

## Article

# Nature Scripts to Promote Social Sustainability: Monetizing Wellbeing Benefits of Group-Based Nature Exposure for Young Adults with Mild to Moderate Mental Illness

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## Abstract

The mental health of young adults is a widespread and growing concern in many communities, impacting social sustainability. At the same time, there is growing evidence of the value that nature can provide towards improving health and wellbeing. However, there is little research on the scale of the monetized value of relevant wellbeing benefits from nature exposure. Nature prescribing draws on the growing base of evidence about nature and its health and wellbeing connections, with medical practitioners and/or allied health workers providing a prescription to selected patients to participate in a program that offers interventions intended to improve participant health and/or wellbeing, using a nature setting. This paper is the first to undertake a cost–benefit analysis of nature prescribing, involving a program aimed to improve the wellbeing of young adults with mild to moderate mental illness in regional/rural Victoria, Australia. The evaluation demonstrates that a curated, group-based nature exposure program can yield significant improvement in levels of life satisfaction and mental health in this cohort. Paired sample comparisons and multiple regression analyses suggest that the program produced an increase in mean participant life satisfaction scores of ~0.7 units, measured using Personal Wellbeing Index scores. A project benefit–cost ratio of over four resulted from this. Mental health, as measured by Kessler scale scores, also showed solid improvement, and loneliness was reduced. The unique contributions of nature and of the group-based delivery mode to the measured benefits were not identifiable but the combined effect was evident, improving participants' likelihood of social inclusion, a major social sustainability goal. Furthermore, the solid program benefit–cost ratios indicate an economically sustainable program, which uses an environmental platform (nature) for its delivery. This links all three triple bottom line sustainability outcomes to this program. Topping up group-based nature exposure, after completion of the six-session, two-hours-per-session program, was important for many participants to sustain benefit levels. Participants emphasized the importance of the program being delivered by trained professionals. Achieving involvement of a suitably sized project comparison or control group through the 8-month program evaluation period to follow-up proved challenging, which somewhat weakens the power of the evaluation findings.

**Keywords:** cost benefit analysis; life satisfaction; loneliness; mental health; nature prescribing; social exclusion; social sustainability; wellbeing



Academic Editor: Wenjie Duan

Received: 26 September 2025

Revised: 27 October 2025

Accepted: 5 November 2025

Published: 8 November 2025

**Citation:** Stanley, J.K.; Stanley, J.R.; Vella-Brodrick, D. Nature Scripts to Promote Social Sustainability: Monetizing Wellbeing Benefits of Group-Based Nature Exposure for Young Adults with Mild to Moderate Mental Illness. *Sustainability* **2025**, *17*, 9988. <https://doi.org/10.3390/su17229988>

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## 1. Introduction

### 1.1. The Nature Scripts Trial and This Evaluation

One in five Australians experience mental illness, such as anxiety, depression and substance use disorders [1]. This is a particular concern among young Australians, with 29% experiencing high psychological distress, almost a quarter being lonely most of the time and 60% experiencing some social exclusion, with those living in regional and remote areas amongst the groups more likely to experience social isolation [2]. Young Australian adults (18–34 years) have the lowest wellbeing and highest feelings of mental distress and loneliness [3].

Social inclusion, sometimes expressed using language such as ‘leaving no-one behind’, is increasingly seen as a way to frame the social sustainability goal within a triple bottom line approach to sustainability [4,5]. The United Nations Report on the World Social Situation 2016 [4] provides a comprehensive argument for why leaving no one behind should be an important policy imperative internationally and this priority is recognized and embedded in UN Sustainable Development Goals 8, 10, 11 and 16 [6]. Reducing social exclusion/increasing inclusion is also central to the European social model [7]. Saunders [8] p.12 argues that ‘Social exclusion has emerged as a major organizing theme of social policy in an increasing array of countries.’ Australian research suggests that increasing life satisfaction (subjective wellbeing) is one way to enhance prospects for social inclusion [5,9] and, as a consequence, improve social sustainability.

Against this background, there is growing evidence of the value that nature can provide towards improving personal health and wellbeing [10–16]. Nature refers to living and non-living elements of the natural world, including plants, animals, landscapes and water bodies. It encompasses outdoor environments such as green and blue spaces and can include forests, parks, gardens, oceans and rivers [17]. Nature prescribing draws on this growing evidence base whereby medical practitioners and/or allied health workers provide a ‘script’ to selected patients to participate in a nature-based program intended to improve their health and wellbeing.

Australia’s People and Parks Foundation’s (PPF) Nature Scripts initiative reflects this intent. It includes a demonstration project aiming to improve the wellbeing and mental health of young adults with mild to moderate mental illness, with subsidiary aims of improving participant connection to community and pro-environmental behavior. The demonstration project was undertaken in Shepparton (regional/rural Victoria), as a partnership between PPF and the regional branch of *headspace*, a national mental health service provider. The region in which the research was based had a low mean life satisfaction score of 6 in 2024, which was well below the Australian mean (of 7.50 [3]). *headspace* and the local authority, City of Greater Shepparton, advised PPF that the mental health of young adults was a particular concern in the region, supporting the choice of this cohort for this study.

All participants in the trial were *headspace* clients. The initiative involved participants undertaking curated group-based activities within a nature setting and intentionally noticing and integrating the natural context, a variable that may enhance wellbeing outcomes [18], as compared to activities in which the environment is just a background. Activities were based on a weekly 2 h program over 6 weeks and were conducted in group sizes of 5–7, led by a *headspace* social worker and support (lived experience) worker, with guest leaders for some activities. Examples of program activities included nature journaling, yoga, tree planting, bushwalks, macroinvertebrate identification and nature photography. The program included group-based nature experiences and social interaction via a group delivery format.

Shepparton Nature Scripts can be seen as a nature-based derivative of social prescribing. There is a growing base of evidence showing the effectiveness of social prescribing by

health practitioners [19–21]. Evidence regarding the effectiveness of nature prescribing is less readily available but is emerging [14,22–25].

This paper has three aims: first, to measure wellbeing and mental health benefits arising from the Shepparton Nature Scripts project; second, to place a monetary value on some or all of those benefits; and third, to undertake an overall cost–benefit analysis of the Shepparton Nature Scripts project. Evidence accumulated while meeting these three aims can then be used to suggest ways to increase the likelihood that initiatives like Shepparton Nature Scripts will improve participant wellbeing and mental health. Monetizing the benefits of Nature Scripts adds an economic sustainability dimension to the social sustainability benefits assessed through wellbeing and mental health lenses, while the platform of nature engagement through which the program was delivered reveals the importance of environmental sustainability.

As far as can be ascertained, this paper is the first to evaluate the success of nature prescribing from a cost–benefit analysis (CBA perspective). The paper also briefly addresses the Shepparton project’s two supplementary goals: improving participant connection to community and pro-environmental behaviors. It reports on the following issues: the role of nature connectedness and nature prescription in enhancing wellbeing, pro-environmental behaviors and connection to community; the importance of using a comprehensive and established wellbeing framework; the program, designed to promote wellbeing, pro-environmental behaviors and connection to community; the conditions of the nature intervention that optimize its benefits, such as a small group setting that is professionally led and expert guidance for some nature activities and the work undertaken to value the program outcomes in monetary terms, where possible. The study was not able to identify the unique contributions of nature and group activities on participant benefits but their combined effect is encouraging.

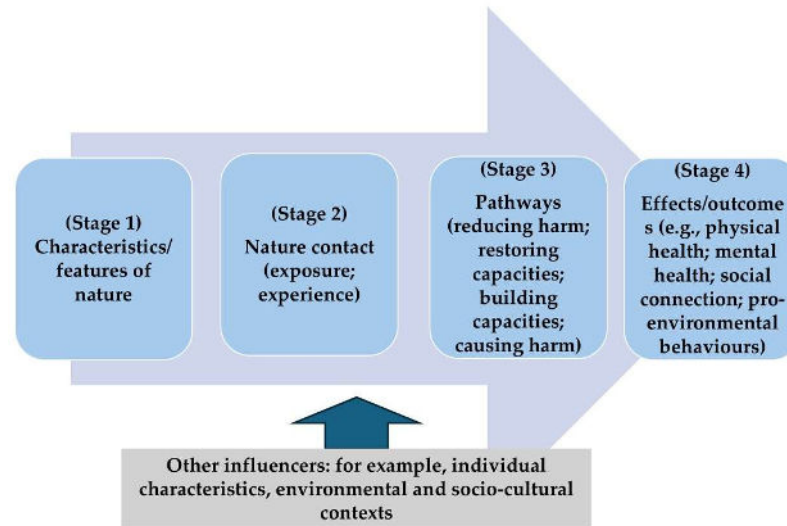
Section 1.2 presents a literature review to develop understanding of relevant source material to inform development of an evaluation framework to assess the Nature Scripts initiative. It identifies some potentially beneficial outcomes that might be pursued using nature-based activities, noting some relevant and well-established measurement tools. Section 2 discusses materials and methods, where the focus is on wellbeing and mental health, the primary outcome targets for the Shepparton initiative. Physical health markers were beyond the project’s scope and budget. Section 3 presents the results of the analysis, which are discussed in Section 4. Section 5 presents the paper’s conclusions.

### *1.2. Literature Review: Nature Benefits and Their Valuation*

Wellbeing is a multidimensional concept; this scientific field of inquiry primarily focuses on assessing evaluative and affective approaches, using standardized self-report scales of life satisfaction and positive and negative affect, respectively [3,26,27]. High levels of life satisfaction and positive affect, along with low levels of negative affect, are argued to reflect subjective wellbeing. Wellbeing can also include higher order eudaimonic elements, such as feeling engaged in life activities, finding authentic life meaning and contributing to the wellbeing of others [28]. These eudaimonic elements are thought to be distinct from hedonic wellbeing [29], adding new insights about wellbeing.

However, the literature review later clarifies that life satisfaction wellbeing measures are the only wellbeing measures for which monetary values are currently available for use in evaluation frameworks like CBA. The lack of monetized values for eudaimonic wellbeing and affective wellbeing has resulted in this paper focusing on life satisfaction as its wellbeing measure. UK research argues that life satisfaction measures align well with the concept of economic wellbeing, as used (for example) in CBA [30,31]. Therefore, the remaining parts of this literature review mainly focus on life satisfaction/subjective wellbeing.

Authors such as Bratman et al. [10], Marselle et al. [32] and Shanahan et al. [15] set out logic models for exploring how nature, or biodiversity in the case of Marselle et al., might impact human health and wellbeing. They link characteristics of nature and experiences of/in nature, through various influencing pathways, to various health, wellbeing and pro-environmental behaviors, as summarized in Figure 1.



**Figure 1.** Pathways linking nature to human health, wellbeing and pro-environmental behaviors. **Source:** Authors, drawing on Bratman et al. [10], Marselle et al. [32] and Shanahan et al. [15].

In terms of impact pathways (Figure 1, Stage 3), the natural environment is thought to have therapeutic and relaxing effects. There are various theories about the mechanisms by which this occurs, including physiological, affective and cognitive processes. The ‘Biophilia Hypothesis’ [33] asserts that individuals are innately driven to affiliate with nature and, when this need is satisfied, everyday mental exhaustion resulting from the built environment is relieved and wellbeing heightened. Stress Reduction Theory suggests that when individuals are in contact with nature, they experience a psychophysiological response involving decreased physiological arousal, increased positive affect and reduced negative affect [34]. Hartig et al.’s [35] Collective Restoration theory suggests that contact with nature can stimulate inclusive and prosocial attitudes and behaviors.

Capaldi et al. [11] undertook a meta-analysis of studies that explored linkages between nature connectedness and happiness using three measures of nature connectedness and three happiness measures. For each nature connectedness measure, they found small positive effect sizes for an association with happiness, and for each happiness measure, they found small positive effect sizes for an association with nature connectedness. Capaldi et al. [36] summarize evidence on beneficial associations between nature and hedonic (and eudaimonic) wellbeing, expressing surprise that nature-based interventions are both understudied and underutilized in mental health treatment.

In developing their Nature Relatedness Scale (NRS), Nisbet et al. [37] found that those scoring higher on the scale (nature-related people) generally reported spending more time in the natural environment and exhibited more pro-environmental behaviors. Nisbet and Zelenski [38] found the short form (six-item) version of the NRS to be a good predictor of positive affect and eudaimonic wellbeing but not life satisfaction. They suggested that nature-relatedness has trait-like qualities but may not be completely fixed.

Shanahan et al. [15] found that people who made long visits to green spaces had lower rates of depression and lower rates of high blood pressure, whereas those who visited more frequently showed greater social cohesion. In addition, higher levels of physical activity were linked to both duration and frequency of green space visits. Astell-Burt et al. [22]

found that those who frequently visited natural environments and spent at least two hours per week in nature reported lower levels of social loneliness. White et al. [16] found that those who did, as compared to those who did not, visit nature the day before were 1.7 times more likely to report high levels of happiness.

Previous research on time in nature and health has found variable amounts of exposure time as being beneficial, from 10 min per week to two or more hours a week. White [39], for example, found that greater improvement in life satisfaction was found in those who spent a total of two or more hours a week in nature, which may include a number of smaller visits, while a review of 78 studies by Bettman et al. [40] found that repeated shorter-duration exposure to nature yielded greater positive impacts for adults with a mental illness.

Bratman et al. [10] identified an extensive literature base demonstrating the positive association between nature experience and wellbeing, including a range of beneficial outcomes, such as increased positive affect, happiness and subjective wellbeing; positive social interactions, cohesion and engagement; a sense of meaning and purpose in life; improved manageability of life tasks and reduced mental distress.

Martin et al. [13] found that intentional contact nature visits (at least once a week) were positively associated with general health but not significantly associated with wellbeing (subjective or eudaimonic). Visiting nature at least once a week was likely to be associated with higher amounts of some pro-environmental behaviors, such as recycling, but not greater commitment to other pro-environmental behaviors, such as volunteering. Richardson et al. [41] found that engaging with nature through simple activities and nature connectedness were significant predictors of mental health and wellbeing, including happiness.

Nejade et al. [42] identified 39 studies evaluating the impact of nature-based interventions, finding improvement in mental health outcomes, physical/physiological health outcomes and cognitive health outcomes. They highlighted the role of enablers and barriers in impacting the likelihood of positive outcomes, such as nature abundance and condition, nature accessibility and proximity, social processes (e.g., the presence of other people during nature intervention is sometimes advantageous) and user attitudes (e.g., to safety).

In a systematic review including 12 experimental and quasi-experimental studies, Vella-Brodrick and Gilowska [17] found that school-based nature connection can result in enhanced cognitive functioning involving working memory and sustained/selective attention. A further review by Ly and Vella-Brodrick [12] of 19 studies focused on school-led nature interventions and found support for school-led nature exposure being effective at improving the wellbeing of children and adolescents, particularly their positive affect, physical activity, and social relationships/interactions.

Nguyen et al. [14] reviewed nature prescriptions and related research, identifying benefits such as improved physical health (e.g., lowered blood pressure), improved psychological or cognitive outcomes (e.g., lower depression and anxiety) and increased physical activity. They note that beneficial effects on depression scores and step counts were more likely when interventions involved social professionals.

Menhas et al. [25] reviewed evidence about nature-based social prescribing, with a focus on treating mental health conditions. They found that improvements in symptoms of stress, anxiety and depression associated with nature interaction varied between non-professional self-chosen activities in nature and those involving a leader or professionally guided program, with the latter producing better outcomes.

The preceding discussion illustrates the growing evidence base on the benefits of interaction with nature, but there is less evidence about the economic value of these benefits as they relate to improving wellbeing and mental health. While the long-standing travel cost approach is commonly used to impute monetary values to the benefits of nature-

based resources [43–45], this approach is most suited to valuing place-specific nature-based resources, like national parks. It is not suitable for valuing programs like Shepparton Nature Scripts that include a range of nature-based activities in multiple nature-based settings, delivered on a group basis. Wellbeing valuation is more relevant to such multi-faceted interventions, where the pioneering efforts of authors such as van Praag and Ferrer-i-Carbonell [46] are notable.

Wellbeing valuation approaches are increasingly being used in the UK, generally involving valuation of changes in Quality Adjusted Life Years and/or in life satisfaction [30,31,47]. Stanley et al. [9] have produced Australian monetized values for changes in Personal Wellbeing Index scores, a measure of life satisfaction. Biddle et al. [48] have also derived Australian monetary estimates for changes in life satisfaction, their values being a little higher than those estimated by Stanley et al. [9], relative to household incomes.

Andrén [49] used a life satisfaction valuation approach to value hypothetical interventions intended to reduce depression in Sweden, estimating values for loss of individual life satisfaction for those experiencing depression varying between EUR 350 and EUR 45,000 a year, with a core annual value of EUR 17,000. Andrén makes the important point that depression can also reduce the wellbeing of those who know someone who experiences depression, finding annual values for the latter of EUR 5000, effectively increasing the cost of depression to societal wellbeing by around 30 percent.

Neumann and Hack [50] reported on work undertaken by Sarabi et al. [51] which found that the barriers to the application of nature-based solutions include a lack of awareness of the benefits, a perception of high costs when compared to other approaches and the difficulty in valuing the social and economic benefits of nature.

The wellbeing valuation approach is increasingly being used in benefit valuation for UK social prescribing programs, reflecting recognition by the UK National Health Service that social prescribing has an important role to play in health care [52]. While still in its early days, benefit valuation work in relation to social prescribing largely revolves around measuring and valuing changes in participant wellbeing and productivity and/or in the costs of providing the health and social services used by participants [18–20]. For example, Bertotti et al. [19] derived monetized estimates for the values of social prescribing benefits such as increased employment and changes in fear of crime and in volunteering, together with changes in health costs incurred by participants. Bertotti et al. [20] estimated benefits from a social prescribing program involving young people, more than half of whom had long-standing physical and/or mental health issues. The largest monetized benefit was for improved mental health, which was valued using monetized wellbeing values from Trotter and Rallings Adams [53].

Similar evaluation approaches are now being used to evaluate initiatives aimed at reducing loneliness but again with a narrow evidence base [54–57]. Peytrignet et al. [57], for example, use UK wellbeing values to impute monetized values to changes in a person's degree of loneliness. They estimate the wellbeing benefit of improving someone's loneliness condition from severe to mild as over EUR 18,000 per annum.

Overall, the nature/social prescribing literature makes it clear that, while the evidence base identifies many potentially beneficial impacts, there is currently an insufficient evidence base from which to draw general conclusions about what works best for whom and in what circumstances [24,58,59]. The emerging literature on wellbeing valuation suggests that a life satisfaction-based approach is well suited to valuing key participant wellbeing benefits of initiatives such as Nature Scripts in monetary terms. The above examples suggest substantial potential benefits, but no cost–benefit analyses of nature prescribing were identified in the studies reviewed.

The Shepparton program adds to the evidence base on these various fronts by measuring wellbeing benefits of curated group-based nature prescribing, valuing the monetary worth of these wellbeing benefits for participants and then undertaking a CBA of the program from which these benefits derive. The CBA findings are this study's novel contribution to this field.

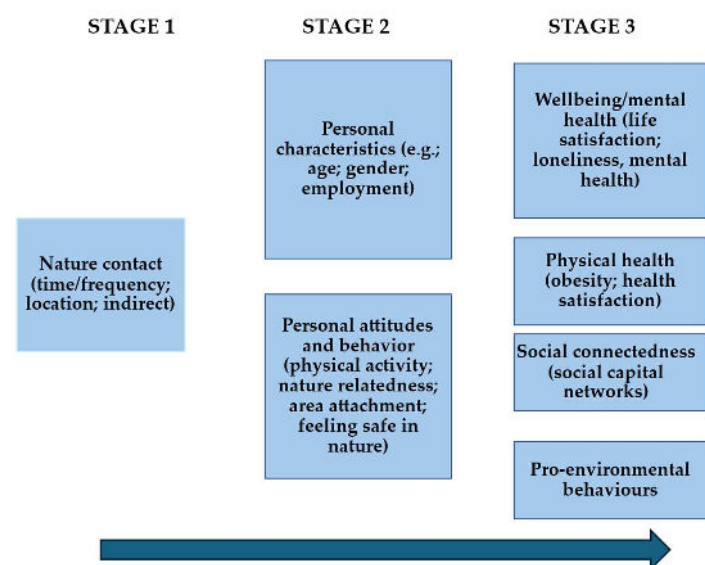
## 2. Materials and Methods

### 2.1. The Shepparton Nature Scripts Initiative

The Shepparton Nature Scripts initiative aims to improve participant wellbeing and mental health, with subsidiary aims of improving participant connection to community and pro-environmental behavior. Discussions between PPF, *headspace* and the Victorian regional City of Greater Shepparton (population just over 50,000) suggested that improving the mental health of young adults was a regional priority, and some local funding was available from philanthropic and governmental sources to support programs with this purpose. PPF and *headspace* Shepparton developed a regional Nature Scripts program targeting this cohort.

Ethics approval for this Nature Scripts evaluation was granted by the University of Melbourne (number 25,137). Intervention and comparison groups were surveyed to shed light on program impacts on target outcomes. The comparison group did not receive treatment from *headspace* during the survey period but some may possibly have received some treatment by another provider over this period. Recruitment for both groups occurred between September 2023 and September 2024, with a target of at least 30 participants in each group completing entry, exit and ~6-month follow-up survey questionnaires. All participants were taken from the *headspace* waiting list for young adults and assessed by *headspace* staff as having mild to moderate mental illness.

Questionnaires included brief questions on contact with nature, questions related to the participant's socio-economic characteristics, attitudes and behaviors and a range of outcome-related questions (Figure 2). In addition, qualitative interviews were undertaken with two facilitators in the Nature Scripts program and with 12 program participants at exit and as part of the 6-month follow-up. This provided an opportunity to further reflect on the program's outcomes.



**Figure 2.** Pathways linking nature to human health, wellbeing and pro-environmental behaviors in Shepparton Nature Scripts. **Source:** Authors, drawing on Bratman et al. [10], Marselle et al. [32] and Shanahan et al. [15].

There are some notable differences between the approach taken to measuring well-being and mental health benefits for the Shepparton Nature Scripts project, as shown in Figure 2, as required to meet the project's first aim, and the broad approach to exploring the nature–wellbeing–health associations identified in Figure 1. At the front end, both figures identify a data requirement for indicators of the quantity and quality of individuals' interactions with nature. Such data is usually specific to place and is expensive to collect. This is particularly important for research seeking to understand the effect of specific aspects of the associations between nature, wellbeing, and health, but that is not the intent of the Shepparton project, which includes a range of nature-based interventions in different nature-based contexts. Some aspects of nature availability are potentially important to the project and have been included, such as distance to natural areas used by respondents, which can be expected to impact usage patterns. However, no questions were included about the complexity or quality of the nature/greenspace available to participants.

Stage 2 in Figure 1 and Stage 1 in Figure 2 are about nature contact, which includes both exposure and experience. Several questions relevant to these matters were asked of participants, particularly related to time spent in nature and how safe people feel in nature.

Stage 3 in Figure 1 shows four pathways from nature to health. The stage with these pathways is not part of the Shepparton process shown in Figure 2 because the Shepparton initiative includes multiple elements of nature exposure and involvement across 6 two-hour sessions, which may involve different pathways, together with group involvement (a social pathway). This means that the direct effects of particular interventions or pathways, both within nature and between nature and social intervention, are unlikely to be discernible but the impact of the set of interventions should be. In short, the Shepparton survey questionnaires should provide a sense of whether the curated, group-based Nature Scripts program has been beneficial for one or more of the main intended outcome areas but will not necessarily help explain why it was successful. Qualitative discussions with program participants, the project coordinator and partner agencies were used to shed light on the latter.

Stage 4 in the Figure 1 framework is critical, being about outcomes of the intervention, which form Stage 3 in Figure 2. The primary intended beneficial outcomes of the Shepparton project are improved participant wellbeing and mental health, with a secondary focus on improving connection with community and pro-environmental behaviors. The survey questionnaires focused on providing data for measuring these outcomes. Figures 1 and 2 also show boxes that identify the potential importance of individual characteristics and environmental/socio-cultural context as potential influencers of the connection between nature, wellbeing, and mental health. A range of such variables were included in the survey questionnaires.

Correlations between a range of wellbeing measures at entry were examined for the complete survey sample (from 57 to 62 responses), encompassing loneliness, life satisfaction/ Personal Wellbeing and the Kessler Psychological Distress Scale (K10). High correlations were found between these measures, suggesting that they are, to some extent, measuring the same thing. There is thus a risk of double counting if more than one of these variables is used in CBA for benefit monetization. For that reason, given the availability of monetized values for changes in life satisfaction [9,30], the current analysis relies on measuring and valuing changes in life satisfaction to assess the monetized wellbeing value of the Nature Scripts initiative.

## 2.2. Participant Samples at Entry

Table 1 shows mean values for three core wellbeing outcome variables at entry for the study's comparison and intervention groups, indicating the measures used for each

outcome. All three measures are well-established. The intervention group is divided into two sub-groups for this comparison, those who completed the program once and a smaller number who requested to complete the program twice, to test potential concerns about whether the latter group may have had greater mental health issues at entry.

**Table 1.** Comparing Shepparton Nature Scripts intervention and comparison group participants on key wellbeing outcome indicators at entry.

| Indicator (Source)                 | Comparison Group Means (N = 23) | Intervention Group Means: One Program (N = 22) | Intervention Group Means: Two Programs (N = 17) | Means for all Respondents (N = 62) | One-Way ANOVA: Significance ( <i>p</i> ) |
|------------------------------------|---------------------------------|------------------------------------------------|-------------------------------------------------|------------------------------------|------------------------------------------|
| Loneliness score (UCLA3; [60])     | 6.04                            | 6.18                                           | 7.00                                            | 6.35                               | 0.172                                    |
| Life satisfaction (PWI; [61]).     | 5.58                            | 5.99                                           | 5.33                                            | 5.66                               | 0.376                                    |
| Psychological distress (K10; [62]) | 29.65                           | 30.10                                          | 29.13                                           | 29.67                              | 0.917                                    |

One-way ANOVA tests (Table 1), undertaken using SPSS version 29.0, show that there was no significant difference between the three groups (Comparison; One Program; Two Programs) at entry on these outcome indicators. This suggests that the groups provide a reasonable starting point for assessing intervention effects. The low mean levels for life satisfaction (PWI) for all groups at entry (all <6/10) are concerning, given that (for example) the 2024 mean Australian PWI score was 7.5, with a lower score of 6.4 for 18–24- and 6.3 for 25–34-year-olds (Frykberg et al. [3]), as compared to only 5.66 for the full Shepparton cohort (N = 62). Section 1.1 also noted that the study region generally had a lower mean level of PWI than Australia as a whole (6.0 compared to 7.5).

### 3. Results of the Intervention

#### 3.1. Regarding Aim 1: Measuring Program Benefits

##### 3.1.1. Entry to Program Exit: Wellbeing Benefits

This paper's first aim is to measure wellbeing and mental health benefits arising from the Shepparton Nature Scripts project. Paired samples *t*-tests were performed on entry/exit survey responses from the intervention group to gain an initial indication of whether the intervention had resulted in beneficial short-term outcomes. Table 2 summarizes key results. For those who completed the program twice, the results relate to their first exit interviews. All indicators show significant improvement in mean values and medium to large effect sizes (Cohen's *d*), an encouraging beginning for assessing program effectiveness.

**Table 2.** Paired sample *t*-tests of entry/exit impacts of Shepparton Nature Scripts program on core outcome indicators for the intervention group.

| Outcome Indicator                      | Change in Mean Score | Significance ( <i>p</i> ) | Point est. Effect Size (Cohen's <i>d</i> ) |
|----------------------------------------|----------------------|---------------------------|--------------------------------------------|
| Loneliness Score (N = 35)              | −1.029               | <0.01                     | −0.768                                     |
| PWI (Life satisfaction score) (N = 35) | +0.714               | <0.01                     | 0.737                                      |
| Kessler Score (K10; N = 31)            | −3.032               | 0.003                     | −0.580                                     |

To achieve a more reliable estimate than paired samples *t*-tests can provide about whether the Shepparton initiative produced net benefits for participants, changes in both intervention and comparison group scores needed to be considered. For example, if some

unmeasured variable improved wellbeing indicators for all study participants over the analysis period, that further influence should be removed when calculating the beneficial impact of the intervention on participants. The comparison group provides a general indication of other potential but unmeasured influences on key outcome variables. Also, scores at entry for outcome (dependent) variables needed to be taken into account in assessing impacts to deal with the problem of positive correlations between repeated measures scores for the same individual, which can produce biased coefficient estimates [63].

This discussion of wellbeing results focuses on changes in respondents' life satisfaction, which were measured as changes in their Personal Wellbeing Index (PWI) scores, a well validated measure of life satisfaction [3,61,64]. Mean PWI scores are the average respondent score across seven life satisfaction domains related to satisfaction with your standard of living, health, what you are achieving in life, personal relationships, how safe you feel, feeling part of your community and future security [61]. Mean PWI scores were used, rather than responses to the separate and often-used single life satisfaction question (satisfaction with life as a whole), because mean PWI scores are the life satisfaction indicator for which Stanley et al. [9] derived monetized wellbeing values. There was a significant positive correlation between mean participant PWI scores and their scores on the separate overall life satisfaction question ( $r = 0.706$ ;  $p < 0.001$ ).

The intervention and comparison groups are primarily differentiated in this analysis by the inclusion of an independent variable for the number of Nature Scripts group sessions completed. For the comparison group, this number is zero. For those in the intervention group, in the entry/exit analysis, it is usually six but may be less (mean attendance per participant was 5.15/6 sessions).

In addition to the impact of the Nature Scripts program intervention, participant wellbeing and mental health was also thought to be likely influenced by a number of other variables. Frykberg et al. [3], for example, identified the importance of loneliness in explaining Personal Wellbeing in an Australian setting. This suggests that it may be more difficult for lonely participants to engage fully with Nature Scripts and its social component. Conversely, those reporting higher amounts of contact with people in their community might find the social component of the program easier, which may enable them to obtain greater wellbeing benefits from the program's nature involvement. Other potential influences on PWI, such as age, level of education, gender identity, nature relatedness and race, were also tested but were not found to be significant. In some cases, this may have been due to the narrow data ranges across these variables within the sample population (e.g., all aged 18–25; only 2/62 with a university degree).

After omitting several highly nonsignificant independent variables, the four PWI models shown in Table 3 were estimated. Model 1 explains 58.1% of the variation in PWI scores at exit. It suggests that the number of group sessions completed is a significant contributor to improving PWI from entry to exit ( $p = 0.011$ ). The co-efficient value of 0.144 for group sessions completed (95% CI = 0.035–0.253) suggests that, for a mean participant attendance rate of 5.15(/6) sessions, as in the Shepparton program, a participant's PWI score might be expected to increase by  $0.144 \times 5.15 = 0.742$  units. This is close to the finding from the paired samples *t*-test that mean participant PWI score increased by 0.714 units from entry to exit, which is encouraging: both suggest that program participant PWI probably increased by a little over 0.7 units from program entry to exit.

**Table 3.** Impact of Nature Scripts Intervention on wellbeing: entry to exit (N = 51) \*.

| Attribute                        | Units       | Group Sessions Models |              | Program Involvement Models |              |
|----------------------------------|-------------|-----------------------|--------------|----------------------------|--------------|
|                                  |             | 1                     | 2            | 3                          | 4            |
| Constant                         |             | 2.856 (2.20)          | 1.879 (3.17) | 2.914 (2.21)               | 1.892 (3.10) |
| Group sessions completed         | Number      | 0.144 (2.66)          | 0.091 (1.78) | -                          | -            |
| Program involvement              | 0/1         | -                     | -            | 0.705 (2.37)               | 0.426 (1.49) |
| Contact with people in community | Scale: 1–6  | 0.172 (1.92)          | -            | 0.158 (1.76)               | -            |
| Loneliness total score (entry)   | Scale: 3–9  | −0.073 (−0.76)        | -            | −0.067 (−0.70)             | -            |
| PWI score at entry               | Scale: 0–10 | 0.684 (5.81)          | 0.717 (7.80) | 0.690 (5.76)               | 0.721 (7.74) |
| Pro-environmental behavior score | Scale: 7–35 | −0.055 (1.77)         | -            | −0.057 (−1.79)             | -            |
| NDIS plan                        | 0/1         | −0.239 (−0.85)        | -            | −0.212 (−0.745)            | -            |
| Adjusted R <sup>2</sup>          | n.a. **     | 0.581                 | 0.531        | 0.569                      | 0.522        |

Notes: \* *t* values in brackets; \*\* not applicable.

Using a 5% significance level to suggest significant associations, contact with people in your community at entry was positively, but not significantly, associated with PWI scores at exit ( $p = 0.061$ ). Higher pro-environmental behaviors at entry tended to be associated with reduced PWI scores at exit but without a significant effect ( $p = 0.084$ ). Neither Loneliness scores at entry nor being on a National Disability Insurance Scheme had a significant influence on PWI scores at exit.

Model 1 was re-run, replacing group sessions completed with a dummy variable that indicated whether a participant had, or had not, been a participant in the program. Model 3 in Table 3 suggests that program involvement leads to a predicted increase in PWI score at exit of 0.705 units ( $p = 0.022$ ), which is close to the predicted increase based on mean number of sessions attended from Model 1 (0.742).

Running a parsimonious PWI model that only included PWI scores at entry and group sessions completed as independent explanatory variables (Model 2) reduced the predicted impact of attending 5.15 Nature Scripts sessions to an increase in PWI of 0.47 units, with sessions completed not being significant ( $p = 0.081$ ). Alternatively, using a dummy variable representing involvement in the program or lack thereof in this parsimonious model predicted an increase of 0.426 units in PWI at exit (Model 4) but this result was not significant ( $p = 0.142$ ).

In short, several ways of modeling the entry/(first) exit impact of Shepparton Nature Scripts suggest a substantial gain in PWI (life satisfaction) from entry to exit from participation in the Nature Scripts program, with others suggesting a smaller impact. Model 1, which we prefer, predicts an increase of 0.742 units from entry to exit. This model is preferred because it is sensitive to the level of participation in Nature Scripts (through sessions completed) and controls for several other potential baseline influences on PWI at exit, including PWI at entry. By way of comparison, COVID-19 was associated with a fall in Australian life satisfaction of ~0.4 units [48], so Nature Scripts has the potential to be a very useful program for building life satisfaction if these wellbeing increases can be sustained.

### 3.1.2. Impact on Kessler Scores

Similar analyses were undertaken for changes in Kessler scores (K10), controlling for influences such as Kessler scores at entry, number of sessions completed, loneliness scores at entry and time spent in nature and in physical activity last week (before entry). Better fitting models suggested a ~4 unit decline in someone's K10 exit score after attending 5.15(/6) Nature Scripts sessions (N = 45;  $p < 0.001$ ), one unit more than the reduction predicted by the simpler paired samples *t*-test (Table 2).

### 3.1.3. Social Connectedness

Preliminary analysis only was undertaken on additional outcomes, mainly using parsimonious multiple regression models. From entry to exit, satisfaction with feeling part of your community was found to increase by 0.157 units (on a 0–10 scale) as the number of group sessions completed increased by 1, but this increase was not significant ( $N = 54$ ;  $p = 0.072$ ).

Attending one group session was predicted to reduce a participant's loneliness score from entry to exit by 0.081 units ( $N = 54$ ), which implies a reduction of 0.417 units on a 3–9 scale from attending 5.15 sessions. This result was not significant ( $p = 0.084$ ).

Both these indicators suggest that Nature Scripts increased participant social connectedness to some degree, from entry to exit, although the increases were not significant.

### 3.1.4. Nature Relatedness and Pro-Environmental Behavior

Multiple regression models suggest that the number of group sessions completed was a significant contributor to increased Pro-Environmental Behavior scores between entry and exit ( $N = 52$ ;  $p = 0.027$ ). This result occurred largely because of a strong increase in scores on the Social Environmentalism sub-scale ( $N = 52$ ;  $p = 0.038$ ), which is a positive affirmation of the program's focus on nature. Impacts on the Conservation Lifestyle sub-scale were less marked, probably because respondents tended to already reflect more of these behaviors at entry.

From entry to exit, time spent in nature increased with increased numbers of group sessions completed but this increase was not significant ( $N = 49$ ;  $p = 0.059$ ). However, there was a significant contribution from the number of group sessions completed evident in relation to improved nature relatedness scores at exit ( $N = 53$ ;  $p = 0.037$ ). Neither Nature Relatedness nor Pro-Environmental behavior scores at entry helped explain PWI scores at exit; their inclusion also made only a marginal difference to the beta values for the effect of group sessions completed on PWI.

### 3.1.5. Other Impacts

Program participants' mean numbers of medical and related visits in the two months prior to interview declined from 3.21 at entry to 2.32 at exit ( $N = 39$ ). However, an entry/exit assessment on the full sample suggests that group sessions completed was not a significant factor in explaining the change in medical and related visits.

Respondents were asked "In the last four weeks, how many days were you totally unable to work, study or manage your day-to-day activities because of these feelings". For program participants, the mean number of days declined from 4.59 for the four weeks prior to entry to 2.35 for the four weeks prior to exit ( $N = 32$ ). If sustained for 12 months, this implies an additional 13 days available for work. This reduction was clearly in the desired direction but the size of the reduction was not statistically significant when comparison group participants were included in the analysis ( $p = 0.768$ ).

## 3.2. Follow-Up Comparisons

Follow-up intervention group surveys were undertaken around 6 months after program exit, with similar timing on comparison group follow-up. However, it proved to be very difficult in both practical and ethical terms to ask comparison group respondents to avoid or defer treatment for their mental health concerns for a period of around 8 months in total (from entry to follow-up). Whereas comparison group data was available for ~23 respondents for most entry/exit assessments, only 5 responses to the follow-up questionnaire were received from this group. Analysis of follow-up impacts herein is thus focused primarily on the intervention group, particularly on respondents who completed

all three surveys, with acknowledgement that the lack of a comparison group of similar scale weakens the power of the resulting findings. However, denying possible treatment to a young person in need to achieve higher survey response rates was not an acceptable ethical position for the authors or the project supervisors.

Paired sample comparisons thus provide the main basis for assessing follow-up outcomes in Table 4, complemented by the regression model in Table 5, the latter including the small number of comparison group participants who completed entry and follow-up surveys ( $N = 5$  only). The center section of Table 4 compares intervention group respondent mean scores at exit from the program to their scores around 6 months later. Mean loneliness scores increased a little over this period (scale range is 3–9) but the change in loneliness was not significant. There were no significant differences between the other two outcome indicators from exit to follow-up (PWI and Kessler scores), suggesting that beneficial impacts at exit on the various indicators were sustained up to the follow-up.

**Table 4.** Shepparton Nature Scripts impacts at follow-up.

| Outcome Indicator                        | Exit to Follow-Up    |              |                                       | Entry to Follow-Up   |              |                                       |
|------------------------------------------|----------------------|--------------|---------------------------------------|----------------------|--------------|---------------------------------------|
|                                          | Change in Mean Score | Sig. ( $p$ ) | Point est. Effect Size (Cohen's $d$ ) | Change in Mean Score | Sig. ( $p$ ) | Point est. Effect Size (Cohen's $d$ ) |
| Loneliness Score ( $N = 24$ ; $N = 25$ ) | 0.125                | 0.734        | 0.070                                 | −1.040               | 0.006        | −0.596                                |
| PWI ( $N = 24$ ; $N = 25$ )              | 0.017                | 0.925        | 0.019                                 | 0.742                | 0.004        | 0.636                                 |
| Kessler Score ( $N = 22$ ; $N = 23$ )    | −0.864               | 0.413        | −0.178                                | −5.043               | <0.001       | −1.119                                |

**Table 5.** Impact of Nature Scripts intervention on wellbeing: entry to exit ( $N = 26$ ) \*.

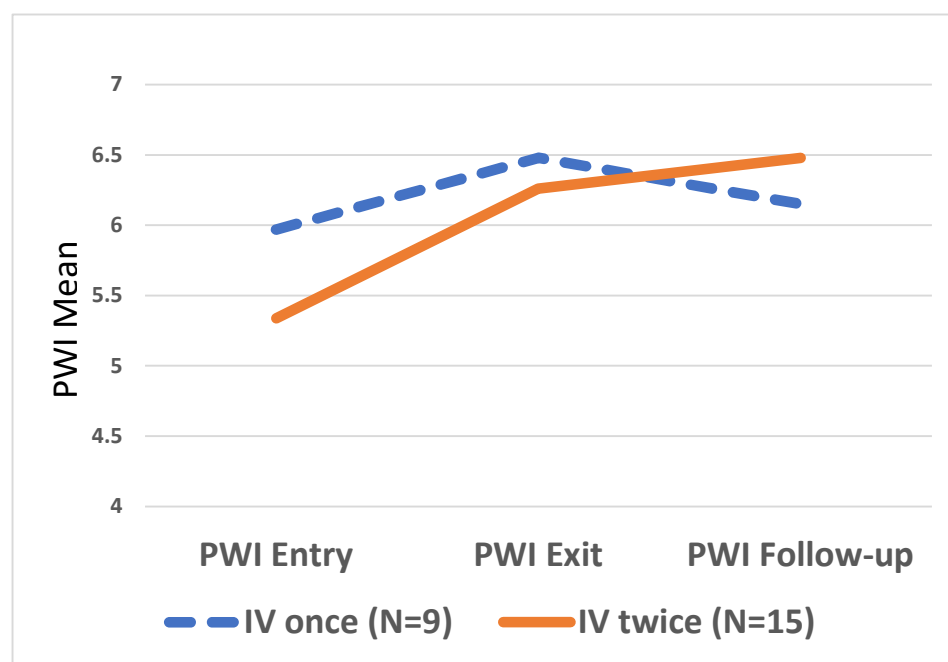
| Attribute                        | Units       | Group Sessions Model |
|----------------------------------|-------------|----------------------|
|                                  |             | Entry/Follow-Up      |
| Constant                         |             | 0.857 (0.47)         |
| Group sessions completed         | Number      | 0.109 (2.06)         |
| Program involvement              | 0/1         | n.a. **              |
| Contact with people in community | Scale: 1–6  | 0.050 (0.41)         |
| Loneliness total score (entry)   | Scale: 3–9  | −0.157 (−1.09)       |
| PWI score at entry               | Scale: 0–10 | 0.865 (5.67)         |
| Pro-Environmental Behavior score | Scale: 7–35 | −0.041 (0.76)        |
| NDIS plan                        | 0/1         | n.a. **              |
| Adjusted $R^2$                   | n.a. **     | 0.59                 |

Note: \*  $t$  values in brackets; \*\* = not applicable.

The second comparison in Table 4 is between intervention group mean outcome scores at entry and those at follow-up. These comparisons show a significant improvement in all three outcome indicators: mean loneliness scores were around 1 unit lower than at entry (on the 3–9 scoring range;  $p = 0.006$ ), PWI was up by 0.742 units ( $p = 0.004$ ), and the mean Kessler score was down by around 5 units ( $p < 0.001$ ), all indicating sustained benefits. Effect sizes were medium to large for the three improved outcomes.

One challenge with the intervention group follow-up data was that the ~24 responses in Table 4 included ~15 (depending on the indicator) from respondents who completed the program twice. Figure 3 tracks mean PWI scores for those who completed the program once and those who completed it twice, from entry through exit to follow-up, using only data for those who completed all three questionnaires. Mean PWI score at entry was lower for those who completed the program twice but a strong increase in the mean PWI at exit,

and a further increase up to the follow-up, resulted in those who completed twice having a higher mean PWI score at follow-up than those who completed once, a striking result. The entry-to-follow-up gain in mean PWI scores for those who completed the program twice was a very strong 1.14 units, whereas it reduced to a net gain of 0.18 units at follow-up for those who completed it once. The latter group lost around two-thirds of the increase they achieved from entry to exit. The loading of respondents in favor of those who did it twice thus explains the finding that PWI levels overall were sustained from exit to follow-up. This highlights that completing the program twice was important for many participants to experience sustained beneficial life satisfaction outcomes.

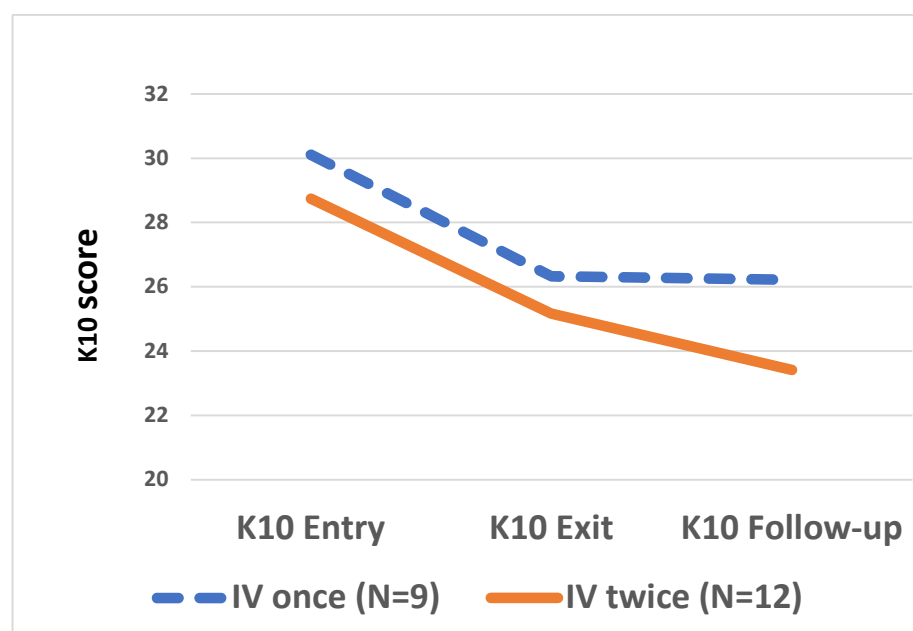


**Figure 3.** Mean PWI levels of intervention group respondents who completed all three surveys.

As a check, regression Model 1 was re-run for an indicative entry/follow-up comparison using data from respondents in the two intervention groups included in Figure 3 plus data for the five comparison group participants who completed all three surveys. This gave us a small entry/follow-up sample for PWI analysis of 26, with some respondents attending no sessions, some attending 4–6 sessions and others attending 10–12 sessions. This model (Table 5) suggested that an additional session would increase PWI by 0.109 units (95% CI = −0.001–0.219), this increase being almost significant at the 5 percent level ( $p = 0.051$ ), albeit with a large confidence range due to the small sample size. Given a mean participation rate of 7.9 sessions for those who completed the program, this would predict an increase of 0.861 units in PWI from entry to follow-up. This result can be no more than indicative, given the challenges with the comparison group sample size, but the regression results do align well with the entry-to-follow-up paired samples  $t$ -test findings. These results are supportive in terms of the direction and broad scale of change they are suggesting but would be more compelling with a larger sample size at follow-up, particularly for the comparison group.

Figure 4 shows similar data to Figure 3 for Kessler scores (K10) at entry, exit and follow-up, again for those who completed all three surveys. From entry to follow-up, mean K10 scores improved by around 4–5 units, with larger mean improvement for those who completed the program twice. This provides further support for the suggestion that completing the program twice is important for some people. Those who completed the program once improved their mean K10 scores between entry and exit but showed little

change from exit to follow-up. In contrast, those who completed it twice had a similar mean improvement in K10 scores from entry to exit but achieved further gains in the time to follow-up.



**Figure 4.** Mean K10 scores of intervention group respondents who completed all three surveys.

In terms of other outcome variables of interest, paired sample comparisons on intervention group participants who completed entry and follow-up surveys suggest that Nature Relatedness Scale (NR6) and Pro-Environmental Behavior Scale scores each increased by ~4%, while satisfaction with feeling part of your community improved by ~10%. While these changes were in the desired direction, none were significant. For Nature Relatedness this may suggest trait characteristics, at least within the bounds set by the Shepparton project (e.g., degree of nature involvement; study period). A parsimonious ordinal regression model controlling for frequency of community contact at entry suggested that the number of group sessions completed was close to being significantly positively correlated with frequency of contact with people in participants' wider community at follow-up ( $N = 22$ ;  $p = 0.058$ ), suggesting that the program helped improve participants' bridging social capital.

The latter finding, and the findings on loneliness, provide some support for the sustained success of the social dimension of the Nature Scripts program. In contrast, while nature relatedness and pro-environmental behavior scores improved significantly from entry to exit, those improvements were not sustained at a significant level at follow-up. Small sample sizes at follow-up pose some questions about the reliability of these findings.

### 3.3. Participant Interview Findings

In addition to the three rounds of survey questionnaires, reactions to the Nature Scripts intervention were also obtained through participant interviews. Two rounds of such interviews were held, involving 12 (of 39) participants in total. Two of the authors conducted all these semi-structured interviews. Interviews were also held with the program organizers, who were trained counselors, and three activity providers.

The program was positively received by all interviewed participants, very positively by most, with participants expressing a desire for further activities like these. For example, comments made by different people included: 'Please keep it going'; 'the nature and social side of the program both work'; 'the program got me to parks and places I haven't seen

before, I got out to do more stuff’ and ‘Nature was a new experience. I sometimes wander into the bush—more often now I have done the program, most places are nice and calming’.

In summary, other findings included the following:

- The predominant motive for participant involvement was social; participants commonly reporting social anxiety at program entry, often resulting in a tendency to avoid contact with others.
- Perceived participant benefits were typically related to increased confidence in social settings (“I go out and socialize more now—I feel more comfortable doing this”).
- The program’s focus on a range of nature-based activities, rather than repetition, was important in sustaining participant interest.
- While the main perceived benefit was social, participants recognized that nature provided a platform that enabled realization of those benefits.
- Program facilitation (e.g., small groups, easy-going and friendly atmosphere; “chilled but not pressured”; a meaningful and supportive platform and skilled counselors) was also important in providing a foundation for benefit realization such that participants could engage with program activities and other participants in the way that best suited how they were feeling.
- Several participants reported little prior contact with nature, with most participants reporting that the Nature Scripts program gave them an increased appreciation and understanding of nature and a desire for greater nature contact arising from the activities undertaken, which is a positive outcome for environmental sustainability.
- The capacity of participants to get to activities was often a challenge (no car and/or poor public transport availability), with program organizers often needing to act as transport providers to support participant attendance.

The importance that respondents attached to opportunities to continue engaging in group-based activities in nature, after completion of the 6-week Nature Scripts program, reinforces the likelihood that participant benefits will decline over time in the absence of such opportunities, as also inferred from the follow-up survey results.

### 3.4. Regarding Aim 2: Valuing Changes in Wellbeing

The UK monetary value for a one-unit increase in someone’s life satisfaction can be represented by 45% of the 2019 UK mean household income [30]. The comparable value from Stanley et al. [9] was 49% of the mean household income of their sample (2008 study), which was strikingly close to the UK percentage and a little below what Biddle et al. [48] found, providing some assurance in terms of using the Stanley et al. [9] values to evaluate the wellbeing benefits of Shepparton Nature Scripts. These values have been updated from 2008 to 2023 prices, using the approach recommended by HM Treasury and SITF [30] but with a lower marginal utility of income elasticity. An elasticity value of  $-1.0$  (rather than  $-1.3$ ) was used to mirror the wellbeing modeling results in Stanley et al. [9], whose monetized values are used here. This results in the mean value of a one-unit change in someone’s PWI (subjective wellbeing) increasing from AUD 110/day (in 2008 prices) to AUD 156/day (2023 prices). Given an elasticity value of  $-1$  for the marginal utility of income, this value should arguably then be adjusted upwards to allow for household incomes in Greater Shepparton being only 73.6% of those in Greater Melbourne (in 2021). This paper conservatively uses the core value of AUD 156/day and undertakes a sensitivity test for the higher value.

The preferred model, Model 1 (Tables 3 and 5), suggests that participation in Shepparton Nature Scripts will lead to a mean PWI increase of around 0.7+ units from entry to exit. At a AUD156/day/unit benefit, this implies a potential mean monetized benefit value of AUD 109 per participant per day, or around AUD 19,875 if this level of benefit can

be sustained for six months (Table 6). Follow-up data suggests that having a number of participants undertake the program a second time is needed to sustain the level of benefits at exit to the follow-up, when they might otherwise decline by about two-thirds. Allowing for a drop-off at this scale would reduce the monetized value of the participant benefits over a 6-month period, valued via changes in PWI, to ~AUD 13,300 per participant, assuming that the wellbeing decline occurs in a linear fashion. This lower benefit figure would form the applicable benefit estimate for those who complete the program once. The value in question would be lower if benefits declined more rapidly than is implied by the assumed linear rate of loss.

**Table 6.** Estimating participant benefits in life satisfaction over six months after the Shepparton Nature Scripts Program.

| Benefit (Outcome) Indicator | Predicted Participant Increase from Program | Unit Benefit Value/Day (AUD) | Predicted Daily Benefit Value per Participant (AUD) | Participant Benefit If Sustained for 6 Months (AUD) | Participant Benefits over 6 Months If Gains Decline (AUD) |
|-----------------------------|---------------------------------------------|------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------|
| Life satisfaction           |                                             |                              |                                                     |                                                     |                                                           |
| - 5.15/6 sessions           | 0.7 units                                   | 156                          | 109                                                 | 19,875                                              | 13,300                                                    |

The Swedish analysis by Andrén [49] suggests that wellbeing costs incurred by friends and colleagues of someone suffering from a mental illness add about 30 percent to societal wellbeing costs. It seems reasonable to assume, by extension, that improving someone's mental wellbeing will also deliver some wellbeing benefits to those friends and colleagues. If they are of a similar order to the Swedish impacts, then the core conservative estimate of PWI wellbeing benefits from Nature Scripts would increase from around AUD 19,875 to over AUD 25,000 per participant.

### 3.5. Regarding Aim 3: Cost of Program Replication and Resulting Project Benefit–Cost Ratio

*Headspace* estimates that replication of the Nature Scripts program for three sequential groups would cost around AUD 50,000 in 2023 prices. This is based on ~AUD 35,000 for program staffing (one counselor at 0.4 full-time equivalents plus one support worker at 0.2 FTE to run the program), including organizational overheads, plus ~AUD 15,000 for payments to activity providers. Intervention group data suggests that PWI gains from entry to exit will be sustained to follow-up if around half the participants participate in the program twice. This suggests that the program participation opportunities provided by running the program three times would cater to 12 separate participants, 6 completing it once and 6 twice (for an average of nine sessions per participant).

Participants will incur travel costs to attend the program, nominally estimated at around AUD 25/session, suggesting a total cost of AUD 150 per group session, or AUD 2700 overall for 18 sessions (if all attend). Participants will also incur time costs for around 3 h per session but experience with the Shepparton project suggests that this activity may substitute for another leisure type activity, such that the net cost for the project is minimal, or even zero. However, if that time was to be fully evaluated for its cost and notionally charged against the project, the current private time value recommended in Australian transport planning guidelines, AUD 21.10/h (2023 prices) [65], is relevant for pricing the time involved. Assuming 3 h per session, from leaving home to returning home, there is a cost of AUD 63.30/participant per session or AUD 380 for six participants. Over 18 sessions this results in a notional time cost of AUD 6840 (rounded). In short, participant travel

and time costs will add between AUD 2700 and AUD 9540 to the AUD 50,000 costs for program delivery.

Table 6 suggests that the mean benefit per participant can be reasonably valued at ~AUD 19,875, which sums to AUD 238,500 for 12 participants, assuming that 6 complete the program twice and 6 once. This results in a strong Shepparton Nature Scripts benefit/cost ratio of 4.33, if participant time costs are excluded ( $=\text{AUD } 238,500 / \text{AUD } 52,700$ ), or 4.01 ( $=\text{AUD } 238,500 / \text{AUD } 59,540$ ) if participant time costs are included in program total costs.

#### 4. Discussion

This evaluation has found that a program involving curated group-based nature exposure, run by professionals, can improve mean levels of participant life satisfaction (wellbeing), reduce loneliness and reduce Kessler scale scores (psychological distress). The wellbeing benefits involved are estimated to be worth around four times the costs of the program, a solid result. These findings, in combination, show that the program has improved social sustainability and done so in an economically sustainable way. It has achieved this using the third leg of sustainability, the environment (nature) as an enabling platform.

While there have been previous CBA studies calculating the value of social prescribing, as illustrated in Section 1.2, this project is the first, to the best of our understanding, that has undertaken a CBA of nature prescribing. It has done so in a study that applies curated nature prescribing in a group-based way, both features (curated nature-based; group-based) being important to the good outcomes that have been identified. The authors believe that the range of core reported benefit/cost ratios (4.01 to 4.33) is conservative for several reasons: it includes only life satisfaction benefits, and only counts these benefits for six months and it does not equity weight benefits. For example, allowing for equity weighting (to recognize low household incomes in Greater Shepparton and using an elasticity value of  $-1$  for the marginal utility of household incomes) would increase the BCR range of 4.01–4.33 by 35.8%, to 5.44–5.88.

Benefits have been assumed to fall to zero for all participants at 6 months post-program completion, an unlikely outcome. However, we have no basis for knowing how they will evolve from there. We can say, however, that continuation of curated nature dosing in a group setting is likely to support benefit levels through both the exit-to-follow-up period and beyond. The BCR also ignores wellbeing benefits to the family and associates of the impacted person, which Swedish research has suggested could add 30% to total wellbeing benefit values [49].

A further reason why the result is conservative is that other potential benefits have been identified (e.g., improved Kessler scores and reduced loneliness) but not monetized, either for conservatism, such as to reduce the risk of double counting benefits, or for the lack of suitable monetary values. For example, wellbeing benefits (as measured and monetized) are likely to pick up some of the value of the improvement in loneliness and reduced Kessler scale scores (psychological distress). We have no basis for knowing the extent to which this happens, which should be a subject for further research.

The range of curated nature-based activities that comprised the Shepparton Nature Scripts project and its group-based delivery mode have meant that this evaluation is not able to ascribe benefits to individual nature-based activities or to split benefits between those due mainly to nature-based activities and those due mainly to the group-based delivery mode. Discussions with participants highlighted that both were important in improving their mental health and wellbeing.

Recruiting participants for the Shepparton comparison group was a challenge, given that such recruitment should mean denial of the opportunity to participate in this, or

another, *headspace* or related program, for about eight months (unless urgent). This was a particular problem while analyzing follow-up outcomes. It has been difficult to obtain a clear picture of what treatment, if any, that comparison group participants might have received external to *headspace* over the program period, even though the aspiration was that there be no such treatment. This poses some questions about the extent to which the comparison group represents a strict ‘no intervention’ group (hence why the group was called comparison rather than control). Any intervention received by comparison group participants between entry and exit was likely to have improved their wellbeing and, accordingly, was likely to reduce the estimated entry-to-exit impact of Nature Scripts on those who undertook that program, since this impact was evaluated as the difference between the intervention and comparison groups. This may have been a source of underestimation of the wellbeing impacts of Nature Scripts from entry to exit.

One major consequence of the difficulties of recruiting and retaining comparison group participants for a period of around eight months was that analysis of entry-to-follow-up impacts had to rely mainly on paired samples *t*-tests conducted on data from program participants (N~25 across the three outcome measures). The addition of five comparison group participants enabled a multiple regression analysis to be undertaken, which controlled for baseline measures, the result of which was supportive of the paired sample test for the main outcome measure (Personal Wellbeing Index scores). Individual discussions with program participants also pointed strongly in the same direction in terms of outcomes, namely that the curated group-based nature exposures enabled through Nature Scripts improved the life satisfaction of most participants. A larger sample size at follow-up would have enabled more sophisticated analysis and for findings about outcomes at follow-up to be more accurately quantified. However, the direction of change is still apparent: improvements in life satisfaction and mental health for most participants, particularly those who completed the program twice.

## 5. Conclusions

The mental health of young adults is a widespread and growing societal concern in many communities, posing a barrier to social sustainability. Prescribing exposure to nature as a form of treatment is of increasing interest. This research builds on the growing body of research about nature’s connections to life satisfaction, mental health and loneliness, nuanced in this case by the current study’s findings relating to curated group-based nature exposure for young adults with mild to moderate mental illness. Recognizing this nuance, similarly to authors such as Bratman et al. [10] and White et al. [39], this study finds a positive association between nature exposure and life satisfaction, the two-hour Nature Scripts sessions having drawn on White et al.’s [39] findings on time in nature. Like Capaldi et al. [36], it finds a positive association between nature exposure and mental health. Like Astel Burt et al. [22], it finds a positive association between nature exposure and reduced levels of loneliness. Like Nisbet and Zelenski [38], it finds that nature relatedness is not a good predictor of life satisfaction. Like Menhas et al. [25] and Nguyen et al. [14], it finds that nature-based social prescribing for treating mental health conditions benefits from having a professionally guided program. And, like Nejade et al., [42], it finds that the presence of other participants is helpful in nature-based treatment of mental health conditions. However, unlike these other studies, the Shepparton study was able to both monetize life satisfaction (wellbeing) benefits and then undertake a CBA of the intervention that generated those benefits. It shows that the monetary value of wellbeing benefits is substantially higher than the cost of the program. Allowing for a mix of people completing the program once and others completing it twice, a conservatively estimated benefit–cost

ratio of over 4 was calculated based on life satisfaction benefits alone. This CBA application to curated, group-based nature prescribing is the study's main contribution to knowledge.

The CBA benefit–cost ratio of 4 or above, a solid outcome, adds economic sustainability to the social sustainability value of the program. A higher BCR is quite likely, given the conservative assumptions that were made about benefit type (life satisfaction only) and benefit duration (six months only), the absence of equity weighting of benefits and the exclusion of benefits to associates. The program's wellbeing benefits will support improved social sustainability through reducing program participants' risks of social exclusion. The study has also noted indications of improved contact with others in the community. Nature relatedness and pro-environmental behavior improved from entry to exit but that improvement was not sustained at a significant level up to follow-up.

A strong finding of the Shepparton research project, both quantitative and qualitative, is that one six-session Nature Scripts program is unlikely to be enough to sustain wellbeing gains for many at-risk young people. Either providing opportunities for a second such program or providing access to alternative curated group-based nature exposures is thus an important step in sustaining a successful program like Shepparton Nature Scripts over the long term for young adults with mild to moderate mental illness. It is encouraging that *headspace* and some of the activity providers are looking at opportunities to meet the perceived need for additional group-based nature contact.

The importance of the program being delivered by trained professionals is also apparent. Qualitative discussions, in particular, highlighted the critical role this played in encouraging and supporting participants throughout.

Difficulties in recruiting and retaining people to form a comparison (or control) group up to follow-up who should not receive treatment for around 8 months proved very challenging and meant that the project's conclusions about the impact scale at follow-up need to be tempered. The project's calculated benefit–cost ratio, however, is sufficiently strong that the evaluation could have made several errors in estimating reduced benefit levels but still remain solidly positive.

People and Parks Foundation is currently undertaking a Nature Scripts program with patients from a major Melbourne hospital's cancer ward and is also initiating a program with schools. These further projects will provide valuable insights into key features needed for an effective group-based nature-based intervention.

**Author Contributions:** Conceptualization, J.K.S.; methodology, J.K.S. and J.R.S.; validation, D.V.-B.; formal analysis, J.K.S.; investigation, J.K.S. and J.R.S.; data curation, J.K.S. and J.R.S.; writing—original draft preparation, J.K.S., J.R.S. and D.V.-B.; writing—J.K.S., J.R.S. and D.V.-B. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the University of Melbourne (No. 25137, 1 June 2023).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

**Acknowledgments:** The authors thank People and Parks Foundation and *headspace* for initiating the Nature Scripts demonstration project and for their assistance during the evaluation. We also thank project participants for their willingness to engage with the evaluation. Dianne Vella-Brodrick also wishes to thank the Higgins family for supporting her role as Gerry Higgins Chair in Positive Psychology at University of Melbourne.

**Conflicts of Interest:** The authors declare no conflicts of interest. John Stanley is a pro-bono director of People and Parks Foundation. He was not involved in development of the Nature Scripts demonstration project, only its evaluation, as reported herein.

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