



Investigating relationships between exposure to nature, nature connectedness and subjective well-being within the student-population

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ABSTRACT

Student subjective wellbeing (SWB) is of increasing concern, notably, because of reports of high anxiety, depression and suicide prevalence within this demographic. Greater 'belief' in a connectedness to nature has been repeatedly associated with positive SWB. This study aimed to investigate the relationships between exposure to nature, nature-connectedness (NC) and SWB within the student-population.

Fifty-eight (58) undergraduate students completed replica versions of pre-existing measures, aimed at assessing; Nature-Connectedness, Eudemonic-, Hedonic- and Evaluative-Subjective Well-being (both before and after an exposure to nature event). Analysis found that all SWB-components and NC were subject to a positive effect by exposure to nature, with consistent associations between Eudemonic SWB and NC. In addition, some significant associations were found between Hedonic-SWB and NC, also Evaluative-SWB and NC.

However, the results also present uncertain findings arising from the investigation into the relationships of SWB-components predicting NC (specifically Eudemonic SWB). Practical implications of this study are outlined to assist Universities in addressing the student-mental health epidemic, by improving student SWB and NC through nature-exposure.

KEY WORDS:	NATURE-CONNECTEDNESS	NATURE-EXPOSURE	HEDONIC SUBJECTIVE-WELLBEING	EUDEMONIC SUBJECTIVE-WELLBEING	EVALUATIVE SUBJECTIVE-WELLBEING
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Introduction

Subjective wellbeing

The concept of psychological subjective well-being (SWB), as defined by Diener et al., (2003), is the umbrella term used to describe how people perceive their lives. More specifically, it encompasses “*peoples emotional and cognitive evaluations of their lives*” (Diener et al., 2003:403). This dominant SWB conceptualisation, differentiates with three distinct associated components; 1) Evaluative-SWB, 2) Hedonic-SWB and 3) Eudemonic-SWB (Diener et al., 2009). These can be respectively elaborated on as life-satisfaction, mood/affect (i.e. happiness sadness, etc.) and meaning in life (Steptoe et al., 2015; MacKerron & Mourato, 2013). There has been debate as to whether these are independent SWB-components, though evidence suggests that they are indeed non-identical factors that should be measured and studied separately (Andrews & Withey, 1976; Kim-Prieto et al., 2005).

It is notable that the components of SWB are measured by self-report instruments. Critics of SWB state that self-report measures may be influenced by situational factors, such as mood at time of assessment (Schwartz & Strack, 1991). This lack of context in the SWB-component conceptualisation prompted Atkinson (2013) to suggest an alternative ‘spaces of wellbeing’ approach, allowing for an understanding of situated and relational effects on SWB. However, examination of self-report vs. non-self-report measures of the SWB-components have suggested validity of SWB self-report measures and the component approach (Sandvik et al., 1993).

As SWB and mental illness are independent dimensions, positive SWB can remain in the presence of a psychiatric disorder (Weich et al., 2011). Yet, poor scores of SWB-components have been found to correlate with poor mental health (MH). For example, Seligman (1988) linked a perceived ‘loss of meaning’ in life with depression, whilst Keyes (2005) found anxiety to be correlated with low SWB. Evidence also exists to suggest a negative relationship between physical illness and longevity (Steptoe et al., 2015), and ‘good health’ to correlate with higher life-satisfaction (Haller & Hadler, 2006). Although direction of causality is unclear, physical and mental-illness can influence SWB, where SWB in itself can influence physical and mental-illness (Dolan et al., 2008). This suggests that promotion of positive SWB could act as a protective factor for mental and physical health.

Despite the likelihood of university students being of an advantaged socio-economic status (Lowe et al., 2009), depression and anxiety disorders are of a progressive prevalence within this population (Ibrahim et al., 2013). For this reason, MH intervention and positive SWB are of increasing priority to governments and higher-education systems.

Giving focus on the United Kingdom (UK) student-population, a survey of 1000 students by UniHealth (2017) reported that; 82% had experienced anxiety, 45% had experienced depression, and 19% had felt suicidal during their studies. These statistics concur with those of the Institute for Public Policy Research (Thorley, 2017). This informed of a 95% increase in a demand for counselling services by higher-education institutions over the last decade and revealed that 2% of UK first-year students disclosed a MH condition in 2015/2016. This is 5 times greater than figures 9 years prior (Johnson & Crenna-Jennings, 2018). Interestingly, Zivin et al. (2009) found that when revisiting students two years after initial self-report of a MH problem, that less than half of the university students had received any treatment/assistance.

It has been argued that these figures can be accounted for due to improvement of the general populations' awareness of MH conditions, decreasing stigmatisation and leading to increased diagnosis where subsequently more sufferers request help (TNS, 2014). Though a cross-temporal meta-analysis of students between 1938-2007 concluded that, a consistent generational increase in psychopathology is proceeding regardless of social changes and declining stigmatising attitudes (Twenge et al., 2009).

A longitudinal study of American students (Eisenberg et al., 2009) found depression to be a significant predictor of lower academic achievement and its presence to increase drop out probability. Additionally, they found the probability of these negative effects to be heightened when a student also had an anxiety disorder. Thus, the presented findings indicate a MH epidemic within student-populations and an unmet need for University wellbeing and MH support. These issues are hindering student's likelihood of excelling in their studies, suggesting universities should take some responsibility in addressing their students' MH and SWB.

The SWB benefits of nature

There are many reported benefits associated with spending time within nature (nature-exposure). These include; longevity and good physical health (Mitchell & Popham, 2008), increased vitality (Ryan et al., 2010) and boosted positive-affect (Nisbet et al., 2011), all of which are encompassed or linked with good general SWB (predominantly Hedonic- and Eudemonic-SWB), (MacKerron & Mourato, 2013). Benefits of nature-exposure on Evaluative-SWB has been least reported, but recently Biedenwig et al. (2017) reported a small but positive effect. Hence, it is proposed that nature-exposure has a positive effect on SWB generally, but to varying degrees when analysing its components.

Consistent with these findings, it has been suggested by Capaldi et al. (2014) that spending more time inside negatively affects SWB. We must note however the possibility that the effects of nature-exposure on SWB may be influenced by its promotion of physical activity, which itself promotes positive-affect (Pasco et al. 2011) and overall SWB (Biedenwig et al., 2017). Shanahan et al. (2016) surveyed 1538 Australian participants aged 18-70 and found nature experiences increased mental and physical health and encouraged positive health behaviours (e.g. exercise). For example, they found that 30-minutes or more of exposure to an outdoor green-space, including *urban green-spaces* ("urban land covered by vegetation of any kind.") (World Health Organisation, 2017: online), reduced depression by 7%. The higher frequency of visits to green-spaces predicted physical activity, where a conclusion was drawn that the *frequency* and *duration* of visits to green-spaces had a more positive impact than the *intensity* of the 'green-space'. This suggests both urban and rural locations promote psychological health, despite differing nature intensities. A meta-analysis of 50 empirical studies also detailed that benefits of nature present in a wide variety of natural environments, such as; "true-wilderness, neighbourhood parks, gardens, and natural features around residences" (Grinde & Patil, 2009:2335). Passmore and Howell (2014) established that nature experiences need not be drastic life changes or involve intensive activities to be beneficial to Hedonic- and Eudemonic-SWB.

From these findings it can be concluded that experiences with nature promote positive SWB and good health. The evolutionary 'Biophilia hypothesis' (Wilson, 1984) could help us to understand this. This hypothesis suggests humans have a genetic and innate tendency to focus on, and affiliate with, the natural world (Kellert & Wilson,

1995) and notes the more we understand other organisms, and ourselves, the greater value we place on them (Wilson, 1984). Hence, negative-affect occurs when environments lack natural components (Grinde & Patil, 2009). Grinde & Patil (2009) suggest the addition of natural visual elements, such as; parks, indoor plants and natural views from windows, could counteract this negative affect of manmade surroundings. Although this theory has compelling evidence to support its human-nature relationship, Joye & De Block (2011) highlights the need for more research to clarify links with evolutionary origins.

Amongst benefits of nature-exposure on SWB, contact with nature also correlates with reduced stress (Chang & Chen, 2005) in addition to improving attention (Kaplan & Kaplan, 1989), focus and concentration (Ohly et al., 2016). These factors are incorporated in the Attention-Restoration Theory (ATR) which hypothesises that nature has the ability to renew attention after mental exertion and fatigue (Kaplan, 1995). Although, Joye & Dewitte (2018) suggest this theory is vague, underdeveloped and not yet thoroughly tested. Nevertheless, ATR is significant to the student-population due to the long hours applied to study, requiring high levels of mental exertion.

Subjective Nature-Connectedness

Literature defines the construct of one's belief in having a connection to nature, as subjective Nature-Connectedness (NC) (Mayer & Frantz, 2004), or Nature-Relatedness (NR) (Nisbet et al., 2009). Tam (2013) confirms these to be the same construct. NC can be further outlined as "*a stable individual difference in cognitive, affective and experiential connection with the natural environment*" (Capaldi et al., 2014:1). By this definition it is an individual 'trait', although evidence suggests it can be state induced (Mayer et al., 2009; Weinstein et al., 2009). Richard & Diener (2009) state relationships exist between specific individual traits and various types of wellbeing.

Studies have investigated NC and SWB, generally, the two constructs have been found to positively correlate (Nisbet et al., 2009). However, mixed findings are reported when breaking down SWB's sub-components; Evaluative-, Hedonic- and Eudemonic-SWB (Howell et al., 2011).

For example, Leary et al., (2008) found no association between NC and life-satisfaction (Evaluative-SWB), whereas Mayer and Frantz (2004) reported a significant correlation between NC and life-satisfaction. Later, Mayer et al. (2009) could not find an association between NC and life-satisfaction, or NC and positive-affect (Hedonic-SWB). Yet, Nisbet et al. (2011) reported NC to be consistently associated with 'vitality' (Eudemonic-SWB) and positive-affect. In the same study, no association was reported between NC and life-satisfaction. Capaldi et al. (2014) and Howell et al. (2013) conclude that, overall, literature suggests positive relationships between NC and all components of SWB. Of those, the strongest relationship is between Eudemonic-SWB and NC, followed by Hedonic-SWB and finally Evaluative-SWB.

Additionally, Passmore & Howell et al (2014), found NC did not moderate the SWB benefits of nature-exposure and suggest further investigation is needed to explore the relationships between SWB and NC.

Utilising the same data as Shanahan et al. (2016), Dean et al. (2018) found persons with higher NR associated more with nature experiences across their life-course. These participants were significantly less likely to experience anxiety disorders, depression and poor physiological health, suggesting that individuals with

higher NR/NC may uphold health and SWB benefits, through spending more time in nature than those with less NC.

Student-Nature disconnect

In general, individuals in the developed world spend far less time in nature than in past decades. Kellert et al. (2017) surveyed 11,817 American adults and children in a nationwide study. They concluded 5 society wide elements that fuel this detachment between nature and modern life; (1) Location of home, work or school, (2) Available time, attention and money, (3) Less dependence on nature for survival, (4) Distraction of technology (i.e. smart-phones, media, etc.) and (5) Lesser expectations for contact with nature in order to gain satisfaction. There is evidence to suggest we could relate these five forces to the general UK student-population:

- 1) When reviewing The Guardian's (2019: online) University League tables, the majority of UK universities are located within urban cities. Cities and university environments are almost entirely manmade, resulting in a depletion of natural-elements from students' day to day lives.
- 2) Student maintenance loans often do not cover basic living expenses. The National Student Money Survey (Bushy, 2018) found of the 83% of students receiving a maintenance loan, 61% of students stated it did not cover costs, with the average student spending £770-per-month compared to their loan amounting to £600-per-month. The report states most often resort to lending from parents, whilst 76% take up part-time employment. Consequently, time is stretched between academia and employment, resulting in lack of available time, attention and money to create routine of nature-exposure.
- 3) "Declining direct dependence on the natural world for livelihoods and subsistence allows [people] to orient their lives towards other things." (Kellert et al., 2017:3). Nature is no longer a necessity integrated into individuals' everyday lives in order to survive.
- 4) Kellert et al. (2017) suggest new technologies, to be captivating attention from natural activities. Current undergraduate-students are most likely born after the widespread adoption of digital technology in 1980 (Bennett et al., 2008). Generational generalisations assume that these individuals have spent their lifetimes immersed in technology (Prensky, 2001), thus influencing the increased usage of technology compared to previous generations. For example, over 94% of 18-24-years-olds report to using 'YouTube' compared to 56% of 50+ year-olds (Smith & Anderson, 2018). Gemmill & Peterson (2006) reported 25% of undergraduate-student participants struggle with disruptions caused by technology, affirming Kellert et al.'s (2017) technological distraction element.
- 5) Although there is no specific evidence considering students, Kellert et al.'s (2017) findings of shifting expectations, regarding contact with nature to gain satisfaction, could be generalised to this population. This suggests, in general, that adults are content with the small amount of contact time they experience in nature.

Rationale

The current body of literature informs an association between higher NC and greater involvement in nature, of which nature-exposure itself is reported to promote positive SWB. Furthermore, mixed findings of associations between NC and SWB-components have been reported. Kellert et al.'s (2017) framework of nature disconnect, can be attributed to the UK student-population, highlighting the increasing susceptibility of students to interact less with nature. Thus, it is important to attempt to clarify associations and investigate relationships between these factors to better inform Universities in creating effective strategies to encourage nature-exposure, which could reap benefits for students psychologically, physiologically and academically.

The aim of this study is to investigate (within the UK undergraduate-student population); the correlations and relationships between the three SWB-components and NC, the strengths of these relationships before and after nature-exposure and the effect of nature-exposure on NC and the SWB-components. Considering all the evidence presented it is hypothesised:

H1 - Eudemonic-SWB measures will most strongly correlate with NC, both pre- and post-nature exposure.

H2 - Hedonic-SWB will correlate with NC, both pre- and post-nature exposure.

H3 - Evaluative-SWB correlate least with NC, both pre- and post-nature exposure.

H4 - Nature-exposure will positively effect NC and each SWB component.

H5 - SWB measures will predict NC, both pre- and post-nature exposure.

H6 - Nature-exposure will strengthen the relationships between NC and the SWB-components.

Analysis will show to what extent the hypotheses are true.

Methodology

Design

A repeated-measures, non-experimental, design was used in this investigative study, whilst regression analysis was used to investigate relationships of the pre- and post-nature-exposure measures separately. *T*-tests were also conducted on all pre and post-nature exposure measures to measure the effect of 'nature-exposure' on each measure

In two multiple regression analyses, utilising data pre- and post-nature exposure, the predictor variable was 'NC' and the criterion variables were; 'Hedonic-', 'Eudemonic-' & 'Evaluative- SWB.' The results of these were compared to investigate the difference in strength of the relationships after nature-exposure. A supplementary linear regression was also conducted to further investigate the relationship between 'Hedonic-SWB' criterion and 'NC' predictor variable.

Participants

58 undergraduate-students (18 men, 40 women, mean age = 22.83, SD = 3.58, age range = 18-to-40), at Manchester Metropolitan University (MMU), were recruited by volunteer sampling, utilising MMU's 'Participation Pool'. Opportunity sampling recruited further participants (by word-of-mouth with a snowballing effect) within the

University campus. Sample size aimed to be justifiable according to Greens (1991) rule-of-thumb that $N \geq 50 + (8 \times 4) = 82$. However, imposed deadlines lead to termination of participant recruitment before this figure was attained. Roscoe (1975) states that a multiple regression analysis should aim for a sample size 10 times that of the number of variables, though a sample size larger than 30 is appropriate for most research. Therefore, the number of recruited participants was accepted, and analysis proceeded.

Measures

The 'Connectedness to Nature Scale' (CNS) (Mayer & Frantz, 2004) (See appendix 2) was employed as a measure of NC. This is a 14-item Likert-scale where participants must answer by scoring statements between 1 ('strongly agree') and 5 ('strongly disagree'). Scale items include; "I often feel disconnected from nature", "I have a deep understanding of how my actions affect the natural world" and "I often feel a kinship with animals and plants". Statements 4, 12 and 14 were reverse scored before analysis. Reliability alpha of this scale was presented as satisfactory by its authors ($\alpha=.84$)

Eudemonic-SWB was measured using Ryan & Fredericks (1997) 'Subjective Vitality Scale' (VS) (See appendix 2). This measure contains 7 items scored on a 7-point Likert-scale ('Not at All True' to 'Very True'). Items include; "I feel alive and vital", "I look forward to each new day", and "I feel energized". The second item was reverse scored before analysis. The internal consistency of this scale in Ryan & Frederick's research was satisfactorily reported as $\alpha=.96$.

Hedonic-SWB was measured using the 'International Positive and Negative Affect Schedule Short Form' (I-PANAS-SF) (Thompson, 2007) (See appendix 2). This measure produces two scores from its 10-item Likert-scale. Items are rated between 1 ('Never') and 5 ('Always') when considering to what extent do participants generally feel. Items; 1, 2, 4, 6, and 9, produce a 'negative-affect' (NA) score. Items; 3, 5, 7, 8, 10, produce a 'positive-affect' (PA) score. Examples of the included items are; "Active", "Hostile" and "Nervous". The reliability of the subscales, of this version, were prior established showing all alpha levels to be satisfactory (NA subscale $\alpha=.74$ and PA subscale $\alpha=.80$).

Evaluative-SWB was measured using Diener et al.'s (1985) 'Satisfaction with Life Scale' (LSS) (See appendix 2). Participants were required to rate each of the 5 items, of the Likert-scale between 1 and 7 (1 = 'Strongly Disagree' and 7 = 'Strongly Agree'). Items included; "I am satisfied with my life", "The conditions of my life are excellent", and "In most ways my life is close to my ideal". The internal consistency of this scale is presented as satisfactory by its authors ($\alpha=.87$).

Procedure

The MMU Psychology Department reviewed the study and granted ethical approval prior to data collection (see appendix 1). Data/information was collected and provided by means of hard copies or digitally (through www.qualtrics.com). Detailed information about the present study was provided, notifying the right to withdraw at

any time (see appendix 3). Participants were then asked to provide informed consent before completing demographic questions and the scales (see appendix 4). Subsequently, participants were requested to walk through a nature-setting of their choice (e.g. a park, urban green-space or countryside, etc) with a required duration of 30-minutes. (46.6% of participants reported their walk location as 'urban green-space'). Participants were then required to complete a follow-up questionnaire repeating the four scales (see appendix 5). The post-walk the scales were ordered differently to minimise order effect. On completing the follow-up questionnaire, participants were reminded of their ability to contact the researcher (via email) for any queries and/or an optional debrief.

Results

Questionnaire responses were input entered, from 'Qualtrics' and hard copies, into SPSS v.25.0.

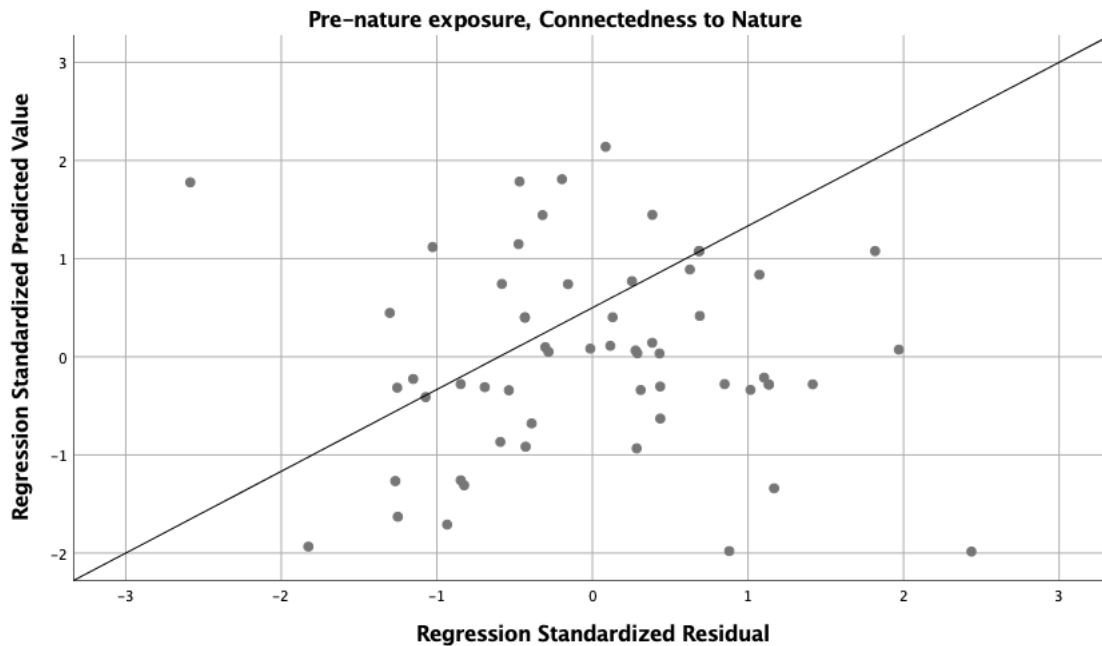
Data Preparation

Items were reverse scored in accordance to requirements of the individual questionnaires. Of the CNS scale, questions 4, 12 and 14 were applicable and for the VS, question 2 only. The original data set of 81 participants was pre-screened for incomplete entries. This resulted in the removal of 23 participants with incomplete data sets.

Parametric assumptions of the data were then established, Z-scores were computed for all variables to test for outliers, where one participant was found to be an outlier. This outlier was not removed from analysis as the score reflects the participant's subjective experience. Therefore, the final data set comprised 58 participants. Shapiro-Wilk displayed normality of distribution, and satisfactory skew and kurtosis was confirmed.

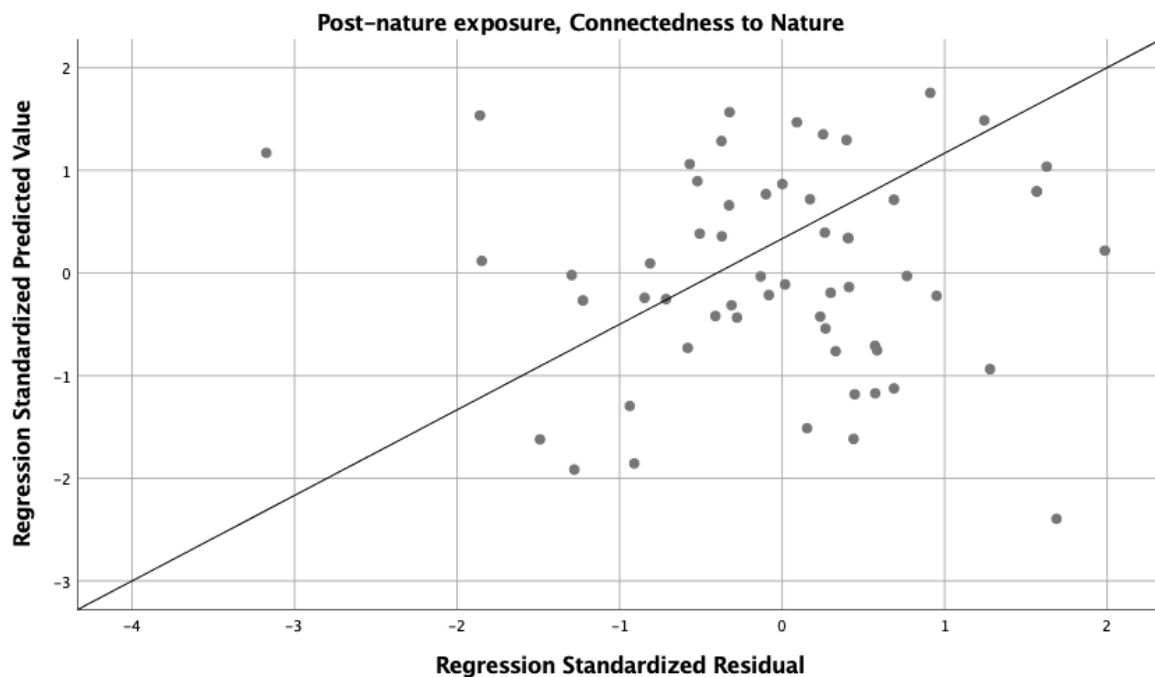
Collinearity tests indicated that the pre-nature exposure data met the assumption of no multicollinearity (Life-satisfaction, Tolerance = .53, VIF = 1.89; PA, Tolerance = .68, VIF = 1.48; NA, Tolerance = .81, VIF = 1.24; Vitality, Tolerance = .55, VIF = 1.81.) The data met the assumption of independent residuals (Durbin-Watson = 2.18). The scatterplot of standardised residuals (**Figure 1**) indicates that the data met the assumptions of linearity and homogeneity of variance according to Field (2009).

Figure 1: Scatterplot of standardised residuals pre-nature exposure.



Collinearity tests indicated that the post-nature exposure data also met the assumption of no multicollinearity (Life-satisfaction, Tolerance = .49, VIF = 2.04; PA, Tolerance = .50, VIF = 2.01; NA, Tolerance = .79, VIF = 1.26; Vitality, Tolerance = .45, VIF = 2.21.) The data met the assumption of independent residuals (Durbin-Watson = 1.79). The scatterplot of standardised residuals (**Figure 2**) indicates that the data met the assumptions of linearity and homogeneity of variance according to Field (2009).

Figure 2: Scatterplot of standardised residuals post-nature exposure.



Reliability Analysis

Internal consistency analysis of each questionnaire was measured to ensure scale items are closely related. Nunnally (1978) dictates that questionnaire scales should aim for a Cronbach's alpha above .70 ($\alpha > .70$).

I-PANAS-SF sub-scales were measured separately consistent with past research. **Table 1** shows all scales, except the NA subscale ($\alpha = .55, .57$) of the I-PANAS-SF, have satisfactory reliability ($\alpha > .7$). Dall'Oglio et al. (2010:421) states "when there are fewer than 20 items, [...] a value of 0.50 is satisfactory". Therefore, all reliabilities were accepted, and no questions were removed from analysis.

Table 1. Reliability Analysis of Scales

Measure	No. of Items	Cronbach's Alpha (α)	
		Pre-Nature Exposure	Post-Nature exposure
Connectedness to Nature	14	.79	.84
Satisfaction with Life	5	.88	.87
Positive Affect	5	.79	.89
Negative Affect	5	.55*	.57*
Vitality	7	.82	.82

Note. * $\alpha < .7$

Descriptive Statistics

Table 2. Means and Standard Deviations of all variables

Measure	Pre-Nature Exposure		Post-Nature exposure	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Connectedness to Nature	46.84	7.48	51.10	7.80
Satisfaction with Life	22.50	6.54	24.91	5.95
Positive Affect	15.72	3.49	16.98	4.22
Negative Affect	9.84	2.13	8.72	1.90
Vitality	30.38	8.72	35.76	8.74

Note. *M* = Mean, *SD* = Standard Deviation.

Table 3 indicates that there was a positive correlation between NC and Satisfaction with Life $r(56) = .24, p = .038$ and a strong positive correlation between NC and Vitality $r(56) = .41, p = .001$. There was a strong positive correlation between Satisfaction with Life and PA $r(56) = .48, p < .001$, and Satisfaction with Life and Vitality $r(56) = .61, p < .001$. There was a strong negative correlation between Satisfaction with Life and NA $r(56) = -.43, p < .001$. There was strong positive correlation between PA and Vitality $r(56) = .53, p < .001$. Finally, there was a positive correlation between NA and Vitality $r(56) = .30, p = .011$.

Table 3. Pearson's Correlations among pre-nature exposure variables

	Connectedness to Nature	Satisfaction with Life	Positive Affect	Negative Affect	Vitality
Connectedness to Nature	-				
Satisfaction with Life	.24*	-			
Positive Affect	.21	.48**	-		
Negative Affect	-.12	-.43**	-.15	-	
Vitality	.41**	.61**	.53**	-.30*	-

Note. * indicates $p < .05$, ** indicates $p < .001$

Table 4 indicates that there was a positive correlation between NC and PA $r(56) = .25$, $p = .029$ and NC and Vitality $r(56) = .26$, $p = .026$. There was a strong correlation between Satisfaction with Life and PA $r(56) = .57$, $p < .001$, and Satisfaction with Life and Vitality $r(56) = .62$, $p < .001$. There was a strong negative correlation between Satisfaction with Life and NA $r(56) = -.46$, $p < .001$, and a negative correlation between PA and NA $r(56) = -.25$, $p = .028$. There was a strong positive correlation between PA and Vitality $r(56) = .68$, $p < .001$, and a negative correlation between NA and Vitality $r(56) = -.26$, $p = .025$.

Table 4. Pearson's Correlations among post-nature exposure variables

	Connectedness to Nature	Satisfaction with Life	Positive Affect	Negative Affect	Vitality
Connectedness to Nature	-				
Satisfaction with Life	.91	-			
Positive Affect	.25*	.57**	-		
Negative Affect	-.05	-.46**	-.25*	-	
Vitality	.26*	.62**	.68**	-.26*	-

Note. * indicates $p < .05$, ** indicates $p < .001$

Pre-Nature Exposure Regression Analysis

A multiple regression analysis was conducted on the data to test the extent to which each measure of SWB ('Life-satisfaction', 'Vitality', 'PA' & 'NA') relate to one another and predict NC, 'pre-nature exposure', among university students.

Overall significance emerged from the model (shown in **Figure 3**), $F(4,45) = 2.67$, $p = .042$. The relationship between the variables was moderate ($R = .41$), and the model could explain 10.5% of the variance in NC scores ($R^2 = .168$, $R^2_{adj} = .105$).

Figure 3. Scatterplot with regression line showing significant positive relationship between NC and overall SWB, pre-nature exposure.

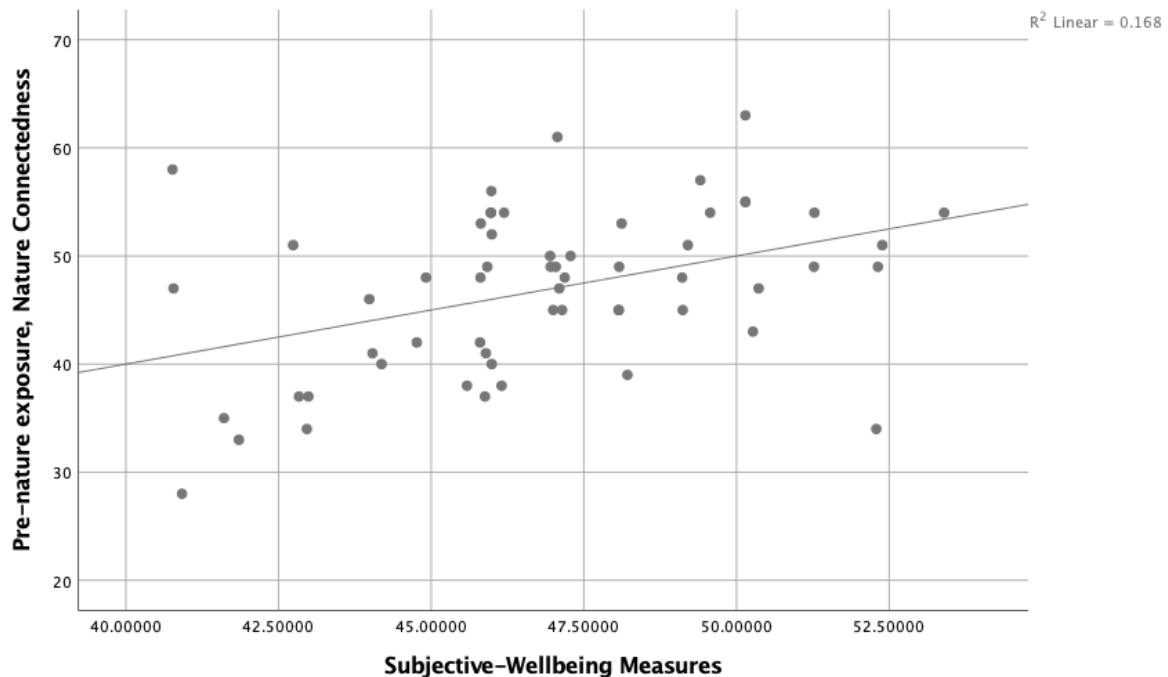


Table 5 gives information about regression coefficients for each predictor variable entered into the model. 'Vitality' was found to significantly predict NC, $\beta = .46$, $t(53) = 2.53$, $p = .015$. However, there was no significance found between 'Satisfaction with Life', $\beta = -.02$, $t(53) = -.11$, $p = .915$; 'PA', $\beta = -.01$, $t(53) = -.05$, $p = .960$; and 'NA', $\beta = <.01$, $t(53) = .02$, $p = .986$.

Table 5. Summary of regression analysis for predicting pre-nature exposure student Nature Connectedness scores

Measure	B	SE B	β	p
Satisfaction with Life	-.02	.20	-.02	.915
Positive Affect	-.02	.33	-.01	.960
Negative Affect	-.01	.49	<.01	.986
Vitality	.37	.14	.46*	.015

Note. * indicates $p < .05$, $R_2 = .168$

The results provide insight into each SWB component's relationship with NC, among university students, pre-nature exposure, and found neither 'Satisfaction with Life', 'PA' or 'NA' to significantly predict NC. 'Vitality' was found to be a significant predictor.

Post-Nature Exposure Regression Analysis

A multiple regression analysis was conducted on the data to test the extent to which each measure of SWB ('Life-satisfaction', 'Vitality', 'PA' & 'NA') relate to one another and predict NC, 'post-nature exposure', among the same university student sample.

A non-significant model emerged from the analysis (shown in **Figure 4**), $F(4,53) = 1.12$, $p = .357$. The relationship between the variables was weaker ($R = .28$), and the model could explain 0.8% of the variance in NC scores ($R_2 = .078$, $R_2 adj = .008$).

Figure 4. Scatterplot with regression line showing non-significant positive relationship between NC and overall SWB, post-nature exposure.

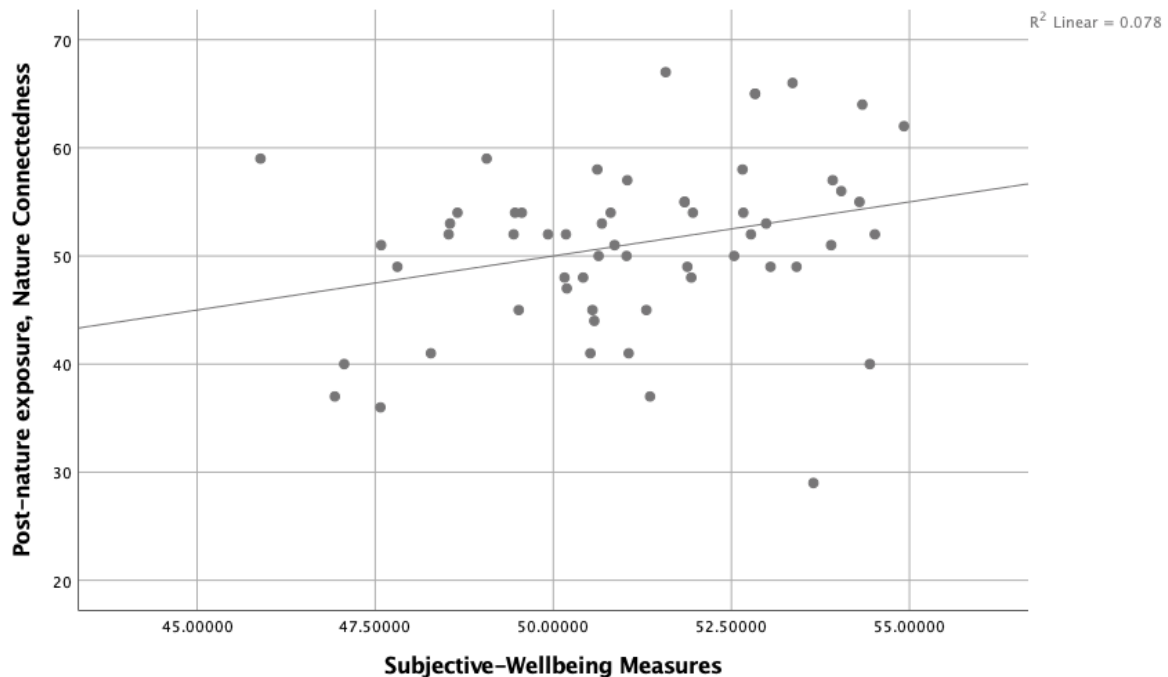


Table 6 shows regression coefficients for each predictor variable entered into the model. No variables were found to significantly predict NC Scores, 'Satisfaction with Life', $\beta = .05$, $t(53) = -.21$, $p = .835$; 'PA', $\beta = .14$, $t(53) = -.72$, $p = .474$; 'NA', $\beta = 0.43$, $t(53) = .29$, $p = .771$; and 'Vitality', $\beta = 0.15$, $t(53) = .77$, $p = .445$.

Table 6. Summary of regression analysis for predicting post-nature exposure student Nature Connectedness scores

Measure	B	SE B	β	p
Satisfaction with Life	.05	.25	.04	.835
Positive Affect	.25	.35	.14	.474
Negative Affect	.18	.61	.04	.771
Vitality	.14	.18	.15	.445

Note. $R_2 = .078$

The results provide insight into each SWB-components' relationship NC, among university students, post-nature exposure. Neither 'Satisfaction with Life', 'PA', 'NA' or 'Vitality' were not found to significantly predict NC.

Regression comparison

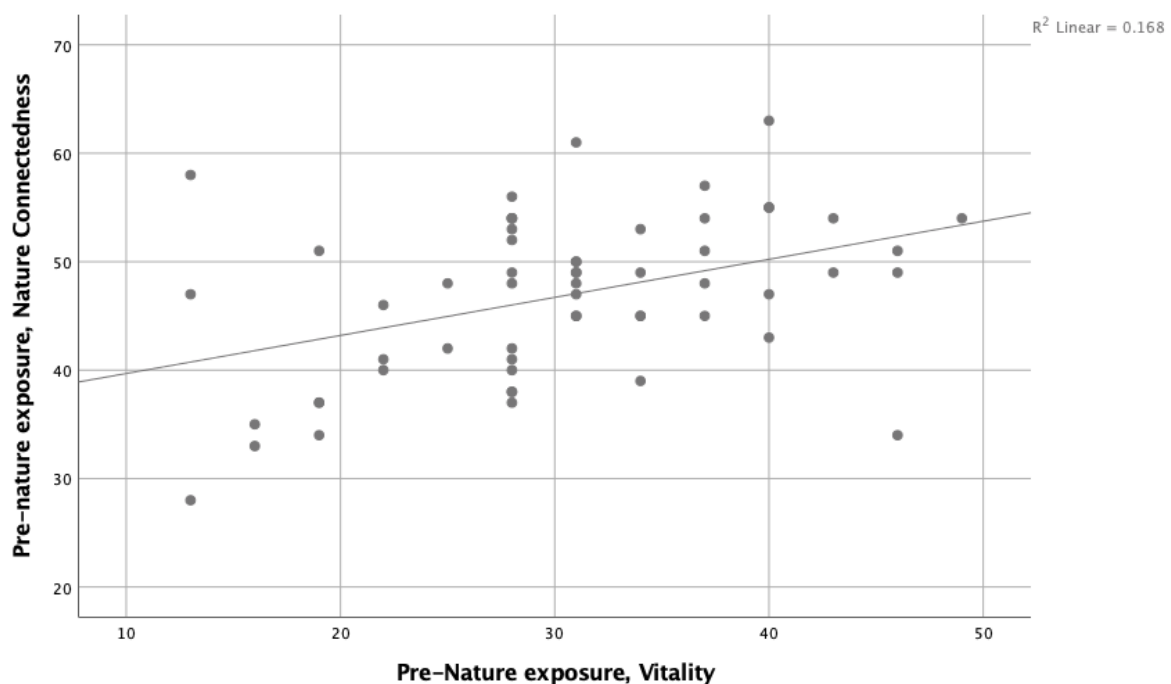
When comparing the results of the post- and pre-nature exposure multiple regressions, SWB measure predicted 10.5% of the variance in NC scores, pre-nature exposure. Whereas, post-nature exposure, SWB measures only predicted 0.8% of the variance of NC scores.

Simple linear regression

The multiple regression results warranted more specific investigation of the relationship between Vitality and NC. Parametric assumptions of linearity, normality, homoscedasticity (**Figure 5 and 6**), and multicollinearity (pre-nature exposure, Tolerance = 1, VIF = 1; post-nature exposure, Tolerance = 1, VIF = 1) were met. Two simple linear regressions were utilised to predict NC based on Vitality scores, for both pre- and post-nature exposure conditions.

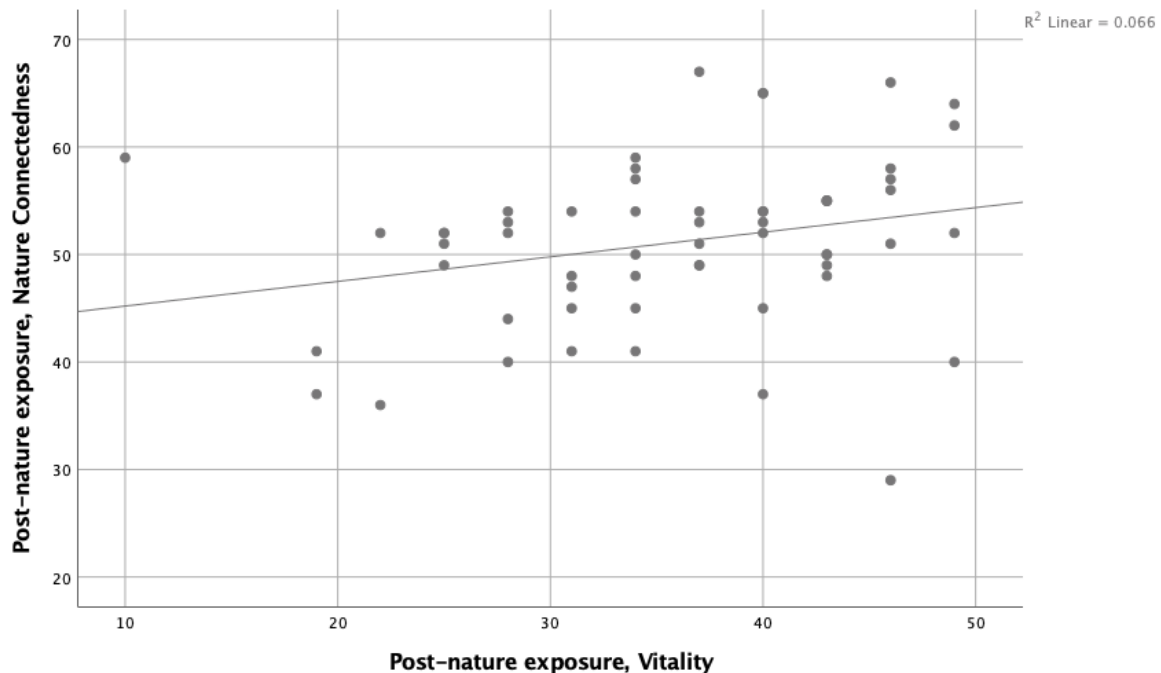
The results of the first regression, shown in **Figure 5**, indicated that the pre-nature exposure model explained 15.3% of the variance ($R_2 = .168$, $R = .409$, $R_2adj = .153$), and that the model was significant, ($F(1,56) = 11.3$, $p = .001$). It was found that, pre-nature exposure, Vitality significantly predicted NC ($\beta = .41$, $t(56) = 3.36$, $p = .001$).

Figure 5. Scatterplot with regression line showing significant positive relationship between NC and Vitality, pre-nature exposure.



A weaker, (arguably) significant model, shown in **Figure 6**, emerged post-nature exposure. The model explained 4.9% of the variance ($R_2 = .066$, $R = .257$, $R_2adj = .049$), and that the model was 'marginally' significant, ($F(1,56) = 3.95$, $p = .052$). It was found that, post-nature exposure Vitality 'marginally' significantly predicted NC ($\beta = .26$, $t(56) = 1.99$, $p = .052$).

Figure 6. Scatterplot with regression line showing ‘marginally’ significant positive relationship between NC and Vitality, post-nature exposure.



Paired-Sample *t*-test analysis

As data met parametric assumptions, paired-sample *t*-tests were conducted on each measure, pre- and post-nature exposure. Using Cohen's (1988) proposed Effect-sizes this analysis displays nature-exposure's effect on the variables. NC scores increased after 'nature-exposure' ($M = 46.84$ pre-nature exposure, and $M = 51.10$ post-nature exposure), this difference between conditions was significant and Effect-size was moderate ($t = 4.49$, $df = 57$, $p < .001$, $d = .56$).

Results of the Paired-Sample *t*-tests also found all variable scores, except for NA, to have significantly increased after 'nature-exposure'; Satisfaction with Life scores ($M = 22.50$ pre-nature exposure, and $M = 24.91$ post-nature exposure) had a small Effect-size ($t = 3.86$, $df = 57$, $p < .001$, $d = .39$), PA scores ($M = 15.72$ pre-nature exposure, and $M = 16.98$ post-nature exposure) also had a small Effect-size ($t = 3.31$, $df = 57$, $p < .001$, $d = .32$), and Vitality scores ($M = 30.38$ pre-nature exposure, and $M = 35.76$ post-nature exposure) were found to have a moderate Effect-size ($t = 5.90$, $df = 57$, $p < .001$, $d = .62$). NA scores were found to have significantly decreased after 'nature-exposure' ($M = 9.84$ pre-nature exposure, and $M = 8.72$ post-nature exposure), this Effect-size was moderate ($t = 3.48$, $df = 57$, $p = .001$, $d = .56$).

Discussion

Findings

The present study investigated the relationships between nature-exposure, NC and the three components of SWB; Evaluative-, Eudemonic- and Hedonic-SWB (Diener et al, 2009).

Correlation analysis on pre-nature exposure measures found strong significance between Eudemonic-SWB and NC whilst Evaluative-SWB also significantly correlated with NC. Post-nature exposure, Eudemonic-SWB and the

'positive-affect' aspect of Hedonic-SWB both significantly correlated with SWB. These correlations add to the plethora of inconsistent evidence for associations between NC and SWB-components, but the results do support the notion that Eudemonic-SWB is most associated with NC (Howell et al., 2014; Capaldi et al., 2014; Nisbet et al., 2011). Therefore, these results allow for H1 to be accepted.

Consistent with mixed literature findings (Howell et al., 2011), Hedonic-SWB did not correlate with NC before nature-exposure (Nisbet et al., 2011; Mayer et al., 2009) whilst Evaluative-SWB did not correlate post-nature exposure (Leary et al., 2008; Mayer and Frantz, 2004), therefore the H2 and H3 are rejected and their null hypotheses accepted.

Although differing associations were found between pre- and post-nature exposure conditions, some significant evidence remains for links between all measures of SWB and NC, as each measure significantly correlated with NC in at least one of the conditions, supporting Capaldi et al. (2014) and Howell et al. (2014) and emphasising the need for larger-scale research.

Subsequently, these correlational findings indicate possible relationships between the variables. It is noteworthy that the SWB scales significantly correlated, as expected, since they measure individual components of the same construct (Diener et al., 2009).

When investigating the effects of nature-exposure on the SWB measures using Paired-Sample *t*-tests, Eudemonic-SWB was found to moderately increase, consistent with findings of Ryan et al. (2010). Additionally, the NA subcomponent of Hedonic-SWB moderately decreased and its PA subcomponent was found to increase with small effect. This is also consistent with previous finding such as Nisbet et al. (2011) and Grinde & Patil (2009), i.e. nature-exposure promotes positive mood/affect and decreases negative mood/affect. Though a small effect, life-satisfaction also increased after nature-exposure. Therefore, we can accept H4 as nature-exposure positively affected all SWB measures, and NC increased with moderate effect.

This positive effect of nature-exposure on all aspects of SWB is valuable support for the notion that nature experiences promote SWB and psychological health. Universities should take these results on board in order to combat the increasing prevalence of poor MH, depression and anxiety disorders reported within student-populations (Ibrahim et al., 2013; Unihealth, 2017; Thorley, 2017). If these results cause effective change in university systems, we should also hope to see benefits of a reduction of stress, increased attention, focus and concentration of students whilst attaining their degrees (Chang & Chen, 2005; Kaplan & Kaplan 1898; Ohly et al., 2016).

When interpreting the present study's findings, we can conclude that NC was state induced as nature-exposure led to a moderate positive effect of NC. This supports Mayer et al. (2009) and Weinstein et al. (2009) and implies promotion of state-level NC through nature exposure.

Multiple regression analysis investigating relationships between pre-nature exposure of SWB measures and NC found an overall significant model but only 'vitality', a measure of Eudemonic-SWB, to significantly predict NC. The strength of these relationships dramatically weakened post-nature exposure, as this second multiple regression found an insignificant model and none of the SWB variables were shown to significantly predict NC after the nature-exposure event. These results

present, that although some SWB-components correlate with NC, no SWB measures predicted NC. Consequently, H5 and H6 is rejected.

The weakened relationship between Eudemonic-SWB and NC after nature-exposure inspired further investigation, due to its pre-nature exposure significance, correlational significance and the moderate effect of nature-exposure on both Eudemonic-SWB and NC. Thus, a simple linear regression was conducted between Eudemonic-SWB and NC, both pre- and post-nature exposure, finding Eudemonic-SWB to significantly predict NC in both conditions. Although, post-nature significance is arguable due the 'marginal significance' debate in statistics literature (Pritschet et al., 2016). This is later addressed as criticism.

Practical implications

These findings can be practically utilised by Universities in order to tackle the student MH epidemic in the UK.

Implications would suggest utilising Kellert et al.'s (2017) elements to inform measures to combat student-nature disconnect, increase NC and consequently promote positive SWB. Firstly, since most universities are in urban locations, such Universities could include more 'urban green-spaces' and natural-components into campus development. Although manmade, these types of environment have been found to promote adequately similar benefits to SWB and health as the opposing extreme of 'true wilderness' (Grinde & Patil, 2009). Grinde & Patil, (2009) also suggest elements such indoor plants and a view of natural-surroundings can contribute to these benefits, which could be incorporated into university development. Despite the initial expense of this suggestion, benefits to NC and SWB, arguably, outweigh monetary costs.

Secondly, as time, money and attention are stretched resources for students, Universities could fund nature activities for students, in addition to encouraging involvement in societies that operate outdoors, such as those that involve climbing, hiking, picnics, skiing, etc. These methods would attempt to combat the effects of the lack of dependence modern society has on the natural world, by incorporating many natural-elements in to University life (i.e. through environment and behaviour). Complementarily, Universities could block technological distractions, for example websites such as 'YouTube' and 'Facebook' (Smith & Anderson, 2018) from University systems, in the hope students would seek more natural distractions around the campus.

These implementations, combined, would hope to confront Kellert et al.'s final contributor of nature-disconnect, shifting expectations of how much contact with nature individuals should seek. Thus, increasing students personal 'drive' for nature experiences (Dean et al., 2018) by promoting NC and SWB through nature-exposure.

Although most of these methods have preliminary costs, if effective, they could offset the increasing cost of counselling services and MH support that is required of, and underprovided for, by Universities (Thorley, 2017; Zivin et al., 2009). Actual participation of students who would spend time outside and within nature is ultimately free. Therefore, once initially implemented, these strategies will be money saving strategies for both Universities and services that provide MH interventions.

In addition to the direct benefits of nature-exposure on SWB, according to the ATR theory (Kaplan, 1995), strategies of increasing student contact with nature, utilising restorative natural environments, will also positively effect attention, focus and concentration whilst studying, aiding mental exertion and stress (Bratman et al., 2012; Ohly et al., 2016; Chang & Chen, 2005) and promote academic achievement

(Eisenberg et al., 2009). Consequently, this would profit both the students and Universities in their future ambitions.

Criticism & Future Recommendations

A flaw of the present study is the possibility of physical activity contributing to the improvements of SWB, as nature-exposure (being outdoors) often invoke activities involving exercise (Shanahan et al., 2016). Exercise itself has been found to improve mood states, and in the long-term increase SWB (Argyle, 2001; Pasco et al. 2011; Biedenwig et al., 2017). Therefore, the walking pace of participants during the 'nature-exposure' may have effected SWB outcomes. Further studies could aim to differentiate between the effects of physical activity on SWB when participating in nature exposure activities.

Another shortcoming of this study is the lack of control over the 'nature-exposure' walk, in terms of environment and duration, despite previous literature proposing 30-minute duration and differing nature intensities as adequate to reap the benefits of nature-exposure (Shanahan et al., 2016; Grinde & Patil, 2009). Additionally, the weather and season at the time of data collection was not considered. Data collection occurred during winter in the UK, weather conditions may have affected results and were not accounted for. Therefore, lack of consistency between the participants walk in terms of environment may have influenced effect of the nature-exposure on the individual participants NC and SWB. Therefore, control of conditions and nature intensities of the 'nature exposure' environment would be beneficial to overcome present shortcomings.

Comparisons of SWB benefits from different environmental nature intensities could be of interest, especially those investigating factors that could maximise the benefits of 'urban green-spaces', since most Universities are located within urban cities (The Guardian, 2019). Similarly, prospective research could compare the results of students enrolled at urban vs rural universities, significant results of this investigation could stimulate universities to consider migration to more rural whereabouts in the hopes of benefitting their students SWB, NC, mental and physical health.

As the sample size was unable to meet Green's (1991) rule-of-thumb, despite acceptance according to Roscoe (1975). This may have undermined the internal and external validity of the study (Faber & Fonseca, 2014) and contributed to the 'marginally significant' p -value. The acceptance of marginal significance is itself a criticism of the study as it contradicts Neyman & Pearson's (1933) widely adopted $<.05$ p -value significance level, despite being widely used in psychological literature (Pritschet et al., 2016). Therefore, future research is required with greater sample power to investigate the relationships between SWB and NC, in order to improve validity and reliability of findings (Simmons et al., 2011). Focus on Eudemonic-SWB as a predictor of NC would be most interesting considering the uncertainty within present study's findings. A wider sample would also increase generalisability as participants were all enrolled at MMU, within an urban city.

Finally, Investigating the diverse sensory stimuli of nature environments that most influence the degree to which SWB and NC are positively affected, i.e. visual stimuli, natural aromas, etc. (Howell & Passmore, 2013) would enhance the research base and could be practically implicated into University developments.

Conclusions

The results from the present study, although statistically arguable, suggest that Eudemonic-SWB predicts NC. Therefore, if Eudemonic-SWB increases it can be predicted that NC would improve also. Stronger evidence for this would benefit our understanding, thus further research is needed to investigate this relationship.

Nature-exposure promoted significant positive effect on Eudemonic-, Hedonic- and Evaluative-SWB and NC. Greater NC increases the likelihood of an individual participating in nature-exposure activities (Dean et al., 2018), participation in experiences with nature is likely to encourage further nature seeking behaviour, such as the effects of heightened NC such as that demonstrated in this study. This promotion of nature-exposure contributes positive effect on an individual's SWB, with likely additional benefits to student MH and academic achievement (Dolan et al., 2008; Bratman et al., 2012; Eisenberg et al., 2009).

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