, whilst having a greater effect on those with hypertension, than normotension, whilst these BP lowering effects are not due to physical exercise (Ideno et al., 2017) but by increasing PSNA and reducing SNA (Kotte et al., 2019).

Similarly, to PFC and HRV, limitations were noted, including failure to compile data of socio-economic status, medication usage and exercise/smoking habits (Yu et al., 2017), potentially affecting the physiological effects of SY. Future studies highlighting the chronic effects of SY, as well as acute, with longer and repeat studies, need to be considered, along with increasing studies on aged people; Horiuchi et al. (2013) states few studies have been conducted with aged people.

Natural Killer Cells (NKC)

Whilst SY has shown to reduce physiological stress levels, studies also demonstrate SY improves immunity by increasing Immune System NKC levels, which Li et al. (2008/2008b) and Peterfalvi et al. (2021) cite as crucial for fighting tumours and infections, which stress inhibits. The stress reducing effect of forestry settings could therefore have favorable outcomes on immune function (Lee et al., 2012).

Compiling the LR highlighted minimal recent studies on NKC activity. The cardinal research, conducted in 2005 (Li et al., 2007), concluded 11 of 12 Japanese males (37-55 years), saw NKC increase by 1.5 times, after a 3-day SY trip.

Li et al. (2008b) also studied the long-term effects of a 3-day SY trip on NKC activity on 12 Japanese males (35-56 years), along with a similar 3-day study of 13, non-pregnant female nurses (25-43 years), with measurements being taken on days 7 and 30 (Li et al., 2008). The studies concluded NKC activity remained

increased in both male and female groups on day 7, remaining increased in males, one month later, subsequently suggesting if citizens visit a forest once a month, NKC activity may be maintained, which is imperative for health promotion and preventive medicine (Li et al., 2008b), killing tumours or virus infected cells. These results were not found by walking in urban settings. Tsao et al. (2018), whose recent research with 11 predominantly female participants (average age 64), is also consistent with Li et al. (2008b) findings; NKC effects can last more than 4 days, yet stipulates NKC activity increases with age, possibly affecting their results.

Finally, limitations were noted; sample sizes are relatively small, whilst Tsao et al. (2018) stipulates they did not compare the same urban trial group with the forest group, when comparing activating NKC. Future studies are also foreseen to understand the processes which determine the effects of SY on health, whilst considering any likely influencing components of NKC and activating human NKC.

The author subsequently presupposes SY offers a way of managing modern-day stress, offering physiological restoration, repeatedly supported by studies antecedent. As SY reduces physiological stress, the review will now progress to the third question, exploring the effects of SY on psychological stress.

Question 3: What does the Literature tell us about the effect of SY on Psychological Stress?

A note on the research

This section concentrates on the effect of SY on mood, using the Profile of Mood Scale (POMS). Due to the plethora of studies available and word-count limits, the author has been unable to include research relating to Semantic Differential and State-Trait Anxiety Index. Whilst also responding positively to SY, Appendix 1.3 demonstrates the research.

Psychological Effects – Self-Reported Indicators

Mood

SY helps alleviate physiological stress, and fiercely heralded as equivalently favourable for psychological stress also (Kotera et al., 2020). Li (2018) posits “high levels of stress are directly linked to anger and irritability” (pg. 73), increasing SNS activity (Singla et al., 2020); SY can help individuals regulate their emotions through calming the PSNS (Richardson et al., 2016).

Li et al. (2008) explains the effect of SY on mood can be measured through the Profile of Mood States (POMS) test; individuals are given a listing of 65 emotions, rating the degree they are experiencing each on a scale from ‘not at all’ to ‘extremely’. Taken *before* and *after* SY, the test will produce six mood scale scores: anxiety, depression, anger, vigour, fatigue and confusion.

Li et al., (2007/2008) reported a positive correlation between a Japanese 3-day/2-night male (37-55 years) and female (ages 25-43) SY trip (n=12/13 respectively) and vigour increasing, whilst depression, anxiety, fatigue, confusion and anger reduced. Lee et al. (2014) and Joung et al. (2015) recorded equivalent results, whilst McEwan et al. (2021), although a *guided* daytrip, reported indistinguishable findings also. Additionally, Yu et al. (2017) found similar POMS scores during a two-hour Taiwanese SY trip, with 128 elderly individuals (85 female/43 male), evidencing you don't need to spend much time in the forest for psychological stress recovery to occur (Li, 2018).

Similar POMS results were also proclaimed by Tsunetsugu et al. (2013). 48 males (ages 20-22) *viewed* (seated) a Japanese forest landscape for 15-minutes, suggesting viewing forest landscape is equally beneficial to mood as SY walking; anxiety, fatigue and confusion lowered, whilst vigour increased. This study also announces the male mood worsened within 15-minutes of being in the urban setting, showing the environmental stress derived from urban life, causing increased anxiety, fatigue and confusion, whilst decreasing vigour.

Additionally, Horiuchi et al. (2013) noted during their study investigating the effects of SY on psychological factors in young and aged people, following a 3-hour walk, the aged (mean age 59) experienced a greater reduction in POMS scores than the young (mean age 22-years). Research also concurred SY has a greater effect on those more depressed (Furuyashiki et al., 2019), during a Japanese

study of 155 participants. Following SY, the negative scales: anxiety, anger, fatigue and confusion for the group with depressive tendencies decreased to levels equal to those recorded by the group without depressive tendencies, therefore showing the greatest improvement, demonstrating Wilders (1957) LIV (as cited in Song et al., 2015).

Finally, Li (2018) reports women's moods are greater affected by SY than men. Whilst these are subjective POMS scores, objective evidence supports these findings (Song et al., 2019); female stress hormone levels reduced after SY (Li et al., 2008), supporting the enhancement of mood reported on their POMS survey.

As noted heretofore, limitations of these studies were detailed; McEwan et al. (2021) highlights the lack of follow-up studies executed following recording of results, whilst Horiuchi et al. (2013) did not collect comparative urban data, thus, the results may contain the “effects of exercise per se rather than the effect of exercise in a forest environment” (pg.15). Ultimately, minimal studies have been conducted on aged people (Horiuchi et al., 2013), needing consideration for future studies.

Rumination

In addition to improved mood, SY reduces rumination, which Bratman et al. (2015) defines as “repetitive thought focused on negative aspects of self” (pg. 8567). Gilbert (2019) found a positive correlation between SY and reduced

rumination; the participants Subgenual PFC's were less active during SY, signifying diminished rumination and greater self-compassion.

McEwan et al. (2021) also supports the findings of decreased rumination. This first UK study, although *guided*, found a decrease in rumination of problems and feelings, following a two-hour Derbyshire SY walk (61 participants, ages 18-60). However, a three-month follow-up saw rumination increase, whilst nature connectedness decreased, suggesting the continued practice of SY is required, if beneficial effects are to be maintained.

Additionally, Bratman et al. (2015) demonstrated rumination reduction; following a 90-minute walk amongst oak trees and shrubs, 38 participants reported a decrease in self-reported rumination. No such effects were noted during the same urban walk. Supporting these findings, Scholars identify the Attentional Restoration Theory (Bielinis, 2019; Zabini et al., 2020) and Stress-Reduction Theory (Yin et al., 2020) as having a positive impact upon rumination, whilst Egner et al. (2020) posit it is the Conditioned Restoration Theory, built upon the classical conditioning model, proposed by Russian physiologist Ivan Pavlov (1848-1936) in 1901 (Hart-Davis, 2018), which offers psychological restoration. Lastly, Appleton (1996), who remains with the conditioning theory, suggests it is the Prospect–Refuge Theory, described by Buss (2000) as “a womb with a view” (pg. 21), which offers psychological relaxation. Meanwhile, Li (2018) proposes the involuntary attention used during SY, referred to as ‘soft-fascination’, requires no mental effort allowing “our minds to wonder and to reflect, and so restore our

capacity to think more clearly” (pg. 110), demonstrating the beneficial effect of SY on psychological stress.

Finally, prior to the author concluding this LR, conveying her sentiments on the research and suggestions for future research, limitations of the rumination studies were noted. Although McEwan et al. (2021) undertook a three-month follow-up, presenting scarce longitudinal data, a lack of follow-up reports is a study limitation. Sample sizes were also relatively small, therefore, increasing the number of participants in future research needs to be considered.

Conclusion

SY is a slow, mindful forest walk, whereby international research demonstrates possibly foreseen results of overwhelming physiological and psychological relaxation for men and women. Research of the literature suggests SY positively affects PFC (Park et al., 2007), stress hormones (Li, 2008; Olafsdottir et al, 2020), BP (Yu et al., 2017), HRV (Kobayashi et al., 2018), NKC (Li et al., 2007), mood (Joung et al., 2015) and rumination (Gilbert, 2019); the more stressed/depressed the person is, the more there is to be gained (Song et al., 2015). Forestalling and managing stress is fundamental for good health, therefore, it would seem apparent from the literature that the stress-reducing benefits of SY are imperative, offering health promotion opportunities for modern life. Practiced individually or in a group, SY is about finding what works best for the individual, to provide *instant* stress-reduction benefits; for SY to be beneficial, a person must enjoy it.

SY is widely accessed in Japan, due to vast forest coverage and cultural valuing of nature. However, research highlighted a lack of Western research, therefore raising the question: what would the physiological and psychological impact on the UK be, if we were more akin to nature?

Historically, people naturally take themselves back to nature for stress relief. However, scientific quantitative and qualitative evidence is beginning to substantiate what we naturally felt to be true (Li, 2018). This feeling can be gained from as little as 15 minutes, or three-days of SY, the choice is that of the participants; the research suggests all durations prove beneficial. Whilst many stress-reductions are noted as short-term, (research often lacks follow-ups: BP, PFC activity, HRV, stress hormones, mood and rumination), long-term positive effects on the immune system were also noted; a SY trip once a month would keep men's immune systems strengthened, and once every 7 days for women (Li et al., 2008). However, it remains difficult to establish cause and effect; is someone's BP, for example, lower simply because they are taken away from a stressful situation, such as work, or are the benefits solely due to SY?

Four decades of Japanese research culminated in SY being prescribed by the Japanese, and South Korean, National Health Service (NHS) (*Science and Research*, 2022, para. 8) Additionally, following McEwan et al.'s (2021) study, UK research is now being taken seriously; Guildford Council now socially prescribes SY, whilst also being tried by 200 NHS patients, for the UK Government's Green

Social Prescribing Programme. Whilst comparatively new to the UK, SY still needs assessing for its UK effectiveness, due to only 13.2 % forestry covering (*Forest Area*, 2016) and not sharing similar cultural history as Japan. Overall, the aim is for SY to be widely available on the UK NHS, once scientific UK studies have culminated duly (*Who are we?*, 2022).

Nonetheless, the author notes, today, interaction with forests can be problematic; not all individuals can travel to such places. Subsequently, some of the most socio-economically deprived people may not have access to SY. As well as activities which can be conducted at home, replicating SY results (Appendix 1.2), an urban version of SY may draw those who would benefit the most; research demonstrates the wellbeing benefits of acknowledging green areas in urban environments (McEwan et al., 2019). Subsequently, such knowledge may inform future city planning. By heralding more engaging and diversified green spaces, including forestry areas, impediments to engage with nature for those living in urban environments with paramount socioeconomic hardship, may be focused upon.

Finally, I believe SY is a practical way to reduce physiological and psychological stress; our bodies are attuned to nature. We should marvel at ourselves as a mammalian species and how we individually regulate in forests: the Physiological Adjustment Effect (Song et al., 2015). The art of stress reduction through SY is to connect with nature via our senses, all we must do is acknowledge nature's invitation; “Mother nature does the rest” (Li, 2018, pg. 117), therefore raising the question: what are the suggestions for future SY research?

Suggestions for Future SY Research

The majority of SY research has Eastern origin; UK quantitative literature is minimal. However, interest in SY is developing within the UK, therefore it may be beneficial to see more research from UK Scholars. Future studies may also explore how to further enhance SY awareness, and curtail the stigma amalgamated with its title, owing to misinterpretation surrounding what SY entails.

The author also became aware of small, homogeneous, participant numbers in each study, biased towards males; few females were involved, due to the effect of hormones. Women are more attracted to SY than men (McEwan et al., 2021), seeing a greater reduction in POMS scores, therefore further research demonstrating the effects of SY on females would be valuable, along with larger group sizes, exploring the effects of SY on both homogenous and heterogeneous groups. However, Saraev et al. (2021) suggests the structure of a SY walk “can be broad and difficult to define precisely” (pg. 5), proving challenging when contemplating how to scale-up findings. Additional clarification of which senses are used within each study, and whether conversation is permitted or not, may also prove beneficial for future research, as research of literature failed to establish this each time.

Future research could also focus upon the aged population. Mood, PFC and BP research relied upon younger participants, therefore research focusing upon the aged population would provide a wider assessment of the effects of SY across the

population. This may be further enhanced by including children in the research also, as the author only ascertained the effects of children's BP being noted. Research of the literature failed to identify any further effects of SY upon children.

Penultimately, longer and repeat studies may prove beneficial for future research, thereby highlighting the chronic effects of SY, rather than the acute, as with the shorter trips forementioned. More work is needed on follow-up studies, as only McEwan et al. (2021) study, includes a 3-month follow-up. Literature research did not establish this within any other study, subsequently further follow-up studies would help to establish long-term SY effects. Additionally, results obtained during rainy weather would also be beneficial for future research, as these have been previously eliminated from studies.

Finally, future studies with a more robust control, whereby urban is not the comparison, may be favourable. This would allow the examination of SY when benchmarked against reduced stress, as the urban setting itself increases stress, making the comparison less meaningful. This may help to clarify whether it is the lack of stress which makes SY effective, rather than the forest itself.

Final notes from the author

I thoroughly enjoyed researching and writing this LR; I am aware of all the literature which could not be included in my final submission (Appendices 1.2,

1.3). I intend to continue reading around SY and its overwhelmingly beneficial effects, which I feel has informed me as a trainee counsellor and within my personal life also; I feel more confident in holistically treating stress. I feel more knowledgeable about a practice I had previously taken on faith; SY has beneficial qualities for me, and others of all ages.

Prior to this assignment, I wondered whether SY had any stress reducing benefits, or whether this was a placebo effect. My feeling post LR, is SY unquestionably helps individuals ease and reduce physiological and psychological stress.

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Appendix 1.1

During Lockdown of 2020, my garden, amongst the trees, became my sanctuary. It eased my stress and provided immense physical and mental relaxation. I noticed something regulated and reset within me when I spent time outdoors, and this got me wondering – is there something in this then, the idea of being outside amongst nature and trees? It was during this time in Lockdown, the idea for my Literature Review was born.

As I began reading and researching, my main misunderstanding surrounded the many different, often misleading, terms used to describe Shinrin-yoku (SY). Kotte et al., (2019), in their International Handbook of Forest Therapy, display a myriad of alternate phrases used in varying countries, including: Semlin Yog (South Korea), Senlin Zhiyu (Taiwan), Forest Bathing (commonly found in the United States of America tabloid media) and Forest Immersion (used in some Western media).

The main terminology, however, which caused my greatest misunderstanding was the term “Forest Therapy” (FT), as I had initially understood this to mean the same as SY. The phrase “therapy”, whilst connected to forests, may denote FT as “extending the workspace of Psychotherapists, Clinical Psychologists or Counsellors from an indoors location into nature and an outdoor environment” (Kotte et al., 2019, pg. 381). It would appear this is not the case; FT is not Counselling or Psychotherapy. In 2003, Miyazaki (2021) suggested the phrase FT,

to define SY “supported by scientific evidence” (pg. 10). However, although this may initially sound the same as SY, I have come to learn FT is undertaken following a medical referral, i.e., prescribed, on a structured and restricted course, “led by a certified guide” (Kotte et al., 2019, pg. 179). Western society emphasises being momentarily functional, rather than holistically healthy for the long term, meaning we may subsequently lose sight of the importance of our connection to the natural world; “we therefore now return to this connection for ‘therapy’” (Kotte et al., 2019, pg. 410).

Saravez et al. (2021) details there is “no standardised approach as to what constitutes a forest bathing session” (pg. 5), as the definition of SY can be “broad and difficult to define precisely” (pg. 5). SY is about finding what works best for you; activities may include Yoga, T’ai chi, Meditation, Plant Observation, Hot-Spring Therapy and Art Classes (Li, 2018); “if you go with others, make an agreement to refrain from conversation” (*Shinrin Yoku*, 2013, 2:13). However, I have based this LR upon a SY forest walk; a recreational, self-guided, spontaneous and open-ended walk, where no training is required (Kotte et al., 2019). Following numerous studies investigating the effects of forests on human health, a new medical science, Forest Medicine, has been established; SY cannot treat disease, but can be used as a preventative measure, helping to make illness less likely. Thus, reducing the annual pressure on the health services, caused by stress-related illness. Nonetheless, Kotera et al. (2020) recognise SY is more involved than a simple walk in nature, which feels more relatable to my experience within lockdown.

Ultimately, during my time reading, I was astounded by how enormous the SY subject was and in how many different directions the research could take me. I became aware of the potential for another two LR's; foremost, the components of the forest which are beneficial: Phytoncides, Fractals and the Fractal Theory, Biophilia Hypothesis and Negative Air Ions, along with the tactile, sight, and thermal comfort of the forest, whereby I recognised a gap in research, surrounding the effects of the sounds of the forest. I have not unveiled any auditory research conducted in the forest, only indoor experiments.

Additionally, I recognised the potential for a second LR, surrounding the practices which can be undertaken at home, to obtain the same benefits as a physical visit to the forest, therefore making the benefits more widely available. These include artificial greening via houseplants and bonsai trees, viewing forests via a screen, forest auditory, olfactory stimulation via essential oils and touching wood with hands and feet. Correspondingly, I again recognised two gaps in research. I have not unveiled any analysis detailing how these practices may reduce stress hormones in the home, and secondly, the effect of home treatment on NKC. Therefore, I may complete the potential LR's in the future, for which the literature can be found in Appendix 1.2. However, for now, my sight remains focused upon the effects of SY on physiological and psychological stress.

Appendix 1.2

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