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SPECIAL ISSUE: NATURE AND HEALTH

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Exploring Nature- and Social-Connectedness as Mediators of the Relationship Between Nature-Based Exercise and Subjective Wellbeing

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AU3 Abstract

EQ1 **Background and Objectives:** *Underlying mechanisms behind the benefits of nature-based exercise (NBE) for subjective wellbeing (SWB) remain largely unknown. Nature- and social-connectedness may be the factors that contribute to better subjective wellbeing. This study explores whether nature connectedness and social connectedness mediate the relationship between NBE and SWB. Method: Participants (N = 359 Australian citizens; Female = 229 (63.8%); M_{age} = 40.15, SD = 16.23) recruited through social media responded to an online survey focused on NBE, SWB, social connectiveness, and nature connectedness. Results: Correlations revealed positive associations between variables. The relationship between NBE and SWB was significantly serially mediated by nature connectedness and social connectedness. Yet, at an individual level, social connectedness mediated the relationship, but nature connectedness was not significant. Conclusion: It is important that researchers better understand potential mechanisms associated with increased perception of happiness and life satisfaction through nature. Individuals who exercise in nature, with stronger connections to nature, perceive a stronger bond to the social world, and are more likely to have greater wellbeing. The importance of social connectedness identified further supports that more research is needed to better understand the role of connection to humanity regarding exercise in nature. Key Words:*

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Nature-based exercise—Ecological dynamic perspective—Subjective wellbeing—Nature connectedness—Social connectedness.

Introduction

On average, life satisfaction and wellbeing of Australians have been declining since 2003 (Ambrey & Fleming, 2014), and as a result, researchers have attempted to better understand the benefits therapeutic lifestyle changes can provide to an individual's subjective wellbeing (SWB) (Phulkerd, Thapsuwan, Chamrathirong, & Gray, 2021). Recently, the World Health Organization (2021) reported that exposure to blue (i.e., presence of water) and/or green (i.e., presence of grass and green foliage) environments not only increases wellbeing, but also aids the recovery from psychological or stressful events (Kolokotsa, Lilli, Lilli, & Nikolaidis, 2020).

Specifically, nature enables a vast array of activities that may encourage one to interact with natural environments in a personalized and especial manner, individually or with those around them, which helps facilitate improved SWB (Araújo, Brymer, Withagen, Brito, & Davids, 2019; Yeh et al., 2016). As SWB encompasses both life satisfaction and happiness (Diener, 1984), and is often used to measure of how individuals evaluate their own lives (Diener, Pressman, Hunter, & Delgado-Gil, 2017), more research is needed to better understand the role of nature and why it influences wellbeing (Yeh et al., 2016).

The benefits of engaging with nature

Nature provides individuals with a greater incentive to momentarily escape their busy lives, allowing them to harness the benefits of

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the natural environment and relieve work-related stress (Berto, 2014). It is well accepted that engaging with nature can result in numerous physical (e.g., lower blood pressure), psychological (e.g., reduced stress), and social (e.g., increased social connectedness) health benefits (Frumkin et al., 2017). Underpinning much of this work are numerous evolutionary and psychological restoration frameworks that explain the benefits of performing nature-based exercise (NBE), that is performing exercise in green, blue, and other natural environments (Calogiuri & Elliott, 2017), on SWB.

For example, stress reduction theory (Ulrich, 1984) suggests that the natural environment can reduce psychological and physiological stress responses and enhance functioning. Along a similar vein, attention restoration theory (Kaplan & Kaplan, 1989) proposes that nature can restore our focus and ability to concentrate. Individuals who exercise in nature may experience these benefits when exposed to various environmental stimuli that may alleviate stress and or improve attention, in addition to the associated benefits of performing exercise. A slightly different perspective on the benefits of engaging with nature is posited by the biophilia hypothesis, which suggests that individuals are genetically predisposed to engage with nature due to an innate drive to seek out life (Wilson, 1984).

On this basis, our long-term survival is ensured by adapting to particular environmental conditions (Araújo et al., 2019). Yet, these theories have drawn criticism regarding their narrow scope pertaining to human interaction with nature; humans are not exclusively drawn to nature when we are stressed or need to restore our attention (Brymer & Schweitzer, 2017). Equally, our unique individual experiences with nature shape subsequent encounters and, whether these are beneficial for our existence or not, it is difficult to generalize to a population level (Araújo et al., 2019). Therefore, a more holistic perspective of the human–nature relationship is required to frame investigations related to exercising in nature.

The ecological dynamic perspective (Brymer & Davids, 2014; Davids, Araujo, & Brymer, 2016) is one such approach; theorists posit that human–nature interaction contributes to individuals actively utilizing affordances that emerge from direct interactions with the natural environment to help facilitate beneficial outcomes (Yeh et al., 2016). In this context, affordances refer to opportunities where aspects of the environments provide reference to the functional capabilities of the individual to deliberately select and utilize the option that benefits them in the current option (Araújo et al., 2019).

As the opportunity for action is self-initiated, engaging with affordances when in nature is determined by the individual's capabilities and the opportunities for action within the environment/task. Ecological dynamic perspective theorists acknowledge that

individuals are not passive receivers of stimuli that subsequently produce a reactive response; rather humans are inherently active organisms, scanning the ambient energy patterns, and continually adjusting their goal-directed behaviors to cope with, or devise, changes in the environment (Araújo et al., 2019). This view emphasizes that one situation (e.g., a puddle on a nature trail) may elicit different behaviors and outcomes between individuals (e.g., jump over it, walk/roll around it, stop and take a picture).

NBE has been recommended as an activity to promote wellbeing (Brymer, Cuddihy, & Sharma-Brymer, 2010). Although engaging in exercise in general has been evidenced to foster positive wellbeing (Penedo & Dahn, 2005), NBE provides readily accessible unique locations that may contribute to greater wellbeing, compared with urban or manufactured settings (Araújo et al., 2019). The presence of accessible nature also encourages individuals to participate in exercise (Sandifer, Sutton-Grier, & Ward, 2015), and that people who engage in higher levels of physical activity also tend to visit natural spaces more frequently and for longer durations (Shanahan, Franco, Lin, Gaston, & Fuller, 2016).

Initial research investigating NBE interventions has revealed many health benefits, including enhanced wellbeing and reduced levels of anxiety and depression (Martyn & Brymer, 2016; Ryan et al., 2010). Critically, these benefits are evident beyond individuals merely contemplating nature; interacting with the natural environment when performing exercise appears to have an additive impact on wellbeing (Shanahan et al., 2016). Yet, further research is needed to better understand the factors that may influence the relationship between NBE and wellbeing (Shanahan et al., 2016; Twohig-Bennett & Jones, 2018).

Factors mediating the relationship between NBE and SWB

Considering that the ecological dynamic perspective enables a holistic account of human–nature interactions, two such factors that may influence the relationship between NBE and improved SWB are nature connectedness and social connectedness. Nature connectedness is underpinned by a sense of belonging, embeddedness, and connection to nature (Mayer & Frantz, 2004), such that participating in nature-based activities (e.g., hiking, skiing, cross-country, and canoeing) elicited feelings of greater connection with the natural environment (Wolsko, Lindberg, & Reese, 2019). Higher levels of connection with nature have also been consistently associated with better SWB (Howell, Dopko, Passmore, & Buro, 2011).

More broadly, nature connectedness was positively associated with subjective, psychological, social, and cognitive wellbeing (Cervinka, Röderer, & Hefler, 2011; Howell et al., 2011; Mayer &

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Frantz, 2004). Furthermore, Lawton, Brymer, Clough, & Denovan (2017) identified that both physical activity in nature and nature connectedness had a positive impact on participants' wellbeing. Given that connection with nature appears related to the notion of happiness (Capaldi, Dopko, & Zelenski, 2014), it is likely that the wellbeing of individuals who exercise in nature is partially predicated by feeling connected with nature (Loureiro & Veloso, 2014).

Individuals who participate in NBE are also more likely to spend greater time interacting with others compared with those who exercise indoors (Rogerson Gladwell, Gallagher, & Barton, 2016). For example, feelings of social connectedness (i.e., a subjective awareness of being in close relationship with the social world; Lee & Robbins, 1998), are facilitated by nature connectedness (Moreton Arena, & Tiliopoulos, 2019) such that our experience with nature affords us greater sense of social connectedness (Passmore & Howell, 2014). These interactions with nature also increase social cohesion, pro-social behavior, and orientation toward others (Goldy & Piff, 2020). Building on this work, individuals who are more attuned to nature may be inspired by its perception of beauty and increase the feeling of oneness with others (Shiota Keltner, & Mossman, 2007).

For example, a recent study that categorized participants' nature connectedness to low, moderate, and high levels of social connectedness found that nature connectedness was positively associated with social connectedness regardless of assigned categorization levels (Moreton et al., 2019). This potentially supports the view that connection to nature may be acting to reduce the feeling of social disconnectedness (Poon, Teng, Wong, & Chen, 2016), such that environmental and social influences overlap in relation to their effect of wellbeing (Cartwright, White, & Clithrow, 2018). These studies imply that connectedness in one domain may elicit feelings of connectedness in another. Specifically, NBE exposes individuals to the natural environment, which in turn may afford the experiential feeling of oneness (with nature) (Mayer & Frantz, 2004; Yeh et al., 2016). In short, connection with nature reduces the shortcomings in social connectedness (Poon et al., 2016) and improves wellbeing.

The present study

Based on the reviewed literature, there are strong associations between NBE and nature connectedness (Loureiro & Veloso, 2014), and nature connectedness and social connectedness (Moreton et al., 2019). Independently, NBE, nature connectedness, and social connectedness are all positively correlated to SWB (Cartwright et al., 2018; Howell et al., 2011; Passmore & Howell, 2014). NBE and social connectedness remain largely unexplored in the literature (Rogerson

et al., 2016), but exposure studies suggest an existence of a possible relationship.

For example, an exploration of social connectedness within exposure to nature and wellbeing revealed that both greater social connectedness and nature exposure were predictive of greater SWB (Cartwright et al., 2018). Moreover, proximity to nature moderated the relationship between social connectedness and wellbeing. Notably, nature exposure did not increase participants' social connectedness but rather reduced the negative impacts of low social connectedness, thereby emphasizing the role of both exposure to nature and being connected to humanity in predicting wellbeing.

According to the ecological dynamic perspective, the benefits of exercising in nature operates beyond a restoration framework such that different affordances offered during NBE provide the individual an opportunity to enhance their SWB. As individuals' experiences of both nature and social connection influence overall wellbeing (Cartwright et al., 2018; Mayer, Frantz, Bruehlman-Senechal, & Dooliver, 2009), it is important to understand the individual contribution these variables provide to the NBE and SWB relationship. To our current knowledge, no previous research has investigated the combined effect of nature connectedness and social connectedness as a serial mediation on the relationship between NBE and SWB.

However, in the absence of such empirical work, the notion that humans first develop their connection with nature before then developing a sense of connection with their social world is supported by the biophilia hypothesis (i.e., our evolutionary drive ensures our survival in the environment) thereby providing justification for testing nature connectedness before social connectedness in the serial mediation. Accordingly, we sought to address the question: does nature connectedness and social connectedness mediate the relationship between NBE and SWB?

In aiming to investigate whether the relationship between NBE and SWB is mediated by nature connectedness and social connectedness, it is initially hypothesized that NBE will be positively associated with SWB. Based on theoretical assumptions, it is hypothesized that nature connectedness and social connectedness would serially mediate the relationship between NBE and SWB. As part of the serial mediation analysis, we also wanted to confirm the contribution of the nature- and social-connectedness individually. Based on research by Lawton et al. (2017), it is hypothesized that there would be an indirect path from NBE to SWB through nature connectedness. It is also hypothesized that there would be an indirect path from NBE to SWB through social connectedness, based on the findings of Rogerson et al. (2016) and Cartwright et al. (2018).

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Method

Participants

A total of 636 participants commenced the survey, of which 227 did not complete the entire survey and were removed due to incomplete data. The final data set consisted of 359 participants (60% response rate), which included 229 females (63.8%) and 129 males (35.9%). One participant's gender data were missing. The mean age was 40.15 years ($SD = 16.23$), with ages ranging from 18 to 80 years. On average, the sample reported participating in 4.97 h ($SD = 2.78$) of NBE per week.

The most common categories of activity included general aerobic exercise ($n = 58$, 16.7%), weight training ($n = 42$, 12.6%), running ($n = 39$, 11.7%), walking ($n = 25$, 7.5%), and competitive sport ($n = 22$, 6.6%). When asked whether participants exercised with any others, 16.5% preferred the company of their partner/spouse ($n = 59$), 10.0% preferred their friends ($n = 36$), 2.8% preferred a club or training squad ($n = 10$), 2.4% preferred other family members ($n = 9$), 0.2% preferred a nonspecified other individual ($n = 1$), and 68.1% preferred to exercise alone ($n = 244$).

Measures

Participants completed a brief demographics questionnaire in which they provided their age and gender, followed by the average amount of time (i.e., hours) spent exercising in nature each week. Participants then completed the following psychometrically validated measures.

Nature relatedness scale. The Nature Relatedness Scale (NRS) is a 21-item self-report scale, with participants indicate their agreement to each statement on a 5-point Likert response ranging from 1 (disagree strongly) to 5 (agree strongly) (Nisbet, Zelenski, & Murphy, 2009). A person's nature connectedness score is calculated by averaging the total score of all items with higher scores indicating higher levels of connectedness to nature. An example of an item from the scale is "I always think about how my actions affect the environment." The items in NRS combine to provide a reliable assessment of individuals differences in nature connectedness (Nisbet et al., 2008), and the Cronbach's alpha for this study was 0.93, indicating excellent internal consistency.

Social connectedness scale-revised. The Social Connectedness Scale-Revised (SCS-R) is a 20-item self-report scale in which participants are asked to report how much they agree or disagree with each statement on a 6-point Likert response format ranging from 1 (strongly disagree) to 6 (strongly agree) (Lee, Draper, & Lee, 2001).

Example items are "I feel connected with other people" and "I feel close to people." Total score of an individual is calculated by summing the scores for each of the 20 items with higher scores indicating higher levels of social connectedness. SCS-R has previously demonstrated good internal reliability and is more normally distributed compared with the original scale (Lee et al., 2001). Cronbach's alpha for this study was 0.74, indicating good internal consistency.

The World Health Organization: five wellbeing index. The World Health Organization—five (WHO-5) Wellbeing Index is a self-reported measure in which participants indicated for each of the five statements how they have been feeling for the past 2 weeks (Topp Østergaard, Søndergaard, & Bech, 2015). Each response is rated on a 6-point Likert format ranging from 1 (at no time) to 5 (all the time). Statements such as "I felt cheerful and in good spirits" tap into participants' satisfaction with life and positive affect. The score is calculated by totaling the figures from the five answers. A score of 0 represents worst possible quality of life and 25 represents best possible quality of life. A score <13 indicates poor wellbeing and is an indication for further psychological assessment. WHO-5 has been used globally to investigate SWB since 1998, and is one of the most reliable scales to screen for wellbeing (Topp et al., 2015). Cronbach's alpha for this study was 0.85, indicating excellent internal consistency.

Procedure

This study was undertaken following ethics approval from the Human Research Ethics committee (HEAG-H 38_2021) at the authors' institution. Participants were recruited through convenience sampling predominantly through social media platforms such as Facebook, Instagram, and Twitter, with the advertisements linking participants to the online survey platform (Qualtrics). Participants were initially provided with an overview of the study, and then provided implied consent to proceed to the survey. Participants were presented with a number of demographic questions, including questions regarding NBE. Participants were presented with the NR, SCS-R, WHO-5. At the conclusion of the study, participants were thanked and provided an opportunity to win one of four e-gift card voucher worth \$50.

Statistical analysis

All study data analysis was conducted using SPSS Version 28. Pearson's correlation coefficient was initially used to assess the relationship between variables. In subsequence, serial mediation analysis was performed using model number six of Hayes' PROCESS

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macro (Hayes, 2012). The model was examined using 10,000 bootstrapped samples as recommended by Hayes (2012).

In the hypothesized model, hours spent exercising in nature was entered as the independent variable, SWB was entered as the dependent variable. Exercising in nature has been associated with increased connection with nature, and subsequently with reduced negative effects of social isolation (Cartwright et al., 2018; Poon et al., 2016). Therefore, nature connectedness was entered as the first mediator (*M1*) and social connectedness was entered as the second mediator (*M2*). According to the hypothesized serial mediation model there are four possible pathways that can be examined: (a) the direct pathway from NBE to SWB, (b) the indirect pathway through nature connectedness, (c) the indirect pathway through social connectedness, and (d) the indirect pathway through nature connectedness (*M1*) and social connectedness (*M2*) sequentially.

Results

Descriptive statistics and correlational statistics

Assumption testing indicated normal distribution across variables. Preliminary descriptive statistics and correlational analysis conducted are presented in Table 1. Nature-based physical activity was positively correlated with SWB, as well as the nature connectedness and social connectedness variables. Nature connectedness and social connectedness was also positively correlated with SWB.

Mediation analysis. The overall model examining the total association between NBE and SWB was statistically significant ($R^2 = 0.04$, $F(1, 357) = 10.12$, $p < 0.01$). When nature- and social-connectedness were entered into the model, the model remained statistically significant ($R^2 = 0.14.1$, $F(3, 355) = 20.54$, $p < 0.01$). Specifically, NBE significantly predicted nature connectedness ($b = 0.30$, $SE = 0.01$, $p < 0.01$), nature connectedness significantly predicted social con-

nectedness ($b = 0.12$, $SE = 0.06$, $p < 0.05$), and social connectedness significantly predicted SWB ($b = 0.32$, $SE = 0.35$, $p < 0.01$). In terms of the R^2 change, the variance in SWB explained by NBE when no mediators are in the model was $\approx 4\%$ and increased to $\approx 14\%$ when both nature- and social-connectedness were included in the model.

The path coefficients of the mediation analyses with NBE entered as the independent variable, nature connectedness and social connectedness as the serial mediators, and SWB as the dependent variable is represented in Figure 1. The analysis revealed a significant serial mediation between NBE and SWB through increased nature connectedness and social connectedness.

The contribution of nature connectedness and social connectedness as individual mediators illustrated different outcomes (as outlined in Table 2). Insignificant indirect effects was observed between NBE and SWB when nature connectedness was included as a sole mediator, $b = 0.03$, $SE = 0.03$, 95% CI = -0.02 to 0.05, $b = 0.01$. However, when exploring social connectedness as an individual mediator, there was a statistically significant path as an indirect effect on the relationship between NBE and SWB, $b = 0.07$, $SE = 0.03$, 95% CI = 0.01–0.14, $b = 0.04$.

Discussion

This study is, to our knowledge, the first to examine the serial mediating roles of nature- and social-connectedness in the association between time spent exercising in nature and SWB. The study is important as the current findings confirm that individuals who engage with exercise in nature are more likely to have a better connection with the natural environment, which in turn is associated with higher levels of social connectedness and ultimately greater levels of SWB.

In total, of the four predictions made, three were supported. First, as expected, we found that NBE showed a significant positive relationship with SWB. This study supports that NBE has a direct benefit on SWB, in

Table 1. Descriptive Statistics and Correlations Between Nature-Based Exercise, Nature Connectedness, Social Connectedness, and Subjective Wellbeing

| | <i>M</i> | <i>SD</i> | 1 | 2 | 3 | 4 |
|--------------------------|----------|-----------|--------|--------|--------|---|
| 1. Nature-based exercise | 4.97 | 2.78 | – | | | |
| 2. Nature connectedness | 3.87 | 0.61 | 0.31** | – | | |
| 3. Social connectedness | 4.44 | 0.72 | 0.16** | 0.16** | – | |
| 4. Subjective wellbeing | 14.23 | 4.91 | 0.19** | 0.14** | 0.35** | – |

** $p < 0.01$.

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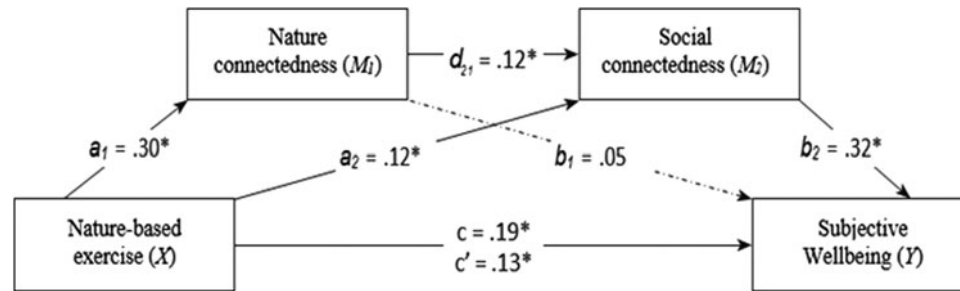


Fig. 1. Mediated model. Serial mediation of nature- and social-connectedness in the association between nature-based exercise and subjective wellbeing with standardized b values. Bold paths represent significant pathways ($*p < 0.05$).

line with previous research illustrating that exercising in nature is effective in inducing positive affect and feelings of elevation (Passmore & Howell, 2014). Benefits of NBE potentially illustrate a critical role in reducing levels of anxiety from stress-inducing events (Ryan et al., 2010), where the increases in life satisfaction occur due to the reduction in stress (Rogerson et al., 2020). Thus, supporting NBE theories that emphasize the benefit nature to improve individual’s satisfaction with life.

The central contribution of this study is the finding that the relationship between NBE and SWB is partially explained by both

nature connectedness and social connectedness, sequentially. In this sequence, exercising in nature was indicative of greater connectedness to nature, which was associated with enhanced connectedness to humanity, and that this contribution linked to develop SWB. Our serial mediation findings build upon existing theoretical foundations that suggest individuals possess an innate drive to connect with life and ensure our survival (i.e., the biophilia hypotheses; Wilson, 1984) before looking to connect with the social world.

Furthermore, the findings align with previous empirical research that has revealed two main avenues through which nature connectedness

Table 2. Bootstrapping Coefficients for the Hypothesized Model

| PATH | EFFECT (b) | BOOT LLCI | BOOT ULCI | SE | T | P |
|---|-------------|-----------|-----------|------|------|-------|
| Total effect (c) | 0.34 (0.19) | 0.13 | 0.55 | 0.12 | 3.18 | <0.01 |
| Direct effect (c') | 0.23 (0.13) | 0.02 | 0.44 | 0.12 | 2.12 | <0.05 |
| a_1 | 0.07 (0.30) | 0.04 | 0.09 | 0.01 | 5.88 | <0.01 |
| a_2 | 0.03 (0.12) | 0.003 | 0.06 | 0.01 | 2.20 | <0.05 |
| b_1 | 0.37 (0.05) | -0.47 | 1.22 | 0.43 | 0.39 | >0.05 |
| b_2 | 2.18 (0.32) | 1.50 | 2.85 | 0.35 | 6.30 | <0.01 |
| d_{21} | 0.14 (0.12) | 0.02 | 0.27 | 0.06 | 2.28 | <0.05 |
| Total indirect effect | 0.11 (0.06) | 0.05 | 0.21 | 0.05 | | |
| $X \diagdown M1 \diagup Y$ | 0.01 (0.01) | -0.03 | 0.08 | 0.03 | | |
| $X \diagdown M2 \diagup Y$ | 0.07 (0.04) | 0.01 | 0.14 | 0.03 | | |
| $X \diagdown M1 \diagdown M2 \diagup Y$ | 0.02 (0.01) | 0.002 | 0.05 | 0.01 | | |

X = nature-based exercise; M1 = nature connectedness; M2 = social connectedness; Y = subjective wellbeing.

LLCI, lower limit confidence interval; ULCI, upper limit confidence interval.

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influenced social connectedness. First, increases in nature connectedness allow individuals to feel inspired by its beauty, which lead to growth in pro-social behavior, social cohesion, and oneness with others (Goldy & Piff, 2020; Shiota et al., 2007). Second, connection with nature may be compensating for the shortcomings of the individual's connection with others (Moreton et al., 2019), such that the feeling of oneness with nature reduces the feelings associated with social isolation, thereby improving SWB (Mayer & Frantz, 2009; Moreton et al., 2019).

As a single mediating variable, social connectedness was significant in explaining the relationship between NBE and SWB. As such, this study suggests that individuals who exercise in nature are more likely to have higher levels of social connectedness, which in turn is associated with greater levels of SWB. In short, our findings illustrate that individuals who engage with exercise in nature are more likely to have a better connection with the natural environment, which in turn is associated with a greater perception of being more connected with the social world, and ultimately greater levels of SWB (i.e., life satisfaction and positive affect). This finding is congruent with the notion that exposure to nature may buffer the negative effects of social isolation and, therefore, enhancing wellbeing (Cartwright et al., 2018). Furthermore, nature exposure assists with increasing social cohesion among peers (Goldy & Piff, 2020), with NBE activities such as hiking, canoeing, and skiing thought to create social bonds and connections (Wolsko et al., 2019).

Contrary to previous research that has reported nature connectedness is linked to higher levels of SWB (Howell et al., 2011; Lawton et al., 2017), we found that nature connectedness did not significantly mediate the relationship between SWB and NBE. Although NBE was associated with higher levels of nature connectedness, connectedness to nature was not significant in influencing wellbeing. Thus, the results indicate that nature connectedness is not significant in explaining the influence of NBE without the presence of social connectedness.

One explanation for the inconsistent finding is that previous research focused on physical activities rather than specifically exercise in nature (Lawton et al., 2017, Wolsko et al., 2019). Physical activities such as fishing, horse riding, and hiking may improve SWB by allowing individuals to pay attention to surrounding environment and appreciate their own connection with nature. In contrast, individuals exercising in nature may not have the capacity to attend to their surrounding environment as more emphasis is placed on performing the activity.

These results have important theoretical implications for understanding how nature may facilitate improved SWB. For example, the positive relationship between NBE and SWB supports the notion that exposure to nature influences wellbeing, potentially by reducing the

levels of fatigue, stress, or renewing attentional focus, which allows individuals exercising in nature to feel more satisfied and happier (Kaplan & Kaplan, 1989; Ulrich, 1984). However, humans are not exclusively drawn to nature when we are stressed or need to restore our attention (Brymer & Schweitzer, 2017). More holistic accounts of human–nature interactions emphasize that it is important to understand additional psychological factors that may improve subject wellbeing. Nature connectedness and social connectedness provide an indirect effect illustrates a holistic view that perceived affordances contribute to beneficial SWB.

Our findings lend support toward an ecological dynamic perspective framework. For example, our findings highlight that those individuals who exercise in nature and possess a stronger connection to nature may also perceive a stronger bond to the social world, and these factors contribute to having greater wellbeing. Fundamentally if two individuals were to present with identical levels of social isolation, the individual with greater levels of participation in NBE would be less likely to report the negative effects due to the compensating properties of connection with nature and social settings.

Furthermore, as the opportunity for action is recognized individually, engaging with different affordances offered during NBE could extend the scope of connectedness, either at a micro level with the nature offering important affordances that suit the capabilities and opportunity for the individual, or at a macro-level in where the nature affords better connections within the environment/task. Nevertheless, exercising in nature allows individuals to engaged with the natural environment, providing affordances toward the environment and others, which in turn may have acted in promoting wellbeing (Yeh et al., 2016).

Limitations and future directions

The implication of these findings provides a better understanding of the underlying role of nature connectedness and social connectedness as mechanisms behind the benefits of exercising in nature and how this influences our SWB. However, interpretation of these findings should be considered in respect with the limitations of this study. As this study was collected through self-report measures, the data may be vulnerable to bias (Meltzoff & Cooper, 2018), and cross-sectional data limit the ability to make causal claims regarding our model. Future research would benefit from utilizing an experimental/longitudinal design to investigate whether exercising in nature leads to an improvement in our SWB. Along a similar methodological vein, future studies could be strengthened by substituting self-report measures for a range of different measurements that are less prone to bias (e.g., clinical interviews).

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Another potential limitation of this study was that participants were recruited during a period where the majority of the Australian population was experiencing lockdowns due to the COVID-19 pandemic. Australian lockdowns may have restricted the amount of time individuals could spend exercising each day and prohibited them from visiting certain regions (e.g., national parks). Our survey did not allow participants to indicate whether their exercise routine had been impacted by the pandemic; thus, our independent variable may have been not accurately captured the time people would normally spend exercising in nature.

We found that both nature- and social-connectedness in unison are significant in explaining the relationship between NBE and SWB. However, the results also suggest a strong direct relationship between social connectedness and SWB. Notably, in our study, connection to humanity appears to be a stronger predictor of wellbeing. Furthermore, it appears that without the presence of social connectedness, the effect of nature connectedness would have remained insignificant. Future research is needed to not only further examine the role of social connectedness within the relationship between exercise in nature and wellbeing, but also develop a greater understanding on the relationship between NBE and social connectedness.

Conclusion

In this study, we investigated whether nature connectedness and social connectedness influenced the relationship between NBE and SWB. NBE was positively associated with SWB, and that nature- and social-connectedness serially mediated this relationship. Although social connectedness explained this relationship at an individual level, the insignificant mediating role of nature connectedness may suggest that it insufficiently explains the indirect relationship between NBE and SWB.

Consequently, this study illustrates that psychological variables offer additional affordances during NBE and that variables positively contribute to improved SWB. Specifically, these findings importantly highlight the role of social connectiveness and support the view that NBE offers an opportunity for individuals to spend greater time interacting with others. Future research is needed to better understand psychological factors that influence the NBE and SWB relationship, and also continue investigate the importance of social connectedness in predicting wellbeing, specifically in the context of exercise in nature.

Authors' Contributions

D.G.M., A.S., and T.C. all contributed to the development of the project, data collection and analysis, as well as writing and drafting of the article.

Author Disclosure Statement

No competing financial interests exist.

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