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了解自然與壓力應對之間的關係：從信息處理、動機和認知角度

Understanding the relationship between nature and stress coping: from the perspective of information processing, motivation and cognition

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從信息處理、動機和認知角度

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本論文係楊燕恩 D06227101 在國立臺灣大學森林環境暨資源學系完成之博士學位論文，於民國 112 年 1 月 16 日承下列考試委員審查通過及口試及格，特此證明。

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中文摘要

利用大自然來治療壓力已成為一種趨勢，以填補傳統藥物和心理治療的缺點和不足。心理學方法在解釋和治療壓力或其相關的心理健康問題（例如由此產生的情緒障礙）有著悠久的歷史，然而，透過大自然改善壓力的研究尚處於起步階段，缺乏具有良好理論及結構的基礎。本研究試圖以心理學中信息處理、動機和認知的角度，理解大自然對緩和壓力的影響，以心理學基礎理論去詮釋大自然改善壓力與認知之間的關係。

此博士論文進行了三項研究，包括比較室內和室外環境暴露的隨機對照實驗、調查激勵參與者與大自然聯繫可行性的隨機對照在線研究，以及有關焦慮抑鬱患者在大自然裡反應（包括認知反應）的質性研究。由於新冠病毒大流行，招募的參與者數量受到阻礙，但仍符合進行相關統計和質性分析的要求。

於第一項研究中，四十八名台灣年輕人（二十四人於戶外綠地，二十四人於室內）完成了四節每週四十五分鐘的研究。結果發現，戶外組在降低反芻、帶動正向的自傳體記憶及增強與大自然聯繫方面均優於室內組。計劃結束後，相較於室內組的參與者，戶外綠地組有更多的參與者採用大自然接觸來應對壓力與負面情緒。

第二項研究把閱讀激勵與大自然連繫的訊息配合額外激勵元素跟其他三個對照組進行了對比，當中包括閱讀與壓力無關的訊息、與壓力相關但非大自然相關的訊息，以及純粹激勵與大自然連繫的訊息。共有九十名台灣年輕人被隨機分配到四組。我們對動機和一連串心理健康指標進行了一週前、一週後和一個月後的測量。研究發現，閱讀跟大自然有關的激勵性訊息並回答含激勵元素問題的參與者變得更有動機去接觸大自然，這包括他們更相信大自然可以緩解壓力，更願意將自己暴露在大自然中以緩解壓力，而他們感知到的壓力亦被降低了。此外，動機增強技巧亦增加了正面的大自然回憶。

第三項研究含二至三小時的小組，內容為促進與大自然互動的森林療癒活動。分佈在七個小組中的二十八名焦慮或抑鬱患者，於小組結束後回答開放式問題和於焦點小組中作回應，從中共得出了四百四十七個陳述。分析後概括出六個有意義的主題（體驗、覺察、自我意識、欣賞、自然療法的獨特性、動機）。這些資料，加上對小組體驗的評分，發現參與者於大自然環境下情緒積極、產生正念狀態、

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改變了歸因模式、會自我反省和提升了與大自然連結的動機，大自然因此可視為認知行為治療的有效平台。最重要的是，覺察自然界的微小特徵、其聯繫和生命週期是爭論錯誤歸因的有利材料，可用以糾正引至無助感之全局、內部和永久歸因。

這三項研究均表明，大自然作為環境觸發因素有利於人類的注意力、信息處理和記憶，降低人類的壓力症狀並增加人類與大自然聯繫的動力。本文進一步討論了研究結果如何應用於臨床上，包含信息處理模型如何促進以大自然作治療的評估，動機增強工作如何驅使個人以大自然作舒緩壓力，以及如何利用大自然為平台對焦慮抑鬱者進行認知行為治療。

關鍵詞：大自然、壓力應對、心理健康、信息處理、動機、認知

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Abstract

Utilizing nature to heal stress has become a trend to fill up the service gap that traditional pharmacological and psychological therapy failed to provide. Design of nature-based program however is at its beginning stage that a structured protocol with sound theoretical base still absence. Psychological approach has a longstanding history in explaining and treating stress or its related mental health problems like its resulting emotional disorders. The present study attempts to understand nature and its impact on stress coping from the perspective of information processing, motivation, and cognition with a sake of getting a macro view on the relationship between nature and cognition.

Three studies have been involved in this dissertation, which includes (1) a randomized-controlled experiment comparing indoor and outdoor exposure, (2) a randomized-controlled online study investigating the feasibility of motivating participants to connect themselves with nature, and (3) a qualitative study to examine anxiety-depressed patients' responses including the cognitive ones in nature. Due to the pandemics, recruitment of the participants had been negatively affected but the number of participants still could meet the requirement for conducting the necessary statistical and qualitative analysis.

In the first study, 48 Taiwanese young adults (24 participants in indoor group and 24 participants in outdoor group) completed four weekly 45 min exposure sessions. The study found the outdoor group surpasses the indoor group in lowering rumination, bringing good indicator for autobiographical memory, and enhancing connectedness to nature. A significantly higher number of outdoor group participants had employed nature exposure for coping with stress or emotions after the program.

The second study contrasted a motivational enhancement approach cum additional motivational elements in public messaging with three other control groups, namely

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non-stress related message, stress related but non-nature corresponding message, and purely a motivational enhancement message. Totally 90 Taiwanese young adults were being randomly assigned to four groups. One week pre, one week and one month post measurements on motivation and wellbeing had been conducted. The study found that participants who read the motivational message and answered motivational enhancement questions had higher levels of motivation, as indicated by their greater belief that nature can relieve stress and their greater intention to expose themselves to nature for stress relief, as well as having lowered perceived stress. Besides, recalls of positive nature elements can be increased by motivational enhancement work.

The third study consists of a 2 to 3 hours' groups with common forest therapy activities that facilitating interactions with the nature. Response of the 28 anxiety-depressed patients spread across the 7 groups came up with 447 statements generated from open questionnaires and focus groups after the sessions. They were analyzed qualitatively with 6 meaningful themes (experiencing, noticing, self-awareness, appreciation, uniqueness of the therapy in the nature, motivation) resulted. Such information, further supplemented by ratings on the experience, generates a finding that participants' positive mood, mindful state, altered attribution, self-reflection and motivation in nature make nature a good platform for cognitive-behavioral therapy. Most important of all, the noticing of features, connectedness and cycle of life in the nature are favorable materials for disputing misattribution, namely global, internal and permanent, which are crucial precipitators of sense of helplessness.

The three studies shows nature as an environmental trigger is favorable to human attention, information processing and memory, lowering their stress symptoms and increasing their motivation to get connect with nature. This paper discusses how the information processing model could facilitate evaluation of nature-based treatment, the

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application of motivational enhancement work on driving individuals to go to nature, the how we can make use of nature in conducting cognitive-behavioral therapy to the anxiety-depressed.

Keywords: Nature, stress coping, mental health, information processing, motivation, cognition

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Chapter 1 Introduction of the studies

1.1 Stress as a global problem

Stressors are important risk factors for mental health (WHO, 2022). Higher level of mental distress is associated with maladaptive stress coping (Li et al. 2012; Orgeta & Orrell 2014; Raut et al. 2014). Income of countries has a positive relationship with the prevalence of mental health problems to certain extent reflect that urbanization or industrialization exposes people to higher stressors (IHME, 2019). Thirteen percent of the global population suffers from mental health problems, and common mood problems like anxiety and depression are the top ten reasons underlying global years of disability (WHO, 2022), implying how alarming mental health problems are.

Unfortunately, the seriousness of the conditions are under-resolved as only around 2% of the health budgets had gone to the mental health domains (WHO, 2021). The effect size of the most popular therapeutic approaches of anxiety-depression, namely pharmacotherapy and psychotherapy, is of great variations (Leichsenring et al., 2022). This together with other common critiques of these traditional approaches, including its non-response or even deterioration of the illness (e.g. Braud et al., 2021; Stassen et al., 2022; Klatte et al., 2018), brings an urgent need for alternative solutions. Fortunately, nature offers a possible way out for mental health problems (Bratman et al., 2019; Lee et al., 2017).

1.2 Nature and Stress Reduction

Stress-reduction theory states that natural settings trigger-off an “automatic positive affective response,” which screens out negative thoughts and feelings and lowers physiological activation (Ulrich et al., 1991). Accordingly, human has psycho-evolutionary bonding established with the nature for satisfying survival needs

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since ancient time while finding urban as strange and detached (Ulrich, 1983). There are studies proofing the notion of Stress Reduction Theory. Examples are viewing or experiencing of the nature can lower negative feelings including self-reported stress, no matter it is a natural life stress or experimentally imposed stress (Ulrich et al., 1991; Ulrich, 1979; Ulrich, 1981; Park et al., 2007; Lee et al., 2009). It can also lower physiological responses of stress like cortisol or diastolic blood pressure (Park et al., 2007; Lee et al., 2009).

1.3 Cognitive component of stress and its relationship with nature

In respect to Lazarus Theory (Lazarus, 1993), one of the famous perspective of stress, stress is a by-product of the interaction between individuals and their environment. Appraisal, as a cognitive activity, is a core mechanism underlying stress. Primary appraisal is about whether something relevant to the individual's well-being occurs, while secondary appraisal is about the coping options. The role of cognition is undeniably an important element that we have to address in designing intervention approach. Bratman et al. (2019), in proposing a conceptual model (starting from nature features, to exposure and interaction pattern) for mental health as an ecosystem service, recognized the role of cognitive functioning which could be improved by nature exposure and eventually could enhance psychological well-being. Despite the traditional psychological approach has longstanding history in associating cognition with mental health problems particularly mood disorders (Beck 1967, 1993, 2008; Ellis, 1991; Ellis & Ellis, 2011; Seligman, 1975), a structural application of psychological or cognitive perspectives on nature-based therapy has yet been arising. Understanding the benefit of nature for stress coping from a structured cognitive model, exploring motivational concern for general public to visit nature, and addressing cognitive elements to heal the

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clinical population in nature-based program, hopefully could help moving nature-based intervention towards an evidence-based approach.

1.4 Defining nature in the present study

In hectic city, life is time-competitive. Traveling to wilderness was relatively costly. In view of this, in the present study we refer nature to the relatively narrow scope, that is, urban greening. Urban greening is open-space areas specifically designed for parks and other "green spaces", which can include plant life, water features as well as other kinds of natural environment (WHO, 2017). Researches had shown that urban green land can help lowering anxiety-depression (Sugiyama et al., 2016) and enhancing stress coping (Barton & Rogerson, 2018).

1.5 Objectives of the study

The present study aims at exploring the relationship between nature and stress coping from the cognitive perspective. It attempts to combine nature with traditional psychological perspectives to test out different approaches to promote closeness to nature for human wellbeing. Detailed objectives of the three studies as follows:

Objective 1: Through referring to the Information Processing of Cognitive Model to identify cognitive-emotional variables related to nature exposure

Cognitive function is a comprehensive term that specifies the mental processes involved in knowledge acquisition, information manipulation, as well as reasoning (Kiely, 2014). Finer classification of cognitive functions could include perception, attention, memory, learning, decision-making, and language competence. Not every cognitive functioning is associated with emotional state. According to the Information

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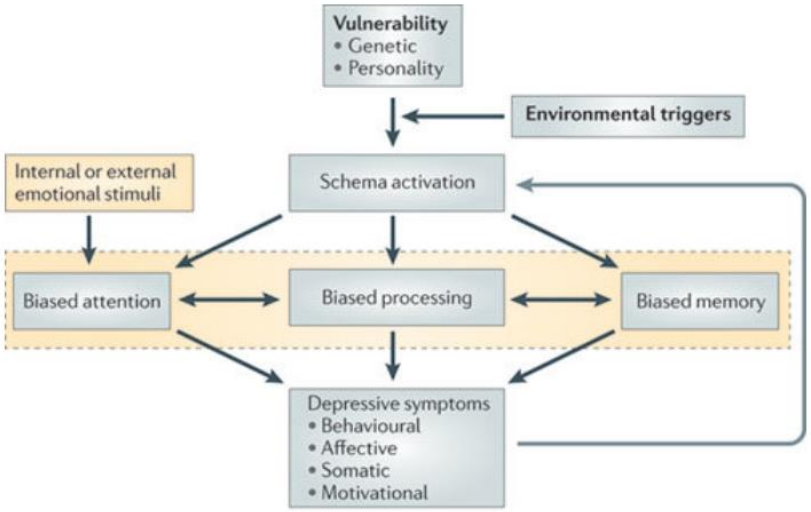
Processing of Cognitive Model (Disner et al., 2011, see Figure 1), while human have genetic and personality vulnerability to depression, environmental triggers could affect schema activation leading to biased attention, biased memory and other information processing problems like ruminations, which subsequently brings behavioral, affective, somatic and motivational symptoms of depression. Nature exposure is an environmental trigger may bring impact on the corresponding cognitive functioning that in turn affects the emotional manifestation. Therefore, the study is conducted that refers to Information Processing of Cognitive Model to identify the cognitive variables in measuring the effect of four weekly 45 minutes' visit to urban greening versus indoor environment.

Figure 1 Information processing in the cognitive model of depression (Disner et al., 2011)



Objective 2: Exploring how to motivate people to connect with nature for stress coping by motivating young adults to connect with nature for stress relief

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Western figures show that people tends to spend less time outside and more time indoors (Office for National Statistics, 2017), people spends nearly 90% of life time within buildings (Evans & McCoy, 1998), and people have fewer direct contact with the nature (Soga & Gaston, 2016). There is also a trend that people tend to use convenient ways to seek for satisfaction while they are deprived (Shah and Gardner, 2007).Echoing the western figure, local news in Taiwan (Focus Taiwan, CNA English News, 2015) reported people between ages 25-29 spent on average 10 hours more on internet per week. A significant portion of Taiwanese people at their early adulthood mentioned their stress (75%) and trouble sleeping (70%). All these figures reveals that Taiwanese are of no exception from the global trend of staying indoor, indulgence in online activities and facing active stress. While the coverage of green land in Taiwan is of more than 60% (Taiwan Forest Bureau, 2016), the usage of it is relatively low (Taiwan Forest Bureau,2018). Obviously there is space for increasing use of nature for stress coping purpose. Motivating people to make use of green land is a topic that seems to be rarely addressed in literature. A study across three European countries found that the deployment of theory- and research-based messages is most likely to persuade individuals to reduce their alcohol intake, a lifestyle problem (Abraham et al., 2007).There are some proven effective approaches, like motivational interviewing (Miller & Rollnick, 2012) which is often regarded as a supplement to Cognitive-behavioral therapy, for trial of application on lifestyle problems. The study 2 focuses on motivating people to visit nature, which is also a lifestyle problem, through established psychological approach.

Objective 3: Exploring what makes nature a good platform for conducting cognitive-behavioral therapy on anxiety-depressed patients

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For patients with active mental health problems, the use of nature should be more intensive other than simply a general motivational approach of connection with nature. In a systematic review on forest therapy for adults with depressive symptoms, 21 out of 28 studies showed significant improvement in depression (Lee et al., 2017). Programs included are walking, five senses experiencing and related therapy, forest viewing, meditation, Qi-Qong, and craftwork, etc. The study found programs using “viewing or walking in the forest” as core mode of intervention was not effective in depressive symptoms soothing. Cognitive-behavioral Therapy (CBT) is one of the most commonly adopted psychological approaches in the treatment of depressive patients. Successful application of CBT in nature has been report (e.g. Woo et al., 2012; Sung et al., 2012; Kim et al., 2009). Nevertheless all these studies mentioned about confrontation of cognition during the program are absence of further elaboration on the mechanism of changes or how the CBT techniques could be applied. Therefore, could nature environment facilitate CBT intervention and how it could attain such is still a myth. The study 3, targeting on the above questions by a qualitative study, is to explore how we can utilize nature in conducting CBT.

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Chapter 2 Literature Review

2.1 Nature's relationship with cognitive functioning: attention & memory

Restoration of cognitive ability of the nature has been raised by the Attention Restoration theory (ART) (Kaplan, 1995). The theory posits that directed attention requires conscious use of one's faculties to focus on a stimulus that attracted or demanded their attention. The individual, for the sake of focus on a particular task, must inhibit attention to the distractions. Prolonged practice of this would lead to fatigued, difficulties in concentrating and irritability. ART claims that interaction with natural environments employs faculties of concentration not normally used, which is an involuntary ones. The neural mechanisms underlying directed attention have a chance to rest and replenish (Kaplan, 1983). Evidence had been showing that a self-paced 30 min walk in a natural environment including included parkland or a canal path with vegetation resulted into greater restoration experiences and improved cognitive function than a comparable walk in a pleasant, urban-residential setting, of which could be maintained up to 30 min after leaving the environment (Gidlow et al., 2016).

Study on the difference between walk in "arboretum" and "urban group" found that the "arboretum" group performed significantly better on the memory or directed attention task than did the "urban" group (Berman et al., 2008). The authors also showed increases in positive affect (as measured through the PANAS) in the arboretum-walk group. Since working memory involves paying attention, maintaining focus and concentration to the present information, the study concluded that walking in the nature can enhance the said skills than walking in the urban.

There are studies showing relationship between residential environment and performance in cognitive assessment. It was found that the more natural a view from home, the better the performance on digit span backward, alphabet backward, the

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Stroop color-word test and even in test on delay gratification. While the authors' concern the aggregate performance on these tests correspond to a form of "self-discipline" (Taylor et al.,2002), all the said tests requires attention and focusing on the current moment reflects the nature's impact on being at the present. Similarly, a study on students' dormitory with "all natural" (trees and a lake) to "all built" (city streets, other buildings, or a brick wall) views found that students whose dormitory faced the most natural views showed better capacity in directing attention. The authors concluded that the window views had provided the opportunity for "micro-restorative activity" (Tennessen & Cimprich, 1995).

Regarding recall of memory, so far there is no study focusing on the relationship between nature and memory. A possible inference is that if the nature can restore attention, its impact on restoring the progression to more specific memory in the hierarchy of information processing can be likely. When in the stressful situation, sympathetic nervous system (SNS) is being activated, all of the body's resources are mobilized for fighting or fleeing. In such case, a very quick and automatic response is required and progression in information processing could be hindered. However, when we are in a much more relaxed state, we feel safer and the defense mechanism would be lowered. In that sense, our brain might be able to retrieve more specific memory.

2.2 Nature's relationship with cognitive functioning: rumination

Using advanced technology the relationship between cognitive functioning and nature can be shown more clearly. For instance, brief experience in nature decreases both self reported rumination and neural activity in brain areas associated with self-focused behavioral withdrawal and rumination (Bratman et al., 2015). Tang et al. (2017) used the latest functional magnetic resonance imaging (fMRI) technology to

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explore the psycho-physiological benefits from the natural environment. The study found that the brain responded differently to the urban and natural environment images in terms of the visual and attentional brain areas, with viewing natural landscapes seemingly enabled the rest of the attention system.

In Dybvik et al. (2018)'s study, 12 participants (aged 25 to 60) in residential treatment for varying nonpsychotic mental health issues were interviewed about past and present experiences with nature and the meaning of these experiences to their recovery. Combined phenomenological life world approach with thematic analysis of the data found that effect on focus and attention in the nature. The participants said their having attention shifted away from worry to sensory experience in nature like "pleasure" "powerful experience" "being awake in body" "to live in the present" "time stops". This qualitative study indicated non-psychotic clinical patients' focused attention on sensation in the nature is seemingly associated with their lowered rumination and worrisome. Another qualitative research also showed that under the nature people paid attention to positive aspects of the environment, for example, the said "Experiencing the Beauty of the Landscape" (Richardson & Hallam, 2013), feeling "awed by….for example, something powerful about watching the clouds go around the sky (Naor & Mayseless, 2020).

2.3 Nature's relationship with cognitive functioning: rumination: self-reflection

In the Attention restoration Theory (Kaplan, 1995), it is proposed that one of the element of nature is fascination which refers to the ability of an environment to generate awe in people with good enough space for reflection and retrospection. Foster & Borrie (2011) found that in the nature, away from daily routine, social constraints, technology, and routines, one has "the time and space to re-connect with others and with the greater

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creation" (p. 7). This allows focus on spirituality (Heintzman, 2009) and the sacredness of life (McDonald et al., 2009), implying a deeper reflection on life. Research on the beneficial and restorative characteristics of the natural environment support the notion that nature makes one distanced from social constraints and cultural expectations (Bobilya et al., 2011; Heintzman, 2009), implying one's freeing from restriction. Self-reflection perhaps can be enhanced as a result.

Literature reviews indicating the nature's ability to stimulate self-reflection are of quite a lot and is mostly in qualitative studies. Sonntag-Öström et al. (2015) investigated the personal experiences and perceived effects on mind for19 patients with severe exhaustion disorder (ED). They paid visits to forest for 3 months (totally 22 sessions). Through grounded theory analysis, reflective thinking was one of the theme arising. The patients mentioned that it was the positive feeling including at ease and rest that induced self-reflection. Some patients pointed out that individual solitude was one of the crucial elements that that provide an escape from social roles and demands and hence help the person explore their personal feelings.

Naor & Mayseless (2020) addresses the potential beneficial effect of experiencing spirituality in nature from the perspective of the nature-based practitioner/facilitator. In-depth interviews conducted with 26 nature-based therapists/facilitators who are of different professional backgrounds from five countries and field observations of six nature-based workshops. The experiences of nature's immensity lead to expanded world- and self-view through which the discovery of authentic self and soul was attained.

Dybvik et al.(2018) studied the significance of nature in a clinical setting and patients' perceived therapeutic value. 12 participants (aged 25 to 60) in residential treatment with varying non-psychotic mental health issues were interviewed for

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previous and present experiences with nature and its meaning for their recovery. Combined phenomenological life world approach with thematic analysis found that nature as therapy was one of the theme come up. It was said that the serenity and tranquility opening the mind and letting them think and feel differently. Nature was regarded as a place for unimpeded reflection which allows individuals to think freely while indoor therapies may have limitations.

Despite the positive finding on nature's impact on self-reflection, it could be of more complicated issue when talking about the association with mood problems. Brennan et al. (2015) found relationship between reflective pondering, memory specificity and levels of mindfulness. 276 adults with a history of at least three previous episodes of depression were involved in the study. Result shows that higher reflection was associated with less depression in all situations except when both memory specificity and mindfulness were low. Therefore, reflection, memory specificity and ability to sustain attention on the present (or so called mindfulness) are associated together in affecting mood and are better be examined globally.

2.4 Motivation to visit the nature

To inspire interest in or contact with the natural world is a mean to foster human well-being benefited from the nature. Corresponding literature is rare particularly on purposeful techniques in driving people to visit nature. Some ideas got from the literature review can stimulate us on what can motivate people to visit nature. Enjoyment was found the greatest motivator (Fraser et al., 2019; Kim et al., 2015). Qualitative materials suggested that extrinsic motivators like the environment, family, and friends were key factors in initiating and continuing green activity (Fraser et al., 2019). Escaping from daily life, pursuing new type of travel, pursuing healthy life and

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intimacy are also motivations for people to go hiking (Kim et al., 2015). For adults in specific, time availability, lack of interest, or even no reason can be the justification for not going to the nature apart from external factors like regional, seasonal and annual effects (Boyd et al., 2018). As intrinsic motivators are found as more important in adherence to green exercise (Fraser et al., 2018), it would be valuable to investigate how to strengthen such intrinsic motivation. In such, traditional psychological approach arising from Self-determination theory (Ryan & Deci, 2000; 2017) or motivational interviewing techniques (Miller & Rollnick, 2002) can be explored for enhancing human's motivation to get connected with nature.

2.5 Connectedness to nature

Connectedness to nature relates to an individual's subjective sense of their relationship with the natural world. While meta-analysis has found that those being more connected to nature tend to have more positive affect, vitality, and life satisfaction, which are indicator of hedonic well-being (Capaldi et al. 2014). There is however evidence showing that the relationship between connectedness to nature with eudaimonic well-being is higher than the current mood and subjective well-being (e.g. Cervinka et al. 2012; Howell et al. 2013). A recent meta-analysis found individuals who are more connected to nature tend to have greater eudaimonic well-being, particularly having higher levels of self-reported personal growth (Pritchard et al., 2019). Evidence of the association between connectedness to nature with hedonic and eudaimonic well-being implies the value of enhancing human's nature connectedness. While there could be many variables (like personality) associated with nature connectedness, direct experience, simple engagement and noticing nature are essential elements to developing nature connectedness (McEwan et al. 2019; Richardson et al.

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2022).

2.6 Nature-based therapy's impact on cognition

Cognitive-behavioral Therapy has been widely applied in treatments of mood disorders, such as anxiety and depression (e.g. meta-analysis by Twomey et al., 2015; Watts et al., 2015). According to Beck et al., (1979), cognitive distortions, including those about the persons themselves, the world, the future, misrepresent reality, causing impairment and distress, and hindering problem resolution. Individuals become depressed because they come to believe they are incapable of controlling reinforcements around them (Seligman, 1975).

Unlike synthetic environments, natural environments might have qualities that promote health and well-being A well-known study showing such impact was a randomised controlled trial that compared a nature-based therapy namely Nacadia® NBT (NNBT) with the cognitive–behavioural therapy on individuals suffering from Severe Bodily Distress Syndromes (Stigsdotter et al., 2018). Both treatments were found to be resulted in a significant increase in the Psychological General Well-Being Index and a decrease in burnout which were both sustained 12 months later, supporting the application of nature-based program for treatment of mood problem.

The combination of the two evidence-based approaches, namely nature-based program and CBT is in the relatively early stages of its application. Some promising results have already been reported. For example, staying in forests with CBT programs yields better results when compared to staying in the same environments without any programs for depressed patients (Woo et al., 2012). CBT forest therapy programs involving participants' self-reflections and goal setting has resulted in a significant decrease in salivary cortisol, a biomarker of stress, an increase in quality of

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life, and a decrease in anxiety (Sung et al., 2012). Four weeks' forest CBT programs focusing on patients' reflections and cognitive error reconstructions has resulted in a lower rate of recurrence of depressive symptoms and has enhanced social adjustment (Kim et al., 2009).

Since cognitive-behavioral therapy is a very common approach in treating anxiety-depressed patients and the application of it in nature is now getting popular, a qualitative method to generate perspectives on how to utilize nature in a cognitive-behavioral approach is valuable for future program design.

2.7 Concluding remarks from the literature review

The above literature review shows that there are some evidences of the impact of nature on cognitions of which could have impact on mood functioning. Connecting with nature have positive impact on human well-being and could be enhanced purposefully. It's worth to validate the impact of nature from a structured psychological framework, say information processing model which is of cognitive base. At the same time, through two approaches, motivational enhancement for connecting with nature and structured nature-based program, we could further test whether cognitively and emotionally people can benefit from nature connection.

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Chapter 3 Methodology

3.1. Study 1: Cognitive-Emotional Benefits of Weekly Exposure to Nature: A Taiwanese Study on Young Adults[1]

3.1.1 Introduction

Depression is the third leading cause of disease worldwide. Its onset ranges from mid-adolescence to middle age (Malhi et al., 2018), and there is an increasing trend of depression internationally in the college student population (Liu et al., 2019). In Taiwan, 15.1% of a community sample reported depressive symptoms, with younger age (those in an age group of 20 to 44) being a variable significantly related to a higher depression rate (Hu et al, 2021). Apart from psychiatric and psychological interventions as treatments, systematic review and meta-analysis has revealed the effects of nature-based interventions on mental health (Kotera et al., 2020), depression, and anxiety (Kotera et al., 2021). There is demand for more evidence-based support of the long-term outcomes and effects on behavior that nature-based programs produce (Kondo et al., 2020), as well as demand for more evidence-based encouragement for people to be physically active in nature (Leung et al., 2012; Koselka et al., 2019).

Identify Evidence-Based Outcome Measurements

Identifying outcome measurement accurately can result in better representation of what the benefits of nature exposure are. According to Bratman et al. (2019), the production of affective benefits from nature experiences may occur through multiple psychological causal mechanisms and pathways, including decreased stress and negative affect, increased subjective well-being and positive affect via connectedness to

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nature, and regulation of affect as guided by cognitive processes.

The cognitive model of depression may help explain how depression develops and is maintained, and the model can provide insight regarding which outcome measurement is best for evaluating affect-regulation-related cognitive changes in nature, as was mentioned by Bratman et al. (2019). According to Beck (1967, 1987, 2008), biased acquisition and processing of information play a primary role in the development and maintenance of depression. Latent schemas, which are internally stored representations of stimuli, ideas, and experiences, can be activated by internal events or external environmental events and can influence the processing of incoming information. Supported by neurobiological data, Disner et al. (2011) highlighted how biased attention, memory, and thought are interrelated with biased information processing, which results from neurobiological malfunctioning. Attention to stimuli with a negative valence blocks out the processing of potentially more positive information. Ruminative thought patterns constantly remind the individual of their own perceived flaws. While biased memory is related to biased attention and processing, there is a difference in autobiographical memory recall (i.e., less specific but excessive generalization in memory) between depressed and non-depressed patients. Ample empirical evidence explains the relationships between depression and biased attention (Beevers et al., 2011; Mennen et al., 2019; Sanchez et al., 2013), biased memory (Hallford et al., 2020; Jiang et al., 2020; Liu et al., 2017), and ruminative thoughts (Kovács et al., 2020; Wilkinson et al., 2013), and through intervention, these biases can be modified (Beevers et al., 2015;Hitchcock et al., 2016; Parmentier et al., 2019;Raes et al., 2009).

In Beck's model, negative views held by depressed individuals about themselves, the world, and the future form a cognitive triad (Beck, 1967), and depression is instituted by one's view of oneself. Therefore, while Disner et al.'s model (Disner et al.,

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2011) can help identify cognitive constructs empirically related to depression, it is crucial to consider self-referential thinking, which entails an individual relating information from the external world to themselves. Therefore, in evaluating a nature-exposure program, it is worth identifying the cognitive variables, particularly those with self-referential properties, that nature may positively influence in people.

Robust findings of nature's impact on attention have mainly focused on restored or sustained attention (Amicone et al., 2018; Berto, 2005; Hartig et al., 2003;Qiu et al., 2021), which do not specifically concern attention on oneself. Another impact nature may have on attention is attention shifting or attentional deployment (Bratman et al., 2019). Research indicates some aspects of natural environments allow for "positive distraction" away from the self (Jiang et al., 2019; Nolen-Hoeksema et al., 2008; Roelofs et al., 2009) and attention driven specifically to the aesthetic qualities of nature (Capaldi et al., 2017; Zhang et al., 2014; Harrison et al., 2020). Studies demonstrating a greater appreciation of the body's function or image after nature exposure (Swami et al., 2016, 2020) demonstrate how attention related to oneself can be shifted to be more positive because of the influence of nature. Evidence of whether exposure to nature can influence attention to the global self and others has yet to be established.

Rumination is focused attention to one's distress and carries a self-referential property. As for nature's impact on rumination, however, findings are still emerging. Nature exposure's impact on reducing rumination has not yet been confirmed as a cognitive domain in a meta-analysis (Stevenson et al., 2018) and currently is not viewed as an evidence-based mental health benefit (Bratman et al., 2019).

Nevertheless, isolated findings indicate the effects. Among healthy participants, walking in nature reduced ruminative thoughts, while walking in an urban setting did not have the same result, whether the walk was 90 min (Bratman et al., 2015) or as short

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as 30 min (Lopes et al., 2020). More data is needed to build an evidence base for the relationship between nature exposure and rumination.

Empirical evidence on memory centers around the relationship between working memory and exposure to nature, though the findings are not consistent (Koselka et al., 2019; Bratman et al., 2015; Berman et al., 2012;Dadvand et al., 2015; De Brito et al., 2019; Fuegen & Breitenbecher, 2018;Perkins et al., 2011). Evidence, however, has not yet been established for a relationship between nature and autobiographical memory, a memory system that is a marker of depression and consists of episodes recollected from an individual's life. Given the presence of stress impairs the ability to access consolidated autobiographical memories (Sheldon et al., 2018), we expect overgeneral autobiographical memory would be lowered and specific autobiographical memory would be increased during exposure to nature. Nature's restorative effects (Kaplan& Kaplan, 1989; Kaplan, 1995) may render individuals less preoccupied by distressing thoughts; as a result, bottom-up information processing and, ultimately, specific retrieval of memory could be more likely.

Measurements of self-reflection, one of the cognitive domains, were not listed either in the available quantitative studies of nature or in Disner et al.'s model (Disner et al., 2011) of depression. The Attention Restoration Theory (Kaplan, 1995) addresses the ability of an environment to improve concentration and mental fatigue. Themes related to "reflective thinking" (Sonntag-Öström a et al., 2015), "expanding personal perspective," and "inspiring a discovery of self" (Naor & Mayseless, 2020) have emerged from qualitative studies of nature experiences. A reduction in stress while in nature facilitates enhanced reappraisal capability (Sheppes et al., 2011) and mental flexibility (Stevenson et al., 2018). Each of these potentially contributes to increased self-reflection and self-insight in nature. The resulting reappraisal counteracts the tunnel

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vision of depressed patients and, thus, may be beneficial to emotional functioning.

In short, work addressing treatment for depression is in demand for Taiwanese young adults. Both the latest views of nature's benefits and traditional views of depression consistently point to the importance of exploring its cognitive elements. The above literature review narrowed down the cognitive domains that may be improved during nature exposure, in addition to serving as an important guide for identifying evidence-based evaluation tools that may reflect cognitive changes in nature corresponding to affective problems, particularly those related to depression.

Define Evidence-Based Nature Experience

To measure nature's impact on human cognitive and emotional functioning, an evidence-based program is required. Bratman et al.(2019) 's ecosystem service perspective provided a suitable reference for establishing program content.

Nature. Whereas biodiversity (Bratman et al., 2019) and "being away" (Kaplan& Kaplan, 1989) are acknowledged as favorable aspects of natural settings for a healing experience, travelling distance may hinder individuals (Calogiuri & Chroni, 2014). Though systematic review revealed urban green spaces have mixed associations with a reduction in depression, in general, nature exposure has an association with positive emotions (Kondo et al., 2018). This favors hosting of a therapy program in a park to accommodate the busy lives of people living in urban areas.

Exposure. Exposure refers to the amount of contact with nature (Bratman et al., 2019). A systematic review of nature and human attention revealed the duration of exposure to environmental treatments has varied from 40 s to three hours, across one session or multiple sessions (Stevenson et al., 2018). Two nature-exposure programs, one targeting ruminative thoughts (Bratman et al., 2015) and one targeting psychological states (Koselka et al., 2019), hosted walks in nature of 90 min and 50 min, respectively.

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Research focusing on the longitudinal effects and sustainability of nature's impact on adult health is in demand (Kondo et al., 2020).

Experience. Cultivating appropriate sensory qualities is a priority for nature experiences, as is building interaction patterns (Bratman et al., 2019). Walking is the most frequently employed mode of physical engagement and exposure in nature (Steveson et al., 2018). Having participants complete the journey alone is a common approach in studying nature exposure and cognition and psychological state (Koselka et al., 2019; Bratman et al., 2015). Hunter et al. (2019) allowed participants to freely immerse in nature by walking, sitting, or doing both, adjusted time duration for each weekly experience, and suggested behaviors to avoid during the nature experience (e.g., physical exercise, phone calls, etc.). This approach addresses autonomy, a fundamental need linked to the health and psychological well-being of emerging adults (Inguglia et al., 2015; Melendro et al., 2020), which should be regarded as an essential element in designing a nature experience.

Through identifying evidence-based outcome measurement and defining the program that has yielded desirable findings in prior research, we want to find the true differences in effect between green spaces and the indoors on cognitive and emotional changes.

3.1.2 Methods

Study Hypothesis, Design and Content

We examined the cognitive and emotional effects for young adults of staying in urban green spaces, with an assumption that green space is superior to an indoor environment in yielding positive effects. While our focus was on the difference between one week pre- and one month post-test, we also took the measurement immediately after

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the weekly session in order to examine the trend of the changes as the sessions proceeded, which we anticipated should, for the outdoor group, show progressively enhanced positive indicators of well-being (such as attention to positive information or self-reflection and insight) and progressively lowering negative indicators (such as rumination or anxiety-depressive symptoms). Given nature experiences can change one's behavioral orientation towards nature, we wanted to explore whether there would be any difference between the two groups after the program in their number of visits to nature or their utilization of nature exposure for coping with emotions or stress.

Regarding nature selection, we chose Drunken Moon Lake, the largest and most easily accessible green space area at National Taiwan University (NTU). The path around the lake is nearly 480 m and has shaded grassland under the trees. The biodiversity of the park is rich, with ducks, geese, birds, fish, and squirrels easily seen despite the presence of manmade constructions such as stalls and teaching buildings. In general, this area grants a sense of serenity and connection to nature. As for the indoor group serving as a comparison group, due to the pandemic and entry restrictions in most faculties, we chose a forestry building that allowed for quality monitoring. The venue is a four-story building with corridors shorter than 100 m and a conference room in which the participants could freely move around during the program sessions. Lights and air ventilation were activated during sessions. To make the environment less congested for the indoor group, we restricted the number of participants to eight per session. Each session took place on a weekday and was conducted at 11:30 a.m. for the outdoor group and 1:00 p.m. for indoor group to avoid the peak hours of the usage of the park and the building, correspondingly. See Figure 2 and Figure 3 for images from the indoor and outdoor groups, respectively.

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Figure 2 Picture of Study 1 Indoor Group.

(Yeung & Yu, 2022a)

Figure 3 Picture of Study 2 Outdoor Group on Rainy Days. (Yeung & Yu, 2022a)

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For the exposure, we arranged for four weekly 45 min visits to observe the impact of exposure to the same green space over a series of sessions. Some degree of flexibility was allowed for the participants to schedule the weekly sessions, that is, at most two days earlier or later than the original schedule, to accommodate their routine. As a result, the sessions were spaced out over an interval of five to nine days. For the experience, walking, sitting alone, or doing both were allowed, while it was recommended not to sleep, conversate, use a cell phone, perform physical exercise, or eat. To reduce interference by insects, outdoor group participants were advised to wear pants and long sleeves. A raincoat, transparent umbrella, and mosquito repellent were provided so participants could appreciate the environment in any conditions. Two sessions were rescheduled, one due to heavy rain and one due to chilly weather.

The participants were gathered at the entrance of the largest park on the NTU main campus for the outdoor group and in front of the forestry building for the indoor group. All participants had to silence their phones and set a 45 min alarm before starting a session. Both groups completed questionnaires onsite immediately after the session. The indoor group completed the questionnaire in the conference room, and the outdoor group completed it in the park (or a covered area near the park on rainy days) with a writing pad provided. The participants could earn $1300 Taiwanese dollars upon completion of the four participation sessions of the program, the one-week-pre-test and one-month-post-test sessions, and an online questionnaire one week after the fourth session. The right to withdraw from the study was established, while confidentiality of all participant information was strictly upheld. Briefing was conducted, with a consent form signed before administration of the pre-test (see Figure 4 for the study's flowchart).

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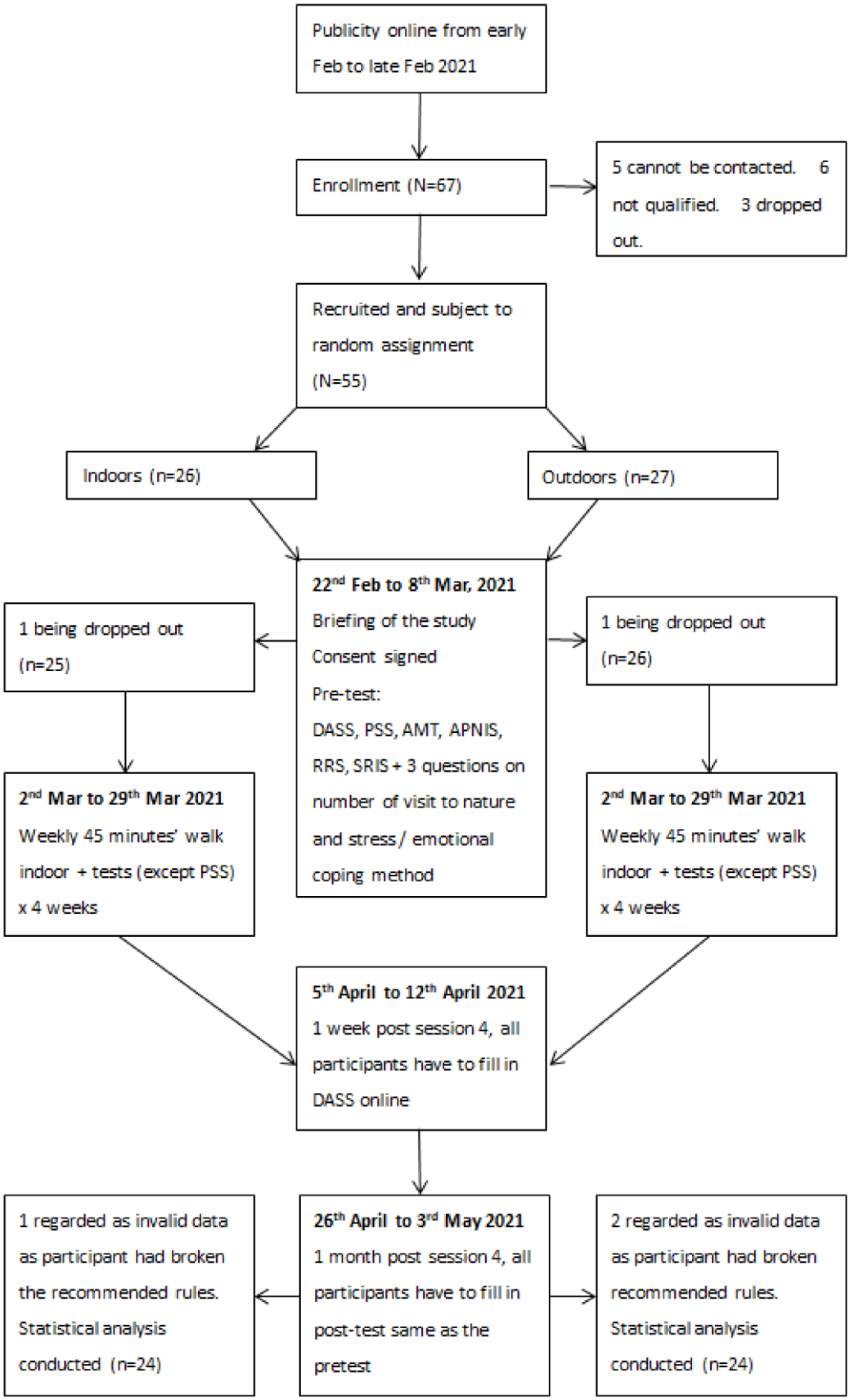
Figure 4 Flowchart of Study 1(Yeung & Yu, 2022a)



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We used an online messaging platform to remind the participants a day before each session or test. One member of the research team was present in the park or the forestry building for observation of any abnormalities or non-compliance with the recommendations of the program. They observed one participant depart from the park and two participants use their phones. These three cases were not included in the final evaluation. The study was approved by Ethical Review of National Taiwan University (Case no.: 202008HS011).

Participants

A statistical power analysis was performed using GPower 3.1.9.7. (Faul et al., 2009) to estimate sample size for a repeated-measures ANOVA. A medium (Cohen's d = 0.50) effect size assuming alpha = 0.05 and power = 0.80 yielded a total sample size of 22. University students of age above 21 were recruited from an online social media platform. In total, 48 participants managed to complete all measurements and the four sessions of the program without breaching the behavioral recommendations. The number of participants is regarded as sufficient to yield the intended statistical effect. Regarding demographics, 52.1% of the participants were male (mean age = 25.08 years, SD = 2.20), and 47.9% were female (mean age = 25.91 years, SD = 5.66). The majority of participants came from NTU (81.3%), while the others represented six other universities. Most were undergraduates, with 64.6% studying in Bachelor's programs, while 35.4% were in Master's programs. Random assignment to indoor and outdoor groups, with insignificant differences in age [$t(46) = 1.35$, $p > 0.05$], sex [$\chi2(1) = 0.08$, $p > 0.05$], and affiliated academic programs (i.e., Bachelor vs. Master) [$\chi2(1) = 0.82$, $p > 0.05$] are noted.

Measurements

The Depression Anxiety Stress Scale—21 items (DASS-21) (1 week pre-test,

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immediately after each session, 1 week and 1 month post-test), self-rating last week's situation on a four-point Likert scale, was used to measure the emotional states of depression, anxiety, and stress (Lovibond &Lovibond, 1995a; Lovibond, S.H.; Lovibond, 1995b). DASS-21's total score reflects general or affective distress. The three-factor structure of the scale has been validated for nonclinical (Lovibond& Lovibond, 1995a) and clinical studies (Brown et al., 1997). Its suitability for regular assessment and treatment evaluation has been established (Moussa et al., 2017). For the depression, anxiety, and stress subscales, Cronbach's alphas of 0.84, 0.79, and 0.83 were yielded, respectively. Good factor structure (CFA = 0.959, RMSEA = 0.063) for the Taiwanese college student sample (Zanon et al., 2021) and a convergent validity with the Chinese Beck Depression Inventory and the Chinese State-Trait Anxiety Inventory in a Chinese college student sample (Wang et al., 2016) are reported. In this study, we employed the adapted Chinese scale (Moussa et al., 2001).

Because the questionnaire was to evaluate the conditions of the previous week, we arranged an online evaluation one week after session four to reflect the impact of session four.

The Perceived Stress Scale—10 items (PSS-10) (1 week pre-test, 1 month post-test), originally a 14-item scale (PSS-14), measures the perception of global levels of stress in the past month and is applicable for any population (Cohen et al., 1983; Cohen et al., 1994). Its shorter version, PSS-10, is comprised of 10 items rated on a five-point Likert scale and is reported to be of a superior psychometric property (Cohen, 1988;Lee, 2012). Its high validity has been reported in assessing perceived stress among Chinese adolescents or adults, with Cronbach's alpha varying from 0.79 to 0.83 and a concurrent validity on indices of anxiety and depression (Liu et al., 2020; She et al., 2021). The present study employed the Chinese version of PSS by Chu and Kao (Chu &

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Kao, 2005).

The rumination subscale of the Ruminative Response Scale (RRS) (1 week pre-test, immediately after each session, and 1 month post-test), a subscale of the Response Styles Questionnaire (Nolen-Hoeksema & Morrow, 1991), consists of 22 items that assess repetitive, self-focused thought processes about the meanings, causes, and consequences of one's negative affect (e.g., "Think why I always react this way" and "Think about how alone you feel"). The items are rated on a four-point Likert scale ranging from 1 (almost never) to 4 (almost always), with higher sums of scores indicating greater rumination. The RRS has high internal consistency (0.97) (Zvolensky et al., 2018) and test–retest reliability ($r = 0.67$) (Treynor et al., 2003). It had been employed in a study involving cognitive measures of the impact of nature viewing (Meuwese et al., 2021). Studies have demonstrated the ability of the scale to capture within-person variation in depressive brooding (Brose et al., 2020) and real changes in rumination over a two-month period (He et al., 2021). The present study employed the translated and validated 13-item symptom-based rumination subscale, with high concurrent validity with Beck Depression Inventory ($r = 0.79$, $p < 0.001$) in the Taiwanese population (Huang et al., 2015).

The Autobiographical Memory Test (AMT) (1 week pre-test, immediately after each session, and 1 month post-test) (Williams& Broadbent, 1986) was employed to assess specific or overgeneral autobiographical memory, which are considered cognitive vulnerability factors and concurrent depressive symptoms (Van Vreeswijk & de Wilde, 2004; Williams et al., 2007). The AMT has been administered to adolescents (Griffith et al., 2012a; 2012b) and young adults (Fishman& Ashbaugh, 2022; Warne& Rice, 2022). It differentiated in a Taiwanese population the depressed from the non-depressed, who reported fewer specific and more categorical autobiographical memories (Dritschel et

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al., 2011).

In AMT, respondents are presented with positive and emotional cue words and are asked to recall and describe personal memories of which those cue words remind them (Williams& Broadbent, 1986). With consent obtained, we adapted the online version of the Autobiographical Memory Test (AMT) (Williams& Broadbent, 1986). We followed Hallford et al.'s approach (Hallford et al., 2018) (p. 898), in that "the participants were not explicitly advised to recall specific AMs, but rather just to recall a personal event from their life that could not be from the past week or have been mentioned multiple times. They were asked to state as many details as they could in relation to the event but were not given a definition of a specific AM or practice cues." In addition, there was no time limit for how long participants had to respond to each cue word. This approach for investigating AMT seems more valid and more sensitive to individual differences in non-clinical samples that tend to have a greater proportion of specific memories (Debeer et al., 2009; Griffith et al., 2009).

Addressing the cultural uniqueness of cue words, we generated a bank of 60 total positive and negative words by referencing Asian studies (Liu et al., 2017;Dritschel et al., 2011;Takano et al., 2017) and Western studies (Hallford et al., 2018;Martens et al., 2019; Witheridge et al., 2010). Repeated words were deleted. The final emotional or adjective word bank for positive words was 25 words, and for negative words, it was 28 words. Six additional positive words (achieved, beautiful, committed, free, funny, and grateful) and two additional negative words (fear and vigilance) were added by searching online discussion platforms and Chinese studies of emotions (Shyi et al., 2006). Each set of the AMT test was 10 words, 5 positive and 5 negative, in alternate order. The six sets of tests had previously been trial-tested on 10 young adults to ascertain the comprehensibility of the instructions and words. Coding was performed

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based on established criteria (William & Broadbent, 1986). Twenty responses (200 items in total) were coded as specific, categorical, extended, or semantic by two coders who were at least of graduate qualification in psychology. The intraclass correlation coefficient (ICC) of 0.88 for the two independent scorers should be regarded as reflection of excellent agreement among the two coders (Fleiss, 1986).

As such, one of the coders completed all the residual ratings. We treated AMT as a unifactorial structure (Takano et al., 2017) and added the positive and negative items together for analysis. We conceptualized overgeneral AM as including categorical and extended AM (Bunnell & Greenhoot, 2018), so we summed these two items to obtain the overgeneral AM.

The scale of Attention to Positive and Negative Information (APNI) (1 week pre-test, immediately after each session, and 1 month post-test) (Noguchi& Gohm, 2006) is 40 items. It is rated on five-point Likert scale for cognitive tendencies (including attend to, think about, and focus on) for either positive (Attention to Positive Information, API; 22 items) or negative information (Attention to Negative Information, ANI; 18 items). Samples of the items are “I pay attention to things that lift me up” and “I notice when something is not going well even if it’s a trivial thing.” Attention to positive information (Cronbach’s alpha = 0.84) was positively correlated with positive affectivity and negatively correlated with negative affectivity, whereas attention to negative information (Cronbach’s alpha = 0.72) was positively correlated with negative affectivity (Noguchi & Gohm, 2006). The Cronbach’s alphas of the API subscale and APN subscale were 0.87 and 0.84, respectively, in a Chinese sample (Chan et al., 2011). The present study employed its translated version (Chan et al., 2011).

The Self-Reflection and Insight Scale (SRIS) (1 week pre-test, immediately after each session, and 1 month post-test) (Grant et al., 2002), which is 20 items in total, is

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comprised of self-reflection (SRIS-SR) and insight (SRIS-IN) subscales. Its sample questions are: “It is important to me to try to understand what my feelings mean” (self-reflection) and “Thinking about my thoughts makes me more confused” (insight). The test–retest reliability of its seven-week period was 0.77 (SRIS-SR) and 0.78 (SRIS-IN). The SRIS-SR positively correlated with anxiety and stress, while the SRIS-IN negatively correlated with depression, anxiety, and stress. The present study employed the 12-item SRIS-Chinese (SRIS-C) scale that was found to have Cronbach’s alphas of 0.79, 0.87, and 0.83 for total, SRIS-SR (seven items), and SRIS-IN (five items), respectively, as well as a three-week test–retest reliability of 0.74 among Taiwanese college students (Chen et al., 2016).

The Connectedness to Nature Scale (CNS) (1 week pre-test, immediately after each session, and 1 month post-test) assesses the “experiential sense of oneness with the natural world” of individuals (Mayer & Frantz, 2004) (p. 504) or the cognitive identity dimension of one’s relationship with nature (Perrin& Benassi, 2009). Being a 14-item inventory rated on a five-point Likert scale, CNS is of a single factor and possesses high internal consistency ($\alpha = 0.84$) and test–retest reliability ($r = 0.79$) (Mayer & Frantz, 2004). Its inverse correlation with perceived stress ($r = -0.16$, $p = 0.01$), anxiety ($r = -0.11$, $p = 0.04$), and depression ($r = -0.15$, $p = 0.04$) (Huynh & Torquati, 2019) as well as its positive correlation with subjective well-being (Zhang& Howell, 2014) have been reported. Because CNS can be utilized for evaluating whether interventions can increase a person’s contact with nature (Mayer & Frantz, 2004), it is a suitable indicator of whether our program design could successfully manipulate nature exposure. The present study employed Li & Cao’s (2020) translated and validated CNS, which had a Cronbach’s alpha of 0.90.

Frequency of visits to nature and emotional or stress coping method (1 week

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pre-test and 1 month post-test) are constructed items in this study for investigating changes in participants' daily interactions with nature, which could be an indicator of motivation to continuously seek connection with nature and should be favorable for well-being. One week before and one month after the study, we required participants to specify their number of 45 min visits to nature by themselves or with family and friends in the past month and to provide three emotion or stress coping methods they had employed. After studying the descriptive statistic of frequency of visits, we recoded the frequency as 0 to 4, corresponding with those numbers of visits, and 5 if the frequency of visits was five or more. Meanwhile, we studied the emotional coping methods listed by the participants and treated the answer as 0 or 1, dependent upon whether nature exposure as an emotional coping method was present in the past month.

We acknowledge there was concern for some of the assessments, such the scale of APNI and SRIS, being administered immediately after the session, given it is uncertain whether self-referential thinking could be transformed immediately after a session. The same concern applied for DASS, as the instrument assesses the condition of the past week, and measurement immediately after the session may not reflect the effects potentially caused by the session. Nevertheless, to make the assessment easier to complete during the pandemic when physical gathering of the participants was not encouraged, we arranged all questionnaires to be administered at once after each session. The difference between one week pre-test and one month post-test was our main focus, while each session's data served as a reference to monitor the tendency of changes. It was an explorative effort, given that APNI and SRIS had not been employed in empirical studies of nature experiences as far as we were aware. For the same reason of simplifying the study protocol during the pandemic, we limited our evaluations to one week pre-test, four program sessions, and one month post-test (without taking one week

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post-test), as we wanted to explore the impacts of nature exposure at a longer duration. A one-time brief online post-test evaluation aimed only at evaluating the impact of the fourth session of nature exposure on DASS-21 was administered that asked participants to report their situation over the past last week.

Method of Analysis

The data were analyzed in SPSS statistics 27. We calculated the reliability, mean, and standard deviation of all the measurements. Two-way repeated-measures ANOVA was performed for all measurements, except PSS, because it only had pre-test and post-test measurements, in order to examine the main effect as well as the interaction the effect of time and group. For the repeated measures, we adjusted the degrees of freedom to Greenhouse–Geisser (when Epsilon of Greenhouse–Geisser was <0.75) or Huynh–Feldt (when Epsilon of Greenhouse–Geisser was >0.75) when the test of sphericity was significant (Navarro & Foxcroft, 2022). For AMT, we produced scale data arising from frequency counts. For DASS total scale and subscales, the scales were square-root transformed to meet the assumptions of normality and constant variance. A visual inspection of model residuals was used to test whether model assumptions were being met. A less stringent LSD test was employed for the DASS depression subscale, for which no significant pairwise comparison was yielded in the multivariate test by using Bonferroni. Across all other pairwise comparisons, we employed Bonferroni in the subscales.

For PSS, which was measured only at one week pre-test and one month post-session, Analysis of Covariance (ANCOVA) was performed. The effectiveness of the indoor vs. outdoor group in reducing PSS was compared with the difference in the pre-PSS score treated as a covariate. Finally, we conducted t-test to compare the indoor and outdoor groups' frequency of paying 45 min visit to nature in the last month as well

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as their employment of nature for stress or emotional coping.

3.1.3 Results

Reliability, Means, and Standard Deviations of the Measurements

Table 1 lists the reliability, means, and standard deviations of the measurements broken down into indoor and outdoor groups. As noted, the anxiety subscale of DASS and the negative information subscale of APNI had Cochbach's Alphas lower than 0.80 for a number of the measurements. The reliability of all other scales was within or approached the good-to-excellent range.

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Table 1 Reliability, means, and standard deviations of the measurements (N = 48) by indoor and outdoor of Study 1. (Yeung & Yu, 2022a)

	Time	Reliability	Indoor		Outdoor	
			M	SD	M	SD
DASS_depression (7 items)	1 week pre	0.82	4.50	4.63	4.92	4.042
	Session 1	0.86	3.67	4.08	4.17	3.71
	Session 2	0.92	3.00	4.33	3.88	5.10
	Session 3	0.87	4.38	4.77	3.46	3.40
	Session 4	0.90	3.63	4.81	2.92	3.30
	1 week post	0.89	3.04	4.28	3.38	4.23
	1 month post	0.90	4.25	5.19	3.08	3.61
DASS_anxiety(7 items)	1 week pre	0.78	5.00	4.28	3.67	3.13
	Session 1	0.72	4.71	3.78	3.17	2.79
	Session 2	0.68	4.46	3.48	2.38	2.10
	Session 3	0.77	3.17	2.57	3.25	3.66
	Session 4	0.77	3.13	3.48	2.54	2.96
	1 week post	0.82	2.96	3.13	2.92	4.16
	1 month post	0.80	3.67	3.50	3.46	3.79
DASS_stress (7 items)	1 week pre	0.78	7.71	4.2	6.79	4.48
	Session 1	0.84	6.88	4.46	6.25	4.6
	Session 2	0.81	8.08	4.88	5.42	3.35
	Session 3	0.88	6.29	4.18	5.71	5.40
	Session 4	0.90	6.21	5.31	4.33	4.10
	1 week post	0.86	5.54	4.46	4.92	4.13
	1 month post	0.86	5.92	4.34	6.21	4.77
DASS_total (21 items)	1 week pre	0.91	17.21	11.86	15.38	10.38
	Session 1	0.91	15.25	11.00	13.58	9.55
	Session 2	0.90	15.54	11.17	11.67	8.16
	Session 3	0.93	13.83	10.18	12.42	11.22
	Session 4	0.95	12.96	12.95	9.79	9.63
	1 week post	0.94	11.54	10.93	11.21	11.82
	1 month post	0.93	13.83	11.27	12.751	10.77
PSS (14 items)	1 week pre	0.87	30.21	7.97	30.63	6.23
	1 month post	0.89	28.58	7.13	30.21	6.97
RRS_rumination (13 items)	1 week pre	0.85	27.17	7.43	28.54	7.46

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	Time	Reliability	Indoor		Outdoor	
			M	SD	M	SD
	Session 1	0.89	25.38	8.69	27.88	6.04
	Session 2	0.89	27.04	9.02	24.58	6.09
	Session 3	0.94	27.42	10.24	24.71	8.97
	Session 4	0.88	25.75	10.40	23.29	6.50
	1 month post	0.91	25.29	8.53	23.45	7.79
APNI_positive information (22 items)	1 week pre	0.78	56.38	6.85	56.33	7.13
	Session 1	0.87	55.58	9.21	57.29	6.77
	Session 2	0.89	54.00	8.56	56.13	9.52
	Session 3	0.89	55.75	8.70	54.67	9.89
	Session 4	0.89	55.42	7.98	57.29	8.51
	1 month post	0.88	56.54	7.70	56.17	9.42
APNI_negative information (18 items)	1 week pre	0.66	37.96	5.30	39.17	6.06
	Session 1	0.69	37.96	6.00	39.75	5.39
	Session 2	0.73	38.46	5.05	38.04	6.64
	Session 3	0.75	38.33	5.96	38.25	6.74
	Session 4	0.73	37.75	5.70	37.46	6.56
	1 month post	0.77	37.58	6.61	38.83	6.55
SRIS_self-reflection (7 items)	1 week pre	0.89	29.71	7.421	32.58	5.80
	Session 1	0.89	29.96	6.85	33.00	5.93
	Session 2	0.88	30.51	6.89	31.67	5.87
	Session 3	0.90	28.55	6.61	32.29	6.43
	Session 4	0.96	28.13	8.03	32.50	6.84
	1 month post	0.88	28.42	7.45	32.29	5.53
SRIS_insight (5 items)	1 week pre	0.75	20.54	4.81	21.71	5.06
	Session 1	0.80	20.25	5.12	21.25	4.37
	Session 2	0.87	19.50	5.73	22.46	4.99
	Session 3	0.78	20.92	4.54	21.00	4.56
	Session 4	0.87	20.38	5.39	23.04	4.53
	1 month post	0.90	22.46	4.70	22.71	5.84
CNS (14 items)	1 week pre	0.83	48.96	8.46	50.29	9.18
	Session 1	0.87	50.42	8.00	53.17	9.07

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	Time	Reliability	Indoor		Outdoor	
			M	SD	M	SD
	Session 2	0.85	49.38	7.65	53.79	8.47
	Session 3	0.89	50.79	7.85	54.04	10.39
	Session 4	0.89	50.08	8.10	55.63	9.35
	1 month post	0.93	49.92	8.37	56.79	11.39
AMT_specific	1 week pre	N.A.	3.71	1.92	4.42	2.06
	Session 1	N.A.	2.50	1.79	2.96	2.37
	Session 2	N.A.	2.92	1.86	3.63	1.71
	Session 3	N.A.	2.79	1.69	4.33	1.86
	Session 4	N.A.	2.46	1.61	4.96	2.27
	1 month post	N.A.	3.75	2.33	4.08	1.79
AMT_over-general	1 week pre	N.A.	5.83	2.06	4.92	1.82
	Session 1	N.A.	6.50	2.02	5.92	2.32
	Session 2	N.A.	5.33	2.51	4.58	2.04
	Session 3	N.A.	6.13	1.83	4.38	1.61
	Session 4	N.A.	6.63	1.84	4.25	1.89
	1 month post	N.A.	4.79	1.77	4.79	1.59
Frequency of visit to nature with family/friends for 45 min (1 single item)	1 week pre	N.A.	2.33	1.86	1.25	1.33
	1 month post	N.A.	1.33	1.24	1.71	1.46
Frequency of visit to nature on one's own for 45 min (1 single item)	1 week pre	N.A.	1.63	1.35	1.63	1.50
	1 month post	N.A.	1.79	1.69	2.58	2.17
Emotional or stress coping by nature exposure (1 single item)	1 week pre	N.A.	3	N.A.	7	N.A.
	1 month post	N.A.	6	N.A.	13	N.A.

Abbreviations: M, Mean; SD, Standard Deviation; N.A., Not Applicable; DASS, Depression Anxiety Stress Scale; PSS, Perceived Stress Scale; RRS, Ruminative Response Scale; APNI, The scale of Attention to Positive and Negative Information; SRIS, The Self-Reflection and Insight Scale; CNS, Connectedness to Nature Scale; AMT, Autobiographical Memory Test.

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Repeated Measurement of Cognitive or Emotional Well-Being

Table 2 lists the effects of the time and time x group on the instruments that underwent repeated measurement analysis.

Table 2. Repeated measurement of cognitive or emotional well-being (N=48) of Study 1. (Yeung & Yu, 2022a)

Measurement	Effect of Time			Effect of Time x Group		
	F	df	η^2	F	df	η^2
RRS_rumination	3.19 *	4.40, 202.35	0.07	2.38 *	4.40, 202.35	0.05
AMT_specific	4.82 **	5, 230	0.10	3.54 **	5, 230	0.07
AMT_over-general	3.87 **	4.88, 224.44	0.08	2.91 *	4.88, 224.44	0.06
APNI_positive information	1.34	5, 230	0.03	1.51	5, 230	0.03
APNI_negative information	1.04	4.52, 208.04	0.02	0.25	4.52, 208.04	0.03
SRIS_self-reflection	1.02	5, 230	0.02	1.31	5, 230	0.03
SRIS_insight	3.12 *	3.83, 176.17	0.06	3.83	3.83, 176.17	0.05
DASS_depression	2.90 *	5.73, 263.44	0.06	0.93	5.73, 263.44	0.02
DASS_anxiety	4.97 **	5.67, 260.91	0.10	1.27	5.67, 260.91	0.03
DASS_stress	4.58 **	5.75, 264.70	0.09	1.46	5.75, 264.70	0.03
DASS_total	7.10 **	4.35, 200.22	0.33	0.60	4.35, 200.22	0.07
CNS	4.83 *	3.56, 163.81	0.10	2.83 *	3.56, 163.81	0.06

Abbreviations: RRS, Ruminative Response Scale; AMT, Autobiographical Memory Test; APNI, The scale of Attention to Positive and Negative Information; SRIS, The Self-Reflection and Insight Scale; DASS, Depression Anxiety Stress Scale; CNS, Connectedness to Nature Scale. * indicates p<.05. ** indicate p<.01.

Rumination Subscale of RRS

For the rumination subscale of RRS, there was a significant effect of time, as well as an interaction effect of time and group. For the indoor group, the pairwise comparison did not indicate a significant reduction in rumination across the different

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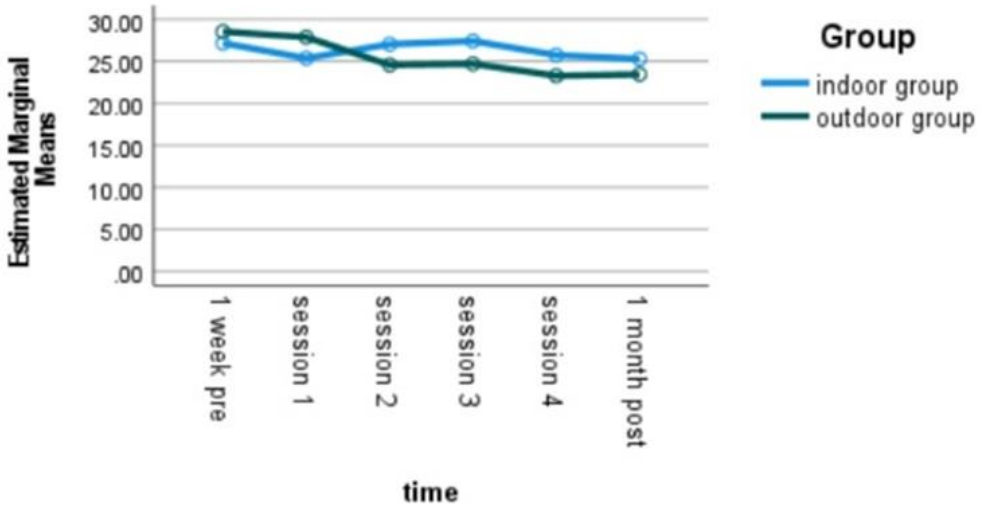
time points, whereas for the outdoor group, a significant reduction in rumination was observed when comparing the post-test (M = 23.45, SE = 1.67) to one week pre-test (M = 28.54, SE = 1.52, t(47) = −3.38, p < 0.01) and the first session (M = 27.88, SE = 1.53, t(47) = −2.89, p < 0.01). See Figure 5 for comparison of the two groups across the different time points.

Figure 5 Estimated marginal means of rumination subscale of Ruminative Response Scale by groups across different time of Study 1. (Yeung & Yu, 2022a)



Specific AMT and Overgeneral AMT

Repeated measures revealed there was a significant main effect of time and interaction effect of time and group on the number of specific AM. In the pairwise comparison of groups, the number of specific AM of the outdoor group was significantly higher than that of the indoor group for session three (indoor group mean = 2.79, SE = 0.36, and outdoor group mean = 4.33, SE = 0.36, t(47) = 3.01, p < 0.01) and session four (indoor group mean = 2.46, SE = 0.40, outdoor group mean = 4.96, SE = 0.40, t(47) = 4.39 p < 0.01). When examining the two groups individually, the indoor

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group's number of specific AM had no significant differences across any time point. However, for the outdoor group, at session four, the number of AMT specific memories ($M = 4.96$, $SE = 0.46$) was significantly higher than for session one ($M = 2.96$, $SE = 0.48$, $t(23) = 3.58$, $p < 0.01$) and for session two ($M = 3.63$, $SE = 0.37$, $t(23) = 3.11$, $p < 0.01$).

A significant time and time x group interaction effect is reported for the number of overgeneral AM. For both the indoor and outdoor groups, individual group profiles indicate there were not any significant pre- or post-test differences in the number of overgeneral AM. In addition, the outdoor group had no significant differences in the number of overgeneral AM pre-test when compared with the indoor group (indoor group mean = 5.83, $SE = 0.42$, outdoor group mean = 4.92, $SE = 0.37$, $t(47) = 1.64$, $p > 0.05$). However, the outdoor group had a significantly lower mean number of overgeneral AM than the indoor group did in session three (indoor group mean = 6.13, $SE = 0.37$, outdoor group mean = 4.38, $SE = 0.33$, $t(47) = -3.52$, $p < 0.01$) and in session four (indoor group mean = 6.63, $SD = 0.38$, outdoor group mean = 4.25, $SD = 0.39$, $t(47) = -4.41$, $p < 0.01$).

APNI Subscales and Self-Reflection Subscale of SRIS

For the APNI subscales and self-reflection subscale of SRIS, there were not any significant time or time × group interaction effects. However, for the insight subscale of SRIS, there was a significant time effect. The pairwise comparison indicates the insight scale post-test score ($M = 22.58$, $SE = 0.77$) was significantly higher than the scores for session one ($M = 20.75$, $SE = 0.69$, $t(47) = 3.69$, $p < 0.01$) and for session three ($M = 20.96$, $SE = 0.66$, $t(47) = 4.01$, $p < 0.01$).

DASS

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For the DASS total and all its subscales, there was no interaction of time x group, but there was a significant time effect. For the DASS depression subscale, session two ($M = 3.44$, $SE = 0.68$, $t(47) = -2.13$, $p < 0.05$), session four ($M = 3.27$, $SE = 0.59$, $t(47) = -2.32$, $p < 0.05$), one week after session four ($M = 3.21$, $SE = 0.61$, $t(47) = -2.56$, $p < 0.05$), and one month after session four ($M = 3.67$, $SE = 0.66$, $t(47) = -2.14$, $p < 0.05$) had significantly lower means than the pre-test ($M = 4.71$, $SE = 0.62$). Interestingly, repeated measures also showed session four ($M = 2.83$, $SE = 0.46$, $t(47) = -3.32$, $p < 0.01$) and one week post-session-four ($M = 2.94$, $SE = 0.53$, $t(47) = -3.04$, $p < 0.01$) were significantly lower than the pre-test for the anxiety subscale ($M = 4.33$, $SE = 0.55$). Similar findings were yielded for the stress subscale, with session four ($M = 5.27$, $SE = 0.69$, $t(47) = -3.02$, $p < 0.01$) and one week post-session-four ($M = 5.23$, $SE = 0.61$, $t(47) = -3.43$, $p < 0.01$) being significantly lower than the pre-test score ($M = 7.25$, $SE = 0.62$). This was also the case for the total scale, with session four ($M = 11.38$, $SE = 1.65$, $t(47) = -2.81$, $p < 0.01$) and one week post-session-four ($M = 11.38$, $SE = 1.63$, $t(47) = -2.72$, $p < 0.01$) being lower than the pre-test score ($M = 14.42$, $SE = 1.48$).

Connectedness to nature scale

For CNS, there was a significant main effect of time as well as interaction effect of time and group. In the pairwise comparison of groups, the CNS of the outdoor group was significantly higher than the CNS of the indoor group for session four (indoor group mean = 50.08, $SE = 1.79$, outdoor group mean = 55.63, $SE = 1.91$, $t(23) = 2.19$, $p < 0.05$) and one month post-session-four (indoor group mean = 49.92, $SE = 1.71$, outdoor group mean = 56.79, $SE = 2.32$, $t(23) = -2.38$, $p < 0.05$). Examining the simple effect of time, the indoor group had no significant difference across different times; however, the outdoor group's CNS scores for session two ($M = 53.79$, $SE = 1.73$, $t(23)$

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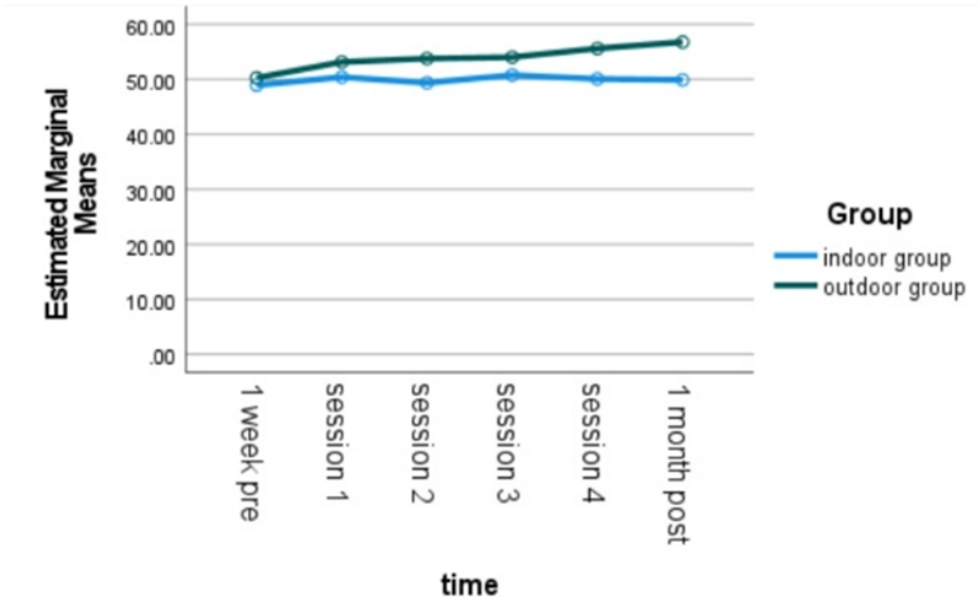
= 3.32, p < 01), session three (M = 54.04, SE = 2.12, t(23) = 2.68, p < 0.05), session four (M = 55.63, SE = 1.91, t(23) = 3.45, p < 0.01), and one month post (M = 56.79, SE = 2.32, t(23) = 3.78, p < 0.01) were each significantly higher than the pre-test score (M = 50.29, SE = 1.88). See Figure 6 for comparisons of the two groups across the different time points.

Figure 6 Estimated marginal means of the Scale of Connectedness to Nature by groups across different time. (Yeung & Yu, 2022a)



Analysis of PSS

For PSS, the assumption of linearity was fulfilled (R = 0.65 between pre- and post-test PSS score), while the homogeneity of the regression slope was confirmed by the Univariate test of GLM (Group*PSS_pre F (1, 44) = 0.86, p > 0.05). The result of ANCOVA suggests the two groups had no difference in lowering PSS (F (1, 45) = 0.78, p > 0.05). Table 3 illustrates the findings of the pairwise comparison.

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Table 3 Mean Differences in post-test PSS score by Group Controlling for pre-test PSS score (N = 48) of Study 1. (Yeung & Yu, 2022a)

Comparison	Mean Difference (Outdoor–Indoor)	*p*	Standard Error	Bonferroni Adjusted 95% CI
Indoor vs. outdoor group	1.35	>0.05	1.53	−1.73 → 4.43

Comparisons based upon ANCOVA adjusted means controlling for pre-test PSS score mean of 30.42. Abbreviation: PSS, Perceived Stress Scale.

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T-Test on Frequency of Visits to Nature and Chi-Square on Emotional & Stress Coping Method

Regarding the frequency in the past month of 45 min visits to nature with family or friends, the indoor and outdoor groups differed significantly one week pre-test (indoor group mean = 2.33, SE = 0.38, outdoor group mean = 1.25, SE = 0.27, $t(47) = -2.33$, $p < 0.05$) but insignificantly post-test (indoor group mean = 1.33, SE = 0.25, outdoor group mean = 1.71, SE = 0.30, $t(47) = -0.96$, $p > 0.05$). For the frequency of 45 min visits to nature by oneself, the indoor and outdoor groups did not differ significantly either at one week pre-test (indoor group mean = 1.63, SE = 0.28, outdoor group mean = 1.63, SE = 0.31, $t(47) = 0.00$, $p > 0.05$) or at one month post-test (indoor mean = 1.79, SE = 0.35, outdoor mean = 2.58, SE = 0.44, $t(47) = -1.41$, $p > 0.05$). For the presence of employing nature for stress or emotional coping, the two groups differed insignificantly pre-test (indoor group mean = 3, outdoor group mean = 7, $\chi 2\ (1) = 2.02$, $p > 0.05$) but differed significantly post-test (indoor group mean = 6, outdoor group mean = 13, $\chi 2\ (1) = 4.27$, $p < 0.05$).

3.1.4 Discussion

The present study investigated several confirmed or potential cognitive and emotional benefits humans gain from exposure to nature. In our findings, among the cognitive variables, ruminations and AMT were two domains that differentiated the indoor group from the outdoor group. We found the outdoor group, who spent 45 min weekly in nature for four weeks, had lowered ruminations one month post-test, while the indoor group did not have the same change. This result echoes findings reported by Bratman et al. (2015) and Lopes et al. (2020) regarding ruminative thoughts being lowered via exposure to nature. Meanwhile, in our study, the pre- and post-test

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differences in the counts of specific and over general AM were not significant for the indoor and outdoor groups. The outdoor group's specific AM was significantly higher and its over general AM was significantly lower than the indoor group's for sessions three and four. Theoretically biased thoughts, including memories and ruminations, influence processing of incoming information and play a primary role in the development and maintenance of depression (Disner et al., 2011), and depression is empirically associated with rumination (Kovács et al., 2020; Wilkinson et al., 2013) and specific/overgeneral AM (Hallford et al., 2020; Jiang et al., 2020; Liu et al., 2017). Therefore, exposure to nature for four 45 min sessions successfully reduces rumination and results in a desirable impact on AM, as found in the present study, and should be regarded as favorable for decreasing depression.

In the present study, we attempted to explore using nature and non-nature exposure to address self-referential-thinking-related responses associated with attention. We employed the scale of Attention to Positive and Negative Information as an indicator. We found indoor and outdoor groups showed no significant difference for pre-test, post-test, and all sessions. One possible explanation of why this program that lasted for only four sessions did not produce significant effects in this domain is that cognitive tendencies, such as optimism and pessimism, that emphasize the positive or negative aspects of life events are associated with less changeable trait factors (Noguchi et al., 2006). Our current findings do not rule out how, in other studies, attention has been reactive in positive ways to nature. Seemingly, the best method to assess and measure whether attention is shifted or deployed by nature exposure is the following: first, discern whether nature can direct our attention to positive environmental stimuli at all, and second, explore whether repeated exposure to nature helps humans to more easily transfer their attention to a more positive self-referential stimulus.

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Surprisingly, there was no evidence in the present study of nature exposure offering great capacity in enhancing self-reflection and insight. Reflective thinking and self-discovery have been common themes in qualitative studies of the subjective experience of exposure to nature (Sonntag-Öströma et al., 2015; Naor & Mayseless, 2020). The failure of this study to yield similar positive findings may indicate that, compared with the seemingly more inspiring forest or wilderness utilized in the two referenced qualitative studies, the urban green environment in which this study was conducted did not possess stimuli meaningful enough to stimulate reflection or insight.

In this study, we employed DASS (which covers clinical symptoms of depression, anxiety, and stress) and PSS (which measures subjective experiences of stress) to robustly confirm the effects on emotional well-being. The findings consistently indicate the two groups did not differ one month post-test in mood or stress-related measures. DASS provided additional information that both groups exhibited similar effects, decreasing depression, anxiety, and stress at the fourth session and one week after the fourth session. The decrease in depression was sustained one month after the last session.

The above findings on affective and emotional well-being, including mood and stress, are quite different than most of our literature review, which showed contact outdoors with nature elements is better at enhancing mood than staying indoors (see review (Bowler et al., 2010)). We offer the following explanations for our findings. First, because of the pandemic, our indoor group had to be conducted in the forestry school's building for convenience. Although it is a standard classroom setting, it does have some forestry decoration that may elicit a certain emotional healing effect. Second, although the 45 min sessions of walking and sitting did not explicitly require practicing mindfulness skills, participants may have attained some degree of mindfulness simply

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because they refrained from using phones and instead focused attention on a new environment they may have viewed as fascinating. In addition, the participants, though not compulsorily required, were advised not to sleep during the program. The indoor group, staying in a relatively monotonous environment, may have taken more initiative to walk to avoid feeling sleepy, which would have resulted in them engaging in more physical exercise. Given that mindfulness (Parmentier et al., 2019; Takahashi et al., 2019) and physical exercise (Schuch et al., 2018; Wegner et al., 2020) are known to decrease depression and to protect against the emergence of depression, the indoor group's possible increase in physical exercise and mindfulness may have resulted in mood benefits that offset the boost in emotional well-being from nature exposure that was experienced by the outdoor group.

Of importance, the outdoor group experienced a greater sense of connectedness to nature at the fourth session and one month post-test than the indoor group. This finding is comparable to a prior finding that in a student population, nature experiences can lead to an enhanced nature connection for up to six weeks (Braun& Dierkes, 2017). Given that CNS has previously associated favorably with a well-being index (Zhang et al., 2014;Huynh & Torquati, 2019), the present finding is another indicator of the benefits of nature exposure. Empirical data on the long-term impact on connectedness to nature resulting from interventions are rare, and our study helps contribute to the established evidence.

We explored changes in participants' interaction patterns with nature by asking about their frequency of visiting nature alone or with family and friends, as well as their usage of nature exposure for coping with emotions or stress. We note the result for the outdoor group in the increase in the number of visits to nature with family and friends should be interpreted with caution. First, under random assignment, the outdoor group

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had a significantly lower pre-test frequency, which implied a different baseline, which was not favorable for this statistical analysis. Second, while the outdoor group did not more frequently visit nature alone, the increase in the number of its visits to nature with family and friends from pre-test to post-test was instead beyond our expectation, because the pandemic should have hindered motivation to visit nature with other people. We wonder if our standard for the time of the visit, which was set as 45 min, was too demanding, particularly during the pandemic; perhaps we should have attempted to capture nature visits of a shorter duration. We could have instead referenced Hunger et al. (2019)'s findings on the impact of 20–30 min nature experiences on stress reduction.

While the program only lasted four weeks for the young adults, the lowered rumination and increased connectedness to nature were sustained one month after the program. In addition, there are data showing the outdoor group's significantly higher utilization of nature exposure for coping with emotions or stress. A series of visits to urban greenspace during the experiment seemingly mobilized participants to visit nature when they felt negative emotions and, thus, may have resulted in a continuous increase in the participants' connections with nature and a decrease in their rumination. Such evidence of nature's longer-term cognitive benefits and inducing continuous nature connection brings good news to counseling services for young adults, given that the nature-visiting approach is somewhat more like a leisure activity, which can make young adults less resistant to try it when compared with traditional counseling services. In addition, we show that the healing place might not necessarily be wilderness but can be a park nearby, while the visit can be as brief as only four 45 min sessions. This, from both the recipient and policy maker's point of view, is appealing given that such brief intervention in urban greening is convenient and of lower transportation or other setup cost. Connecting individuals with nature for lowering of rumination is a sound approach,

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as the world at present is constantly facing large-scale health hazards and subsequent social distancing, which can trigger repetitive negative thinking and hinder traditional emotional support from family and friends. This is particularly true for young adults who are facing stress at the turning points of their life for career development and family establishment.

The strengths of the study are as follows. First, this was a random-assignment study that comprehensively employed measurements of cognitive domains containing self-referential elements, of which the rumination subscales of RRS and AMT were found to be capable of differentiating the indoor group versus the outdoor group. Second, the program lasted four sessions, and we attempted to observe the cumulative effects of nature exposure over a longer term, specifically one month after the program. Third, we referred to Bratman et al.'s (2019) ecosystem service perspective to develop a nature-exposure protocol defining nature, exposure, and experience. Considering young adults prioritize their autonomy, we structured the program with flexibility, allowing participants to freely choose a route within the park and requiring no designated behavior other than a few basic restrictions. The weekly visits to nature, which occurred for four weeks, were personally adjusted (scheduled earlier or postponed within a two-day range) to enhance the motivation of participants to attend all sessions. We provided a raincoat, transparent umbrella, and mosquito spray to make the trip comfortable for the participants and to facilitate their connection with nature. This protocol possibly increased enjoyment of the trip, cognitive benefits during and after the sessions, and motivation after the program to use nature experiences for stress or emotional coping.

There are a number of limitations of the study. First, because of the pandemic, we were unable to schedule the indoor group anywhere other than in our own department,

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the forestry school. The department, with a relatively woodsier display than other departments, may have facilitated a degree of nature connectedness that contaminated the differences between the indoor and the outdoor group. Second, because of practical concerns during the pandemic, we sacrificed a one-week-post-test result for a longer-term measurement, the one-month-post-test result. Third, originally, we aimed to identify self-inferential thinking using the cognitive theory; however, unfortunately, inventories that serve this purpose are limited. The scales for attention and self-reflection/insight employed in this study may not be responsive to variations in self-referential cognition. Fourth, in order to avoid making either exposure experience too congested, we scheduled the two groups to two different time slots according to the degree of usage of the venues. Though the timeslots were both around lunch hour, we still have to admit that this could be a variable affecting the treatment effect. Fifth, due to the pandemic, the sample in the experiment was not large enough to include a treatment-free control group this time (that is, indoor or outdoor without non-suggested behavior). Lastly, the total number of subjects completing all sessions being 48 hindered further exploration of the association between coping with emotions or stress and a continual decrease in rumination and a rising connectedness to nature, as was interestingly found in the present study.

Conducting a similar study on clinically depressed patients, using a larger sample size, exploring cognitive-emotional impacts of nature exposure over a longer time period, further examination of the ideal duration for an impactful nature exposure, studying the relationship of behavioral changes (e.g., motivation to visit nature or employ nature exposure to cope with emotions or stress) and well-being after repeated nature exposure, and enriching protocol of nature experiences by developing dos and don’ts for a program are possible future research topics. Our findings of similar effects

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in the indoor group and the outdoor group in decreasing depression, anxiety, and stress indicate it is worth investigating the ways manmade buildings with nature-related decorations facilitate therapeutic effects. This could be timely and beneficial, as in the future, pandemics may again keep people indoors and present mental health challenges.

3.1.5 Conclusions

The cognitive theory posits that environmental stimuli cause changes in emotions and information processing. We studied whether four 45 min sessions of nature exposure could result in favorable changes in cognition and mood. The present study, though, did not find differences in mood between the indoor group and the outdoor group; however, the results did indicate nature exposure was more effective for reducing ruminations, positively impacting autobiographical memory, and connecting young adults to nature. Although we discussed why the indoor group experienced the benefit of mood improvement, we cannot rule out that, if the program duration was longer, the favorable impacts of relatively smaller cognitive changes could be transformed to impact overall emotional well-being, given that, logically, the impact of an environment on depressed mood takes time. Ultimately, through defining nature, exposure, and experience, we managed to establish an evidence-based yet flexible, convenient, comfortable, and appealing urban greenspace-exposure program for young adults. This can serve as a reference for nature prescription, a value-for-money treatment modality, and a therapeutic focus worldwide in the coming decade.

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3.2. Study 2: Motivating young adults to connect with nature for stress relief: A study in Taiwan during the COVID-19 pandemic[2]

3.2.1 Introduction

During the pandemics, social distancing under the lockdown measures, anxiety toward being infected as well as the uncertainty in future planning can put young adults, who are most vigor for social activities and passionate for making roadmap for their life, in stress. Actually, the current generation of young adults may not be experiencing the most enjoyable period of their lives and may not be in their healthiest psychological state, which runs contrary to what is generally expected for people in this age group. From 2008–2017, serious psychological distress in the past month and suicide-related outcomes in the past year increased for the 18–25 age group (Twenge et al., 2019). More than a quarter of a sampled university student population in Taiwan reported a poor mental health status, and more than 60% of the respondents had experienced stressful events in the past year (Chen et al., 2020). A study of college students spanning nine countries reported 64.3% of respondents had experienced stress related to their health (Karyotaki et al., 2020), implying that, for young adults, health concerns can be a trigger for stress. With the outbreak of the pandemic, college students are expected to experience increased stress levels as the general population has. It is worth exploring effective methods that improve the mental health of young adults. Using exposure to nature or connection with nature is one possible option.

Empirical evidence confirms younger adults (of age 18–34), when compared with older adults (of age 35–54, and 55 or above), fared the worst during the COVID-19

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pandemic with regards to symptoms of depression, stress, and anxiety (Varma et al., 2021). Most college students (85%) suffered psychological impacts during the pandemic (Browning et al., 2021), and this was also true for Chinese young adults. Analysis of 17, 865 online social platform users with a median age of 33 found that symptoms of depression and anxiety increased after the onset of COVID-19, while life satisfaction and positive emotions decreased (Li et al., 2020). The psychological impact on college students has been reported (Liu et al., 2020), with nearly 10% of students having developed or maintained mental health problems during the pandemic (Li et al., 2021).

A systematic review revealed an unfortunate outcome, that many young people are reluctant to seek help from formal mental health services (Gulliver& Griffiths, 2010). Visiting nature, which is a leisure activity, has a positive impact on mental health (Kotera et al, 2020) by decreasing depression, anxiety (Kotera et al., 2021), and stress (Kondo et al., 2018; Shuda et al, 2020). As such, visiting nature may be an effective treatment approach for young people, whose health and psychological wellbeing are associated with autonomy needs gratification (Inguglia et al., 2014; Melendro et al., 2020). For cognitive and emotional benefits, a 50-min walk in nature elicits the desired effects (Bratman et al., 2015). A review of evidence revealed biological markers of stress, namely cortisol, decrease in natural environments (Jimenez et al., 2021), and a nature experience as brief as 20 to 30 min can result in positive effects (Hunter et al., 2019).

Despite the known benefits that result from exposure to nature, growing older (Hughes et al., 2019), urbanization (Haaland C& van den Bosch, 2015) and the increased use of electronic screen technology (Michaelson et al., 2020) have deterred people from spending time outdoors and has lowered their eagerness to connect with

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nature. During the pandemic, continuous exposure to nature could improve the health of the participant. Views of nature are associated with lower levels of somatization (Ribeiro et al., 2021), not to mention calmness, stress relief, and anxiety reduction in young people (Zamora et al., 2021). Young people have reported wanting to spend more time in nature but have encountered barriers to doing so (Zamora et al., 2021). In view of the increased stress experienced by young people during the pandemic and their ambivalence toward visiting nature, as well as the evidence of the benefits of nature exposure on mental health and stress reduction, it is prudent to explore an evidence-based approach for motivating young people to connect with nature during stressful periods.

Self-determination theory (SDT) (Ryan & Deci, 2000; 2017) depicts how autonomous motivation and behavioral change can be achieved by addressing psychological needs of autonomy (i.e., self-driven), competence (i.e., feeling of mastery and self-efficacy), and relatedness (i.e., connections not restricted to one person but with a wider community as well). On the other hand, outcome expectancy (Feather, 1982) has successfully been applied in promoting health behaviors, such as physical exercise (Morrison & Stuifbergen, 2014), drinking/smoking/weight control (Reesor et al., 2017), and medical adherence behavior (Okuboyejo et al., 2018). Given that overly positive expectations can in turn lead to negative treatment outcomes (Swift & Callahan, 2008), setting realistic expectations is of the utmost importance.

Motivational Interviewing (M.I.) (Miller & Rollnick, 2002) is a “client–centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence” (Miller & Rollnick, 2002, p. 25). While direct persuasion may not be effective and may increase resistance, M.I. advocates recognition of an individual’s ambivalence in balancing the costs and benefits of possible changes. As

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such, evoking an individual to find solutions on their own is encouraged under this approach. M.I., originally a micro-counseling technique in clinical settings (Frost et al., 2018), has successfully facilitated lifestyle changes, such as physical activity (O'Halloran et al., 2014), treatment adherence (Palacio et al., 2016), teen pregnancy prevention, and fitness behavior (Bell et al., 2018).

Motivational interventions do not have to be face-to-face. In fact, written motivational messaging is common and can take the format of written guidelines (Frank et al., 2021), web-based interventions (Hargreaves et al., 2016), text messages (Anderson, 2020), and leaflets (Vaillancourt et al., 2019). Encouraging individuals to visit nature by using written motivational messages aligns with the self-determination theory's need for autonomy and connectedness. If written motivational messaging is integrated with realistic expectations, and if the ambivalence is addressed in M.I., the approach should possess motivational properties.

Nature prescription becomes a trend for mental health problems given that traditional psychiatric and psychological approach like cognitive-behavioral therapy have their weakness particularly on the maintenance of the effect (Cipriani et al., 2008; 2018; Schermuly-Haupt et al., 2018). While simple nature exposure, such as sitting or walking outdoors, have been shown to reduce stress and anxiety compared to control settings, the use of motivational technique to suggest more nature exposure has not been examined for enhancing the mental health benefits. We targeted on essential elements of M.I. which was shown to be an evidence based approach to increase treatment adherence. We conducted a between-subjects study in which we randomly assigned young adults recruited from universities in Taipei, Taiwan to an experimental group that received messaging about nature-related stress relief measures plus MI, compared with three control groups.

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3.2.2 Materials and methods

The first research question is that "can reading stress-relief (nature) messages together with motivational enhancement questions increase participant motivation for nature exposure and result in benefits to their wellbeing?" Three other control conditions for comparison read: (1) Non-stress-relief message (2) Stress-relief (non-nature) message, and (3) Stress-relief (nature) message without answering the motivational enhancement questions. In view of the sudden outbreak of the pandemic, we grasped the opportunity to answer the following questions "during different stages of the COVID-19 pandemic (pre, 1 week, and 1 month), how much variance in connectedness to nature is explained by the indicators of motivation for nature exposure?" and "during the COVID-19 pandemic, how much variance in perceived stress can be explained by connectedness to nature?"

Define life stressor to the participants

This research originally targeted stress experienced by university students regarding studying. Its pre–test covered the period from 2nd May 2021 to 15th May 2021. Unfortunately, an epidemic escalation occurred on 15th May 2021 in Taipei, in the northern part of Taiwan, with classes and exam suspended. Our study's 1 week post-test took place after 16th May, which followed the lockdown of the city. The study's timeline coincided with the development of the pandemic in Taiwan. After outbreak of the pandemic, we asked participants to recall three impressive images from their daily lives. We examined these items and categorized the images. Of the 540 total images the participants recalled 1 week and 1 month post experiment, 133 images were related to the pandemic, while 54 were related to study stress, resulting in a significant

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difference [$\chi 2(1) = 34.04$, $p < 0.01$]. We concluded the pandemic was the main concern to participants during our present study and, appropriately, have the pandemic as our research focus and primary discussion topic.

Participants

University students aged 21 to 35 years old were recruited from an online social media platform. We selected this age range because the term "young people" is used interchangeably for ages 15–24 and can be extended in some cases to 30 or 40 years old (Society for Adolescent Health and Medicine, 2017). Figure one illustrates the flow and drop out of the study. The final sample size was 90 (mean age = 23.41 years, SD = 2.40). For gender identity, 63.3% were female (mean age = 23.28 years, SD = 2.48) and 36.7% were male (mean age = 23.64 years, SD = 2.28). Most participants came from National Taiwan University (45.6%), National Taiwan Technology University (13.2%), National Taiwan Normal University (5.5%), and Yang Ming University (5.5%), and the others were spread across 20 universities. Regarding program of study, 73.3% were studying in a Bachelor's program and 26.7% were in a Master's program. The four experimental groups were not significantly different in age $F(3, 86) = 1.13$, $p > 0.05$, gender $\chi 2(3, 90) = 3.79$, $p > 0.05$, or affiliated academic programs (i.e., Bachelor vs. Master) $\chi 2(3, 90) = 0.77$, $p > 0.05$.

Program content

After being recruited, the participants were given a written explanation of the stages and content of the study. See Figure 7 for the flow of the study and drop out at different stages. Participants had to sign a consent form before the study started. The participants were asked to access online materials via QR code that was sent to their

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social media account during the experimental sessions (fixed on a particular weekday). For stages 1, 3, and 4, they were given a questionnaire to complete. For stage 2, the participants read a passage and answered questions. Throughout the four stages of the study, the participants had to return the questionnaires within 12 h. Failure to do so would lead to disqualification of the participant. The participants could terminate participation in the study at any time. Upon completion of the study and verification of identity online, $400 in Taiwanese dollar payments were deposited in participant bank accounts. Such minimal monetary return, equivalent to one movie ticket in Taiwan's cinema, should be regarded as imposing very low influence on the motivation of the participants and hence confounding the study very minimally. All the data collected was kept confidential and was used only for analysis in this study. The study had been approved by the Research Ethics Committee of National Taiwan University.

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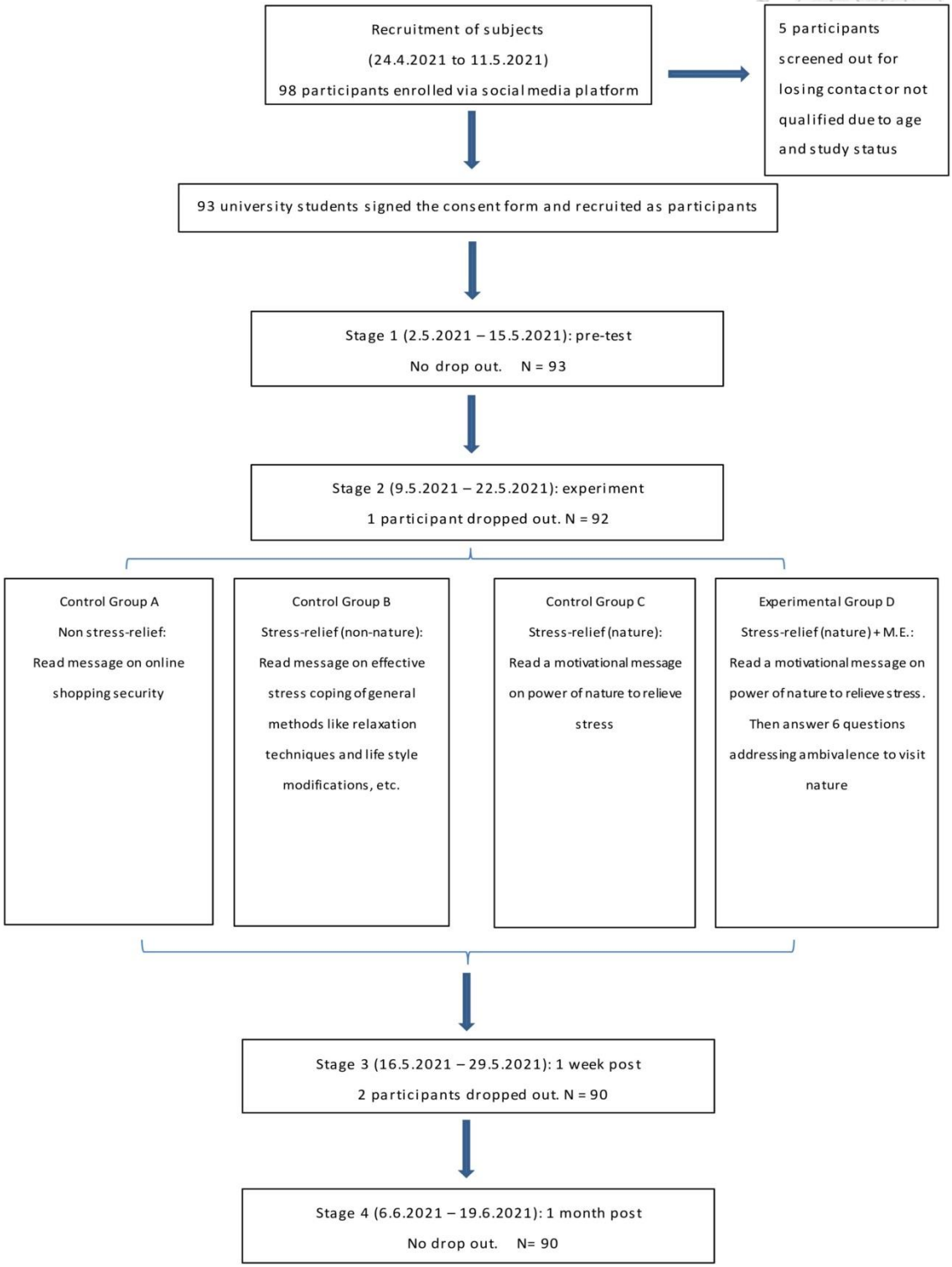
Figure 7 The flow of Study 2 and its drop out at different stages. (Yeung & Yu, 2022b)



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For all measurements, participants were to answer the questions based on what they had experienced during the past week, except for the Perceived Stress Scale which concerned conditions the past month. We gave the participants a soft reminder 1 h before questionnaire submission deadlines. After receiving a questionnaire, we immediately examined the answers to check for signs of a response set. If a response set was found, we contacted the participants within an hour to confirm the validity of their responses and to check whether they wanted to revise the answers. For the entire study, there were nine suspected response set replies, among which four were subsequently revised by its participant.

As for the written messages of the four experimental conditions, we drafted them and then piloted them on five young adults before the study to ensure readability and to collect feedback on whether the messages motivated them to seek nature exposure. Feedback from the pilot was considered, and we incorporated the final messages into a 1500-word Chinese article. During stage 2 of the study, the participants received a specific message depending upon which group they belonged to. They answered five questions assessing their comprehension of the message, and those that answered two or more questions incorrectly would be disqualified (and their data would not be further analyzed). All participants passed the comprehension test.

The content of the messages was as follows:

Control group A (n = 23): Non-stress relief.

The reading is related to online shopping security with information consolidated from the web.

Control group B (n = 21): Stress relief (non-nature).

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The reading addresses the stress of students empathetically at the beginning and then summarizes generally effective stress coping techniques, which include relaxation, connection with a support network, positive thinking, and lifestyle modification. The content was written by one of the researchers, who is a clinical psychologist, with reference to Alborzkouh et al. (2015) review of the effectiveness of stress management skills.

Control group C (n = 23): Stress relief (nature).

The reading is about the power of nature in relieving stress. It begins expressing empathy for the stress of students and then summarizes research findings of how a brief nature experience can induce a physiological stress reduction effect (Hunter et al., 2019). It describes how autonomous, restorative, and inspiring it can be to simply expose oneself to nature. The information presented resembles self-determination theory's autonomy, self-efficacy, and connectedness while also addressing optimistic yet realistic outcome expectancy.

Experimental Group D (n = 23): Stress relief (nature) + M.E.

They received the same reading material as group C. However, after finishing the comprehension test, the participants had to fill in six open-ended motivational enhancement (M.E.) questions on how to resolve scenarios that hindered visits to nature. Making reference to an integrated systematic review on barriers to nature exposure (Calogiuri & Chroni, 2014), we developed questions addressing traveling time, cost, difficulty finding proper nature sites, weather and insect interference, and boredom while in nature. Although the inspiring questions were presented as a case study, they were really for the participants to resolve their possible

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ambivalence toward nature exposure. Use of a case study approach was to minimize side-taking of conflicts and the subsequent escalation of resistance (Miller & Rollnick, 2002) arising from first person perspective. Hopefully the above measures generated an inviting atmosphere rather than pressure on the participants to adopt new ways of thinking. Also, we intentionally guided participants' preference toward nature by asking them to recall a positive memory involving nature.

Measurements

Motivation for nature visit

Because there was no available established measurement of motivation concerning nature exposure, we had to develop our own assessment tool for this domain. We attempted to measure motivation in a multi-construct manner according to three fields of motivation, namely cognitive, emotional, and behavioral (Touré-Tillery & Fishbach, 2014), with a single question for each indicator. While single-item assessments have been criticized for their shortcomings of higher susceptibility to random measurement error (Nunnally & Bernstein, 1994), there is evidence it has equal predictive utility as compared to multi-item measures (e.g., Postmes et al., 2013; Konrath et al., 2014; Smith et al., 2017). For the emotional aspect, we used "I intend to," since Fishman et al. (Fishman et al., 2020) reported this expression may be optimal for predicting specific behavior. For questions on belief and intention, we asked participants to answer on a seven-point Likert scale.

Cognitive: Belief that exposure to nature can relieve stress.

Question: "Exposure to nature can relieve stress." To what degree do you agree with this statement?

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Emotional: Intend to expose oneself to nature for stress relief.

Question: “To what degree do you intend to expose yourself to nature for stress relief?”

Behavioral: Referencing Hunter et al. (2019) study, we set the time standard to 20 min. We were aware the answers to this question could be a mixture of visiting nature alone and visiting nature with family and friends. For visiting nature with family and friends, it could be for a social purpose apart from a stress relief purpose. Therefore, this question was further broken down into two:

Frequency of exposure to nature for at least 20 min in last week on one’s own.

Question: “In the last week, how many times have you exposed yourself to nature alone for at least 20 min?”

Frequency of exposure to nature for at least 20 min in last week with family and friends.

Question: “In the last week, how many times you have exposed yourself to nature with family and friends for at least 20 min?”

Motivation for virtual nature visit

Because the pandemic may have reduced visits to nature while online activities likely increased for young adults, we added three questions regarding virtual nature visits for stages 3 and 4. The questions were parallel to similar questions

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concerning nature exposure.

Cognitive: Belief exposure to virtual nature can relieve stress.

Question: “Exposure to virtual nature can relieve stress.” To what degree do you agree with this statement?

Intend to expose oneself to virtual nature for stress relief.

Question: “To what degree do you intend to expose yourself to nature for stress relief?”

Frequency of exposure to virtual nature for at least 20 min the past week.

Question: “In the past week, how many times have you exposed yourself to virtual nature for at least 20 min?”

Referring to Hunter et al. (Hunter et al., 2009), we originally defined nature experience as “anywhere outside that, in the opinion of the participant, included a sufficiency of natural elements to feel like a nature interaction.” We surveyed ten young Taiwanese adults, and eight of them indicated this definition of nature experience was too broad or too vague for them. This perhaps may be due to Chinese preference for concrete stimuli rather than abstract stimuli (Liang & Cherian, 2010). Having taken the pilot participants’ advice to offer more guidance for the definition, in the present experiment we clarified nature experience as “outdoor space that grants you a sense of nature, including mountain, water, sky, plants or animals, the songs of the birds or sounds of insects, and even a grassland ….. The ellipsis is to render it a non-inclusive description for the participants to elaborate or imagine for themselves. For the virtual nature, “virtual” refers to media information or videos, and “nature” assumes the same

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definition as aforementioned.

To avoid polarization impact by response outliers, we studied the descriptive statistics and re-categorized the answers into four categories, with frequencies of zero to two being the same as the actual frequency, and frequencies of three or above being classified as three. This categorization applied to all questions with frequency counts.

Recall of three impressive images in the last week

As the pandemic and resulting social distancing likely hindered the participants physically connecting with nature, we innovatively constructed an item at 1 week and 1 month post-test to hopefully capture how often the participants had tended to nature and its positive images. The participants recalled three images from their daily lives and stated whether the images brought them positive, negative, or mixed/uncertain feelings. The instructions for this question were as follows:

"Our eyes are comparable to a camera lens while our heads are comparable to hard disks of our memory. Whether these images are from indoors or outdoors, they can elicit feelings. Please recall images from your daily living that brought you feelings in the past week. Write three of these images, describe them in detail, and then determine whether they brought you positive, negative, or mixed/uncertain feelings."

We randomly selected 50 images recalled by the participants and had them scored independently by two scorers who had a psychology background and were pursuing a Master's degree or higher in the Forestry School. The scorers decided whether the images related to nature or not by referring to Hunter et al. (2019) definition of a "nature-experience." Of the 50 images, 48 were classified in the same category. The inter-rater reliability was regarded as high, which made us feel comfortable with the scoring criteria. Once the two inconsistent ratings were resolved, one of the scorers

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completed the remaining categorizations.

Six categories were yielded from the three (positive/negative/mixed) × two (nature/non-nature) dimensions. Since feelings are subjective, we aimed not to edit the classifications of the participants unless there was an absolute doubt of the classification. In total, seven positive image statements and four negative image statements were found to be problematic. Examples of the problematic positive statements are: “Empty high-speed rail makes seating spacious and comfortable. Unfortunately, I still have to return home” and “The roses that I have planted for half a year pecked off by birds thrice before it blooms. It’s beautiful but I feel sad for it.” Examples of the problematic negative statements are: “The weather is cloudy, but it makes me feel cool!” and “There was a prolonged drought. Watching the rain infiltrates the ground, I can feel the prosperity.” These items carried mixed feelings and, therefore, were reclassified as mixed/uncertain by the researchers. The categories entered into statistical analysis were: (1) number of recalls of positive nature stimuli (i.e., positive nature), (2) number of recalls of positive stimuli (i.e., positive nature + positive_non-nature) (3) number of recalls of nature stimuli (images about nature regardless of it being positive, negative, or mixed/uncertain one).

While research involving recall like autobiographical memory (e.g., Emmerdinger & Kuhbandner, 2018; Waisman et al., 2022) and narrative study (e.g., Chu et al., 2020; Wang & Geale, 2015) are not uncommon to elicit one’s memory of past experience, the use of recall as a measurement should be very careful due to its validity. The concerns are individuals’ memory of past mood, emotions, cognitions, and behaviors seem to do more with the reconstructions combing opinions, behaviors and thoughts of an individual than pure retrieval (Kihlstrom et al., 2000; Levine & Safer, 2002; Robinson & Clore, 2002a, 2002b; Ross & Wing, 2018). In this study, the

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measurement capturing memory of daily life was added in an ad-doc manner as the pandemics may affect human's reaching out to the nature and hence hinder the experimental effect captured by planned measurements. We therefore thought it was worth to pilot the memory measurement in such a special situation. We followed the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986) to suggest the participants to state as many details as they could in relation to an impressive event. However what being different from AMT was that we did not confine the participants' recall by cued words. In such a way we can tap into what really catch the attention of the participants in daily life. Also, requiring the participants to make the recall for last week is of advantageous given that research had shown under short delay (1 week) the participants were more capable to recall details of a memory than long delay (1 month) (Spearing &Wade, 2022). Our target population on young adult was also favorable for eliciting distinctive memory after participation in the experiment given that young adult, when compared with older adults, was found to detect and remember more changes (Wahlheim & Zacks, 2019). Finally but also hopefully, we assume that the problem to do with memory bias should have been even out under random subject assignment to the experimental groups. See Appendix for "Measurements on motivation for nature visits" and "Recall of three impressive images in the last week".

Other measurements

Wellbeing

We wanted to explore whether the wellbeing of the participants was impacted under the different experimental conditions.

Perceived Stress Scale-14 items (PSS-14) (1 week pre and 1 month post).

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The Perceived Stress Scale (PSS) (Cohen &Williamson, 1988), a commonly used psychological instrument indicating the perception of stress, is rated on a five-point Likert scale. A recent systematic review of more than 40 experimental studies found measures of perceived stress grant convincing evidence of the relationship between exposure to nature and reduced stress levels (Kondo et al., 2018). PSS's Cronbach's alpha was 0.85 in a study of Taiwanese adults (Chu & Kao, 2005) and 0.77 in a study of stress, active coping, and problem behaviors among Chinese adolescents (Hsieh et al., 2014), indicating its good reliability. During the COVID-19 pandemic, PSS scores among healthcare workers in China were higher than a cut-off value (Xiao et al., 2020), revealing the scale is sensitive to stress in the Chinese population related to the pandemic. The present study employed the validated Chinese version of PSS by Chu and Kao (Chu & Kao, 2005).

Depression Anxiety Stress Scale-21 items (DASS-21) (1 week pre, 1 week post, and 1 month post).

To measure participant response to stress, we employed the Depression Anxiety Stress Scale-21 (DASS-21) (Lovibond & Lovibond, 1995a) to supplement PSS-14. The questions are rated on a four-point Likert scale. Good psychometric properties of the scale have been demonstrated in studies (Antony et al., 1998; Lovibond, 1998). The three factor structure of the scale has been validated in non-clinical (Lovibond &Lovibond, 1995a) apart from clinical samples (Brown et al., 1997). DASS-21's convergent validity coefficient was 0.87 in a young adult population experiencing psychological distress (Lee, 2019). Chinese DASS-21 was found to be effective in differentiating between depression, anxiety, and stress, and it is suitable for regular assessment and treatment evaluation (Moussa & Lovibond, 2017). The

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Chinese-translated scale employed in this study is from Moussa et al. (2001).

Flourishing scale (FS) (1 week pre, 1 week post, and 1 month post).

Studies on nature and mental health should focus more on positive health, such as happiness, purpose, and flourishing, rather than just the absence of negative mental health outcomes (Jimenez et al., 2021). Thus, flourishing was measured in the present study. The flourishing scale (FS), formerly known as the psychological wellbeing scale (PWBS), consists of eight items. They are rated on a six-point Likert scale for measuring respondents' self-perceived successes in relationships, self-esteem, purpose, and optimism (Diener et al., 2010). The scale has a high internal consistency ($\alpha = 0.87$), high 1-month test–retest reliability ($r = 0.71$), a robust single-factor structure in EFA, and good criterion-related validity with basic life satisfaction ($r = 0.78$) and psychological wellbeing ($r = 0.73$) (Diener et al., 2010). During the pandemic, the fear of COVID-19 correlated significantly with FS at −0.16 for a student population (Elemo et al., 2021). The present study employed the translated Chinese version of PWB, which was found to be above 0.90 in Cronbach's alpha and of adequate fit indices for a single-factor model (Lin, 2015).

Connectedness to Nature Scale (CNS) (1 week pre, 1 week post, and 1 month post).

The Connectedness to Nature Scale (CNS) (Mayer & Frantz, 2004), a popular instrument for tapping this construct, was employed as an indicator of success for our motivational strategy to connect young adults with nature. The scale assesses the "experiential sense of oneness with the natural world" (Mayer &Frantz, 2004 p. 504), or the sense of whether people feel part of their surrounding natural world. As a 14-items scale that is rated on five-point Likert scale, CNS has only one factor and possesses

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high internal consistency (α = 0.84) and test–retest reliability (r = 0.79) (Mayer & Frantz, 2004). CNS is inversely correlated with perceived stress (r = -0.16, p = 0.01), anxiety (r = -0.11, p = 0.04), and depression (r = -0.15, p = 0.04) (Huynh & Torquati, 2019). It correlates significantly with FS at 0.31 (Wolsko et al., 2019). The present study employed Li and Cao (Li & Cao, 2020) translated version of CNS.

Control variable

Multidimensional Scale of Perceived Social Support Scale (MSPSS) (1 week pre, 1 week post, and 1 month post).

Since a low perceived social support could have a negative impact on psychological symptoms during the COVID-19 pandemic (Li et al., 2020), we used the 12-item Multidimensional Scale of Perceived Social Support rated on a seven-point Likert scale (MSPSS; Dahlem & Zimet, 1991) to measure as a control variable participants' perceived social support. In a study of college students, MSPSS correlated significantly with the DASS subscales of depression (−0.34), anxiety (−0.14), and stress (−0.22) (Shelton et al., 2017). While there are three sources of support specified in the scale, namely family, friends, and significant others, we used the combined total score as an index for general social support; higher scores indicate more perceived social support. We employed the validated translated scale of Chou (2000), which has good internal consistency (0.89) and correlated negatively with depression and anxiety in a sample of Chinese adolescents.

Methods

We followed the rule of thumb of 20 + 5k (Khamis & Kepler, 2010), with k being the number of predictors, to govern our selection of variables to be put in our

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multiple regression model. We performed a priori sample size calculation (G*Power; Faul et al., 2007) with an estimation of main treatment effect of 0.50, assuming a significance level (alpha) of 0.05, and a statistical power (1-beta) of 80%. This calculation indicated 48 participants would be required for Analysis of variance (ANOVA). The study's actual number of participants, 90, was regarded as sufficient for performing statistical analyses of repeated measurements, ANOVA and hierarchical regression. The data were analyzed using SPSS statistics 27. Correlations for all the measures, including the self-constructed items and the employed instruments, had been performed.

We conducted three time (pre/1 week/1 month) × four groups repeated-measures ANOVA on "Belief in exposure to nature can relieve stress," "Intend to expose oneself to nature for stress-relief," "Frequency of exposure to nature for at least 20 min in last week on one's own," and "Frequency of exposure to nature for at least 20 min in last week with family and friends" to explore the groups' effects on motivation to be exposed to the nature. We adjusted the degrees of freedom to Greenhouse-Geisser (when Epsilon of Greenhouse-Geisser was <0.75) or Huynh-Feldt (when Epsilon of Greenhouse-Geisser was >0.75) when the test of sphericity was significant (Navarro & Foxcroft, 2019). For belief, intention, and frequency of exposure to the virtual nature, as well as for recalls of "Positive Nature," "Positive," and "Nature" images, only 1 week and 1 month post data were available because we did not initially plan to ask these questions. One way between-subjects ANOVA was conducted instead on these items.

For the wellbeing impacts of the different experimental conditions, one way between-subjects ANOVA were conducted for PSS, which only had two measurements (i.e., pre and 1 month post), while three Time (pre/1 week/1 month) × four Groups

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repeated-measures ANOVA on DASS Total, DASS_Stress, DASS_Anxiety, DASS_Depress, and Flourishing, and three Time (pre/1 week/1 month) × four Groups repeated-measures ANOVA on CNS had been performed.

To approach the research question of whether connectedness to nature can be explained by belief, intention, and behavior of exposure to nature, hierarchical linear regression analyses were conducted across the different time measurements. For behavior exposure, we put both the frequency of exposure and the recall of positive images of nature into the model at 1 week and 1 month post because they had yielded valuable findings in the prior ANOVA analyses.

Finally, a Hierarchical Multiple Regression was performed to examine the role of Connectedness to Nature in explaining PSS with gender, age, group membership, pre-score of PSS, and pre-score of the MSPSS being controlled for.

3.2.3 Results

As noted in Table 4, the mean response scale values were calculated for all measures and all times. The reliability of each scale was acceptable and some attained an excellent level as indicated by Cronbach's α.

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Table 4 Mean, standard deviation and reliability of the scales employed in Study 2 (N = 90). (Yeung & Yu, 2022b)

	Time	Reliability	Control group A (n = 23)		Control group B (n = 21)		Control group C (n = 23)		Experimental group D (n = 23)	
		α	*M*	SD	*M*	SD	*M*	SD	*M*	SD
Inventory										
Perceived stress scale (14 items)	1w pre	0.84	31.09	7.23	28.33	7.68	29.96	7.40	31.83	7.26
	1 m post	0.74	33.22	7.66	30.90	11.40	32.35	8.26	24.52	12.79
Depression, anxiety and stress scale (21 items)	1wpre	0.89	19.22	9.50	16.38	10.32	16.30	9.99	15.13	9.03
	1w post	0.90	18.65	10.50	15.19	8.95	14.91	9.37	14.64	10.51
	1 m post	0.92	17.52	11.14	16.43	10.60	16.96	9.75	15.91	12.44
Flourishing scale (8 items)	1w pre	0.86	37.91	7.79	37.48	8.71	37.22	6.41	35.96	7.23
	1w post	0.85	37.35	6.12	38.10	8.43	37.78	5.80	36.57	7.26
	1 m post	0.89	35.52	8.90	36.71	8.98	36.91	6.35	37.39	7.41
Connectedness to nature scale (14 items)	1w pre	0.89	36.30	8.82	33.57	8.29	32.04	7.35	32.61	9.89
	1w post	0.86	36.74	8.70	34.90	7.65	35.40	7.07	35.04	10.64
	1m post	0.88	36.35	11.15	35.14	6.97	36.04	6.48	35.91	10.62
Multi-dimensional scale of perceived social support (12 items)	1w pre	0.88	59.30	9.82	60.71	11.52	57.74	12.81	60.61	11.33
	1w post	0.91	60.91	10.73	62.29	12.03	60.09	10.02	62.22	11.43
	1m post	0.93	61.43	13.20	60.95	11.76	59.04	11.26	62.57	12.46

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General findings

Table 5 contains correlations for all the measures in the present study. The correlations of the same battery of tests across three measurements were each above or approaching 0.80 (<0.01), except for PSS pre and post, which were only 0.50 (<0.01). Table 6 contains correlations across three measurements for the self-constructed items regarding belief and intention related to nature or virtual nature. Interestingly, we could nearly note the emergence of distinct correlations for the categories of “Nature” and “Virtual nature,” with items belonging to the same category significantly correlating. The two categories did not correlate with each other except at 1 month post when “Intend to expose oneself to virtual nature”’ was significantly correlated with “Belief in exposure to nature can relieve stress” 0.29 ($p < 0.01$) and “Intend to expose oneself to nature for stress-relief” 0.30 ($p < 0.01$). The major correlations for items belonging to the same category support the validity of these constructed motivational questions.

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Table 5 Correlations of inventories employed in Study 2 (N = 90). (Yeung & Yu, 2022b)

	PSS_ 1w pre	PSS_1m post	DASS_1w pre	DASS_1w post	DASS_1m post	FS_1w pre	FS_1w post	FS_1m post	CNS_1w pre	CNS_1w post	CNS _1m post	MSPSS _1w pre	MSPSS _1w post	MSPSS_1m post
PSS_ 1w pre	1													
PSS_1m post	0.508**	1												
DASS_ 1w pre	0.551**	0.466**	1											
DASS_1w post	0.538**	0.515**	0.758**	1										
DASS_ 1m post	0.482**	0.568**	0.678**	0.802**	1									
FS_1w pre	−0.457**	−0.420**	−0.443**	−0.524**	−0.542**	1								
FS_1w post	−0.478**	−0.387**	−0.425**	−0.586**	−0.605**	0.776**	1							
FS_1m post	−0.396**	−0.486**	−0.471**	−0.580**	−0.676**	0.747**	0.817**	1						
CNS__1w pre	−0.130	−0.178	−0.136	−0.205	−0.153	0.354**	0.294**	0.233*	1					
CNS_1w post	−0.193	−0.214*	−0.192	−0.246*	−0.190	0.355**	0.404**	0.310**	0.838**	1				
CNS_ 1m post	−0.167	−0.293**	−0.253*	−0.327**	−0.305**	0.330**	0.359**	0.390**	0.752**	0.868**	1			
MSPSS _ 1w pre	−0.242*	−0.182	−0.227*	−0.266*	−0.317**	0.589**	0.564**	0.524**	0.194	0.220*	0.183	1		
MSPSS _ 1w post	−0.276**	−0.214*	−0.192	−0.232*	−0.328**	0.551**	0.652**	0.528**	0.136	0.216*	0.188	0.819**	1	
MSPSS _ 1mpost	−0.262*	−0.283**	−0.212*	−0.273**	−0.443**	0.582**	0.656**	0.653**	0.098	0.205	0.227*	0.791**	0.884**	1

**Correlation significant at the 0.01 level (2-tailed).

*Correlation significant at the 0.05 level (2-tailed).

1w: 1 week; 1m: 1 month.

PSS, Perceived Stress Scale-14 items; DASS, Depression Anxiety Stress Scale-21 items; FS, Flourishing Scale; CNS, Connectedness to Nature Scale; MSPSS, Multidimensional Scale of Perceived Social Support Scale.

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Table 6 Correlations of self-constructed items related to motivation of Study 2 (N = 90). (Yeung & Yu, 2022b)

	Belief in nature can relieve stress_1w pre	Intend to expose oneself to nature for stress-relief _1w pre	Belief in nature can relieve stress _1w post	Belief in virtual nature can relieve stress_1w post	Intend to expose oneself to nature for stress-relief _1w post	Intend to expose oneself to virtual nature for stress-relief_1w post	Belief in nature can relieve stress _1m post	Belief in virtual nature can relieve stress_1m post	Intend to expose oneself to nature for stress-relief_1m post	Intend to expose oneself to virtual nature for stress-relief _1m post
Belief in nature can relieve stress_1w pre	1									
Intend to expose oneself to nature for stress-relief _1w pre	0.560**	1								
Belief in nature can relieve stress _1w post	0.158	0.236*	1							
Belief in virtual nature can relieve stress_1w post	0.106	0.127	−0.107	1						
Intend to expose oneself to nature for stress-relief _1w post	0.290**	0.422**	0.541**	−0.066	1					
Intend to expose oneself to virtual nature for stress-relief_1w post	0.098	0.132	−0.077	0.434**	0.054	1				
Belief in nature can relieve stress _1m post	0.256*	0.250*	0.623**	0.008	0.531**	0.132	1			
Belief in virtual nature can relieve stress_1m post	0.165	0.088	−0.195	0.619**	−0.150	0.233*	0.109	1		
Intend to expose oneself to nature for stress-relief_1mpost	0.285**	0.344**	0.237*	0.034	0.496**	0.182	0.579**	0.108	1	
Intend to expose oneself to virtual nature for stress-relief _1m post	0.154	0.163	0.143	0.271**	0.075	0.587**	0.291**	0.488**	0.296**	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
1w: 1 week; 1m: 1 month.

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Table 7 displays correlations for the self-constructed items concerning the frequency of exposure to nature or virtual nature for at least 20 min in the past week. The clustered pattern of correlation is less obvious but still grossly distinguishes between frequency of nature exposure on one's own vs. nature exposure with family and friends vs. access via virtual means, supporting the validity of the questions in tapping into different behaviors. Interestingly, exposure to virtual nature 1 month post significantly correlated with 1 week and 1 month frequency of nature exposure on one's own and with family and friends. This may be because virtual nature visits replaced actual nature visits during the pandemic.

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Table 7 Correlations of self-constructed items on frequency of exposure to nature or virtual nature for at least 20 min in last week of Study 2 (N = 90). (Yeung & Yu, 2022b)

	Exposure to nature with family/friends_1w pre	Exposure to nature on one own_1w pre	Exposure to nature with family/friends_1w post	Exposure to nature on one own_1w post	Exposure to virtual nature_1w post	Exposure to nature with family/friends_1m post	Exposure to nature on one own_1m post	Exposure to virtual nature _1m post
Exposure to nature with family/friends_1 w pre	1							
Exposure to nature on one own_1 w pre	0.158	1						
Exposure to nature with family/friends _1w post	0.288**	0.187	1					
Exposure to nature on one own_1w post	0.131	0.232*	0.162	1				
Exposure to virtual nature_1w post	0.304**	0.077	0.411**	0.100	1			
Exposure to nature with family/friends _1m post	0.059	0.136	0.125	0.113	0.162	1		
Exposure to nature on one own_1m post	0.063	0.362**	0.053	0.024	0.016	0.053	1	
Exposure to "virtual" nature_1m post	0.251*	0.347**	0.340**	0.347**	0.440**	0.070	0.198	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
1w: 1 week; 1m: 1 month.

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Research question 1: Group effect on motivation indicators and wellbeing

Group effect on motivation indicators related to exposure to nature

The repeated measures ANOVA on “Belief in nature can relieve stress” yielded a significant effect for time $F(1.89, 162.87) = 5.15$, $p < 0.01$, $Eta2 = 0.06$ and the interaction between time and group $F(5.68, 162.87) = 4.75$, $p < 0.01$, $Eta2 = 0.14$. This reflects that the changes in “Belief in nature can relieve stress” over time among the different groups differed. Results of a pairwise comparison suggest the four groups were similar in “Belief in nature can relieve stress” at the beginning of the study. However, 1 week after the experiment, “Stress-relief (nature) + M.E. “Group were higher in “Belief in nature can relieve stress” than the “Stress-relief (non-nature)” Group ($MD = 1.80$, $SE = 0.38$, $p < 0.01$) and the “Non-stress-relief” Group ($MD = 1.48$, $SE = 0.37$, $p < 0.01$). One month after the experiment, there were not any significant differences among the four groups. See Figure 8 for Estimated Marginal Means of “Belief in nature can relieve stress” for the four groups 1 week pre-experiment, 1 week post, and 1 month post.

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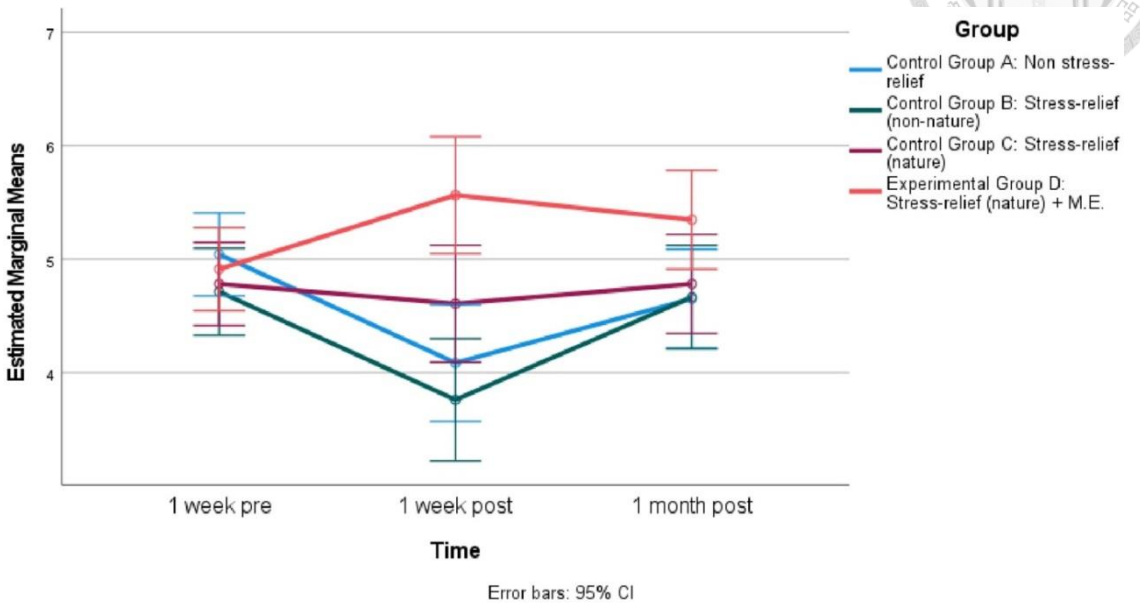
Figure 8 Estimated marginal means of "Belief in nature can relieve stress" across different time for four groups of Study 2 (N = 90). (Yeung & Yu, 2022b)



The repeated measures ANOVA on "Intend to expose oneself to nature for stress-relief" yielded a significant effect for time $F(2, 172) = 3.14$, $p < 0.05$, Eta2 = 0.04 and the interaction between time and group $F(6, 172) = 3.78$, $p < 0.01$, Eta2 = 0.12. This reflects the changes in "Intend to expose oneself to nature for stress-relief" over time among the different groups differed. Result of a pairwise comparison suggest the four groups were similar in "Intend to expose oneself to nature for stress-relief" at the beginning of the study. However, 1 week after the experiment, the "Stress-relief (nature) + M.E. "Group were higher in "Intend to expose oneself to nature for stress-relief" than the "Stress-relief (non-nature)" Group (MD = 1.71, SE = 0.39, $p < 0.01$) and the "Non-stress-relief" Group (MD = 1.39, SE.38, $p < 0.01$). One month after the experiment, there were not any significant differences among the four groups. See

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Figure 9 for Estimated Marginal Means of “Intend to expose oneself to nature for stress-relief” for the four groups across 1 week pre-experiment, 1 week post, and 1 month post.

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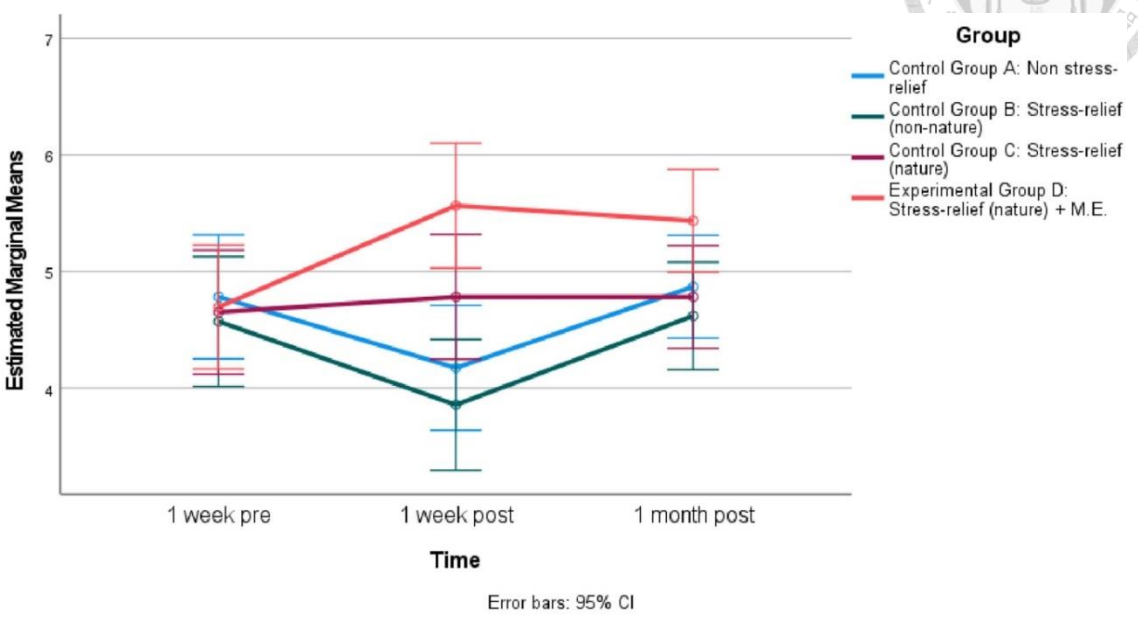
Figure 9 Estimated marginal means of "Intend to expose oneself to nature for stress-relief" across different time for four groups of Study 2 (N = 90). (Yeung & Yu, 2022b)



For "Frequency of exposure to nature for at least 20 min in the past week on one's own," there was not a significant effect for time $F(1.87, 161.03) = 1.87$, $p > 0.05$, Eta2 = 0.02 or time × group $F(5.62, 161.03) = 0.88$, $p > 0.05$. For "Frequency of exposure of nature for at least 20 min in the past week with family and friends," there was a significant effect for time $F(2, 172) = 1.39$, $p > 0.05$, Eta2 = 0.12 but not for time × group $F(6, 172) = 1.40$, $p > 0.05$, Eta2 = 0.05. In general, participants experienced a decrease in their "Frequency of exposure of nature for at least 20 min in last week with family and friends" from pre experiment to 1 month post experiment, regardless of their group membership. This is likely explained by the pandemic hindering social activities in nature.

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The above findings reflect that young adults only had more favorable attitudes toward exposure to nature in 1 week, measured by belief and intention, when compared with the two control groups, namely “Non-stress-relief” and “Stress-relief (non-nature),” when prompted to answer motivational enhancement questions after reading their motivational message. Group membership failed to make a difference on the actual frequency of exposure to nature, regardless of whether exposure was on one’s own or with family and friends.

Group effect on motivation to be exposed to virtual nature

Table 8 shows the one way between-subjects ANOVA for belief, intention and frequency of exposure to the virtual nature.

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Table 8 One way ANOVA on PSS, virtual items and recall items, comparing experimental group with three control groups of Study 2(N = 90). (Yeung & Yu, 2022b)

Domain		ANOVA			*Post hoc* test by Turkey HSD comparing "Stress-relief (nature) + M.E."[a] with				
	Pre/post	df	Between group Mean[2]	F	Control group[b]	MD (a minus b)	Standard error	Upper bound	Lower bound
PSS	1w pre	3, 86	50.52	0.93	A	0.74	2.18	−4.97	6.45
					B	3.49	2.23	−2.35	9.33
					C	1.87	2.18	−3.84	7.58
	1m post	3, 86	355.81	3.41*	A	−8.70*	3.01	−0.16.59	7.03
					B	−6.38	3.09	−14.47	1.7
					C	−7.83	3.01	−15.72	0.07
Belief in virtual nature can relieve stress	1w post	3, 86	7.57	6.28**	A	−1.17**	0.32	−2.02	−0.33
					B	−1.27**	0.33	−2.14	−0.41
					C	−0.74	0.32	−1.59	0.11
	1m post	3, 86	8.67	6.66**	A	−1.22**	0.34	−2.1	−0.34
					B	−1.37**	0.34	−2.27	−0.47
					C	−0.65	0.34	−1.53	0.23
Intend to expose oneself to virtual nature for stress-relief	1w post	3, 86	6.99	3.87*	A	−1.09*	0.4	−2.13	−0.05
					B	−1.26*	0.41	−2.32	−0.19
					C	−0.83	0.4	−1.86	0.21
	1m post	3, 86	4.15	1.84	A	−0.87	0.44	−2.03	0.29
					B	−0.94*	0.45	−2.13	0.25
					C	−0.52	0.44	−1.68	0.64
Frequency of exposure to virtual nature for at least 20 min in last week	1w post	3, 86	0.94	0.92	A	−0.09	0.3	−0.87	0.69
					B	−0.15	0.3	−0.95	0.64
					C	−0.04	0.3	−0.82	0.74
	1m post	3, 86	1.27	1.21	A	−0.27	0.3	−1.05	0.54
					B	−0.53	0.31	−1.34	0.28
					C	−0.04	0.3	−0.84	0.75
Number of recall on positive image of nature	1 week post	3, 86	2.74	3.64*	A	0.78*	0.26	0.11	1.45
					B	0.3	0.26	−0.39	0.98
					C	0.61	0.26	−0.06	1.28
	1 month post	3, 86	2.18	3.56*	A	0.65*	0.23	0.05	1.26
					B	0.45	0.24	−0.17	1.07
					C	0.65*	0.23	0.05	1.26
Number of recall on positive image	1 week post	3, 86	1.82	2.34	A	0.65	0.26	−0.03	1.33
					B	0.21	0.27	−0.49	0.91
					C	0.43	0.26	−0.25	1.12
	1 month post	3, 86	1.7	3.10*	A	0.35	0.22	−0.22	0.92
					B	0.22	0.22	−0.36	0.81
					C	0.65*	0.22	0.08	1.22
Number of recall on nature image	1 week post	3, 86	1.29	1.22	A	0.49	0.3	−0.32	1.27
					B	0.1	0.31	−0.71	0.92
					C	0.43	0.3	−0.36	1.23
	1 month post	3, 86	1.01	1.21	A	0.22	0.27	−0.49	0.92
					B	−0.08	0.28	−0.8	0.64
					C	0.39	0.27	−0.31	1.1

Control Group A: Non-stress-relief.
Control Group B: Stress-relief (non-nature).
Control Group C: Stress-relief (nature).
*$p < 0.05$; **$p < 0.01$.
[a]Stress-relief (nature) + M.E. group.
[b]The corresponding control group.

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Regarding “Belief in virtual nature can relieve stress,” there were significant differences between the four groups both 1 week post and 1 month post. As indicated by the post hoc comparisons made using the Turkey HSD test, “Stress-relief (nature) + M.E.” Group (1 week post: M = 2.87, SD = 1.42, 1 month post: M = 2.87, SD = 1.39) was significantly lower than “Non-stress-relief” Group (1 week post: M = 4.04, SD = 1.07; 1 month post: M = 4.09, SD = 1.28) and “Stress-relief (non-nature)” Group (1 week post: M = 4.14, SD = 0.06; 1 month post: M = 4.24, SD = 0.70). For “Intend to expose oneself to virtual nature for stress-relief,” significant differences were found among the four groups at 1 week post. A pairwise post hoc test revealed “Stress-relief (nature) + M.E. “Group (M = 2.70, SD = 1.66) was significantly lower than “Non-stress-relief” Group (M = 3.79, SD = 1.09) and “Stress-relief (non-nature)” Group (M = 3.96, SD = 0.97). However, the significant differences among the groups no longer existed at 1 month post. For “Frequency of exposure to virtual nature for at least 20 min in last week at 1 week and 1 month post,” no significant differences existed among the four groups.

Interestingly, as everyone faced the sudden outbreak of the pandemic, the “Stress-relief (nature) + M.E. “Group seemed to have a lesser belief that virtual nature could relieve stress at 1 week and 1 month post as compared to the “Non-stress-relief” Group and “Stress-relief (non-nature)” Group. However, their significantly lower

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intention to expose themselves to virtual nature for stress relief no longer existed at 1 month post, perhaps because people had no choice but to use virtual nature as a substitute for nature experiences as the pandemic continued. Group differences in attitude were present, but there were no differences in the actual frequencies of virtual nature exposure among the groups.

Group effect on recalls of "Positive Nature," "Positive," and "Nature" images

This set of questions also was added after the outbreak of the pandemic, so only 1 week and 1 month post data are available. One way between-subjects ANOVA (see Table 8) showed the "Number of recall on nature image" was not significantly different among the four groups. "Number of recall on positive image" was not significantly different for the four groups at 1 week post, but it became significant at 1 month post, at which time "Stress-relief (nature) + M.E." Group (1 month post: M = 1.65, SD = 0.65) had a higher number of the recalls than "Stress-relief (nature)" Group (1 month post: M = 1.0, SD = 0.80). On the other hand, for "Number of recall on positive image of nature" 1 week post, "Stress-relief (nature) + M.E." Group (1 week post: M = 1.39, SD = 0.99) had a higher number of recalls than "Non-stress-relief" Group (1 week post: M = 0.61, SD = 0.72). At 1 month post, "Stress-relief (nature) + M.E." Group (1 month post: M = 1.26, SD = 0.81) had a higher number of recalls than

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"Non-stress-relief" Group (1 month post: M = 0.61, SD = 0.72) and "Stress-relief (nature)" Group (1 month post: M = 0.61, SD = 0.72).

The results indicate answering the motivational enhancement questions in addition to reading the motivational message related to nature resulted in participants having a significantly greater recall of positive images or positive nature images at different times as compared to the control groups. Also, "Stress-relief (non-nature)" Group may have been influenced by the positive thinking presented in their message to look for nature or positive images, resulting in this group having no significant difference with "Stress-relief (nature) + M.E." Group in the number of recalls of positive images or positive nature images.

The effects of different messages on wellbeing and connectedness to nature ANOVA shows no significant differences in the means of the four groups at 1 week pre (see Table 8). One month later, the differences in the means of the four groups were significant. Post hoc comparisons using the Turkey HSD test found the mean score for "Stress-relief (nature) + M.E." Group (M = 24.52, SD = 12.79) was significantly lower than "Non-stress-relief" Group (M = 33.22 SD = 7.66). As indicated by Figure 10, the PSS score for all groups increased from 1 week post to 1 month post, except for "Stress-relief (nature) + M.E." Group, which experienced a decrease.

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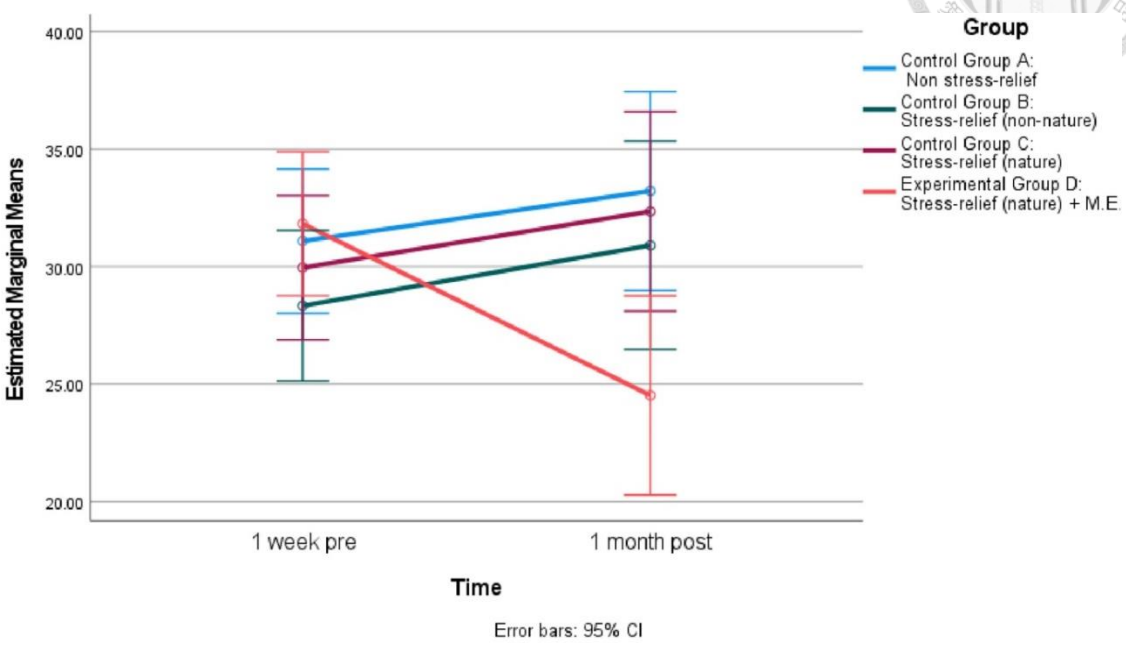
Figure 10 Estimated marginal means of "Perceived Stress Scale-14" across different time for four groups of Study 2(N = 90). (Yeung & Yu, 2022b)



ANOVA (see Table 8) also shows for DASS_Stress, DASS_Anxiety, DASS_Depress, and Flourishing, there was not a time or time × group effect. Apparently, the experimental conditions impacted the feelings and thoughts that are directly measured by PSS-14 (Cohen & Williamson, 1988) but not the clinically significant perceived severity of symptoms related to depression, anxiety, and stress as measured by DASS-21 (Lovibond & Lovibond, 1995a). There was no impact on the variable "Flourishing," which relates more closely to "meaning and purpose" in life (Diener et al., 2010) and eudaimonic wellbeing (Schotanus-Dijkstra et al., 2016).

The main effect of time for CNS was significant $F(2, 172) = 9.54$, $p < 0.01$, Eta2 = 0.10. Pairwise comparison showed the mean difference 1 week post vs. pre-test

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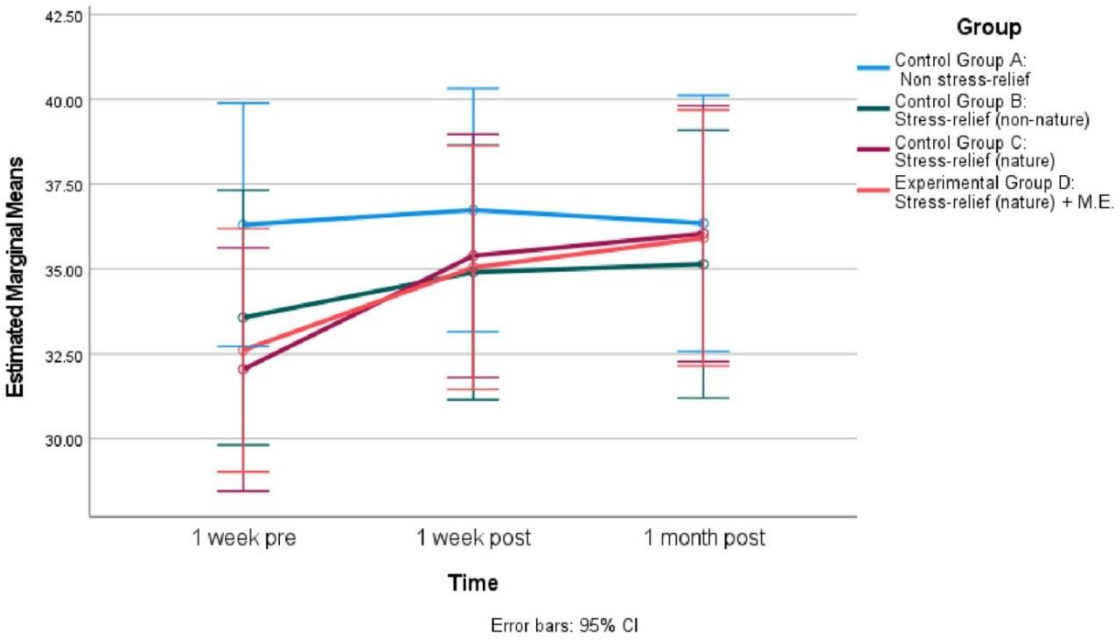
was 1.99 (SE = 0.51, $p < 0.01$) while 1 month post over pre-test was 2.23 (SE = 0.48, $p < 0.01$). This indicates people sought closeness with nature during the pandemic, as their connectedness to nature increased significantly regardless of their group membership. See Figure 11 for Estimated Marginal Means of CNS for the four groups across pre-experiment, 1 week post, and 1 month post.

Figure 11 Estimated marginal means of "Connectedness to nature" across different time for four groups of Study 2 (N = 90). (Yeung & Yu, 2022b)



Research question 2: To what extent motivation indicators contributed to connectedness to nature during the pandemic

Table 9 lists the summary of Hierarchical Multiple Regression results for CNS. We interpreted the adjusted R^2 instead of R^2 for the adjustment in the number of predictors.

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Table 9 Summary of Hierarchical Multiple Regression result on connectedness to nature of Study 2 (N = 90). (Yeung & Yu, 2022b)

DV = Connectedness to nature									
	Pre			1 week post			1 month post		
Variable	*B*	SE	β	*B*	SE	β	*B*	SE	β
Step 1:									
Gender	−4.35	1.85	−0.25*	−3.72	1.84	−0.21	−3.85	1.93	−0.21
Age	0.54	0.37	0.15	0.41	0.37	0.12	0.46	0.39	0.12
Adjusted R^2		0.06			0.03			0.03	
ΔR^2		0.08*			0.06			0.06	
Step 2:									
Gender	−3.34	1.76	−0.19	−3.29	1.86	−0.19	−4.20	1.72	−0.23*
Age	0.62	0.35	0.17	0.09	0.39	0.03	−0.02	0.35	−0.01
Belief in nature can relieve stress	0.10	1.17	0.01	0.60	0.74	0.10	2.48	0.97	0.30*
Intend to expose oneself to nature for stress-relief	0.94	0.83	0.14	0.77	0.75	0.13	−0.09	0.96	−0.01
Frequency of exposure to nature for at least 20 min in last week on one's own	2.07	0.90	0.23*	−0.44	0.98	−0.05	−0.72	1.14	−0.07
Frequency of exposure to nature for at least 20 min in last week with family or friends	2.28	1.02	0.23*	1.46	1.07	0.16	−1.04	1.96	−0.05
Belief in "virtual" nature can relieve stress	–	–	–	0.36	0.90	0.05	0.23	0.79	0.03
Intend to be exposed to "virtual" nature for stress relief	–	–	–	1.59	0.81	0.26	1.47	0.71	0.25*
Frequency of exposure to "virtual" nature for at least 20 min in last week	–	–	–	−0.63	1.04	−0.07	1.01	0.84	0.12
Number of recall on positive image related to nature in last week				1.00	1.11	0.11	3.53	1.13	0.32**
Adjusted R^2		0.19			0.10			0.30	
ΔR^2		0.17**			0.15			0.33**	

*$p < 0.05$; **$p < 0.01$.

The results of the first block of hierarchical linear regression, measuring the time before the outbreak of the pandemic, yielded a statistically significant model ($p < 0.05$) that explained 8% of the variance in CNS, namely from the control variables of gender and age. The second block analysis, too, yielded a significant model ($p < 0.01$), with "Frequency of exposure to nature for at least 20 min in last week on one's own" ($\beta = 0.23$, $p < 0.05$) and "Frequency of exposure to nature for at least 20 min in last week with family and friends" ($\beta = 0.23$, $p < 0.0105$) significantly explaining the model and contributing 17% of variance in CNS.

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At 1 week post, when the pandemic was just beginning, neither the control nor the independent variables examined were significant in the model. That means the model did not explain the variance in CNS well. This is likely because people were adjusting to the pandemic and, as a result, the usual profile of connectedness to nature was disturbed.

For 1 month post, when the pandemic has been occurring 3 to 5 weeks, the second block of variables, including belief, intention, and frequency of exposure, rendered the model significant. The R2 change indicates 33% of the variation in CNS can be explained by the variables, including gender ($\beta = -0.22$, $p < 0.05$), "Belief in nature can relieve stress" ($\beta = 0.30$, $p < 0.05$), "Intend to expose oneself to virtual nature for stress-relief" ($\beta = 0.25$, $p < 0.05$), and "Number of recall on positive image of nature" ($\beta = 0.32$, $p < 0.01$). When connectedness to nature was taken away by the pandemics, people pursued other methods to maintain their nature connection, and this included by cognitive means of believing nature can relieve stress, emotional means of intending to expose oneself to virtual nature, and, most importantly, by paying closer attention to positive images of nature present in daily life, as measured by the item "recall of positive image of nature," which was the most significant variable in the model.

Research question 3: To what extent connectedness to nature contributes to perceived

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stress at 3 to 5 week post blooming of the pandemic

Table 10 displays the summary of the Hierarchical Multiple Regression which examines the role of Connectedness to Nature in explaining PSS. The controlled variables namely gender, age, group membership, pre-score of PSS and pre-score of MSPSS accounted for 42% of the model's variance. CNS was added as the block 2 variable and explained 4% of the variance of PSS ($\beta = -0.20$, $p < 0.05$). The negative relationship between the two variables implies increases in Connectedness to Nature are associated with decreases in Perceived Stress. Nevertheless, by comparing standardized coefficient Betas, it was revealed Connectedness to Nature contributed much less to the model than did the pre-score of PSS ($\beta = 0.49$, $p < 0.01$) and membership in the experimental groups ($\beta = -0.36$, $p < 0.01$).

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Table 10 Summary of Hierarchical Multiple Regression result on Perceived Stress Scale-14 of Study 2 (N = 90). (Yeung & Yu, 2022b)

	DV = Perceived Stress Scale-14		
	B	**SE**	**β**
Step 1:			
Gender	−0.72	1.98	−0.03
Age	−0.25	0.38	−0.06
Perceived support measured at 1 month	−0.12	0.08	−0.13
Control Group A	0.43	2.52	0.02
Control Group B	0.42	2.64	0.02
Control Group C	–	–	–
Experimental Group D	−8.53	2.56	−0.35**
PSS_pre	0.74	0.13	0.51**
Adjusted R^2		0.37	
ΔR^2		0.42**	
Step 2:			
Gender	−1.41	1.95	−0.06
Age	−1.15	0.38	−0.03
Perceived support_1 month	−0.09	0.08	−0.10
Control Group A	0.56	2.46	0.02
Control Group B	0.18	2.58	0.01
Control Group C	–	–	–
Experimental Group D	−8.66	2.50	−0.36**
PSS_pre	0.70	0.13	0.49**
Connectedness to Nature measured at 1 month	−0.23	0.10	−0.20*
Adjusted R^2		0.40	
ΔR^2		0.04*	

Remarks: Control Group C has been excluded by the Regression.
Control Group A: Non-stress-relief.
Control Group B: Stress-relief (non-nature).
Control Group C: Stress-relief (nature).
Experimental Group D: Stress-relief (nature) + M.E.
*$p < 0.05$; **$p < 0.01$.

3.2.4 Discussion

General discussion

This was a randomized control trial to explore whether messages with motivational elements can lead young adults to nature exposure for stress reduction. Compared with "Non-stress-relief" Group and "Stress-relief (non-nature)" Group, participants who read the motivational message and answered motivational enhancement questions had higher levels of motivation, as indicated by their greater belief that nature can relieve stress and their greater intention to expose themselves to nature for stress relief. Such a significant

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difference, though it only lasted for a duration of 1 week, was not present between "Stress-relief (nature)" Group (i.e., without answering motivational enhancement questions) and the aforementioned two control groups. Also, "Stress-relief (nature) + M.E." Group was seemingly more resistant to virtual nature, which is supported by them being less likely to believe in beneficial effects of virtual nature and less likely to intend to expose themselves to virtual nature. While frequency of exposure to nature may have been impacted by the pandemic and therefore not only in response to the experiment, a relatively higher number of recalls of positive images of nature, an indicator of behavioral change we constructed in the later part of the study, was present in "Stress-relief (nature) + M.E." Group. The present study found a trend of increasing amounts of perceived stress across the three control groups, which aligns with the relationship for young adults between stress and the COVID-19 pandemic (Brownin et al., 2021; Li et al., 2020, 2021; Liu et al., 2020). Interestingly, there was a trend of decreasing perceived stress for "Stress-relief (nature) + M.E." Group.

These favorable findings for motivational indicators, together with stress reduction effects, reflect the success of the motivational enhancement strategy. The strategy supports the notion that, to promote help-seeking in young people, the role of the internet and online resources should be treated as an adjunct to offline help-seeking (Pretorius et al., 2019). Our design of the motivational message aligned with the

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self-determination theory as proposed by Ryan and Deci (Ryan & Deci, 2017; 2000), that is, supporting autonomy to visit nature, enhancing self-efficacy by suggesting an easily accomplished task (i.e., simply expose yourself to nature), and addressing connection with the larger community including nature. However, in the present study the message solely addressing the said concepts did not increase motivation of the young adults to expose themselves to nature. It was only with ambivalence addressed as is recommended by the Motivational Enhancement Therapy, or Motivational Interviewing (Miller & Rollnick, 2002), that motivation of young adults for nature exposure increased. Young adults, a self-reliant population that enjoys informal help-seeking (Rickwood et al., 2005), perhaps are more receptive to an indirect approach that grants them freedom for ambivalence resolution. By asking the young adults to assume a third person view in solving problems they may also encounter, we successfully addressed their resistance to an extent. Defining the nature experience as not restricted to a physical visit to nature, as suggested by Hunter et al. (2019), may also contribute to a pro-attitude of nature exposure in young adults.

Very often physical exposure to nature is regarded as a behavioral indicator for motivation of nature exposure. Our study indicates that, apart from actual physical exposure, recalls of positive nature elements can also be increased by motivational enhancement work. The recall somehow reflects the corresponding attention to the

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positive nature stimuli. Though it did not attain a stress reduction outcome as Hunter (2019) yielded for 20 to 30 min subjective nature experiences, its impact on connectedness to nature can results in positive wellbeing outcomes, including changes in perceived stress, depression, anxiety and flourishing (Huynh &Torquati, 2019). This finding implies behavioral measurement of exposure to nature may be shorter or less deliberate, as we expected, or it can present as attention to positive stimuli in nature.

Shortly after all participants in this study completed the 1 week pre-test, the outbreak of the pandemic occurred in Taiwan. We had the opportunity to examine how motivational indicators could explain connectedness to nature, as well as whether perceived stress could be explained by connectedness to nature, a variable that is associated with human wellbeing (Huynh &Torquati, 2019; Wolsko et al., 2019). The contributing variables differed during different phases of the pandemic, with actual physical contact, typically a contributing variable to nature connectedness, vanishing once the outbreak began. Gradually, as people adjusted to the pandemic, their belief in physical nature's ability to heal, their intention to connect with virtual nature (while physical contact was still hindered), and recall of positive images of nature contributed to their connectedness to nature. This implies humans are flexible in adopting different means to attain closeness to nature when the actual environment hinders it.

Thus far, empirical studies of connectedness to nature have mainly centered

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on closeness with actual forests (e.g., Carrus et al., 2020) and urban greenspaces (e.g., van den Bogerd et al., 2018). The present study echoes findings of previous studies, that virtual or simulated nature (Yeo et al., 2020;Pasca et al., 2021) can be one source of human connectedness to nature, as we found that people who intended to expose themselves to virtual nature had a higher connectedness with nature. Although the effectiveness of virtual nature in increasing positive moods is inferior to outdoor exposure (Browning et al., 2020), it remains a possible substitute for nature among young adults, especially when actual access to nature is deprived, as was the case during the pandemic.

For young adults stress is associated with different life domains. Li et al. (2020) reported a significant inverse relationship between perceived social support and psychological symptoms during the COVID-19 pandemic. However, by comparing the coefficient of beta in the regression, our study surprisingly found the influence of connectedness with nature on perceived stress is double that of perceived social support. We can say promoting connectedness to nature during a health crisis like the pandemic would be beneficial to the wellbeing of young adults and such benefits may be greater than those from their perceived social support.

Connectedness to nature, a fluid quality reflecting how much a person feels emotionally connected to the natural world (Mayer &Frantz, 2004), increased across the

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four experimental groups over time during the pandemic. Although there was not a treatment-free group in the present study for comparison, we believe the increased connectedness to nature is a result of the pandemic rather than the experiments, given that logically it is unlikely being subjected to a message about online shopping security (as was the case for Control Group A) would lead to increased connectedness with nature. Humans possess an innate tendency to seek connection with nature (Wilson, 1984) and they hunt for "atmospheres of safety and belonging' (Duff, 2012 p. 68). While the pandemic affected the entire world, some researchers have attributed this health crisis to global human-nature interactions (Di Marco et al., 2020) and have advocated for the protection, restoration, and promotion of sustainable use of terrestrial ecosystems for preventing future pandemics (Thoradeniya & Jayasinghe, 2021). Such literature has led individuals to reexamine the human-nature relationship and perhaps raise their tendency to have closeness with nature. Our present study found subjecting individuals to motivational messages did not help increase connectedness to nature. Exploration of other methods to promote nature connection should be a future research item.

While we conducted an online research study, we had to be extra cautious during the study administration. Because the number of survey items can affect the drop out of an online study (Hoerger, 2010), we controlled the number of questions across

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every stage of the experiment to below 100 questions. To further decrease drop out, we politely reminded participants when the deadline for questionnaire completion was approaching. This resulted in a very low drop out (i.e., only three dropouts) across all stages of the study. Also, we detected potential response set by examining the questionnaire immediately, and we allowed participants to change their answers, with the hope of raising the reliability of the study. Most importantly, we responded promptly when the pandemic began and innovatively added measurements that potentially could provide meaningful information about the relationship during the pandemic between humans and nature. Finally, we made the remuneration minimal, $400 Taiwanese dollars, to not confound the motivation of participants. By applying our understanding of the characteristics of online studies and young adults and the pandemic's impact on human behavior, we hope we can maximize the rigor of the study.

Limitations

There are a number of limitations of the study. First, we note the time frame of the study relatively coincided with the outbreak of the COVID-19 pandemic. However, because the questionnaires asked the participants to refer to the past week, during the 1 week post responses there may be participants who referred to conditions before the city locked down, rendering the 1 week post findings a mixture of responses. Also, the opening of the message read by Groups B, C, and D was not adjusted to

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address stress relating to the pandemic. We must admit these slight incongruences between the study materials and timing of the study are things we could not control in a dynamic situation, and they may have affected the experimental effects.

We notice the participants' accessibility to urban Greenland and the surrounding environment (e.g., congestion, urban constructions) can be varied according to their residence. These are the variables that the present study had not inquired as Taiwanese students used to travel among school, dormitories and their home thus the accessibility to Greenland is difficult to be defined. Or if rigidly defining it the creation of bias would be very likely. We finally decide to let the random sampling to even out the influence of this variable.

Single-item questions for motivation, including belief, intention, and frequency, hindered the investigation of psychometric properties such as reliability. Although clustering of the same items across different time periods in correlations could serve as evidence of the items' validities, further construction of multi-dimensional motivational indicators for each construct is warranted. Similarly, we added questions addressing virtual nature and recall of impressive images from daily life peremptorily to supplement information of human relationships with nature during the pandemic. Though meaningful findings were yielded for these variables, further validation of these measurements is required.

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The total of 90 study participants guaranteed power of the statistical analyses, but it still imposed limitations for conducting mediation analysis on variables, including four group membership, motivational index, outcome measurement on wellbeing, and controlled variables such as age, gender, and perceived social support. For the sake of upholding a certain power of the tests, we could only conduct separate hierarchical regressions to examine the relationships among connectedness to nature, the motivational index, and the outcome measurements. Fortunately, through this approach we managed to generate meaningful findings for understanding the subject matter.

Constrained by the number of participants, we eliminated a control group involving motivational enhancement questions only (i.e., without reading the motivational message). With this additional control group, we would have examined the pure effect of the motivational enhancement questions. Future study is warranted to include this control group so that clarity may be attained regarding what constitutes an effective motivational message or strategy in mobilizing people to connect with nature.

3.2.5 Conclusion

Literature review indicates the increasing stress experienced by young adults should not be neglected during the pandemic, nature offers potential benefits on wellbeing, and young adults are more receptive to intervention approaches that address

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their need for autonomy. By addressing ambivalence, as is suggested by the motivational enhancement approach, in addition to core principles of motivation, we induced young adults to display favorable changes in motivational indicators in terms of belief and intention to connect with nature to relieve stress. In this intervention the young adults exhibited greater recall of positive nature memories from their daily lives and reported lower perceived stress 1 month after the experiment. Our study explored indicators measuring motivation for nature exposure during the pandemic when real exposure to nature was less likely. During the pandemic and after, people have been more health conscious and seemingly more likely to connect with nature, so it may be a golden time to consolidate such motivation to benefit their physical and mental health.

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3.3. Study 3: What makes nature a good platform for conducting cognitive-behavioral therapy on anxiety-depressed patients

3.3.1 Introduction

Impact of nature based benefits on mood problems

Figure shows that 15% of the health care global burden is related to mental health in 2020 (WHO, 2001). Although treatments are available in the city, an estimation of 30 to 35% of the patients who have received evidence-based therapy do not benefit from the treatment (Newnham & Page, 2010). Alternatives are demanded for to enhance emission rate. Modern psychotherapies have been suggested to employ natural therapy instead of a gray office (Kim et al.,2009).

Exposure of oneself to the natural environment at different degree of wildness, including forest, artificial roof gardens, dwarfed tree appreciation, and green-scene simulations, etc. is concluded as forest therapy (Kamioka et al., 2012). When exposed to the nature, anxiety symptoms are lowered more than local urban environment (Park et al., 2011; Song et al., 2014; Lee et al., 2014; Ochiai et al., 2015). Lee et al. (2017) has reviewed the effectiveness of forest therapy on treating depression. Twenty-one out of twenty-eight studies, with duration of the therapy ranging from two to three hours, have showed significant remission in depression. The review has also found that “viewing nature” or “being present near nature” may not be enough to bring significant impact on the level of depression, implying the importance of the active involvement with the nature. On the other hand, Morita et al. (2007) investigated Shinrin-yoku’s effect on 498 Japanese residents found those suffering from chronic stress state showed the greatest reduction in subjective feelings of anxiety when being exposed to the nature. The above studies gave a general impression that therapy in the nature, involving more active

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interaction, targeting on those suffering from chronic stress, can bring the better therapeutic effect.

Perspective on relationship between active involvement with the nature and wellbeing

Attention Restoration Theory (ART, Kaplan, 1995) is one of the famous perspectives on how to make use of the nature actively for human wellbeing. It proposes that spending time in the nature through four supporting elements namely being away, fascination, extension and coherence could allow one to regain cognitive resources that are essential for "directed attention". Nature can engage one's mind from a bottom up manner without taxing the executive functioning. As a result, the neural mechanisms underlying directed attention have a chance to rest and replenish (Kaplan, 1983). Though ART has concrete directives on hunting appropriate venue to attain the most efficient restorative effect, its four components were being critique as being too vaguely defined to be applicable in design practice. High intercorrelation and overlap between the four constructs (Chang et al., 2008; Herzog et al., 2003) have made operationalization of the concepts in benefiting human wellbeing difficult and hence it is worth to explore other models to support the evidence-based nature program for the anxiety-depressed. .

Cognitive-behavioral Therapy (CBT) intervention in the nature

The ability of nature on cognitive functioning perhaps is not merely on attention restoration as stated in ART, but the alternation in the thinking pattern. The application of CBT is at the starting phase in the field of nature-based therapy when compared with other approaches like mindfulness and meditation (e.g.Lymeus et al., 2018; Nisbet et al., 2019). However a promising impact has been reported. For example, staying in forest

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with CBT program makes better results when contrasting to staying in the same environment without any programs for depressive patients (Woo et al.,2012). CBT forest therapy program involving participants' self-reflection and goal setting has resulted into significant decrease in the salivary cortisol as a biomarker of stress, increase in quality of life, and decrease in anxiety (Sung et al., 2012). Four weeks' forest-CBT program that focusing on patients' problems reflection and cognitive error reconstruction after strolling in the forest or hearing stories about trees has lowered the recurrence of depressive symptoms and social adjustment as well as enhanced rate of remission (Kim et al. 2009).While able to show the effect of CBT in the forest, the above studies fail to explain how the nature brings the changes. In another words, in what ways the nature has facilitated the cognitive changes remains a myth. Most important of all, the application of the CBT program in the nature yields a finding on the interaction effect of CBT techniques with the nature but not purely how the nature brings impact on the cognition or behavior of the participants.

To integrate CBT and the nature, we firstly need to know the rationale and treatment components of CBT so that we can know how to make use of the nature to conduct CBT.

Cognitive-behavioral perspectives of mood disorder and CBT

Cognitive distortions, including those about the persons themselves, the world, and the future, misrepresenting reality, cause impairment and distress, and prevent individuals from resolving their problems (Beck et al., 1979). Such plays a fundamental role not only in the onset, but also the maintenance of all manner of psychological dysfunction, be they Axis I and II disorders (e.g., Beck et al., 2004).The cognitive distortions, just to name a few, include all-or-nothing thinking, overgeneralization,

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mental filter, disqualifying the positive, jumping to conclusions, and catastrophizing, etc.(Beck & Bredemeier, 2016).

Learned helplessness, a cognitive-affective process, explains in more details about the onset and maintenance of mood problems particularly for depression (Seligman, 1975). Individuals become depressed because they come to believe that they are incapable in controlling the reinforcements in their lives. The person's acceptance of their powerlessness discontinues the attempts to escape or avoid the aversive stimulus, even when alternatives to avoid the stimuli are available. Attribution style is an explanation of the mood problems and behavioral patterns that further maintain the negative mood (Seligman,1991).

Misattribution includes internal attribution that fixes blame on oneself (e.g. I screwed up"), global attribution which treats the same bad things would happen across situations (e.g. "I am not good at maths, neither I will be good at other science participants like physics), and permanent attribution which treats cause as more or less permanent (e.g. "I will never be able to learn this stuff") (Seligman,1991).

CBT, according to Beck (1993) "is best-viewed as the application of the cognitive model of a particular disorder with the use of a variety of techniques designed to modify dysfunctional beliefs and faulty information processing characteristic of each disorder" (p. 194). The transformation requires a deep exploration of the relationship between thinking, feeling and behavior. For example, depressive patients have to see the fault in attributing the cause of an event being internal, global and permanent while learning to uphold more flexible thinking in order to be adaptive.

Recently, it has been argued whether alternation in cognition is necessary nor sufficient for improvement. In laboratory study, subjects attempting to control or

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suppress thoughts found to experience them later, in a process of "post suppression rebound effect" (Wenzlaff & Wegner, 2000). As a result, emergence of novel approaches that minimize direct cognitive disputation but relying more on embracing their thoughts and feelings rather than fighting or feeling guilty for them (e.g., acceptance-based strategies) (Hayes, 2004), has been developed. This echoes the perspective of learned helplessness, "one of the potent determinants of explanatory style is reality that interventions cannot be as simple as just urging people to think positive when the world in which they live is relentlessly negative" (p.17, Maier, et al., 2000 p. 17). Often observed in clinical work are patients being over-whelmed by the negative stimuli in the immediate environment. They isolate themselves to lower the risk of facing the precipitated negative stimuli, setback to their comfort zone and become unmotivated for treatment. Finding a safe platform for CBT that could facilitate patients to embrace and validate their cognitions is highly demanded for.

Nature as a platform for CBT

Humans are liable to make cognitive errors based on emotion, believes or past experience, but not on objective aspect of the situation (Beck et al., 1979).Besides, diverting attention to positive elements could bring positive perceptions. For example, there is study showing that individual paying attention to positive information perceived character in a story as happy (Noguchi et al., 2006). Therefore training up individuals to observe the objective fact in the environment or pay attention to the positive elements in the environment perhaps can be a mean to alter their cognitions. Urban life is dynamic, full of challenges, emphasizes efficiency and as a result requires immediate response to cope. Superficial thinking or automatic thoughts arising from maladaptive schema are therefore easily activated. We can imagine that those suffering from mood disorders,

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surrounded by the stressors in city life, are day to day immerse in negative stimuli and have relatively less chance to re-divert their attention to positive or at least neutral stimuli. Nature on the other hand is a place that our ancestors know well and feel safe to stay according to the biophilia hypothesis (Kellert & Wilson, 1993). The availability of positive stimuli in the nature could somehow provide a space for human to shift attention, embrace their cognitions and emotion, and reexamine their misattribution.

For confronting the cognitive errors and seeing the relationship between cognitions-emotions-behavior, attention paid to them and the awareness of the presence of them are the prerequisites. While attention is an initial and crucial cognitive processing, training oneself to have focused attention, or being mindful, would be beneficial to the conduction of CBT. Mindfulness has been combined with cognitive therapy for depressive patients with promising result shown (e.g. see Coelho et al., 2013)'s review on Mindfulness-Based Cognitive Therapy). Mindfulness skills however require certain effort to focus and might not be easily attained by everybody. There has been study showing that engaging participants with pleasantly interesting natural stimuli can help regulate attention bottom-up, restore cognitive performance and attain improvement in dispositional mindfulness (Lymeus et al., 2018). Furthermore, nature can demonstrate connections amongst things, the normal life and death cycle, as well as the natural consequences (Russel, 2001). Also, through connectedness to nature, individuals include nature to the cognitive representation of self (Schultz 2002). In a study by interviewing 26 nature-based facilitators, Naor & Mayseless (2020) found that human can be awakened through embodied experience in nature leading to spiritual awareness and connection. Accordingly, experiencing immensity of the natural environment expands personal perspective in form of personal and world views, with personal circumstances and stories then being perceived from the larger context of life.

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Self-efficacy, as a belief in the capability of oneself affect behaviors (Resnick, 2009), is an inevitable element of a successful CBT. When people believe that they can make a positive difference in their life, they are more likely to embark and persist with the behavioral changes. Self-efficacy in CBT of mood disorder concerns about how to make people feel in charge of their own health care and continuously involve in adaptive behaviors (e.g. Wells-Federman et al., 2002). There had been a positive relationship between self-efficacy and treatment success. For example, an increased in perceived self-efficacy was associated with enhanced extinction of fear (Zlomuzica et al., 2015). Jung et al. (2015) showed professional self-efficacy and mastery has been enhanced via a 3 days-2 nights' forest therapy program. Therefore, enhanced self-efficacy and mastery, if can be attained in the nature, would be favorable elements for conducting CBT.

Despite of the popularity of CBT in treating mood problem, it has its disadvantage. CBT drop-out rates is in general of more than 43% (Persons et al., 1988). The confrontational approach may be why some of the patients dropped out prematurely. Sense of autonomy is found to be a significant element in raising treatment motivation according to Deci and Ryan's Theory of Motivation (Dec & Ryan, 1985). Weinstein, et al. (2009) found that, participants who immersed more in the nature scenes felt a greater sense of autonomy while participants who immersed in the non-nature scenes felt reduced autonomy. Also, Ahmed & Lawn (2012) found that behavioural interventions can help to lower the drop-out rate in CBT for outpatients with comorbid anxiety and depression. It may be possible that therapeutic session in nature involves behavioral experiencing can consolidate the participants' motivation.

To conclude, the elicit of positive emotions , facilitation of focused attention, demonstration of connections and life cycle, granting self-efficacy, as well as raising of

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treatment motivation , perhaps are what make the nature potentially a good platform for conduction of CBT. It is valuable to see whether simply exposure to the nature could generate the said experience.

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3.3.2 Methodology

Research objective and approach

The present study aims at understanding what elements make the nature a good platform for CBT in treating patients with mood disorders. It employs thematic analysis, a method for identifying, analyzing, organizing, describing, and reporting themes generated within a data set. This approach has its strength of being able to examine perspectives of different research participants, highlight similarities and differences, generate unanticipated insights (Braun & Clarke, 2006) as well as to produce a clear and organized final report (King, 2004). "A theme is an abstract entity that brings meaning and identity to a recurrent experience and its variant manifestations. As such, a theme captures and unifies the nature or basis of the experience into a meaningful whole" (DeSantis and Ugarriza, 2000p. 362). It brings together fragments of ideas or experiences, which can be meaningless when viewed alone (Aronson, 1994). The integrations of all the themes, as a result, add matters of importance to the overall research question.

Format of nature-based therapy

Nature-based therapy could be a very broad one that consists of any therapeutic program that making use of the nature. According to Moeller et al. (2018) which could include gardening and horticulture-based interventions, animal-assisted interventions, care farms and simulated nature interventions, etc. In order to investigate the effect of the natural environment on human, the involvement of other living beings intentionally (e.g. Animal assisted therapy) or skills training (e.g. horticultural therapy or care farms) are not adopted in the present study. Instead, a forest therapy approach concerning sensational interaction with the nature is chosen as a modality for examination.

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According to a review by Lee et al. (2017) on 28 forest therapy programs, the format and content of the programs could be in great variation. The length of time that the interventions undertaken vary from one day to twelve weeks while the duration range from twelve minutes (Lee et al., 2014) to three hours (Song et al., 2014). In the present study, the nature-based therapy would be of one-session in order to explore the effect merely within the session without exposure to other confounding variables that could be happened in-between the sessions. The session lasted for within 3 hours, in general of 2 hours, which is comparable to most forest therapies shown in Lee et al. (2017)'s study.

The content of the therapy was made reference to Ibes et al. (2018)'s study which was of two approaches to stress reduction, namely mind-body skills and nature exposure. The path, in the said study, was selected on the basis to remove distractions and focus attention on sensory awareness in the present natural environment. Signage had been employed to prompt participants to imagine "bathing in colors," "floating into a cloud," and "mirroring a tree" in recruiting different senses like visual, auditory, tactile, and kinesthetic, etc. to cultivate a physiologically relaxed and alert state. In the present study, a facilitator instead of signage was employed in order to make it more comparable to the traditional CBT groups. The facilitator, with psychology background as well as training and history in leading the sensations experiencing approach of forest therapy, delivered attention-directing invitations.

Throughout the session, three invitations had been delivered. The first one was to direct the participants to the environmental stimuli. The second one was on slowing down the pace. The final one was a "valuable stuff" hunting activity in the environment with the participants had to find a living or non-living beings in the nature that they feel valuable for them. The participants were then to share their own personal stories with the said beings and also to feel if there was any feedback from the beings.

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This involved certain cognitive activities (imagination & self-reflections). All the invitations were to deepen the participants' interaction with the nature. Sharing had been conducted after completion of each invitation. During the sharing the facilitator remained silent. This is to minimize facilitator's influence in the therapy and to study the pure interaction between the nature and the participant. For ethical reason, the session was debriefed after completion of the data collection in the last sharing.

Venue of the nature-based therapy

Totally seven groups have been conducted from November 2019 to July 2020. Five groups were taken place at Lai Chi Kok Park or Rotary Park in Hong Kong. Another two groups took place in Dagouxi Riverside Park of Taiwan. All of them were with minimal view of human construction (like roads, bridges, fence of residence or gazebo). Biodiversity, quietness, spacious, convenience for transportation, as well as the availability of facilities like toilet and road marks, are criteria for the selection of venue.

General time and climate of forest therapy

Three of the therapies took place in the morning while the residual four were in the afternoon. The weather for conducting the forest therapy was in general non-rainydays while the temperature was of 25 to 30 degree Celsius. There was also mild wind at times during the sessions.

Participants

Beck (1993) has described that cognitive model is specific for particular disorder. For this reason, involving patients with wide range of mood disorders in the present study is undesirable. The present study has selected anxiety or depression patients as

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core target for investigation as they are the two major types of mood disorder seen in clinical setting. Great comorbidity between anxiety and depression is another reason for targeting them in the present study. For example, researches have indicated that more than 70% of individuals with depressive disorders also show anxiety symptoms whereas 40 to 70% of them simultaneously fulfill criteria for at least one type of anxiety disorder (Favaet al. , 2008; Wu et al., 2013; Kessler, Merikangas & Wang, 2007; Lamers et al., 2011). As a result, anxiety and depression are often studied together in researches.

An open recruitment was made in social platform accessible to patients suffering from anxiety, depression or anxiety-depression. The participants who fulfilled the anxiety and depression criteria at DSM-IV were being recruited. Totally 28 participants with anxiety and/or depression problems have been recruited and were assigned at their convenience to one of 7 groups. All of them were Hongkongese, with 16 of them were female while 12 of them were male. The mean age of the participant was 36.8. Consent had been obtained for the participation in the study. Table 11 shows the demographic details of the participants in the nature-based program.

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Table 11 Demographic details of the participants in the nature-based program of Study 3.

Characteristics		No.	Percentage
Gender	Male	12	42.86%
	Female	16	57.14%
Age	21 - 30	9	32.14%
	31 - 40	11	39.29%
	41 - 50	6	21.43%
	51 - 60	2	7.14%
Education	Primary	2	7.14%
	Secondary	13	46.43%
	Undergraduate or graduate	13	46.43%
Present psychiatric diagnosis	Anxiety-depression without other psychiatric diagnosis	18	64.29%
	Anxiety-depression with other psychiatric diagnosis	10	35.71%
Present psychiatric treatment status	On psychiatric treatment	18	64.29%
	Not on psychiatric treatment	10	35.71%
Present	Receiving active	7	25.00%

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psychological treatment status	psychological treatment		
	Not receiving active psychological treatment	21	75.00%
History of attending nature-based therapy (e.g forest therapy, horticultural therapy)	Yes	0	0%

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Data collection

Data for analysis came from two sources. Firstly there is a standard evaluation form with two open ended questions include: (1) in what way your goal in joining forest therapy has been attained, and (2) any differences you find about yourself before and after the therapy. A 10 point Likert scale have also been employed in evaluating the overall satisfaction for the journey, trust in forest therapy's benefit, whether the participants would invite others to join the program, and whether they would join future sessions. The closed ended questions were supplementary information on the satisfaction towards the therapy and motivation to join the program again. Secondly, another open ended question on impressive or challenging features of the journey was asked in form of focus group after the program. The open ended questions in survey and focus groups were analyzed as an overall experience in the therapy.

Due to the societal environment in year 2019 and onwards in Hong Kong, people are sensitive towards data handling. Throughout the session, audio-recording had not been made in order to make the anxiety-depressed patients, who are easily distressed, feel more at ease to express. The facilitator jotted down the data for the open-ended questions during the focus group. And for the sake of ensuring the information as exactly what the participants had said, the data jot down was sent to the participants a day after the session to confirm it was what the participant had said during the focus group so as to avoid having twisted the meaning of the participants. Most of the information had been confirmed by the participants as valid and no more information had been amended by them. Three pieces of information had been supplemented by two participants. The information was noted to be an elaboration of the idea of the participants' expression during the focus group and had been integrated in the data set. Information was coded and categorized within 2 days after the session. A clinical

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psychologist, being blind to the research objective and with more than 10 years working experience, was invited to study the coding and categorization in order to enhance the reliability of the analysis. The discrepancy amongst the two psychologists had been discussed until a consensus was arrived at. No more constructs were being generated at the 6th group. One more group was conducted for confirmation if there is no more new construct being generated from the data set.

Data analysis

Totally 271 statements have been generated from the evaluation form and 176 statements had been generated from the sharing circle at the tea receptions. These 447statements were put into analysis. For the sake of attaining Lincoln and Guba (1985) ‘s concept of validity and reliability of qualitative analysis on the criteria of credibility, transferability, dependability, and confirmability, a Step-by-Step Approach for conducting a trustworthy thematic analysis proposed by Nowell et al. (2017) has been followed, which include (1) Familiarization with the data: immersing in the data through repeated reading of the data as an active way searching for meanings and patterns.All raw data are being analyzed in NVivo (version 11). (2) Generating initial codes: no interchangeable or redundancy of the code is employed to enhance its boundary while the levels of the coding was minimized to enhance its clarity. (3)Searching for themes: sorting and collating all the possible relevant coded data extracts into themes, with ongoing reflection and interaction with the data. A theme is initially generated inductively from the raw data and later has it counter-validated with the CBT theory deductively. (4) Reviewing themes: examining the coded data’s coherence. The validity of individual themes depended on whether it could accurately reflect the meanings evident in the data set as a whole. The themes developed were

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counter-validated with the theoretical concepts of CBT. Without comprehensive data supported themes or the too diverse data were being deleted or collapsed into each other.(5) Defining and naming themes: establishing a name for the theme that is punchy and immediately give the reader a sense of what the theme is about. Each theme has to fit into the overall story about the entire data set in relation to the research questions.

3.3.3 Result

Six themes had been generated from the totally 447 statements (See Table 12). The elaboration on the finding is as follows:

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Table 12 Categorized construct resulting from theme analysis of focus groups' response of Study 3.

	Construct	**Content**	**No. of participants (percentage of total number of participants)**	**No. of statements**	**Examples**
i	Experiencing				
	Experiencing_ positive emotion	The positive feelings that the participant experienced in the nature, with comfortable, peacefulness and relaxed as three common positive emotion	26 (92.9%)	107	Breeze makes me feel so refreshing that I nearly get into sleep Feel like flying in the air, with pressure lowered
	Experiencing_ sensation	Physiological sensations and projected feelings on the beings	21 (75%)	57	Greenness and the softness of the nature

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					The nature is listening to me, seemingly in a very friendly manner
	Experiencing_ mind	The mind state experienced, like being recharged, less ruminating, more focused, being at the present and the sense of the flying of time	15 (53.6%)	29	Without the intrusive thinking or images that I always come across in daily life. I can have space to reexamine what I want to be and what I can do to help myself Get in touch with the reality
	Experiencing_ negative emotion	The negative emotions experienced when interacting with the nature	11 (39.3%)	16	Mosquito used to be my enemy that I can hardly tolerate It's sad in the nature, witnessing the fallen leaves, the rotten branches, the dead bodies of insects, the flowing water which could never come back to the stream again

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ii	Noticing				
	Noticing_ features	Notice that features in the world are of great extent and variety. Apply such notice in valuing and accepting the varieties and not to make over generalized remarks through brief observation	17 (60.7%)	36	So many different things, big or small, different species, different texture, different in manifestation like sound, color, texture, shape…. Should not treat all the things as the same, just like I dislike insects, they actually can be of different groups and characteristics. If I dislike all of them perhaps I am making an over conclusive remarks
	Noticing_ connectedness	Notice that beings, no matter human or non-human, are interrelated. Apply such notice to the relationship between cause and consequence	19 (67.9%)	40	The dynamics between them, one evoking another….the wind moves the branches, the leaves are then fallen off

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					I am probably in certain ways related or linked with others though I may not notice such in the past. My behavior links to others' feelings and their feelings link to my feelings
	Noticing_ cycle of life	Notice life for every being is from birth to death. Accept this as normal and applying such notice in facing grief	12 (42.9%)	21	The leaves de-composite and give nutrition to the soil while the soil brings new leaves. The leaves underneath the trees are what feeding the fresh greenness up high in the tree Cycle is normal, manifested in human life and death. So why we have to be so fearful towards death?
iii	Self-awareness	Aware of one's own negative and positive characteristics. Knowing	24 (85.7%)	83	Like an ant, you can see them as dirty and ugly, but you can also see them as

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		the alternative perspective taking and practical skills could help overcome the challenges or enhance one's own adaptiveness			diligent and loyal. So it is a matter of how you view it. I can change my view, if I take a more widened perspective. Next time when I have to express myself I would take deep breath to refresh myself, just like what I have been doing in the nature, so that I can have the braveness and courage
iv	Appreciation	General gratitude towards the nature as a whole or specific beings in the nature, including human or non-human	7 (25%)	10	Thank there are ants, which is comparable to me, work in a non-stop manner. They tell me that working is exhausting but can yield for the family or for the larger society

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					A rare moment that I feel the goodness to have chance to live in this world, and I have to say thanks to my mother!
v	Uniqueness of treatment in the nature	Comment on the uniqueness of therapy under the nature coupled with a non-directive modality. Contrast it with other treatments the participants have experienced before. Explain what are being liked or disliked in the session	14 (50%)	22	The trip is different from the usual hiking. It is not to see or to walk much as I used to experience in hiking. It is not to know more about different species of vegetation. It is instead to deal with the emotions, slow me down, to examine my thinking and feeling, and to allow the nature imposing positive energy on me I used to hate groups as I am fear of evaluation. I do not like expressing myself in front of others as wearing

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					social masks and to uphold a good image is so tired. But interestingly in the present group I do not have such pressure. The nature may have neutralized the tension amongst human. The background is so soft.
vi	Motivation	Motivation to change, to join future forest therapy session, or go out to the nature	15 (53.6%)	26	I feel having a drive to have a breakthrough. No more trapped in the cycle of the thoughts and feelings. If there is similar session I would definitely join.

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i Experiencing

These items are the inner experience of the participants, including positive emotion, sensation, mind state and negative emotion.

Experiencing_positive emotion (92.9% of the participants)

This item is the major theme being found amongst the participants during the interview. 26 participants generated 107 statements, which is nearly one fourth of the totally 447 statements came up in the interview. The top three feelings are comfortable, peacefulness and relaxed. Other common feelings include refreshed, calmness, secure, happy, free, amazed, wonderful, and felt being supported, etc. Sometimes the positive feeling is a removal of the negative emotions like worries, agitation, tension, etc. Some of the feelings are a general one directed towards the nature as a whole while some others are directed to specific scenery or object in the nature like river. There has been one interesting remark expressing the enhanced feeling mode under the nature: "…amazing that throughout the process I'm using my heart to feel instead of to think", implying the participant was more in touch with their feeling in the nature.

Experiencing_sensation (78.6% of the participants)

This item is about the sensation when interacting with the nature or the feelings or sensation projected on the beings. Totally 21 participants have generated 57 statements. The sensations are from five senses including sight (color, texture, shape, beauty), smell (e.g. flowers, the mud), sound (e.g. song of the bird), texture (e.g. softness of the soil), and the taste (e.g of the air). Description of "bathing" in the nature has also been noted. There are projections of the feeling on the beings or animating of the non-human beings,

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like the happiness of the birds, the courage of the water to jump off the fall, and the silence of the stream, etc.

Experiencing_mind (53.6% of the participants)

This item is about the mind state the participants experienced in the nature. Fifteen participants generated totally 29 statements. The most commonly experienced state is being at the present, free from ruminations, feeling vacated or empty in mind, more focused, and less intrusive thoughts. Interestingly some participants noticed that they got boarder perspective under the nature, or their mind being more structured or better in functioning. Insight and new input from the nature and other participants have also been reported.

Experiencing_negative emotions (39.3% of the participants)

Though in the nature, the participants cannot be exempted from negative emotions or feelings that human normally experiences from time to time. Totally 11 participants had generated 16 statements on negative emotions that they experienced in the nature. The most common annoyances are coming from the hotness brought by the sun, the sound and bites by the mosquito. The texture of some items like mud, or the pressure from the view of large rock, as well as the witness of rotten or dead items in the nature could bring distress. There had been a participant mentioning his grief for the return to the reality after staying in the nature.

ii Noticing

Items related to what the participants observed from the outside environment, their inferences from the observation and their reactions resulting from the noticing. This

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item can be further divided into features, connectedness and cycle of life.

Noticing_features (60.7% of the participants)

This item is about participants' noticing of the very fine features of beings in the nature, no matter they are human or non-human. Seventeen participants generated totally 36 statements on this theme. This includes their report of different part of a plant like stems, vines, and stamens. And no matter they are of the same or different species, beings can be in shapes, textures, colors, states, like the leaves in the state of dormant, dancing, or falling. The features could be so tiny for noticing if without paying close attention. The participants also noticed that they could have different feelings, like or dislike towards the features.

Inferences from this noticing have also been found. Nine participants had applied such noticing in valuing and accepting the features of beings as well as not to make over generalized remarks through brief observation. They were aware of the fact that quick glances only lead to vague or over-conclusive impression, and as a result they would treat all things as the same despite of the varieties and differences. Participants also extended their notice of the features that people are of different characteristics (bad will and good will) and such is in fact normal. They noticed that accepting the differences and treating them as the truth of life is necessary for living happier. There were participants mentioning the variety in human characteristics grants the world diversity and thus a less monotonous world. Participant was even able to make inferences that "different format of water represents its flexibility and hence its survival value". It is however worth to take note that 2 participants expressed feelings of discomfort while noticing less appealing features.

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Noticing_Connectedness (67.9% of the participants)

This item specifies the notice of the connectedness amongst beings in the nature, either human or non-human. Totally 19 participants generated 40 statements. Participants noticed that connectedness makes up a unique whole, and there are interactions or dynamics amongst the components, for example, the relationship between the sunlight, the richness of the land and vegetation, and the observed correspondence between the length of the root and the height of the tree. There is an interesting observation that flowers' colorfulness makes it less dependent on aroma to attract insects. The participants also observed that connectedness is somehow through a media, e.g. birds by sound and trees by roots.

More importantly, some participants observed the connectedness being established amongst members in the group or even in the world. They noticed that collectedness can enhance power of the group as a whole and can bring benefits to all individuals. And the connection amongst human was being viewed as harmonious and affectionate, like a participant's saying, "The connection is invisible, and can through an eye contact or a smile, or even from heart to heart".

There were 6 participants further made inferences from relationship between cause and consequence, like through walking fast one can get weight off but might not be able to recognize beautiful things in the nature. There was participant noticing that concerning the cause can get oneself close to a desirable end. There was participant reassuring himself that having done nothing bad to others should put himself at no negative consequences and thus no fear. There was participant wondering how he could sustain the connectedness in daily life.

Noticing_cycle of life (42.9% of the participants)

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This item consists of the notice that most beings have its life cycle, from birth, to living, to rotten, to death and finally to decomposition, or similar cycle of appear, exist and disappear. 12 participants generated totally 21 related statements. There were participants noticed that all plants go through this cycle, sun rises and sets every day, clouds end up with rain fall into stream while eventually evaporate to form clouds again.

Some participants had made inferences from the noticing, for instance, saying that death can be followed by hope and new life. There was participant who noticed "blossoming of flowers as comparable to the blossoming of negative thoughts that should be stopped or else would only end up with a repeating cycle". Quite a number of participants felt pampered in their grief of relationship by noticing the normal life cycle in the nature, accepting it as a fact and hoping a new life (for the deceased) or relationship to come. However, on the negative side there was participant noticing the never ending life cycle expressed "tired of such a game".

iii Self-awareness (85.7% of the participants)

This item is the second largest item that commonly appears in the participants' expressions. It is about the self-awareness that the participants had gained, including their positive and negative personal characteristics, as well as in what cognitive and behavioral aspects they thought they could overcome challenges or enhance adaptiveness. Twenty-four participants generated totally 83 statements. Most common negative self-awareness expressed was being socially isolated and avoidance, resistant or guarded, suppressive, procrastinating, and indulgence in their negative emotions. Some of the participants noticed their tunnel vision or started to be aware of sources of emotional problems. There were participants reexamined, from the slow walking

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exercise in the nature, whether his previous over-emphasis on efficiency is adaptive or not. Besides, there were participants showing insight from the comfortable interaction with other beings in the nature that her fair social relationship in daily life might be originated from her own guardedness. Furthermore, except two participants expressed low efficacy, saying like "many things are not under control" and "don't know how to fix the problems between mother and me", all other participants found the experience in the nature having boost up their optimism. Examples include recognizing everyone has his own values and noticing one's positive physical image through shadow in river.

There was also widened perspective in how to overcome one's own negative characteristics. Such includes accepting the feelings and not to be overwhelmed by them, taking courage to defeat one's own edges, not to restricted by one's own like and dislike or else beautiful things would be ignored, and taking different perspectives (e.g. birds' song could be viewed as disturbing or soothing) etc. Some participants on the other hand mentioned practical skills they learnt in the therapy to overcome challenges, for example, by taking deep breathing, letting go, recapturing of the positive dialogue with the nature, allowing the distress to fade out, etc.. There was participant mentioned that she noticed problem solving was just a matter of a try or giving oneself a chance. For anxiety-depressed patients, such a perspective can be a step forward to open a new chapter of life.

vi Appreciation (25% of the participants)

This item captures the gratitude expressed in the session. Totally 10 statements have been generated by 7 participants. Half of the statements are directed towards specific human being like mother, other participants, the therapist and the god. Interesting appreciation directed towards non-human being (e.g. ants) that bringing the

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participant enlightenment has also been noted. General gratitude towards the nature as a whole had been expressed as well.

v Uniqueness of treatment in the nature (50% of the participants)

This item concerns what the uniqueness that the participants found about therapy under the nature. The statement is classified to this category if the participants contrasted the session with other mode of therapy that they had experienced before, commented on the group session's design or explained what they liked or disliked the session. Totally 14 participants had generated 22 statements on this theme. Except 3 comments which are not positive (i.e.. feeling nervous at the beginning of the group as commonly come across in other groups, disappointed that the group was not of problem solving purpose, or puzzled whether during the group one should continue day dreaming as usual), all others are of favorable comments. There were quite a number of participants mentioned their at ease to disclose in the group because in the session other participants were being perceived as more than human beings (like flowers, trees, etc.) and hence were less intimidating. The absence of demand in the group made them pressure-free as well. The group focus being not on personal issue and the sharing as brief made them feel at ease. Participants had contrasted it with other formats of treatment. For instance, they found going to the nature was easier than doing physical exercise for comparable mood enhancement purpose. They noticed the session was different from purely hiking as it could deal with thinking and feeling. They also felt being less resistant than the usual mode of psychiatric or psychological treatments which address trauma or stressors directly. There was participant expressing that this new group experience brought them hope in treating their mood problems.

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vi Motivation (53.6% of the participants)

This item is about the intention to change, joining future forest therapy session or going to the nature, together with the doubt towards the therapeutic effect. Totally 15 participants generated 26 statements. Quite a number of participants regarded the session a remarkable breakthrough for them to receive treatment, and they would like to upkeep the optimism and energy gained in the group. Some of them mentioned specifically that they would like to come back to the session or go to the nature more in the future. The motivation to go out has even been followed by the altruism to help people who are also of mood problem. For example there was a participant said "I suddenly comes up in my mind to travel to different land, take photos of them, and record the process of life and death in the nature. And through which I might be able to assist people of mood disorder to get out of their trap". However, 8 out of the totally 26 statements showed doubts towards this mode of therapy. The doubts are about how much continuous effort required for sustaining the effect, whether urban nature can grant mental health benefits, and whether their own condition (e.g. psychiatric drugs made them drowsy) would affect the therapeutic impact.

Regarding the 10 point Likert scales of evaluation, the following result had been yielded:

Overall satisfaction for the journey: 8.36

Confidence towards forest therapy's benefit: 8.76

Whether they would invite others to join the program: 8.71

Whether they would come back again: 8.70

3.3.4 Discussion

The present study modifies Ibes et al. (2018)'s study design which originally

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aiming at investigating the psychological impact of green space interventions by mind-body skills and nature exposure. Instead of using signage to instruct or invite the participants to practice the skills or exposure, the present study has involved a facilitator, like most CBT groups do, to deliver the invitations. Through open and closed ended questionnaire together with a brief focus group the experience of the participants are being analyzed. Totally 447 statements have been generated and they are found to have good correspondence with CBT model or being favorable to CBT intervention.

Mood enhancement

The positive experiences in the nature as expressed by the participants coupled with the overall satisfaction for the journey (8.36 in a 10 points liker scale) shows that the nature is a favorable place for patients with emotional problems. In conducting CBT, mental effort is required to override inappropriate innate or habitual responses to stimuli (Hofman et al., 2012). However depressed and anxious patients are often depleted in internal resources due to previous ineffective emotional coping. Feeling comfortable, peaceful and relaxed in the nature are the three commonly identified positive mood in this study. The fountain of positive mood may back up the somewhat threatening and energy consuming cognitive task in CBT. The vigor and excitement as emotional arousal can even be booster of mood which may generate energy to support the individuals' continuous participation in the therapy.

A participant's statement saying that "…amazing that throughout the process I'm using my heart to feel instead of to think" reflects that the nature directs her attention to feelings. Being overwhelmed by negative emotions in city life, patients suffering from mood disorder might not feel comfortable to explore their sensations and feelings. Often observed clinically is patients' avoidance and suppression of their emotions.

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Getting in touch with one's own feelings is a pre-requisite for seeing the relationship between cognition, emotion and behavior, and hence is a significant stepping stone for a successful CBT. Sense of security in the nature (Kellert & Wilson, 1993) may make individual less defensive towards one's own feelings. Nature as a safe platform may have good partnership with the more recent acceptance-based strategies of CBT (Hayes, 2004) which does not encourage direct confrontation of the cognition but to embrace thoughts and feelings. Such can minimize the "postsuppresion rebound effect" (Wenzlaff & Wegner, 2000) that premature cognition challenging may impose.

Mindfulness

In the nature, participants experienced a relaxed feeling, in touch with their physiological sensation and a focused mind state. There were participants described their being immersed in the nature, having a forest bathing or being at the present. All these experiences are good indicators of achieving a state of mindfulness. Mindfulness is "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). It is universally regarded as the capacity to closely attend to presently occurring sensory, cognitive, and affective experiences (Bishop et al., 2004; Lilja et al., 2012). The present study echoes previous findings that nature is associated with an increased aptitude for directed attention (Berto, 2005; Kaplan, 1995; Mayer et al., 2009). If the nature itself can already induce individual to immerse and enter a mindful state, its positive effect as mindfulness program does in combining with CBT (e.g.Segal et al., 2002) could be projected. Such would help the anxiety-depressed patients to deal with their ruminations and mind wandering which can predict negative

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mood (Killingsworth & Gilbert, 2010) or depression (Nolen-Hoeksemam, 1991; Siegle et al., 2002)

Attribution

According to Beck et al. (2004), it is the cognitive distortions that cause impairment and distress as well as preventing individuals from resolving their problems. And according to Seligman (1975), the misattribution makes one feel powerless and helpless and eventually give up to constructively cope with the environment. The three noticing by the participants, namely features, connectedness, and cycle of life, are found corresponding to Seligman (1991)'s three attributional styles and could help confronting the distorted attributions:

Global attribution (can be challenged by "Noticing_many features")

Global attribution treats the same bad things would happen across situations. It is the ignoring of the details end up with the overgeneralization tendency. For example, an anxious patient may interpret his failure to give a public speech as similar failure in other aspects of life like managing his staff. "Noticing_many features" shows the capacity of the participants in seeing things in details rather than globally. It could be a good practice for the participants to notice that a substance can be broken down into different components, and even for one single substance there can be different features, like a participant had described the "…dancing leaves, idling leaves, fallen leave, leaves dormant on the ground". Therefore the global attribution on one's inferiority can be confronted by the awareness of different strengths apart from weaknesses that one might have. There has been a participant who noticed that she should not treat all insects as what she disliked because insects can be of different species and characteristics.

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Practicing drawing of attention to the details has potential to reduce tendency to make a simplistic and prototypical view on beings. Only with such objective view one can get rid of the emotional arousal associated with the past negative experience with the stimuli.

Some participants are able to apply the noticing of features to daily life, like saying that in human world people can be of different characters while life can be happy or unhappy. Such noticing is a step moving towards the flexibility in accepting people of different characteristics and one's own different emotions, rather than holding rigid expectation on the external environment or inner experiences. Noticing the harmonious co-existence of the differences facilitates one to embrace the differences instead of resisting them.

Internal attribution (can be challenged by "noticing_connectedness")

Internal attribution fixes the blame on oneself which leads to negative emotions like guilt, shame or hopelessness. In the nature participants notice that things or beings are interconnected, like their noticing of the association between sunlight and richness of the land as well as between flowers' color and aroma, etc.. Interdependence or causal relationship is manifested vividly in the nature, like there had been participants saying "the tree pressing the soil, the soil pressing the ground, the ground pressing the root…" or "Wind blowing the clouds, the clouds gathering together to form rain, rain dissolving from the clouds". Furthermore, some participants are able to apply the notice of connectedness to generate metaphor. For instance, a participant had noticed the bird's disposal makes the land fertile and ends up with the growth of fruits. As a result, in order to cease the blossoming of negative emotions, the participant said that it is necessary not to lay off the disposal that could lead to blossoming. Here, the blossoming

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represents fostering of the cognitive distortions.

Causal relationship is a significant premise of CBT in the sense that inaccurate beliefs and maladaptive information processing have a significant role in the etiology of depression (Beck et al., 1979). Therefore, in order to get rid of the negative emotions, individuals have to be aware of and dispute the cognitive errors which are usually the root. The chain reactions and interdependence noted in the nature could help participants to see every being, including themselves, is part of the chain. Such awareness could be good materials for CBT. Imagine there is a parent plays temper on children due to his own prolonged work stress. With the recognition of the antecedents, behavior and consequences, this parent's guilt would not be disproportionally amplified. Instead, the awareness of work stress as precipitator perhaps can motivate his rational handling of the work stress.

The result echoes Naor & Mayseless (2020)'s finding that the embodied experiences in the nature can expand one's personal and world view. When the "connectedness" applied on the association between cognition, emotion and behavior, it directs the individuals to see the looping of negative emotion could be broken by intervention targeting on the origin, which is usually started with the cognitive errors. The "connectedness" noticed also help individuals to be aware of the multiple variables accountable for problems. This means there could be many entry points for intervention even if one fails. The notice of "connectedness" can consolidate the direction to target on the cognitions, and from different angels of a problems' origin, for digging up buried emotions.

Permanent attribution (can be challenged by "noticing_cycle of life")

Permanent attribution treats cause as more or less permanent. For example, one's

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lost of job and lowering of socio-economic state may deeply affect children's future. In the nature, participants are able to see things as dynamic instead of static. Everything is of a cycle, like participants' noticing of leaves decomposing, giving nutrition to the soil and bringing new leaves, or the sunlight getting dim and the night coming. With such a non static cycling one can notice that termination of one thing may bring an opportunity. In the prior example, job coming to an end brings financial hardship to the family might in turn develops children's resilience. The awareness of the ever changing or dynamic state could challenge the fallacy of permanency and bring hope to a new start.

The notice of life cycle in the nature can play a crucial role in debriefing human's grief reactions. Facing bereavement individuals tend to see the lost and sadness as pervasive. The overwhelmed emotion, without being faced and treated, ultimately ends up with clinical mood problems like depression. In the nature, however, participants notice that every being follows the normal life path, from birth, living, rotten, to death. This noticing normalizes the life and death cycle and facilitates the acceptance of it. Given that CBT is a common approach for grief therapy (e.g. Rosner et al., 2014; Rosner, et al., 2015), nature with materials showing the natural life and death process could be a good platform for conducting CBT on grief issues.

Self-awareness and positive perspectives

Within CBT the self and self-representations are viewed as the 'final common pathway' for acquisition and maintenance of a variety of emotional disorders (Wolfe, 1994). Therefore, awareness of and forming a more adaptive self-representation was one of the therapeutic goals. In the nature, participants are shown to have self-reflections on their own negative and positive characteristics. Avoidance, suppression, procrastination, indulgence in negative emotions, as behavioral patterns

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that intensify negative emotion, has been brought to self-awareness. The said awareness matches the maladaptive emotional coping of people suffering from anxiety-depression. There is participant starting to notice that one's own tunnel vision is the source of the negative emotion. Tunnel vision is a common cognitive distortion of people suffering from mood disorders who are only able to see the negative aspects of a situation (Beck, 1995).

Broadened view, focused and restored mind as reflected in the experiencing_mind state domain could probably be the source of the enhanced insight. Contrast of positive emotions that individuals experienced in the nature with the negative emotions in daily life may also stimulate the reflection that one has the capacity to experience positive emotions instead of trapping in the helpless state. According to the Frederickson's broaden and build theory, "contentment creates the urge to sit back and savor life's current circumstances and integrate these circumstances into new views of self and the world" (Fredrickson 2004, p. 1369). In the nature, individual attains contentment and inner peacefulness which in return brings alternative mode of thoughts and actions. This is perhaps why we can see in the session participants start to re-examine how their thoughts (e.g. tunnel vision) and previous behavioral pattern (e.g. over emphasizing on efficiency that eventually imposes burden on oneself) contributes to their negative emotions.

Apart from understanding the cause of emotional problem, participants also have examined strategies for emotional coping. Many of them have expressed that employing a new perspective and practical skills could help overcome challenges or enhance one's own adaptiveness. They also found the sensation experiencing tasks in the session like deep breathing or slow walking can be applied in daily life for mood handling.

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In the present study, some of the participants recognized the value of every being in the world, noticed one's own positive characteristics, or revealed enhanced self-image, which is comparable to positive self-esteem or a global self-worth (Rosenberg, 1979). It however is not specifically of "how well one can execute courses of action required to deal with prospective situations" that "self-efficacy", which is a crucial element in CBT (Bandura, 1997; Wells-Federman et al., 2002), refers to. While there has been controversy over the relationship between self-efficacy and self-esteem, i.e. self-efficacy predicting self-esteem (Hermann, 2005) versus self-esteem in bring positive self-efficacy (Afari et al., 2012), the relationship between the two is an undeniable fact. Nature showing impact on the global self-esteem, would be a favorable factor for conducting CBT in view of its emphasis on self-efficacy. Jung et al. (2015)'s studyon the other hand shows that professional self-efficacy and mastery has been raised in a forest therapy program. Under the nature how the transform of the global self-esteem into a sense of mastery in specific life domain happens perhaps is an interesting area for further study.

Most important of all, in the nature the attentions of participants are being directed to positive elements. This is shown by the appreciative remarks that the participants have made in the session. They appreciated the nature and are able to amplify small stuff and treasure them, like gratefulness when watching the life of insects, or appreciating the warmness of sunlight that they used to ignore. They also expressed thanks to the facilitator, other group members and significant others. There was participant who used to hold negative view on her mother mentioning thanks to the latter's bringing her to this beautiful world. Positive perspective on oneself and others can instill an alternate perspective on the anxiety-depressed patients who used to be negative or critical. Study showing the association between appreciation of the

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aesthetic qualities of the natural world, the increased well-being and prosocial behaviors(Capaldi et al., 2017) implies the value of nature if it could strengthen human's gratitude.

Motivation to join future therapy, go out, change and have social contact

Bados et al. (2007) found that 46.7% of drop-outs were because of the low motivation and / or frustration with the treatment or the therapist. Poor treatment adherence and premature dropout hinders the delivery of evidence-based psychotherapies. Studies have indicated that the lower expectations that therapy will work, the higher the psychotherapy dropout rate is (Zilcha-Mano et al., 2016; Zimmermann et al., 2017).

In the present study, the participants gave an overall 8.76 in the 10 point likert scale on their belief in the benefits of the nature based therapy. The participants found therapy in the nature unique in the sense that other members appeared to be less threatening. Besides, sharing in the nature was less directly addressing one's own personal issue, making them feel more comfortable. Some participants, through noticing of the connectedness of beings in the nature, were aware of the power of hand-in-hand to make a more beautiful world. In the group they experienced that human connection could be harmonious and affectionate, which perhaps be different from their past experience of human interaction. This is probably related with participants' high rating of their motivation to participate in the future session of the nature-based therapy (8.70 out of 10) and their high tendency to invite others to join (8.71 out of 10).

Furthermore, the drive of going to the nature by oneself and to change have been revealed in the open ended questionnaire and focus group, which are good indicators of the therapy's success in moving the participants to modify their life style, to approach the nature, and to rehabilitate. Sense of autonomy is found to be a significant element in raising treatment motivation according to Deci and Ryan's Theory of Motivation (1985).

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Feeling “free” in the nature as indicated in the theme Experiencing_positive emotion, is perhaps a contributive factor of the enhanced motivation. On the other hand, the nature-based therapy with experiencing, slow walking and activity can be viewed as a behavioral mode of intervention. The positive finding on motivation in the present study echoed(Ahmed& Lawn, 2012)’s finding that behavioural interventions can help to lower the drop-out rate in CBT for outpatients with comorbid anxiety and depression.

Caution of the non-directive approach of therapy in the nature

Although most of the participants have expressed their enjoyment in the sensation experiencing approach of therapy, throughout the therapy negative feelings have also been noted. For example there were participants mentioning the tiredness of the game of life and death when noticing the looping of such cycle in the nature, reporting the discomfort feelings when noticing the ugly features of the beings, and reporting a pessimistic view that an end still comes no matter how blossoming one have been. Similarly, although some participants are capable to internalize the noticing by making metaphors or relating them to daily life, not all participants have expressed such in the focus group or in questionnaire. Similarly as for self-awareness, only some of the participants manage to mention how to employ what they learnt in the therapy, either cognitive or behavioral strategy, to overcome their challenges or personal edges. While nature provides a platform or resources for cognitive-emotional-behavioral changes, consolidation requires directives in linking up the association among the said three elements for the long term benefits of the patients’ rehabilitation. Purely treating nature as the therapist without giving debriefing on the experience could end up with the risk, in case the natural environment fails to counteract the negative thinking style but reinforces it. Based on the findings in this qualitative study, we tailor made a

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Nature-based CBT program for anxiety-depressed patients (see Appendix 2). It structures the cognitive and behavioral activities in a treatment approach.

3.3.5 The study's values, limitation and wayforward

The present study is the first trial to explore, from the subjective sense of the participants, their experience in the nature-based therapy while studying how such experience could be utilized in CBT. It adopts the sensation experiencing and activity approach that most nature-based therapy uses while minimizing the therapist's role in order to explore the spontaneous response of the patients under the nature. The study however does have the following limitations. Firstly, it is of purposeful sampling from the anxiety-depressed patients' circle that the researcher is familiar of. Secondly, no audio record had been made during the focus group after the experiencing session. This arrangement is for the sake of reducing potential guardedness given that many anxiety-depressed patients had expressed reservation to join the program if having video record. This is probably a result of an increased vigilance at that political environment. A shorthand approach by the researcher during the group coupled with sending of the information to the participants as confirmation of their data is another approach to ensure the reliability of the data. The low re-editing rate by the participants (2 out of the 28) implies the reasonable reliability in adopting such an approach. While the therapist is one of the researchers in making the data analysis, the presence of another analyzer, who is also familiar with the CBT model, in counter validating the coding and categorization of the themes, is a measure to enhance the study's validity. On the other hand, the focus group approach adopts what the participants have expressed. It is about the participants' subjective sense and hence fails to capture what the participants have not expressed. Therefore, while the study is a qualitative one in exploring how the

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nature be utilized in CBT, further validation of such benefits by quantitative pre and post study in comparing CBT in nature and non-nature venue is recommended. Before the said outcome evaluation, a structured nature-based CBT program making reference to the themes being extracted in the present study is to be developed. Self-help journal during or after visit to the nature may be an alternative to consolidate the learning apart from employing a CBT facilitator. Finally, the role of the facilitator in forest therapy, matching of specific sensational mode of individuals, and cultural concerns (i.e., what Chinese needs or prefers in forest therapy) are interesting domains to be studied in order to integrate the element of nature into CBT practice.

3.3.7 Conclusion and final remarks

The present study employs a thematic analysis on an average 2 hours' forest therapy session conducted on 28 patients suffering from mood disorders. A sensational experiencing forest therapy had been adopted. Through information from a questionnaire and focused group after the session, 6 categories of the forest therapy experience has been generated, namely experiencing (positive emotion, sensation, mind, negative emotion), noticing (features, connectedness, cycle of life), self-awareness, appreciation, uniqueness of treatment in the nature, and motivation. Further analysis of the descriptions found that mood enhancement, mindful state, materials for changing attributions, self-reflection and motivation booster makes the nature a good platform for CBT. It is most interesting to find that the noticing on features, connectedness and cycle of life in the nature provides good materials for confronting the global, internal and permanent attribution errors respectively. Through addressing the said three attribution errors the sense of helplessness as substantial precipitators of anxiety-depression could be tackled. Given CBT is a mode of psychotherapy with rich evidence, the nature's

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potential added value, for example, on strengthening patients' motivation through granting them autonomy and behavioral experiencing opportunity, on providing stimulations in widening of perspectives and confronting misattribution, should never be ignored.

Regarding the conduction of CBT in the nature, there are a number of remarks to be highlighted here. Firstly, traditional therapy is conducted in bounded venue for the sake of confidentiality. We cannot rule out that therapy in the nature may not be desirable for patients who are sensitive towards information leakage. Secondly, though in the present study motivation of the participants for continuous forest therapy treatment is found to be high, weather (including humidity and temperature), environmental factors like annoyance by mosquitoes, and long traveling to park (particularly for cities like Hong Kong and Taiwan where residence are usually not near to the nature) might affect treatment motivation in long run. For weather issue, summer time's high temperature in south-east Asia definitely hinders the conduction of therapy in nature. All these environmental factors have to be addressed and handled before a smooth integration of nature with evidence based psychotherapy like CBT.

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Chapter 3 General discussion

4.1 Fulfillment of the three objectives

Objective 1: Through referring to the Information Processing of Cognitive Model to identify cognitive-emotional variables related to nature exposure

Findings: Four sessions of 45 minutes staying indoor (n=24) and outdoor group (n=24) has similar effect in reducing depression, anxiety and stress. Nevertheless, the outdoor group surpassed the indoor group in two cognitive aspects that are part of the information processing model. Firstly, the outdoor group displayed a significant reduction in rumination post-test compared to the one week prior and the first session but the indoor group did not. Secondly, outdoor group's specific autobiographical memory was enhanced while overgeneral autobiographic memory was reduced during the third and fourth sessions, though these changes were not sustained at one-month follow-up. We can conclude that except the attention to positive and negative information that showed no group differences, the other two variables, namely ruminations and autobiographical memory can differentiate between the two groups. This successfully proof that under different environmental triggers the information processing is not the same. Additional findings in the study includesstarting from the second sessions and onwards, the outdoor group's connectedness to nature was significantly higher than pre-test while the indoor group didn't show such effect. Also, the outdoor group has found to more likely to employ visiting nature as emotional coping strategy.

Objective 2: Exploring how to motivate people to connect with nature for stress coping

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by motivating young adults to connect with nature for stress relief

Findings: The study found participants who read motivational message and answered motivational enhancement questions (the experimental group, n=23) had higher levels of motivation when compared with the three control groups (each has n varied from 21 to 23), as indicated by their greater belief that nature can relieve stress and their greater intention to expose themselves to nature for stress relief. They are also being less likely to believe in beneficial effects of virtual nature or to expose themselves to virtual nature. Most importantly, a trend of decreasing perceived stress had been found for the experimental group but not in other control groups. Higher number of recalls of positive images of nature was indicated for the experimental group as well.

Objective 3: Explore what makes nature a good platform for conducting cognitive-behavioral therapy on anxiety-depressed patients

Findings: Twenty-eight anxiety-depressed patients had gone through two to three hours' group consisting of activities that facilitating interactions with the nature, Information generated from open questionnaires and focus groups after the sessions were analyzed qualitatively with 6 meaningful themes (experiencing, noticing, self-awareness, appreciation, uniqueness of the therapy in the nature, motivation) coming up. Such information, further supplemented by ratings on the experience, generates a finding that positive mood, mindful state, altered attribution, self-reflection and motivation are what being come up from the journey in the nature. Most important of all, the noticing of features, connectedness and cycle of life in the nature are favorable materials for disputing misattribution, namely global, internal and permanent, which are crucial

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precipitators of sense of helplessness precipitating depression.

4.2 Relationship between nature and stress coping: from the perspective of information processing, motivation and cognition

Figure 12 summarizes the findings across the three studies. It is worth to take note that the summary is just a description of the findings and there is no intention to compare among the three studies, provided that the experimental groups and control groups are different across the three studies.

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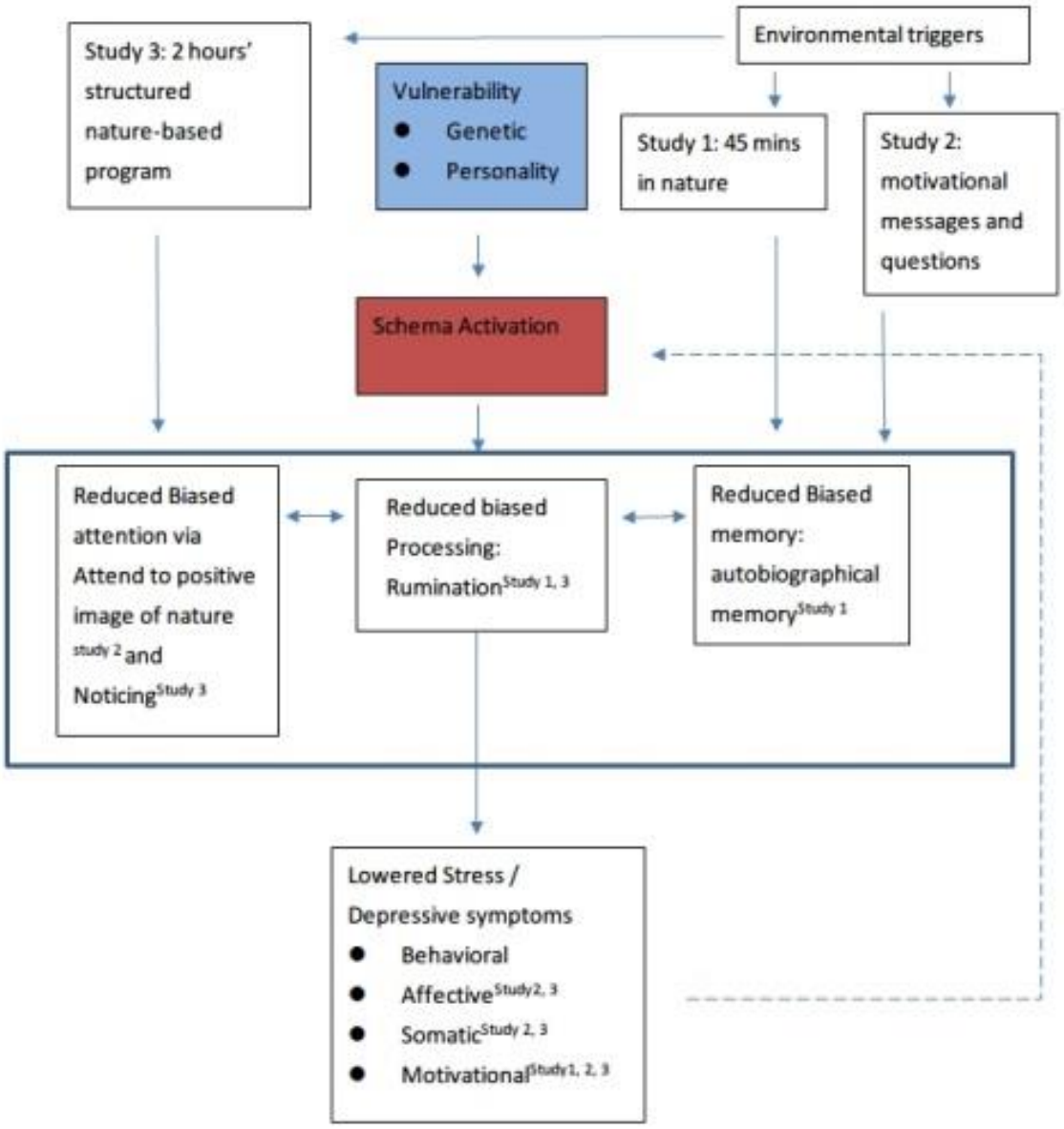
Figure 12 Summary of the findings across three studies on the relationship between nature, cognitive functioning and Stress / Depressive symptoms making reference to Disner (2011)'s Information processing in the cognitive model of depression



Notes: Vulnerability and schema activation are two variables that had not been studied in these studies

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Disner et al (2011) proposed that the environmental trigger could activate schema affecting the cognitive processing including attention, information processing and memory. Convergent evidence across the three studies showed either actual visit to nature or promoting visit to nature could alter the said cognitive processing. Take rumination as an example, Study 1 showed that even the environmental trigger was only as brief as four sessions' exposure in nature, positive impact on lowering of ruminations could persist at 1month after the sessions. Similar findings are noticed in study 3 that a category of "being mindful" had been coming up after attending 2 hours' guided activities in nature.

Another evidence is that at the later sessions of the program (i.e. 3rd and 4th sessions) the specific autobiographical memory had been increased whereas the over-general autobiographical memory had been lowered for those having weekly 45 minutes' visit to the nature, bearing in mind that the these are good indicators for lowering of depression. Even the impact on memory is not long lasting, the immediate positive impact that the nature could bring is already encouraging. It sheds a light that memory style can be altered although how many visits to nature could make the positive changes more stable and sustainable remains uncertain.

Disner et al (2011) also proposed that through the cognitive processing the behavioral, affective, somatic, motivational outcome would be yielded. As for the behavioral symptoms, study 1 intentionally measured any increased visit to nature after 4 sessions of 45 minutes' staying in nature. This could be an indicator of degree of interest in activities according to DSM-IV's criteria of depression (APA, 2013). Unfortunately, due to the pandemics such behavioral indicator is failed to be captured. Nature's impact on other three domains including affective, somatic and motivational however have been supported by the three studies.

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Looking into the affective and somatic symptoms of stress, no difference was found among the indoor and the outdoor group in study 1. Nevertheless, outdoor group's motivational impact (i.e. more likely to visit nature for emotional coping) is affirmative. This is also supported by qualitative data of study 3 that many participants had expressed intention to come back to nature again. We can conclude that no matter it is an actual exposure to the nature alone (Study 1) or guided activities in the nature (Study 3), participants were found having increased intention to visit nature for emotional coping. The enhanced motivation to visit nature when facing stress could widen the options of adaptive emotional coping. It may also form a cycle, or a positive feedback loop of behavioral repetition (Reeve, 2015) in strengthening connection to nature which is associated favorably with well-being (Zhang et al., 2014; Huynh & Torquati, 2019).

Personality vulnerability, according to Disner et al., (2011), is one of the most important factor governing depression. Receptiveness to nature should be do with personality type. One good example is nature-relatedness (a term usually used interchangeably with "connectedness with nature") which is regarded as a stable personal quality or even a trait (Nisbet et al., 2010). This domain is worth to be explored in future study.

Interestingly, subjecting people to motivational message plus answering motivational questions did help lowering perceived stress. Worth to take note is that participants did not have actual increase of visit to the nature perhaps due to the pandemics. However, their recalls of positive image of nature have been increased. To what extent that these increase recall of positive image of nature contributes to the lowered perceived stress is unknown and is worth to be explored in future study.

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The role of schema has been stressed in Disner (2011)'s model. The present study had not addressed this domain directly. In psychology and cognitive science, schema is a set of linked mental representations of the world, which human use both to understand and to respond to situations (Piaget, 1948; Beck, 1967). While Disner et al. (2011) described that there is a loop between depressive symptoms and the schema activation, the present study proposes that through using nature as a platform for cognitive-behavioral therapy the maladaptive schema could be addressed. In study 3, the engagement with nature has shifted attention of the depressed to notice features, connectedness and cycle of life in the nature. These noticing are favorable materials for disputing misattributions(Seligman, 1991), namely global, internal and permanent or cognitive triad related to self (Beck, 1967) which are precipitators of depressive mood.

To conclude, treating nature as triggers can bring desirable impact on cognitive processing and also the affective, somatic and behavioral signs. However, the association between the cognitive processing and the symptoms could not be established in the present study due to its small sample size that hinder more advanced statistical analysis. From the qualitative study we also found nature has the potential to provide a platform to change the maladaptive schema underlying mood problems.

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4.3 Limitation

Overall, the three studies are completed under the challenges during the pandemics with recruitment of subjects and administration of the study being affected. The limited number of participants recruited to the studies hindered employment of more in-depth statistical method like path analysis for understanding the relationship among variables in information processing model. Also, because of the unique objective of each study, the psychometric instruments used are different across them, making a comprehensive comparison across the interventions (i.e. staying in nature, subject to motivational messages, attending guided program) not possible. Moreover, the three studies, two on young adults and one on non age-specific clinical patients make generalization of findings to a particular population less likely. Similarly the significant difference of gender ratio in study 2 could be a confounding variable that we have not looked into.

On the other hand, the studies' venues are in urban green land of which the degree of nature might not be as high as forest or countryside, implying that we could find a different result if the studies have been taken place in more natural environment. We also believe that a very different result could be found if the participants were not to be passively in nature but receiving added value from directives or suggestion as in the usual forest therapy approach. We take note of the fact that the number of test used in study 1 & 2 is quite a lot and it may make the participants fatigue or experiencing confounding effect apart from the effect induced by the independent variables. Finally, we are aware of the extremely high cronbach alpha for some of the assessment sub-test at study 1 is over .90, implying potential item redundancy. Further adaptation of the tests (e.g. trimming down the items) might be necessary if using the instruments in the future.

4.4 Clinical implications

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1. Piloting Nature based CBT program (see Appendix 2) according to the findings of Study 3 particularly on confrontation of misattribution or distorted cognition through noticing in nature.
2. Hunter et al (2019)'s approach of setting "don't" in nature exposure had yield promising result in study 1 in bringing enhanced connectedness to nature and lowering rumination. This seems to be a feasible approach to young adults' population who are busily engaged in personal life and less ready to participate in structured program.
3. In designing promotional messages like publicity leaflets, considering adding motivational questions that address ambivalence of visiting nature is very much recommended.

4.5 Research implications

1. The three approaches' application on different populations would be an interesting research question, that is, whether to read motivational messages as study 2, actively engaged in nature individually as study 1, or join structured program as study 3, are suitable for the general as well as clinical population. This requires evaluation on these approaches' effectiveness in one single randomized study using the same psychometric measurements.
2. Recall of positive image of nature is found to be an outcome measurement capable of differentiating those having read motivational message or not. It is worth to continue research on this domain to explore how it is related to connectedness to nature and stress coping.
3. Staying in nature for four 45 minutes' session yield some positive findings on ruminations and biased memory's reduction. However, as to re-establish a new

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habit of having regular visit to nature, 4 sessions might not be sufficient enough. A program with more sessions could allow observation of long-term impacts on the cognitive variables.

4. Connectedness to nature and exposure to virtual nature seems to be spontaneously raising during the pandemics. This is an interesting phenomenon to be investigated particularly on their association with or implication on stress coping.

4.6 Conclusion

Stress is an unavoidable part of life particularly for those living in city. Globally the world is actively facing problems, just name a few like political, health, economic and pollution. Urbanization makes the use of nature for stress coping not as easy as our ancient time. The present study looked into cognitive variables as proposed by Information Processing Model of Depression in measuring indoor and outdoor difference, explored motivational approach to drive the general public to go to nature, and looked into subjective experience in a structured program for the anxiety-depressed patients. This exploratory attempt yielded encouraging findings given that all these approaches yield different degree of impact on cognitive functioning, motivations of visiting nature as well as stress symptoms. The present study kicks off the integration of traditional psychology discipline like information-processing model, motivational interviewing or cognitive-behavioral therapy to formulate a nature-based stress healing intervention.

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Appendix 1.1 Example of consent form (indoor)

感謝您參與「環境對個人的影響」研究。請細閱以下簡介並簽署

階段一：簡介與前測(今天將會完成)

階段二至五：

1. 請於以下的週一 （3/8, 3/15, 3/22, 3/29） 1:00p.m. 準時到達臺大森林環境暨資源學系系館門外報到 。為了研究順利進行，報到前請先用洗手間。

2. 然後請於森林系內作 45 分鐘的慢步或靜坐，範圍為所有走道及填寫問卷之實驗室。 只要不超出該範圍，您可自由慢步或靜坐。 建議盡量保持清醒狀態，有睡意即以慢步提升清醒度

3. 建議盡量減少攜帶隨身物品，以利走動

4. 研究過程包含戶內慢步及填寫問卷，<u>全程不交談、不進食、不用手機且需把手機音量關掉</u>

5. 請用手機設定於 45 分鐘後震動，返回實驗室填寫(需時約 30 分鐘)並交回問卷

6. 如遇颱風豪雨等天氣因素，將於研究當天早上十點前傳訊息通知延期，一週內再擇日進行

7. 研究排程抵定後，請務必準時。 若不克前來，請提前一日告知，以免影響全勤之個人權益

8. 疫情緣故，請參與者攜帶口罩，如遇疫情加劇，將配合校方公告方式進行延期之調整

9. 完成階段五 1 週後，您將會收到電郵，內含簡單的問卷(填寫需時約 10 分鐘)，請填寫並於 2 天內把完成了的問卷用電郵寄回給楊燕恩同學

階段六：完成階段五 4 週後 (暫定為 4/26，視乎階段二至五有沒有延期) 11:30a.m. 於臺大森林環境暨資源學系系館門外集合，填寫後測問卷 (約 30 分鐘)

個人資料處理： 所有資料僅供學術分析使用，不作他途。待研究完畢，所有資料將即刻刪除

參與權利：

doi:10.6342/NTU202300253

本研究屬於低風險研究，如在研究過程中感到任何不適， 可隨時終止研究

全程參與六階段之研究後，予以 1, 300 元之交通費

如有任何疑問，歡迎致信或來電聯絡楊燕恩同學。 信箱： D06227101@ntu.edu.tw

手機： 0900-414-056

再次感謝您的參與！

同意書

本人已細閱並同意上述事項。

簽署：

姓名：

學生證號碼：

日期：

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Appendix 1.2 Example of consent form (outdoor)

感謝您參與「環境對個人的影響」研究。請細閱以下簡介並簽署

階段一：簡介與前測(今天將會完成)

階段二至五：

1. 請於以下的週一（3/8, 3/15, 3/22, 3/29）11:30a.m. 準時到達博雅教學館門外(近醉月湖, 地圖 A 點)報到。 為了研究順利進行，報到前請先用洗手間。報到後，有需要可取膠袋以方便坐於草地上

2. 然後請於醉月湖作 45 分鐘的慢步或靜坐，範圍請參考附件。 只要不超出該範圍，您可自由慢步或靜坐。 建議盡量保持清醒狀態，有睡意即以慢步提升清醒度

3. 須穿著長袖衣服及長褲，塗抹防蚊液，以免蚊蟲叮咬

4. 建議盡量減少攜帶隨身物品，以利走動

5. 研究過程包含戶外慢步及填寫問卷，<u>全程不交談、不進食、不用手機且需把手機音量關掉</u>

6. 請用手機設定於 45 分鐘後震動，到地圖 B 點取後測問卷。請選舒適的地點填寫問卷(需時約 30 分鐘)並到 B 點交回問卷

7. 如遇雨天，請攜帶雨衣以利研究進行。 為免阻擋視線，建議盡量不撐傘子

8. 如遇颱風豪雨等天氣因素，將於研究當天早上十點前傳訊息通知延期，一週內再擇日進行

9. 研究排程抵定後，請務必準時。 若不克前來，請提前一日告知，以免影響全勤之個人權益

10. 疫情緣故，請參與者攜帶口罩，如遇疫情加劇，將配合校方公告方式進行延期之調整

11. 完成階段五 1 週後，您將會收到電郵，內含簡單的問卷(填寫需時約 10 分鐘)，請填寫並於 2 天內把完成了的問卷用電郵寄回給楊燕恩同學

階段六：完成階段五 4 週後 (暫定為 4/26，視乎階段二至五有沒有延期) 11:30a.m. 於臺大森林環境暨資源學系系館門外集合，填寫後測問卷 (約 30 分鐘)

個人資料處理： 所有資料僅供學術分析使用，不作他途。待研究完畢，所有資料

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將即刻刪除

參與權利：

本研究屬於低風險研究，如在研究過程中感到任何不適， 可隨時終止研究

全程參與六階段之研究後，予以 1,300 元之交通費

如有任何疑問，歡迎致信或來電聯絡楊燕恩同學。 信箱： D06227101@ntu.edu.tw

手機： 0900-414-056

再次感謝您的參與！

同意書

本人已細閱並同意上述事項。

簽署：

姓名：

學生證號碼：

日期：

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Appendix 1.3 The Chinese version of DASS21

Chinese DASS21 情緒自評量表（一）

DASS21

姓名：　　日期：

填表說明：
請小心閱讀以下每一個句子，並在其右方圈上一數字，表示「過往一個星期」如何適用於你。答案並無對錯之分。請不要花太多時間在某一句子上。

評估量表：
0＝不適用
1＝頗適用，或間中適用
2＝很適用，或經常適用
3＝最適用，或常常適用

1	我覺得很難讓自己安靜下來	0	1	2	3
2	我感到口乾	0	1	2	3
3	我好像不能再有任何愉快、舒暢的感覺	0	1	2	3
4	我感到呼吸困難（例如不是做運動時也感到氣促或透不過氣來）	0	1	2	3
5	我感到很難自動去開始工作	0	1	2	3
6	我對事情往往作出過敏反應	0	1	2	3
7	我感到顫抖（例如手震）	0	1	2	3
8	我覺得自己消耗很多精神	0	1	2	3
9	我憂慮一些令自己恐慌或出醜的場合	0	1	2	3
10	我覺得自己對將來沒有甚麼可盼望	0	1	2	3
11	我感到忐忑不安	0	1	2	3
12	我感到很難放鬆自己	0	1	2	3
13	我感到憂鬱沮喪	0	1	2	3
14	我無法容忍任何阻礙我繼續工作的事情	0	1	2	3
15	我感到快要恐慌了	0	1	2	3
16	我對任何事也不能熱衷	0	1	2	3
17	我覺得自己不怎麼配做人	0	1	2	3
18	我發覺自己很容易被觸怒	0	1	2	3
19	我察覺自己在沒有明顯的體力勞動時，也感到心律不正常	0	1	2	3
20	我無緣無故地感到害怕	0	1	2	3
21	我感到生命毫無意義	0	1	2	3

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Appendix 1.4 The Chinese version of Perceived Stress Scale14

這量表是在詢問在最近一個月來，您個人的感受和想法。請您於每一個題項上作答時，指出您感受或想到某一特定想法的頻率。雖然有些問題看是相似，實則是有所差異，所以每一題均需作答。而作答方式盡量以快速、不假思索方式填答。每一題項皆有下列五種選擇：

0：從不　1：偶爾　2:有時　3: 時常　4：總是

請回想最近一個月來，發生下列各狀況的頻率。	從不	偶爾	有時	常常	總是
1. 一些無法預期的事情發生而感到心煩意亂	○	○	○	○	○
2. 感覺無法控制自己生活中重要的事情	○	○	○	○	○
3. 感到緊張不安和壓力	○	○	○	○	○
4. 成功地處理惱人的生活麻煩	○	○	○	○	○
5. 感到自己能有效地處理生活中所發生的重要改變	○	○	○	○	○
6. 對於有能力處理自己私人的問題感到很有信心	○	○	○	○	○
7. 感到事情順心如意	○	○	○	○	○
8. 發現自己無法處理所有自己必須做的事情	○	○	○	○	○
9. 有辦法控制生活中惱人的事情	○	○	○	○	○
10. 常覺得自己是駕馭事情的主人	○	○	○	○	○
11. 常生氣，因為很多事情的發生是超出自己所能控制的	○	○	○	○	○
12. 經常想到有些事情是自己必須完成的	○	○	○	○	○
13. 常能掌握時間安排的方式	○	○	○	○	○

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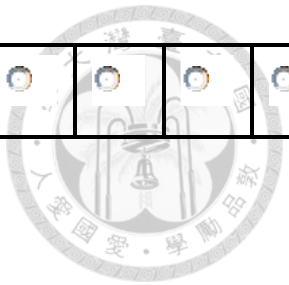
14. 常感到困難的事情堆積如山，而自己無法克服它們	○	○	○	○	○



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Appendix 1.5 Example of the Chinese adapted version of Autobiographical Memory Test

以下各題旨在了解你對生活事項的記憶。針對每個詞語，請回憶並記錄一個發生在你身上的事件，該事件必須是上週或之前發生的。 請不要於各題重覆寫某一事件，也請盡可能陳述更多細節。 緊記要完成所有題目。

	請於此欄寫下你的回憶
光榮	
絕望	
有希望	
尷尬	
漂亮	
疲勞	
誠實	
痛苦	
和睦	
不滿	

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Appendix 1.6 The Chinese version of Attention to Positive and Negative Information Scale

1

APNIS

	以下的句子對形容你自己來說有多正確？	非常不正確	有點不正確	正確與否兩者皆不是	有點正確	非常正確
1.	我留意他人所做正面的事情。	1	2	3	4	5
2.	我不能忘記自己在某些事情上表現差勁的時候。	1	2	3	4	5
3.	我不會忘記其他人傷害我的事。	1	2	3	4	5
4.	我特別察覺到在電視新聞上廣播的壞新聞。	1	2	3	4	5
5.	那些我做得不好的事情總是縈繞在我的腦海中。	1	2	3	4	5
6.	我高度察覺到生活上所給予我的許多微細樂事。	1	2	3	4	5
7.	我注意那些令自己快樂的事情。	1	2	3	4	5
8.	我可以迅速地注意到別人的過失。	1	2	3	4	5
9.	生命中有很多事物都是我所喜歡的。	1	2	3	4	5
10.	對我來說，留意到自己的負面特質是重要的。	1	2	3	4	5
11.	我特別察覺到家人和朋友所稱讚我的特質。	1	2	3	4	5
12.	當有不對勁的事情發生時，即使是件很瑣碎的事，我也能注意到。	1	2	3	4	5
13.	我留意自己正面的特質。	1	2	3	4	5
14.	對我來說，記着別人的好事是重要的。	1	2	3	4	5
15.	我想在多方面改善自己。	1	2	3	4	5
16.	無論誰在微笑，我都會留意到那張快樂的臉孔。	1	2	3	4	5
17.	我察覺並留意到事事順意的時刻。	1	2	3	4	5

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18.	我特別留意自己做得成功的事情。	1	2	3	4	5
19.	別人批評我時，他們的意見會在我的腦海中逗留一段時間。	1	2	3	4	5
20.	無論參加任何活動，我都可以輕易看到活動有趣的一面。	1	2	3	4	5
21.	我執行任務時，總會注意到當中的障礙。	1	2	3	4	5
22.	我慣常地注意過往那些令自己不快樂的情境。	1	2	3	4	5
23.	我記得的，主要是自己快樂的時光。	1	2	3	4	5
24.	我喜歡稱讚其他人的優點。	1	2	3	4	5
25.	我擔心壞事情會發生在我身上。	1	2	3	4	5
26.	如果我發現其他人有需要改善的地方，我會告訴他們。	1	2	3	4	5
27.	我通常認為好事情會發生在我身上。	1	2	3	4	5
28.	我通常認為好事情會發生在我身邊的人身上。	1	2	3	4	5
29.	我覺得自己經常犯錯。	1	2	3	4	5
30.	有時我認為其他人想欺騙我。	1	2	3	4	5
31.	我嘗試努力地去達到自己個人的目標。	1	2	3	4	5
32.	我認為其他人幫助了我許多。	1	2	3	4	5
33.	有許多人都是我不喜歡的。	1	2	3	4	5
34.	我對自己的未來感到樂觀。	1	2	3	4	5
35.	我認為每個人都有些好的特質。	1	2	3	4	5
36.	我經常挑剔別人。	1	2	3	4	5
37.	繼續做自己喜歡的事，確實是件賞心樂事。	1	2	3	4	5
38.	我經常覺得別人看似是快樂的。	1	2	3	4	5
39.	我擔心一些不幸的事情會發生在我身邊的人身上。	1	2	3	4	5
40.	對我來說，對別人有好感是重要的。	1	2	3	4	5

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Appendix 1.7 The Chinese version of Connectedness to Nature Scale

請細閱以下句子，並勾選出您對該句子的同意程度

		非常不正確	有點不正確	正確與否兩者皆不是	有點正確	非常正確
1	我常感到與我周圍的自然世界融為一體	□	□	□	□	□
2	我認為自然界是我所屬的一個群體	□	□	□	□	□
3	我承認並欣賞其他生物的智慧	□	□	□	□	□
4	我常感到與大自然之間沒有聯繫	□	□	□	□	□
5	當我想到我的人生時，我想像自己是更大生命循環的一部分	□	□	□	□	□
6	我常感到與動植物有一種親近感	□	□	□	□	□
7	我感到我是屬於大自然的，大自然也同樣屬於我	□	□	□	□	□
8	我深刻地理解我的行為如何影響大自然	□	□	□	□	□
9	我常感到自己是生命網絡的一部分	□	□	□	□	□
10	我感到所有棲息在地球上的人類和其他生物都分享著同一份生命力量	□	□	□	□	□

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11	就像一棵樹可以成為森林的一部分，我感覺自己融入了更廣闊的自然世界	□	□	□	□	□
12	當我考慮自己在地球的位置時，我認為自己是大自然階梯頂層的一員	□	□	□	□	□
13	我經常覺得我只是周圍自然世界的一小部份，我並不比地上的草或樹上的鳥更重要	□	□	□	□	□
14	我個人的福祉與大自然的福祉互不相關	□	□	□	□	□

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Appendix 1.8 The Chinese version of Ruminative Response Scale

請閱讀以下的項目，勾選出您最近有該思想或行為的頻率。 請依據您實際的狀況作答。

	幾乎不曾	有時	經常	幾乎總是
1. 在想自己有多孤單	□	□	□	□
2. 在想「我將無法做我的事或工作，因為我感覺很糟」	□	□	□	□
3. 在想自己多麼疲倦和疼痛	□	□	□	□
4. 在想集中注意力有多困難	□	□	□	□
5. 在想自己多麼被動和缺乏動機	□	□	□	□
6. 分析最近的事件，以試著瞭解為何自己陷入憂鬱	□	□	□	□
7. 在想自己怎麼好像不再對任何事有感覺了	□	□	□	□
8. 在想「為什麼我不能開展行動？」	□	□	□	□
9. 在想「為什麼我總是做這樣的反應？」	□	□	□	□
10. 獨自離開，並在想為何自己會有這樣的感覺	□	□	□	□
11. 寫下自己正在思考的事，並且分析它	□	□	□	□
12. 在想一個最近發生的情況，遺憾它未能進行得好一點	□	□	□	□
13. 在想「為什麼我有一些別人沒有的問題？」	□	□	□	□
14. 在想自己多麼悲傷	□	□	□	□
15. 在想自己未盡的責任、失敗、缺點和錯誤	□	□	□	□
16. 在想自己為何沒能力做任何事	□	□	□	□
17. 分析自己的性格，以試著瞭解為何自己陷入憂鬱	□	□	□	□

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18. 獨自到某個地方，思考自己的感受	□	□	□	□
19. 思考對自己有多生氣	□	□	□	□
20. 聽悲傷的音樂	□	□	□	□
21. 孤立自己，思考感到悲傷的理由	□	□	□	□
22. 藉著專注憂鬱感受來嘗試瞭解自己	□	□	□	□

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Appendix 1.9 The Chinese version of Self Reflective and Insight Scale

以下敘述句是有關思考(thoughts)、感覺(feelings)、和行為(behaviors)之描述，請依據個人狀況， 勾選出自己的符合程度。符合程度由 1 到 6，數字越大，表示符合程度越高。

		1	2	3	4	5	6
A.	我不常考慮自己的想法	☐	☐	☐	☐	☐	☐
B.	我不太有興趣去分析自己的行為	☐	☐	☐	☐	☐	☐
C.	我通常曉得自己的想法	☐	☐	☐	☐	☐	☐
D.	如何真正地感受到事物，對我而言經常是困惑的	☐	☐	☐	☐	☐	☐
E.	評價自己所做的事，對我而言是很重要的	☐	☐	☐	☐	☐	☐
F.	我通常很清楚自己為什麼會如此表現	☐	☐	☐	☐	☐	☐
G.	我對檢視自己的思慮很感興趣	☐	☐	☐	☐	☐	☐
H.	我很少花時間在自我反思上	☐	☐	☐	☐	☐	☐
I.	我能察覺自己對事物有感受，但我通常不知道那是什麼	☐	☐	☐	☐	☐	☐
J.	我常常檢視自己的感受	☐	☐	☐	☐	☐	☐
K.	我通常想不透自己為何會有這樣的行為	☐	☐	☐	☐	☐	☐
L.	試著瞭解自己的感受所代表的意義，對我而言是很重要的	☐	☐	☐	☐	☐	☐
M.	我沒有認真思考自己為什麼會如此表現	☐	☐	☐	☐	☐	☐
N.	思考自己的想法，反而讓我感到更困惑	☐	☐	☐	☐	☐	☐
O.	我真的很需要去瞭解自己的心智	☐	☐	☐	☐	☐	☐

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	如何運作						
P.	我常常花時間內省我的想法	□	□	□	□	□	□
Q.	去瞭解如何感受事物，對我而言經常是困難的	□	□	□	□	□	□
R.	能夠理解自己的想法是如何產生的，對我而言是很重要的	□	□	□	□	□	□
S.	我時常思考我如何去感覺(感受)事物的方式	□	□	□	□	□	□
T.	我通常清楚為什麼自己想要這麼做	□	□	□	□	□	□

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Appendix 1.10 Self-constructed questions for Study 1

姓名: _____ 日期: _____

謝謝您參與是次研究。請細閱並用心回答以下問題:

於過去一個月內，您獨自接觸大自然環境或公園達 45 分鐘的次數為：___次

於過去一個月內，您與家人和朋友一起接觸大自然環境或公園達 45 分鐘的次數為：___次

請列出於過去一個月內您採用過的三種情緒或壓力處理方法：

1.
2.
3.

再次謝謝參與是次研究！

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Appendix 1.11 Map for outdoor group

「環境對個人的影響」研究戶外組別集合地點(A) 、 領取及交回問卷地點、 步行範圍 (黑色線)

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Appendix 1.12 Definition of the investigated variables

Perceived stress: the degree to which events in a person's life are assessed as stressful, unpredictable and uncontrollable (Cohen et al., 1983)

Depression: a mood disorder that causes a persistent feeling of sadness and loss of interest and can interfere with one's general functioning

Anxiety: a feeling of unease, such as worry or fear, that can be mild or severe.

Rumination: the focused attention on the symptoms of one's distress, and on its possible causes and consequences, as opposed to its solutions (Nolen-Hoeksema , 1998)

Autobiographical memory: memory for one's personal history (Robinson, 1976)

Attention to positive and negative information: individual differences in the tendency to attend to, think about, and focus on positive or negative information related to self and others, as well as past and future events (Noguchi & Gohm, 2006)

Self-reflection: the inspection and evaluation of one's thoughts, feelings and behavior" (Grant et al., 2002, p. 821)

Insight: the clarity of understanding of one's thoughts, feelings and behavior" (Grant et al., 2002, p. 821)

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Connectedness to nature: to what degree people feel part of nature (Mayer &

McPherson Frantz, 2004)

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Appendix 2.1 Publicity message of the study

國立臺灣大學森林環境暨資源學系 誠徵研究參與者

博士生：楊燕恩

研究題目：訊息對個人之影響 (線上研究)

招募條件：

21 歲(含) 以上中華民國籍在學學士、碩士、博士生 (必須為 2014 年或之後入讀本地大學)，並能以中文讀寫

招募人數：120 位

研究內容：

第一階段：

操作日期：2021/5/2 - 2021/5/15 週間的其中一日

操作內容：於網上填寫問卷(約 80 題) 一次，預計填寫時間約為 15 分鐘

第二階段:

操作日期：參與者完成第一階段問卷一週後 (約為 2021/5/9 - 2021/5/22)

操作內容：參與者會收到一篇約 1400 字以內的中文文章。參與者需細閱文章並回答一些問題 (包括選擇題及開放式問題)。 預計填寫時間約為 20 分鐘

第三階段：

操作日期： 完成第二階段的一週後(約為 2021/5/16 - 2021/5/29)

操作內容： 於網上填寫問卷 (約 80 題) 一次，預計填寫時間約為 15 分鐘

第四階段：

操作日期： 完成第三階段的三週後(約為 2021/6/6 - 2021/6/19)

操作內容：於網上填寫問卷(約 80 題) 一次，預計填寫時間約為 15 分鐘

參與權利：

- 本研究屬於低風險研究，如在研究過程中感到任何不適， 可隨時終止研究

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- 完成共四階段研究之參與者，得於第四階段研究結束後 2 個星期內親自攜帶同大學學生證到臺灣大學森林環境暨資源學系確認身份，屆時會獲得$400 元新臺幣之交通補助。 確認身份之時段將於第四階段研究完結後給參與者選擇
- 若欲了解自己最近期的壓力指數及與大自然聯繫指數，參與者可於第四階段研究完畢後要求取得該資料

注意事項：

- 確認身份時出示之學生證，要跟報名時填寫之資料相同，否則無法享有參與權利，而四個研究階段所提供之資料亦不會用作分析

個人資料處理：

- 所有資料僅供學術分析，不作他途。待研究完畢， 所有資料將即刻刪除

如有任何疑問，歡迎致信或以 line 聯絡楊燕恩同學：

信箱： D06227101@ntu.edu.tw

Line: y.y.yeung

有興趣參與者請填寫表單，報名成功者將以 line 或電郵通知。表單額滿後即關閉，期待您的參與！

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Appendix 2.3 Reading for Control Group B

減壓有方

學期末快將來臨，就算成績沒想得到高分通過就好，但是如排山倒海而來的功課、測驗和考試還是會引發我們的焦慮。感到有壓力是身心正常的反應，消極的無視無法消除這種焦慮，逃避它更會抑制我們內在的成長、正向改變和自我療癒的力量。舒緩壓力可以讓我們重拾力量面對問題，讓自己學習能真正解決的問題。

以下介紹有實證的減壓方法：

聽音樂

不少研究證實聽音樂能有效減低壓力賀爾蒙皮質醇，令大腦釋出多巴胺，讓人有愉快的感覺。音樂的旋律及節奏會影響我們的大腦活動，睡前聆聽一些柔和的音樂能有助改善失眠狀況。找自己喜歡聽的音樂，含正向歌詞的歌曲，亦是不錯的選擇。

深呼吸

在心情鬱悶時做深呼吸，將肺部多餘的二氧化碳排出，加強血液循環，令大腦極速消除疲勞。當呼吸調得慢且深時，副交感神經會被啓動，令心跳率減慢、肌肉放鬆，煩燥感便會減退。如常以鼻孔吸入空氣，留意空氣通過氣管進出肺部，留意進出的空氣是暖還是冷，再以嘴巴輕輕呼出空氣，踢走腦袋的雜亂思想，讓耳朵細聽着呼吸聲。也可以於每次呼出空氣時跟自己輕聲說：放鬆、放鬆。

與家人朋友連繫

人是群居的物種，很多研究都發現缺乏社交活動會使負面情緒增多。然而當面對壓力時，我們會更缺乏動力去與人連繫。主動去接觸家人朋友，與信任的人吐心聲，簡單的一個問候、分享，甚至來個聚餐，都可以互相「加油」，又或能得到建議解決當前的困難。

做享受的事情

當腦袋過勞時，不妨試試轉移注意力。做一些自己喜歡的事情，例如閱讀課本以外的書籍、親自下廚弄自己想吃的、泡個熱水澡等。重點是把自己的注意力轉移到有趣味的事情上，最好是能達至「心流」的活動。「心流」是把專注力發揮到極致時的「最優體驗」，當在進行活動如跳舞，面對的挑戰與自己的技能程度相

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差不太懸殊時，注意力就會完全被該項活動吸引，思緒不再遊走，整個人沉浸其中，流暢地釋放能量，人會輕鬆、自在、充滿活力。

從飲食入手

大豆、黑巧克力、香蕉與酪梨等食物，其中的營養素具有穩定血糖的作用，對於神經系統有鎮定效果，能平穩波動的情緒，讓人心情轉好。相反地，刺激性食物如酒精、咖啡、辛辣等會影響睡眠、情緒、消化系統，令人處於不穩定的狀態。

放下電子產品

不停划手機是處於被動的訊息接收狀態，人只會越覺無聊和空虛。手機的藍光抑制褪黑激素的產生，會令人的睡眠品質變差。另外，當人把自己關在手機或電腦的框框裡時，會變得更封閉，與現實生活的聯繫減弱，更難感受到喜樂。

調整思想

面對壓力時，我們猶如困在隧道裡視線變得狹窄，看到的感受到的大多是負面的東西，很容易會產生消極的想法。這個時候，多檢視自己的思想偏差，例如會否對自己要求過高，又或是把結果看得太災難性。明白人生不會是完美的，感恩自己所擁有的。研究發現，每天睡覺前回顧三件值得感恩的事情，抑鬱情緒明顯會得到改善。凡事要作最壞的打算，但亦要抱希望。要相信自己的能力，告訴自己盡了力便行。不要變成自己的敵人，說着悲觀的話，還在自我打擊。

充足睡眠

足夠的睡眠與健康息息相關，因睡眠可增強免疫系統亦令人精神煥發。缺乏休息會令人煩燥，更削弱內在資源無法面對壓力，於是需要更強的力度去應付壓力而變得更疲憊，如此造成惡性循環。所以，儘管要為期末衝刺，也不能不眠不休，要保持平衡的生活作息才是上策。

以上的提醒，希望能幫助你順利過渡期末，然後迎接愉快的暑假！

請根據本文內容回答以下問題:

1. 以下那項並非本文中建議的減壓方法:

A. 聽音樂

B. 多進食

C. 調整思想

D. 放下電子產品

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E. 做享受的事情

2.把自己的注意力轉移到有趣味的事情上,把專注力發揮到極致時的「最優體驗」,名為:

A. 心德

B. 心喚

C. 心照

D. 心流

E. 心海

3. 手機的藍光會令人的睡眠品質變差，因它:

A. 抑制了褪黑激素

B. 釋放了褪黑激素

C. 中和了褪黑激素

D. 消滅了褪黑激素

E. 以上皆不是

4. 研究發現每天睡覺前回顧多少件感恩的事情，抑鬱情緒明顯會得到改善:

A. 一件

B. 兩件

C. 三件

D. 四件

E. 五件

5. 以下那些並非文中提及的深呼吸技巧:

A. 如常以鼻孔吸入空氣，留意空氣通過氣管進出肺部

B. 留意進出的空氣是暖還是冷

C. 以嘴巴輕輕呼出空氣

D. 踢走腦袋的雜亂思想，讓耳朵細聽着呼吸聲

E. 一邊呼吸一邊微笑

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Appendix 2.4 Reading for Control Group C

研究證實－大自然是舒緩壓力的良藥！

每當期末時，總要應付着排山倒海而來的功課、測驗和考試，就算志不在考到傲人的成績，但也希望能順利畢業進入職場吧！這種心情，有時候未必能找到知音分享和獲得支持，在水泥叢林的壓迫中，觸目所及皆是了無生機的晦暗，可能在生活裡找不到讓人快樂的事情，以為癱軟在沙發上划手機便能放空，日復一日地逃避壓力，卻換來更多焦慮與無助感，日漸影響學業表現，形成惡性循環。

回想上一次你接觸大自然是什麼時候？或許，大自然的綠意盎然離你已遠，即使經過公園也不曾久留，兒童時代於大自然中的欣喜更不知去向。我們很容易對大自然的療癒力量存疑，正因這所謂的療癒看似非常虛無飄渺。

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研究證實：每天花 20 至 30 分鐘漫步、或單純靜靜地待在一個有著大自然氛圍的地方，能迅速地減緩皮質醇及唾液淀粉酶指數，減壓效益於 30 分鐘可達至高峰。研究員認為, 這「大自然藥丸」相比情緒藥物來說是安全的，因無負作用。

此研究回應了之前更多類似研究的發現，即觀察大自然景觀能減壓。而它的結果更跨出了一大步，明確指出了「不需逗留於戶外很久便已能達至紓壓效果。」此研究亦發現，要獲得到減壓效果，只需因應個人的日程靈活地去造訪有大自然氛圍的環境，不必長途跋涉到郊外去。「自然藥丸」不需要固定時間，也不需要特別花錢，沒什麼難度，很簡單就能關顧到自己。總括來說是成本低、效用高的減壓方法。

研究員指出「大自然藥丸」並非狹義的指視覺上接觸到綠植，而是一個人張開感觀，持開放的態度跟大自然連結，從而全神貫注於周邊的環境及自身的感受，暫

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停雜亂的思緒。所以，廣義來說，在公園裡嗅到樹木的味道彷如置身於森林中、聽到鳥鳴如同感受到天空的遼闊，都算是親近大自然。

臺大森林環境暨資源系教授余家斌也說過：「我們多看綠色，多聽自然的聲音，腦部的α波會讓我們的神經系統和情緒穩定下來。」在大自然裡，人不用特別專注於任何事物時，大腦就更能產生α波。

更難能可貴的是，大自然永不會拒絕你，它就在那兒等待你的到訪，靜靜細聽你的喜與哀。無論你願不願意分享，它都在陪伴着你。當處於令人讚嘆的大自然美景，人會予以注意和欣賞，把自己的問題暫時拋諸腦後，等再拾起問題時，可能已沒有原來的壓迫感覺，就更能容易以客觀的角度去看原先的糾結。大自然亦暗藏人生哲理，如生命的循環、因果關係等，人若能浸淫於其中，加以觀察和思考，可以體會抗逆精萃。

於世界各地如歐美，現今已有醫生為情緒患者處方「大自然藥丸」，即透過接觸大自然去減壓。在學習壓力大的學期末，路經家居或學校附近的公園時，不妨放緩腳步在那裡待一下，曬曬太陽，就算有沒有蟲鳴蝶影、鳥語花香，也可以讓腦袋放空，或許當再次投入於功課和溫習時，一切會變得事半功倍。沒有去試試，永遠也不會知道這「大自然藥丸」果效如何！

參考資料:

Hunter, M. R., Gillespie, B. W. ＆ Chen, S Y-P（2019). Urban Nature Experiences Reduce Stress in the Context of Daily Life Based on Salivary Biomarkers. Frontiers in Psychology, 10. DOI: 10.3389/fpsyg.2019.0072

請根據本文內容回答以下問題(答案只能選一個選項):

1. 根據密西根大學的研究顯示，一天只要花上多少分鐘親近大自然，就能極速地減緩皮質醇指數?

A. 10 至 20 分鐘

B. 20 至 30 分鐘

C. 30 至 40 分鐘

D.40 至 50 分鐘

5. 50 至 60 分鐘

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2. 以下那個不是「自然藥丸」的優點?

A. 可定時服用

B. 不需要特別花錢

C. 沒什麼難度

D. 沒副作用

E. 是成本低、效用高的減壓方法

3. 台大森林環境暨資源系教授余家斌說多看綠色，多聽自然的聲音的話，腦部會發出什麼波讓神經系統和情緒都穩定下來?

A. α 波

B. β 波

C. γ 波

D. δ 波

E. μ 波

4. 在密西根大學的研究中，受試者可以:

A.上網

B. 講電話

C. 聊天

D. 做有氧運動

E. 待在大自然的氛圍裡

5. 以下那些是本文中有提及大自然的奧妙:

A. 大自然永不會拒絕你，它就在那兒等待你的到訪，靜靜細聽你的喜與哀

B. 無論你願不願意分享，大自然都在陪伴着你

C. 大自然令人把自己的問題暫時拋諸腦後，到再拾起問題時，可能已沒有原來的壓迫感覺

D. 大自然暗藏人生哲理，如生命的循環、因果關係等，讓人體會抗逆精萃

E. 以上皆是

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Appendix 2.5 Reading for Experimental Group D

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回想上一次你接觸大自然是什麼時候？或許，大自然的綠意盎然離你已遠，即使經過公園也不曾久留，兒童時代於大自然中的欣喜更不知去向。我們很容易對大自然的療癒力量存疑，正因這所謂的療癒看似非常虛無飄渺。

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6. 處境問題 (請根據本文內容及您個人的經驗填寫您的回應)

韋庭是一名大學生，一向學業成績中等，儘管對自己的期望僅為期考合格，但每到期末時間，排山倒海的功課、測驗和考試仍然令韋庭吃不消。主觀壓力重，有時身體也會出現焦慮抑鬱的狀況。韋庭聽說過到大自然或公園走走是減壓鑰匙，但總是提不起勁。韋庭的關注是時間、動力和環境因素。請您因應韋庭的關注幫助推動韋庭獨自到大自然或公園走走。

6a: 韋庭：到野郊或公園，包括交通安排，要花很多時間啊！有時間何不在家吹吹冷氣，划划手機？！

您的建議：

6b: 韋庭：要找能達舒緩效果的大自然或公園不容易啊！

您的建議 (包括您為何會給這意見)：

6c: 韋庭：外面太陽又大，要不就是下雨，蚊蟲又多，還是不要外出吧！

您的建議：

6d: 韋庭：到大自然或公園獨處，感覺好無聊啊。過程中做什麼才會得到舒緩的感覺？

您的建議:

6e: 最後請以您個人的經驗、您所知他人的經驗又或是文中的資料，說服韋庭到野郊或公園走走

6f: 假如韋庭最後接受您的建議到野郊或公園走走，您相信他/她能舒緩壓力嗎?

0 至 10，0 為絕對不可以，5 為一半的機會可以，10 為絕對可以

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Appendix 2.6 Self-constructed questionnaire for Study 2. (Yeung & Yu, 2022b)

A. Measurements on Motivation for Nature Visit.

Please circle number on the scales and fill in the blanks.

1. “Exposure to nature can relieve stress.” To what degree do you agree with this statement?

Answer on seven point Likert Scale: 1: totally disagree; 2: Some degree of agreement and some degree of disagreement; 7: totally agree.

2. “To what degree do you intend to expose yourself to nature for stress relief?”

3. “In the last week, how many times have you exposed yourself to nature alone for at least 20 min?”

Answer: _____times.

4. “In the last week, how many times you have exposed yourself to nature with family and friends for at least 20 min?”

Answer: _____times.

5. “Exposure to virtual nature can relieve stress.” To what degree do you agree with this statement?

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6. “To what degree do you intend to expose yourself to nature for stress relief?”

7. “In the past week, how many times have you exposed yourself to virtual nature for at least 20 min?”

Answer: _____times.

Recall of three impressive images in the last week

“Our eyes are comparable to a camera lens while our heads are comparable to hard disks of our memory. Whether these images are from indoors or outdoors, they can elicit feelings. Please recall images from your daily living that brought you feelings in the past week. Write three of these images, describe them in detail, and then determine whether they brought you positive, negative, or mixed/uncertain feelings.”

B. Image 1:

_____

Classify it as (please tick one only):

▢ Positive

▢ Negative

▢ mixed/uncertain feelings

Image 2:

_____

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Classify it as (please tick one only):

☐ Positive

☐ Negative

☐ mixed/uncertain feelings

Image 3:

Classify it as (please tick one only):

☐ Positive

☐ Negative

☐ mixed/uncertain feelings

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Appendix 2.7 Chinese version of Flourishing Scale

「豐盛人生」量表

請細閱以下八項，並根據下列一至七的指標，選擇適當的數字，表達你對各項的同意程度。

7　非常同意
6　同意
5　少許同意
4　不是同意也不是不同意
3　少許不同意
2　不同意
1　非常不同意

我的生活有目標和意義。

我的社交關係富支持性和令我有所有得著。

我對日常活動又投入又感興趣。

我積極爲其他人的快樂和福祉作出貢獻。

我能勝任並能夠做到對我重要的事情。

我是一個好人，並過著好的生活。

我對我的未來樂觀。

別人尊重我。

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Appendix 2.8 The Chinese version of Zimet's Multidimensional Scale of Perceived Social Support

以下是一些描述**<u>你現在和你的朋友及家人的</u>**句子，請你表示你對這些句子的同意程度。

十分不同意 1 2 3 4 5 6 7 十分同意

1. 當你有需要的時候，總有一個好朋友在你身邊。	1 2 3 4 5 6 7
2. 你有一個好朋友，無論開心或者不開心，你都可以同他/她分享。	1 2 3 4 5 6 7
3. 你的家人真的十分願意幫助你。	1 2 3 4 5 6 7
4. 你的家人可以給你情緒上需要的支持。	1 2 3 4 5 6 7
5. 你有一個真的可以安慰你的朋友。	1 2 3 4 5 6 7
6. 你的朋友真的願意嘗試幫助你。	1 2 3 4 5 6 7
7. 如果有甚麼事發生，你可以倚靠你的朋友。	1 2 3 4 5 6 7
8. 你可以和家人訴說你自己的問題。	1 2 3 4 5 6 7
9. 你有一些朋友，無論開心或者不開心，你都可以同他們分享。	1 2 3 4 5 6 7
10. 你生命中有個好朋友，他/她會關心你的感受。	1 2 3 4 5 6 7
11. 你的家人願意和你一起做決定。	1 2 3 4 5 6 7
12. 你可以同你的朋友訴說你自己的問題。	1 2 3 4 5 6 7

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Appendix 3.1 A suggested Nature-based CBT structure for anxiety-depressed patients deduced from Study 3's findings

Session	Main theme	Content	Purposes
1	**Orientation**	**Guided experience different senses in the nature.** **Fun activities**: e.g. find a being or non-being share similar characteristics as oneself	● Sharpen or open up senses and relate the sensations to the subsequent emotion ● Rapport building with the nature, therapist and other participants (if in a group approach)
2.	**Mindfulness**	**Guided or non-guided experience of different senses** (depending on the participants' competence to manage the skills) **Slow walking and mindfulness**	● Capture the focused attention & being in the present as part of the mindfulness skills attained in last session ● Introduce the concepts of non-judgmental as another elements of mindfulness ● Homework assignment: mindful practice in daily life

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3.	**Cognitive triad & how cognitions a matter**	**A brief mindful practice** **Slow walking:** observe relationship among beings in the nature **Discussion:** CBT rationale	● Introduce main concepts of CBT: cognitive triad and the relationship between antecedents-cognition-emotion-behavior-consequences ● Homework assignment: continuous mindful practice
*4.	**Dysfunctional thoughts**	**A brief mindful practice** **Slow walking**: noticing from the nature **Discussion**: dysfunctional thoughts	● Depending on what the participant has noticed in the nature to deduce the dysfunctional thoughts (e.g. arbitrary inferences, personalization, overgeneralization, etc.) ● Homework assignment: continuous mindful practice, real life observation or experiment for collecting information for invalidating dysfunctional thoughts in next session
*5.	**Confrontation of dysfunctional thoughts**	**A brief mindful practice** **Discussion**: invalidate dysfunctional thoughts	● Invalidate dysfunctional thoughts through information collected from real life observation or experiment ● Set up a tone for self-reflection to be taken place in next session

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		Inspiring activity: e.g. treasure hunting (share with a being in the nature your active stressors and get support from it)	via a inspiring activity ● Homework assignment: continuous mindful practice, apply the validated thinking pattern to daily living
6.	**Self-reflection**	**A brief mindful practice** **Discussion**: feedback in applying the validated thoughts in daily life **Solitude in the nature** **Discussion**: self-reflection	● Recapture the new adaptive thoughts which could bring emotions and behavior in positive way ● Consolidate self-reflection particularly on the importance of attending to positive stimuli ● Homework assignment: continuous mindful practice, attend to positive stimuli in daily life
7.	**Self-efficacy**	**A brief mindful practice** **Slow walking:** observe how beings survive in the nature	● Learning from the beings in the nature to develop self-efficacy corresponding to one's strengths ● Homework assignment: continuous mindful practice, observe or

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		Discussion: self-efficacy	utilize one's own strengths in daily life
8.	**Behavioral modification & round up**	**A brief mindful practice** **Discussion**: behavioral modification to facilitate remission **Round up the sessions**	● Conclude on what have been learnt in the program: mindfulness, cognitive triad, dysfunctional thoughts, self-reflection, attention to positive stimuli, self-efficacy, and behavioral modification

Remarks: session 4 & 5 are the core components of the program and could be expanded to more sessions if there is massive information coming up from these sessions, or if in group format more time is required for every participant to share and digest the concepts

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