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Developing a Model Linking Self-Reported Nature Exposure and Positive Body Image:
A Study Protocol for the Body Image in Nature Survey (BINS)

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Abstract

Exposure to natural environments has been shown to be associated with more positive body image, but much of the existing research is limited to Western European nations and little is known about the robustness of these associations in other national contexts. In this protocol paper, we present a conceptual model of the direct and indirect associations (i.e., via self-compassion, connectedness to nature, and restorative experiences in nature) between nature exposure and body appreciation. This model brings together conceptualisations from existing research, but also extends it in a number of important ways. The model will be tested through the Body Image in Nature Survey (BINS), a researcher-crowdsourced project involving researchers in multiple nations worldwide. Data collection began in December 2020 and is expected to be completed in February 2022. Data will be analysed to examine the extent to which our conceptual model is robust across nations, as well as other sociodemographic characteristics. We will also determine the extent to which key variables included in our survey are invariant across nations and associated with cultural, socioeconomic, and gender-related factors. The BINS will likely have important implications for the development of nature-based interventions to promote healthier body appreciation in diverse national contexts.

Keywords: Nature exposure; Positive body image; Cross-cultural; Body appreciation; Study protocol

1. Introduction

Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop off like autumn leaves. As age comes on, one source of enjoyment after another is closed, but nature's sources never fail (Muir, 1901, p. 56).

For the first time in human history, a majority of individuals globally live in urban areas (United Nations, 2014), but urban living and increased time spent indoors have been associated with poorer physical and mental health (e.g., Lecic-Tosevski, 2019; Okkels et al., 2017). In the early part of the twentieth century, naturalists and urban planners such as John Muir (1901) and Ebenezer Howard (1902) advocated for closer contact with natural environments as a “cure” for the ills of urban life, with the potential to promote improved health and well-being (Jones, 2018). These suppositions have received extensive support from scholars over the past several decades: a large body of evidence now shows that nature exposure – living close to, frequenting, or even looking at the continuum of environments from wild nature to designed green spaces (Abraham et al., 2010) – provides salutogenic effects on human physical and mental health (for reviews, see Andersen et al., 2021; Collado et al., 2017; Frumkin et al., 2017; Jimenez et al., 2021; Li et al., 2021; Norwood et al., 2019; van den Bosch & Ode Sang, 2018).

As part of this programme of research, scholars have also documented a link between nature exposure and *positive body image*, which refers to an “overarching love and respect for the body” that includes appreciation of the body and its functions, acceptance of the body despite its imperfections, and body-protective behaviours (Tylka, 2018, p. 9). Thus, cross-sectional (Swami, Barron et al., 2016, 2019, 2020; Swami, von Nordheim et al., 2016) and

experience sampling studies (Stieger, Aichinger et al., 2021; see also Stieger, Lewetz et al., 2021) have shown that self-reported nature exposure is significantly associated with multiple indices of positive body image, including body appreciation and functionality appreciation. Likewise, single-arm pre-post studies have shown that spending time in natural environments – including allotments, beaches, and botanic gardens – significantly elevates state body appreciation (Swami, 2020a; Swami, Barron et al., 2018; Swami, Mohd. Khatib et al., 2020). Finally, experimental studies have shown that exposure to both real and simulated (i.e., images or film) natural environments results in elevated state body appreciation (Rygal & Swami, 2021; Swami, 2020b; Swami, Barron et al., 2018; Swami, Pickering et al., 2018).

The direct link between nature exposure and positive body image has primarily been explained by drawing on Attention Restoration Theory (Kaplan, 1995; Kaplan & Kaplan, 1989), which suggests that natural environments have the capacity to restore depleted psychological resources (for a recent review, see Stevenson et al., 2018). More specifically, it has been suggested that “being away” (i.e., being separate and apart from one’s usual thoughts and concerns) in nature helps to restrict negative appearance-related thoughts and supports speedier recovery from threats to body image, thus turning negative body image states into positive ones (Swami, 2020c; Swami, Barron et al., 2018). Natural environments that are “softly fascinating” (i.e., where one’s attention is held without effort) and that promote “extent” (i.e., immersion and engagement) may also play a role in shifting attention away from an aesthetic view of the body toward greater appreciation for the body’s functionality (Swami, Barron et al., 2019). In this “promotion of positive pathway” (Bratman et al., 2021, p. 2), the restorative setting of natural environments – as well as distance from appearance-focused social contexts (including, for example, reduced screen-time) – is thought to facilitate holistic self-care attitudes that include greater respect, appreciation, and love for one’s body (Hennigan, 2010; Swami, 2020c).

However, given that the cross-sectional direct association between nature exposure and positive body image is generally moderate ($r_s \sim .30$; Swami, Barron et al., 2018, 2019), a multiplicity of pathways involving direct and indirect relationships seems likely. One construct that has been found to mediate the relationship between nature exposure and positive body image is *connectedness to nature*, which refers to a sense of oneness with nature (Mayer & Frantz, 2004). More specifically, nature exposure is known to be associated with greater connectedness to natural environments (Mayer et al., 2009). In turn, connectedness to nature may help shift attention away from appearance concerns onto more holistic embodying experiences (Swami, von Nordheim et al., 2016), and may also help promote a worldview of the corporeal self as requiring care within broader ecological systems (Holloway et al., 2014). Consistent with this perspective, several studies have shown that connectedness to nature significantly mediates relationships between self-reported nature exposure and body appreciation (Swami, Barron et al., 2016, 2020).

Another construct that may mediate the relationship between nature exposure and body image outcomes is *self-compassion*, which has been defined as “the ability to be kind and helpful to one’s self at times of error or despair” (Ferrari et al., 2019, p. 1455). In this view, the restorative qualities of natural environments – especially the promotion of deliberation-without-attention (Kaufman, 2015, 2018) – is thought to provide the space and cognitive tools (e.g., by mitigating negatively-valenced rumination, reducing stress, improved relaxation; Kuo, 2015) for individuals to develop a mindset that facilitates greater self-compassion (Greenberg & Turksma, 2015; van Gordon et al., 2018). Indeed, it is possible that nature exposure is similar in some respects to meditation (Kaplan, 2001), in that both create a capacity for the mind to be calm, which in turn promotes self-compassion. In turn, self-compassion is known to be robustly associated with indices of positive body image (for a review, see Braun et al., 2016), likely because it facilitates recognition that everyone has

imperfections and by encouraging individuals to show kindness and acceptance towards their bodies (Albertson et al., 2015; de Wet et al., 2020). One study examining this mediatory link found that two facets of self-compassion, namely self-kindness and common humanity, significantly mediate the relationship between nature exposure and positive body image (Swami, Barron et al., 2019). A third facet – mindfulness – was found not to be a significant mediator, a result supported by a subsequent study showing that trait mindfulness did not significantly act as a mediator (Swami, Barron et al., 2020).

The available evidence thus supports both direct and indirect associations between nature exposure and body image outcomes, but with few exceptions (Stieger, Aichinger et al., 2021; Swami, Mohd. Khatib et al., 2020) the evidence base is restricted to English-speaking, highly industrialised, Western European populations. This is important because national and cultural groups likely differ in their ideas, values, assumptions, and epistemologies about the natural world (Capaldi et al., 2017; Fox & Xu, 2017; Selin, 2013), as well as in their beliefs about the importance of connecting with nature (Hägerhäll, 2018). That is, relationships with nature are incredibly diverse across societies and nations, and are shaped by shared histories, cultural values, distal and proximate experiences with the natural world, and the speed and direction of social ecological change (Brown et al., 2019). To the extent that such relationships are emplaced, it is possible that cultural/national affiliation will affect the processes involved in generating meaning and embodied engagement with natural environments. That is, although it is unlikely that the link between nature exposure and health and/or body image outcomes will be broken entirely (e.g., see Jiricka-Pürerer et al., 2019; Swami, Mohd. Khatib et al., 2020), it is important to consider whether these relationships are stable cross-nationally.

Consider a simple example: there is some evidence that cultural/national groups differ in the extent to which their nature-based activities either foreground (e.g., picking berries) or

background nature (e.g., exercising; Bang et al., 2007). Indeed, situative approaches to ecology have emphasised how individuals are educated into different sets of relation with the natural world through the values and activities of their local communities, as well as the forms of natural environments that they are exposed to (for a review, see Bang, 2015). This, in turn, may mean that associations between nature exposure and body image outcomes are attenuated or amplified in different national contexts. For example, one possibility is that associations between nature exposure and body image outcomes are stronger in national contexts where nature-based activities are typically foregrounded or where there are historically closer ties to nature. In a similar vein, various factors that vary cross-nationally (e.g., individualism-collectivism, power distance) have been postulated as being important in shaping environmental attitudes and behaviours, conceptualising one's place in the natural world, environmental identities, and experiences in nature (e.g., Atran et al., 2005; Clayton et al., 2021; Milfont & Schultz, 2016). As such, an important task for scholars is to ascertain the extent to which relationships between nature exposure and body image outcomes are stable across nations.

Additionally, assessing the cross-national (in)stability of associations between nature exposure and positive body image is particularly important from a practical point-of-view. That is, if the potential of nature exposure as an interventionist tool to promote more positive body image is to be realised, then it will be important to first understand the extent to which reported associations are robust across diverse social, national, linguistic, and cultural groups (Swami, Mohd. Khatib et al., 2020). Put differently, it should not be assumed that relationships that have been reported as being stable in Western populations will be universally stable. Of course, such stability would be a boon for practitioners, as it would benefit the development of nature-based interventions for the promotion of positive body image that would be effective across diverse groups. However, further data from diverse

national contexts is urgently needed, as reflected in calls by researchers for greater inclusivity and diversity in sampling (Holland et al., 2021). Likewise, although previous research has suggested that both direct and indirect relationships are stable across gender (Swami, Barron et al., 2019, 2020), the possibility of gendered effects across national groups could also be explored further, as could variations as a function of other sociodemographic factors.

1.1. The Body Image in Nature Survey

To better understand direct and indirect relationships between nature exposure and positive body image in diverse national settings, we set up the Body Image in Nature Survey (BINS). The overarching aim of this project is to develop and test a conceptual model linking self-reported nature exposure and body appreciation, and to empirically assess the robustness of this model across diverse national contexts. The development of the model was primarily based on studies conducted with participants from the United Kingdom (Swami, Barron et al., 2019, 2020), wherein greater self-reported nature exposure is expected to be directly and indirectly – via self-compassion and connectedness to nature (i.e., a parallel mediation) – associated with higher trait body appreciation (the solid lines in Figure 1). However, we have also extended the model in two important ways, both of which are based on existing empirical knowledge (the dotted lines in Figure 1).

First, the model includes an index of psychological well-being, namely *satisfaction with life* (i.e., a cognitive evaluation of a person's life based on their personal standard; Diener et al., 1985). This was based firstly on robust evidence documenting a link between self-reported nature exposure and satisfaction with life (e.g., Chang et al., 2020), as well as the expectation that body appreciation would mediate the link between nature exposure and life satisfaction (e.g., Swami, Weis et al., 2018), as would connectedness to nature and self-compassion (i.e., a serial mediation). Second, in acknowledgement of the fact that nature experiences are diverse (e.g., Russell et al., 2013; Shanahan et al., 2015) and to explicitly test

the impact of restoration on body image, our model includes an index of restorative experiences during the most recent nature-based visit, which we expect will mediate the relationship between nature exposure and body appreciation (after Korpela et al., 2014). This expanded model is now being empirically assessed via the methodology we describe below.

2. Method

2.1. Design

The BINS is a collaborative, researcher-crowdsourced (Cuccolo et al., 2021) initiative that will, upon completion, involve researchers working across multiple nations. Beginning in November 2020 and up to March 2021, we actively invited potential collaborators to join the BINS via a call placed on a social networking site for scientists, direct invitations to our networks of colleagues, and via researcher snowballing (i.e., asking confirmed collaborators to disseminate our invitation via their own networks). Potential collaborators were sent written information about the project and its objectives, as well details about expectations and responsibilities. We adopted an inclusive approach to collaborator recruitment (e.g., multiple research groups in any given nation), allowing involvement from any research group that indicated an ability to achieve the project objectives. As of November 2021, a total of 246 researchers working in 73 nations have confirmed their involvement in the BINS¹. Based on past experience (Swami, Tran et al., 2020), we expect some dropout of participation, though we have attempted to mitigate against this by allowing for a long lead-up before the deadline for returning data (February 2022).

A testable model examining direct and indirect associations between nature exposure and body appreciation was developed by the authors of this protocol on the basis of existing research (see Section 1.1.). This will allow us to answer the following research questions: (1) Is the direct relationship between self-reported nature exposure and body appreciation stable

across nations? (2) Are the mediating pathways via self-compassion, connectedness to nature, and restorative experiences stable across nations? (3) Is the expanded model presented in Figure 1 stable across nations, gender, and other demographic characteristics (i.e., socioeconomic status and ethnicity)? Depending on the final sample of nations included in the BINS, we will also be able to address additional, supplementary research questions: (4) Are scores on key variables (i.e., nature exposure, body appreciation, self-compassion, connectedness to nature, life satisfaction) invariant across nations and gender? (5) Are nation-level differences in these variables related to cultural, socioeconomic, and gender-equality indicators?

2.2. Participants

Each confirmed research group involved in the BINS has been asked to recruit a total of 350 adults (175 women, 175 men). We requested data from community (i.e., non-college student) samples to ensure greater value to the data and to ensure some homogeneity of sampling across sites. Inclusion criteria include being adult (≥ 18 years) citizens and residents of a given nation, and fluent in the language of the presented survey. The minimum N in each site was based on an *a priori* power calculation (small-to-medium effect size [$r = .30$], $\alpha = .05$, 95%, $N = 319$), although we have indicated that larger samples would be welcome. It is difficult to estimate size of the final sample, although as of June 2021 we have data from just over 4,000 participants located in ten nations.

2.3. Measures

2.3.1. Nature exposure. Self-reported nature exposure will be measured using the Nature Exposure Scale (NES; Kamitsis & Francis, 2013). This is a 4-item scale that measures an individual's level of exposure to nature in everyday life and activities, and levels of exposure to nature outside of everyday environments (sample item: "How much do you notice the natural environments in your everyday life?"). Response anchors vary depending

on the item, but all include 5-point scales. Scores on the NES have been shown to have a unidimensional factor structure in English-speaking adults (Swami, Barron et al., 2016), but we are not aware of any prior assessment of its factorial validity in diverse national contexts. Previous work has also indicated that scores on the measure have adequate internal consistency and criterion-related validity in English-speaking adults (Kamitsis & Francis, 2013), including significant associations with postulated outcomes (e.g., connectedness to nature; Swami, Barron et al., 2020).

2.3.2. Positive body image. Our primary outcome variable of positive body image will be measured using the 10-item Body Appreciation Scale (BAS-2; Tylka & Wood-Barcalow, 2015), which measures acceptance of one's body, respect and care for one's body, and protection of one's body from unrealistic beauty standards (sample item: "I respect my body"). All items will be rated on a 5-point scale, ranging from 1 (*never*) to 5 (*always*). Recent work has indicated that a unidimensional model of BAS-2 scores is at least partially invariant across a small handful of nations (Lemoine et al., 2018; Razmus et al., 2020; Todd & Swami, 2020), but our project will likely offer an opportunity to assess invariance across a larger and more diverse sample of nations. Scores on the BAS-2 have been shown to have adequate internal consistency and good patterns of construct validity across diverse national groups (for a review, see Swami, 2018).

2.3.3. Life satisfaction. Our secondary outcome variable will be measured using the Satisfaction with Life Scale (SLS; Diener et al., 1985). This is a 5-item measure of an individual's quality of their lives on the basis of their own unique criteria (sample item: "I am satisfied with my life"). All items will be rated on a 5-point scale (1 = *strongly disagree*, 5 = *strongly agree*). The unidimensional model of SLS scores has been shown to be partially invariant across large, multi-national samples (e.g., Jang et al., 2017; Jovanović & Brdar, 2018). Scores on the instrument have also been shown to have adequate internal consistency

and good construct validity in many national samples (for a review, see Pavot & Diener, 2009).

2.3.4. Self-compassion. To measure the mediating variable of self-compassion, we will use the 12-item Self-Compassion Scale-Short Form (SCS-SF; Raes et al., 2011), which measures aspects of self-kindness, common humanity, and mindfulness (sample item: “When something upsets me, I try to keep my emotions in balance”). All items will be rated on a 5-point scale, ranging from 1 (*almost never*) to 5 (*almost always*). Although the unidimensional model of SCS-SF scores has been shown to be factorially valid in diverse national samples (e.g., Bratt & Fagerström, 2020), we are not aware of any studies that have assessed the invariance of SCS-SF scores across nations, which our project will be able to rectify. Scores on the SCS-SF have been shown to have adequate internal consistency and construct validity in English-speaking samples (Raes et al., 2011).

2.3.5. Connectedness to nature. To measure the mediating variable of connectedness to nature, participants will be asked to complete the 14-item Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004). This is a widely-used instrument that measures an individual’s affective and experiential connection to nature (sample item: “I often feel a sense of oneness with the natural world around me”). Items will be rated on a 5-point scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Although the unidimensional model of CNS scores has been supported in English-speaking samples (Mayer & Frantz, 2004), we are not aware of an assessment of invariance of this model across nations. CNS scores have also been shown to have adequate internal consistency and construct validity in English-speaking samples (Mayer & Frantz, 2004).

2.3.6. Restorative experiences. To measure the mediating role of restorative experiences during participants’ most recent nature-based visit, we will use the Restoration Outcome Scale (ROS; Korpela & Ylén, 2009). This is a 9-item instrument that measures the

degree of restorative outcomes in terms of relaxation, calmness, attention restoration, clarity of thought, subjective vitality, and self-confidence (sample item: “My vitality and energy increased”). All items will be rated on a 7-point scale ranging from 1 (*not at all*) to 7 (*completely*). A unidimensional model of ROS scores has been supported in Finnish adults (Korpela et al., 2014), but we are not aware of any assessment of the invariance of ROS scores across nations. Scores on the ROS have been shown to have adequate internal consistency and construct validity in Finnish-speaking adults (Korpela et al., 2014).

2.3.7. Personality. Participants will also be asked to complete the Five-Item Personality Inventory (FIPI; Gosling et al., 2003), which measures the Big Five personality facets of Openness to Experience (“I see myself as open to new experiences”), Conscientiousness (“... as dependable and self-disciplined”), Extraversion (“...as extraverted and enthusiastic”), Agreeableness (“... as warm and sympathetic to others”), and Neuroticism (“... anxious and easily upset”) with one item for each facet. All items will be rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The FIPI has been previously used in large, multinational studies (e.g., Swami, Tran et al., 2020) and scores evidence adequate levels of convergent validity.

2.3.8. Socioeconomic status. Because of the difficulties creating a common metric of socioeconomic status across nations, we will follow previous work (Swami, Tran et al., 2020) in using two proxies for socioeconomic status. First, participants will be asked to self-report how financially secure they felt relative to others of their own age in their country of residence (1 = *Less secure*, 2 = *Same*, 3 = *More secure*) (Swami et al., 2012). Second, we will ask participants about their current place of residence (i.e., urbanicity), with response options adapted from Pedersen and Mortensen (2001) as follows: *Capital city*, *Capital city suburbs*, *Provincial city (more than 100,000 residents)*, *Provincial town (more than 10,000 residents)*,

and *Rural areas*. Response options will be collapsed into *urban* versus *rural* for analyses (Swami, Tran et al., 2020).

2.3.9. Body mass index. Participants will be asked to self-report their height and weight, which we will use to compute body mass index (BMI) as kg/m^2 for descriptive purposes. Self-reported height and weight data have been found to be strongly correlated with objectively measured indices in nationally-diverse samples of adults (e.g., Spencer et al., 2002).

2.3.10. Demographics. Demographic information will be collected, consisting of gender identity, age, majority or minority ethnic/racial affiliation, highest educational qualification, and marital status.

2.4. Ethics

The overall project has received ethics approval from the School Research Ethics Panel at [blinded for review] (approval code: PSY-S19-015). All collaborators have additionally been asked to obtain permission from local departmental/institutional ethics committees or review boards (or equivalent committee subject to the International Ethics Guidelines of the World Health Organization). Records of such approval will be lodged with the first author. In some national contexts, ethics approval is not required; in these cases, collaborators have been asked to confirm to the first author that such approval is not necessary.

2.5. Procedures

Upon confirmation of involvement in the BINS, collaborators will have been sent the survey instruments in English, along with an exemplar participant information sheet, consent form, and debrief sheet. Once local ethics approval has been obtained or collaborators have confirmed that approval is not required, local collaborators will recruit a community sample consisting of, minimally, 350 adults. Because of limitations placed by the ongoing

coronavirus (COVID-19) pandemic, we have recommended a flexible approach to data collection. In many cases, we expect that participants will be recruited online and collaborators have been tasked with ensuring the validity of all data collected in this manner (i.e., checks of IP address, consistency and plausibility of responses, and completion times; Aust et al., 2013). Where participants are recruited offline, collaborators have been asked to ensure that they adhere to all local and institutional guidelines for participant recruitment during the pandemic. All participants will be asked to provide (digital or written) informed consent and complete an anonymous version of the survey. In most cases, we expect that participation will be without remuneration, although collaborators are free to remunerate should they wish. All participants will receive debriefing information upon completion of the survey, which will include contact information for the first author as well as a local collaborator. Data collection will close in February 2022 and all data will be stored securely at the first author's institution, where industry-standard secure data storage and data sharing systems utilising resilient cloud computing facilities are in place. Unless precluded by local restrictions, it is our intention to make the final BINS dataset, analytic codes, and all outputs available to scholars via open access and preprint services.

2.5. Survey Translation

Where it is necessary to present the survey instruments in a language other than English, collaborators have been asked to first assess whether prior translations of individual scales are available and to use these with permission. Where prior translations are not available, collaborators have been asked to adapt the survey instruments using the back-translation technique (Brislin, 1970). We have recommended singular use of back-translation, rather than fuller test adaptation methods (see Swami & Barron, 2019) so as to avoid onerous thresholds of entry into the project. In brief, the back-translation technique involves a bilingual individual first translating an instrument from English into the target language.

Next, a second bilingual individual translates this version back into English. Finally, the two versions of the instrument are assessed and any discrepancies resolved by committee involving the two translators and a researcher involved in the project. The first authors of this protocol will also be available to clarify key concepts or operationalisations. All translations will be lodged with the first author and will be made available to other scholars upon request.

3. Data Analysis Plan

3.1. Missing Data and Data Handling

Upon merging of all local datasets, we will assess the degree of missing data and exclude participants who are missing substantial portions ($> 80\%$) of data (Parent, 2013). For retained participants, missing data will be treated using full information maximum likelihood estimation, which is superior to other methods for dealing with missing data (Enders & Bandalos, 2001). All within-nation data will be pooled so that analyses are conducted at the level of the nation, rather than individual research sites.

3.2. Invariance of Key Variables

To assess whether all key variables (i.e., scores on the NES, BAS-2, SCS-SF, SLS, and ROS) are unidimensional, we will assess measurement invariance using multi-group confirmatory factor analysis (MG-CFA; Chen, 2007). We will first assess configural invariance (i.e., whether scores on each of the instruments form unidimensional scores in every nation represented in the BINS), followed by full invariance (i.e., whether item parameters are identical across nations). If full measurement invariance is not observed, item parameters will be relaxed in individual nations to test for partial measurement invariance (i.e., the parameters of some, but not all, items are equal across nations). Additionally, we will use the alignment method (Asparouhov & Muthén, 2014) if equality constraints largely do not hold. The alignment method does not require exact measurement invariance and

identifies the model with the least amount of measurement invariance. Items will be treated as ordered-categorical variables, using the matrix of polychoric correlations and the WLSMV estimator (weighted least square estimator using a diagonal weight matrix with standard errors and mean- and variance-adjusted chi-square test statistic that use a full weight matrix) in Mplus (Muthén & Muthén, 2019). To assess internal consistency, we will report McDonald's ω (Dunn et al., 2014), with values $\geq .70$ indicative of adequate reliability.

To assess model fit (Hu & Bentler, 1999), we will use the comparative fit index (CFI; values close to .95 indicative of good fit), the Tucker-Lewis index (TLI; values close to .95 indicative of good fit), and the standardised root mean square residual (SRMR; values close to .08 indicative of good fit). It should be noted that WLSMV estimates the model degrees of freedom (df) from the data (Muthén et al., 1997), which could in the MG-CFA models either excessively disadvantage TLI to CFI values (especially in models with a larger number of estimated parameters; i.e., configural invariance models) or excessively disadvantage CFI to TLI values (especially in models with few estimated parameters, such as full and partial measurements models, leading to $CFI < TLI$, which is not possible under ML estimation). Thus, model fit will be considered acceptable in MG-CFA if the SRMR and either CFI or TLI values indicate a reasonable fit. For the various MG-CFA measurement invariance analyses, model fit will be interpreted independently, as the WLSMV estimator does not allow for direct comparisons between models based on indices like ΔCFI (Sass, 2011); because of the large sample sizes likely involved, we will also avoid relying on $\Delta\chi^2$ tests, as these tend to become too liberal (rejecting the null hypothesis too often) with increasing N (Cheung & Rensvold, 2002). For scales with full measurement invariance in MG-CFA, we will also test for the equality of latent and manifest means across nations. Otherwise, the alignment method will be used to test for the equality of latent means.

3.3. Testing the Conceptual Model

Because of the nested nature of the data (i.e., participants within nations), we will use multilevel modelling (Davidov et al., 2018; Hox, 1998) in Mplus to examine associations between the potential antecedent (i.e., nature exposure) and outcomes (i.e., body appreciation and life satisfaction), along with mediators (i.e., self-compassion, connectedness to nature, and restorative experiences), with level-1 variables (see Figure 1) nested within nations (level 2). Based on initial modelling, level-1 variables will be removed if they are not significantly associated with outcomes measures. All level-1 variables will be group mean-centred (Hofmann & Gavin, 1998). In further analyses, we will also investigate whether these results replicate across gender, socioeconomic status (i.e., financial security and urbanicity), and ethnicity (i.e., majority vs. minority ethnicity status). As a further test of robustness, we will also consider the extent to which the model presented in Figure 1 is stable after controlling for personality (cf. Cartwright et al., 2018). This is especially important given that dimensions of personality (especially Neuroticism and Extraversion) have been shown to be reliably associated with several of the variables in the model, including satisfaction with life, body appreciation, and connectedness to nature (e.g., Allen & Walter, 2016).

3.4. Supplementary Analyses

Given the potential uniqueness of our dataset, there may be opportunities to further analyse our data. Here, we present an example of such further analyses. With a sufficiently diverse pool of nations, it may be useful to examine correlation coefficients between nation-level scores on a given variable (e.g., body appreciation) and cultural, socioeconomic, and gender-related factors. To do so, we will collect nation-level data on (1) individualism (i.e., a preference for autonomous, egocentric, self-contained self-construals; Hofstede et al., 2010), cultural looseness (i.e., flexibility in social norms; Uz, 2015), and WEIRDness distance (nation-level cultural distance from the United States as a point of comparison; Muthukrishna

et al., 2020) as cultural factors; (2) human development (an summary index that assess achievements in long and healthy lives, access to knowledge, and a decent standard of living; United Nations Development Programme, 2016) and the Gini coefficient (an index of economic inequality in a population; United Nations Development Programme, 2016) as socioeconomic factors; and (3) gender equity in access to resources and opportunities (World Economic Forum, 2017) as a gender-related factor. These and further analyses will be largely exploratory.

4. Discussion

In this paper, we describe a study protocol to assess direct and indirect associations between nature exposure and body appreciation in a large, multinational sample. There are a number of reasons why the data generated by the BINS will be of interest to body image scholars. First, as scholars have recognised (Swami, Barron et al., 2020), the goal of fully developing nature-based interventions to promote positive body image is contingent on sound theorising and data-informed conceptual clarity, as well as recognition of the applicability of these models across national and cultural groups. That is, what is needed at this point is a greater understanding of the mechanisms by which nature exposure promotes healthier body appreciation specifically and psychological well-being generally, as well as the conditions under which such relationships are most effective. In turn, this will likely lead to the development of sustainable and effective nature-based interventions that effectively promote body and self-care, but that may also have important implications for the treatment of disordered eating (e.g., Jepsen Transgrud et al., 2017).

Beyond testing these primary objectives, the BINS is also likely to produce one of the richest cross-national datasets that includes a measure of positive body image. Although understandings of the cultural factors that may affect body appreciation has grown in recent

years (Swami, 2018), in tandem with the availability of body appreciation data from multiple nations (e.g., Razmus et al., 2020), the BINS if successful will produce an unprecedented dataset that will allow for a more thorough and deeper examination of cross-national differences, as well as the factors that affect body appreciation at a coarser, national level. Such data will be invaluable to body image scholars seeking to more fully understand the way in which cultural and/or national factors affect positive body image in adulthood. Of course, the inclusion of additional measures in the BINS also means that our dataset will likely be of interest to researchers beyond body image scholarship, too. It is our hope that the findings of the BINS will advance knowledge on effective strategies to promote more positive body image and psychological well-being across diverse national groups.

Footnotes

¹As of November 2021, we are in receipt of datasets from 33 nations ($N = 23,394$), which would allow us to test the conceptual model being presented here.

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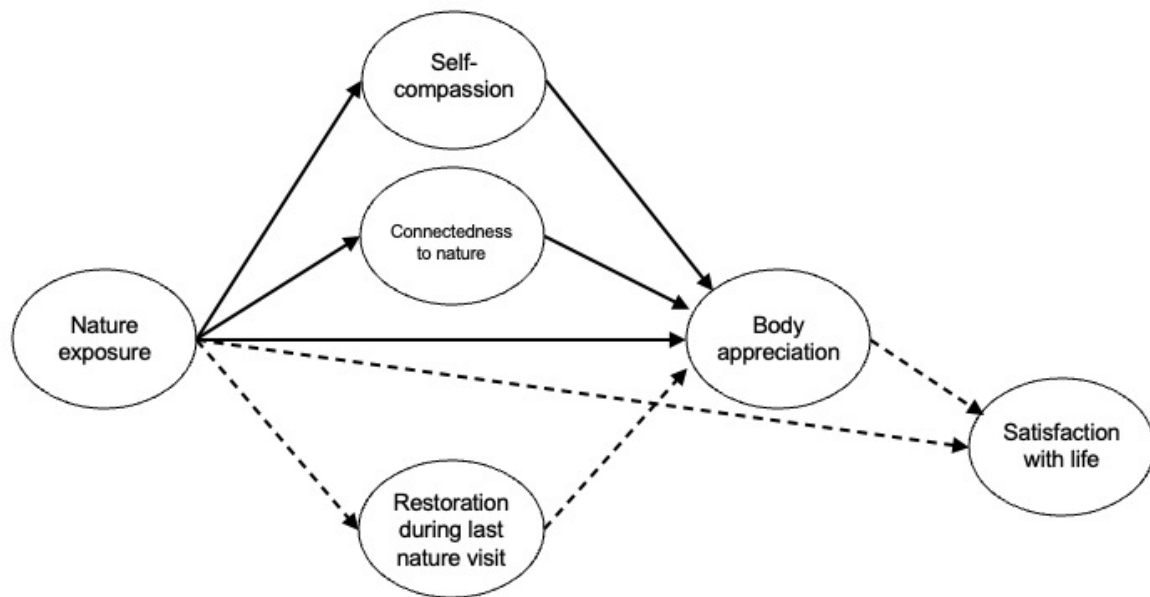


Figure 1

Conceptual model of the direct and indirect relationships between nature exposure and body appreciation and satisfaction with life, respectively. Solid lines represent hypothesised relationships based on existing research; dashed lines represent hypothesised relationships that are novel.