

**Putting Nature back into Nurture:  
The Benefits of Nature for Children**

A Literature Review

**Prepared for:**

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## Summary

Environments containing natural elements (such as trees, rocks, water) provide people with unique and unrivalled mentally restorative settings. It is evident from international research that nature contact is associated with positive physical and mental health for adults, and increasing evidence indicates children also benefit from contact with nature, as it supports their personal and social development, as well as mental and physical health. This is particularly important given the many concerns surrounding the status of physical, mental and social health of many youth today.

Changes in western culture have led to children spending less time outside than previous generations. A vast majority of children spend more than the recommended two hours a day in front of electronic screens and increasingly, it appears many children spend only small amounts of outside time. These changes have resulted in a reduction in the time children spend in contact with nature, an activity that they enjoy and consider an important part of their life.

The reduction in contact with nature is concerning; through mechanisms such as reversing fatigue, providing varied learning environments, enhancing social cohesion and support and providing important micro-organisms, contact with nature is thought to be associated with various aspects of children's health, behaviour and learning.

This report reviews original research studies and finds that increased contact with nature is associated with positive attributes of children's health, behaviour and learning.

Specifically, the evidence to date indicates that:

- There is a decreased risk of children being overweight when more nature is present in their neighbourhood.
- Playing in natural environments assists with building children's motor skills.
- Nature contact enhances children's learning and development. Programs increasing nature contact have identified beneficial effects on children's personality development, cognitive functioning, attitude and school behaviour.
- Contact with nature, especially during middle childhood, has been indicated as having an important role to play in children's mental health
- Children's manage stress better when they have more contact with nature.
- Time in nature assists the performance of children with ADHD.
- Children displaying delinquent behaviour benefit from nature-based programs such as wilderness camps.

New programs to promote increases in children's contact with nature are available both in Australia and internationally, however evaluation and research as to their effectiveness is required. Whilst more research will assist with establishing the role of nature in enhancing children's lives, sufficient evidence is available now to indicate that there is an imperative to promote the substantial reestablishment of nature into children's lives.

# Background: Childhood health and behaviour

## Children's health issues

An emerging crisis in the physical and mental health of today's youth is evident. Nearly one quarter of Australian children have been identified as overweight or obese<sup>1</sup> and a global rise in asthma rates has been detected<sup>2</sup>. Adding to this health burden, 14% of children have been diagnosed with a mental health disorder in Australia<sup>3</sup> and the proportion of children with Attention-Deficit/Hyperactivity Disorder (ADHD) is around 11%<sup>4</sup>. Furthermore, the prevalence of juvenile arrests in Australia and other western societies has increased dramatically over the past 10 years<sup>5,6</sup>.

## Screen-based behaviour

Cultural changes including technological advances have led to changes in children's behaviour and daily activity patterns. Screen-based activities are becoming increasingly popular<sup>7</sup>; one recent Western Australian study<sup>8</sup> found that over 70% of primary children reported participating in more than the recommended maximum of two hours electronic media activity on all of the seven days prior to the survey. Similar proportions of children exceeding guidelines have been revealed in other Australian<sup>1</sup> and international research<sup>9</sup>. The various impacts of excessive time inside and extensive contact with screen-based activities, such as televisions and computers, are only starting to be understood. However, evidence to date indicates that there is an association between higher screen-based activity and poor physical and mental health and risky health behaviours<sup>10</sup>. For example higher time viewing television has been shown to be associated with increased risk of overweight and obesity<sup>11</sup>, higher caloric consumption, attention problems<sup>12</sup> and number of sleep disturbances<sup>13</sup>. Higher time spent in sedentary activity, both after school and on weekends, has consistently been found to be associated with lower adolescent physical activity<sup>14</sup>.

## Physical activity and time outside

Corresponding with increased screen-based activities, and the advent of an increasingly inside existence, children are spending less time being physically active and less time outside. Trend data suggests declines in childhood physical activity over time<sup>15, 16</sup>. After examining research between the 1930s and 1980s, Durnin concluded children's average daily energy expenditure had reduced by around 600-700 kcal<sup>17</sup>. This is not surprising as children now spend another six hours a week in school,<sup>18</sup> participate in less school PE<sup>19-21</sup>,

participate in less active transport<sup>15, 22</sup> have 12% less leisure time<sup>18</sup> as well as engage in more sedentary pursuits than previous generations<sup>23</sup>. Furthermore, research suggests children's physical activity performance is lower than in previous years, with reduced rates of aerobic fitness identified<sup>24</sup>.

A review of research examining factors associated with children's physical activity identified time outside to be consistently positively associated with children's physical activity<sup>14</sup>. A NSW study identified that 37% of 10-12 year old children spent less than 30 minutes a day playing outdoors after school<sup>25</sup>. Furthermore, a Child Development Survey of data collected from three to 12 year old children in the US in 1997, and again in 2003, identified that the biggest change in children's activities was a large reduction in the average time children spent in unstructured outside play, which reduced from an average of 36 to 25 minutes per day<sup>7</sup>. An Australian study found that each additional hour spent outdoors during the cooler months was associated with an extra 27 minutes per week of physical activity for girls and with an extra 20 minutes per week physical activity for boys<sup>26</sup>. This study also found that longitudinally, more weekend time outdoors was associated with higher weekend physical activity for both girls and boys. Time outdoors has been associated with the prevalence of overweight; with 27–41% lower rates of overweight and obesity measured amongst those children spending more time outdoors<sup>26</sup>.

### **Nature deficit**

With little time spent outside children are also at risk of negative consequences resulting from inadequate contact with nature, or Nature Deficit Disorder; a term coined by Richard Louv<sup>27</sup>. Bringing children back to nature may redirect unhealthy behaviours and assist with developing healthy minds and bodies. Promoting increased time outside for youth may benefit children's health as a result of increased physical activity; however evidence also suggests that other aspects of children's health, behaviour and learning may be improved by increasing children's contact with nature.

### **Benefits of nature**

Nature can be described broadly as living and natural forms and environments, and in this context, considered as diverse as bushland and beaches, or as restricted as parks and gardens. Contact with nature has been shown to benefit adults as it is positively associated with positive physical and mental health<sup>28</sup>. Studies with adults have repeatedly shown

positive psychological and physiological states resulting from interaction with nature. Specifically, contact with nature has been indicated to decrease stress<sup>29</sup>, reduce anger<sup>30</sup>, and improve attentional test results and performance<sup>30</sup>. Adult study participants viewing nature videos recorded lower heart rates than those viewing urban environments<sup>31</sup>. Lower blood pressure was recorded in young adults walking in a natural setting when compared to an urban environment<sup>30</sup> and even just having a hospital window with a view has been shown to improve healing, both in the level of pain medication and the speed of recovery after surgery<sup>32</sup>.

## Nature and children

In addition to promoting and supporting adult health, research indicates that contact with nature is beneficial to children's health, behaviour and learning, and that children enjoy being with nature.

### **Natural affiliation: children enjoy nature**

Children want more nature in their neighbourhoods. In a study spanning four countries, Lynch<sup>33</sup> identified that, despite their location, youth frequently commented on their desire for more trees in the city. Recognising that children's hunger for trees was outspoken and seemingly universal, Lynch has argued that landscaping in cities should be an essential part of basic infrastructure<sup>33</sup>. In a Swedish study of playground preferences, children reported to want many possibilities for activities in play areas, and to be able to access forested areas<sup>34</sup>. Another cross-sectional study compared environmental attitudes of children growing up in diverse neighbourhoods such as the Amazon jungle, and inner city Houston, Lisbon and Portugal. In all these locations the majority of children held positive attitudes towards nature and classified nature as being highly important to them<sup>35</sup>. In a photographic exploration of adolescent behaviour in California, adolescents recorded and detailed widespread use of nature and reported valuing nature highly<sup>36</sup>. When Moore<sup>37</sup> explored children's play space preferences in England, 96% of children drew pictures of an outside space.

Adults may not fully understand the affiliation children have with nature and the extent to which children enjoy playing in nature. In another examination of children's perspectives of play spaces<sup>38</sup>, children identified that natural materials and environments were very important to them, and that they perceived adults had little insight into this feature of

children's play. In an assessment of children's and adults' playground preferences as part of efforts to develop a new play area, Francis<sup>39</sup> noted that children requested water and loose elements which change over time, and that they prefer challenging and fantasy elements in their play areas. Parents requested more traditional play environments that were safe, neat and fixed. The highest ranked preferential play equipment item identified by children was open imagination areas, whereas parents identified a slide<sup>39</sup>.

### **Nature cultivates children's physical health**

Playing in natural environments assists with building children's motor skills. Fjørtoft<sup>40, 41</sup> examined the motor functioning of two groups of kindergarten children, one with access to a forest for play, the other only a traditional urban playground. After one year children with access to the forest environment had significantly more improvement in their motor skills, balance and coordination than those children with access to only the traditional playground. Results from a similar study held by Grahn and colleagues (cited in Fjørtoft 2001<sup>40</sup>) indicated better motor performance in kindergarten children who had access to a more natural play environment when compared to children with access to a more traditional urban play setting.

More nature in the neighbourhood is associated with decreased risk for childhood overweight<sup>42-44</sup>. Body mass index, demographics and neighbourhood vegetation were recorded for over 7000 children in Indiana<sup>42</sup>. Increased neighbourhood vegetation was associated with decreased risk for childhood overweight in higher population density regions. This may be due to an increase in physical activity, as a higher number of trees has been shown to be associated with higher use of outdoor spaces by children in inner-city neighbourhoods with more trees<sup>44</sup>. Additionally, time spent in natural spaces was found to be associated with greater physical activity intensity amongst children when compared to outside non nature-based areas<sup>45</sup>. A more recent study exploring neighbourhood greenness indicated that children and youth living in greener neighbourhoods exhibited lower body mass index regardless of residential density<sup>43</sup>.

### **Children's learning and development grows with nature**

While children enjoy playing in nature, it appears that the majority of children's outdoor activity occurs outside of nature<sup>45</sup>. This is concerning as evidence suggests contact with nature enhances children's learning and development.

*'... few areas of life provide young people with as much opportunity as the natural world for critical thinking, creative inquiry, problem solving and intellectual development' (pgs 124-5)<sup>46</sup>.*

After exploring children's interaction with nature, Sobel<sup>47</sup> concluded that contact with nature was important in children's personality development. Another study has shown that contact with nature is likely to enhance children's cognitive functioning. Wells<sup>48</sup> explored children's cognitive functioning before and after families moved within low-income neighbourhoods in the United States. Although the sample was only small (17 participants), the study results indicated that children whose new homes had the most increase in surrounding nature had the greatest ability to direct their attention following the move<sup>48</sup>.

Children's learning, attitudes and behaviour at school have been improved when using the environment as the basis for school curriculum. A large education-based program used the concept of incorporating the school's surrounding natural environment as the basis for school curricula within 40 schools in 12 States in United States<sup>49</sup>. Evaluation of the new curricula indicated that the program led to greater academic achievement, improved classroom behaviour and management, increased engagement and enthusiasm for learning and greater pride and ownership in accomplishments.

Contact with nature may need only to be visual to benefit children. Views from windows may assist with improving attention and learning. In a Californian study examining the school indoor environment and children's performance, researchers gathered information about student, teacher and school demographics along with physical conditions of 450 classrooms<sup>50</sup>. Results indicated that the visual environment was important for learning, and that an ample and pleasant view out of a window (that included vegetation) supported better study learning outcomes. Indeed, the researchers highlighted that the physical characteristics of a classroom, most notably window characteristics, were as significant (and of equal or greater magnitude) as teacher characteristics, number of computers, or attendance rates in predicting student performance. A study was held in a low socio-economic inner-city housing estate in Chicago<sup>51</sup>. With a high response rate of 97%, 169 child-adult pairs were interviewed and views from their apartment windows rated. Children completed tests related to self-discipline including concentration, inhibition of impulse and delay of gratification tasks. Results indicated that girls' self-discipline was higher when the apartment had views incorporating nature, although not significantly different for boys.

## **Nature nurtures children's mental health**

Contact with nature, especially during middle childhood, has been indicated as having an important role to play in children's emotional responsiveness and receptivity<sup>52, 53</sup>. Nature has also been indicated as being associated with children's stress management. Impact of life stress on children was examined by Wells and Evans<sup>54</sup>. Natural vegetation near the residential environment was objectively measured for 337 children in grade three to five in rural New York communities. Results indicated that the presence of nearby nature moderates (buffers) the impact of life stressors on children. A study in Northern England<sup>55</sup> explored the influence of childhood play experiences, particularly in local woodlands, on mental wellbeing in young adults using focus groups and interviews. The researchers concluded that, while some aspects of woodlands were considered scary during childhood for some participants, the woodlands were an important resource for the promotion of well-being and for the alleviation of stress and anxieties for the children.

Outdoor education classes are associated with positive mental and social outcomes for children. Meta-analysis of 43 adolescent outdoor programs<sup>56</sup> found that after completing an adventure program, participants were more internal in their locus of control, had more positive self-concept and better academic achievement. Another meta-analysis<sup>57</sup> incorporating research of over 12 000 youth also established the positive impact from participating in outdoor adventure programmes on leadership, self-concept, academic achievement, personality and interpersonal relationship.

Time in nature has also been indicated as assisting the performance of children with ADHD. An intervention study<sup>58</sup> examining concentration levels of children aged seven to 12 concluded that a twenty minute walk in the park produced a positive effect (an as large as the negative deficit due to ADHD and as large as the effect of an ADHD drug treatment). This effect was not replicated in 20 minute walks 'downtown' or in a 'neighbourhood' environment and children reported significantly higher positive ratings of the walk in the park experience than the walk in the other settings. Similar results were found by this team in an earlier studies<sup>59, 60</sup> in which children with ADD were measured to function better than usual when after school activities were held in green settings. They also found that the more nature in a child's play area, the less severe their attention deficit symptoms<sup>59, 60</sup>.

Children displaying delinquent behaviour may also benefit from nature-based programs such as wilderness camps. Wilson and Lipsey<sup>61</sup> reviewed the impact of wilderness programs

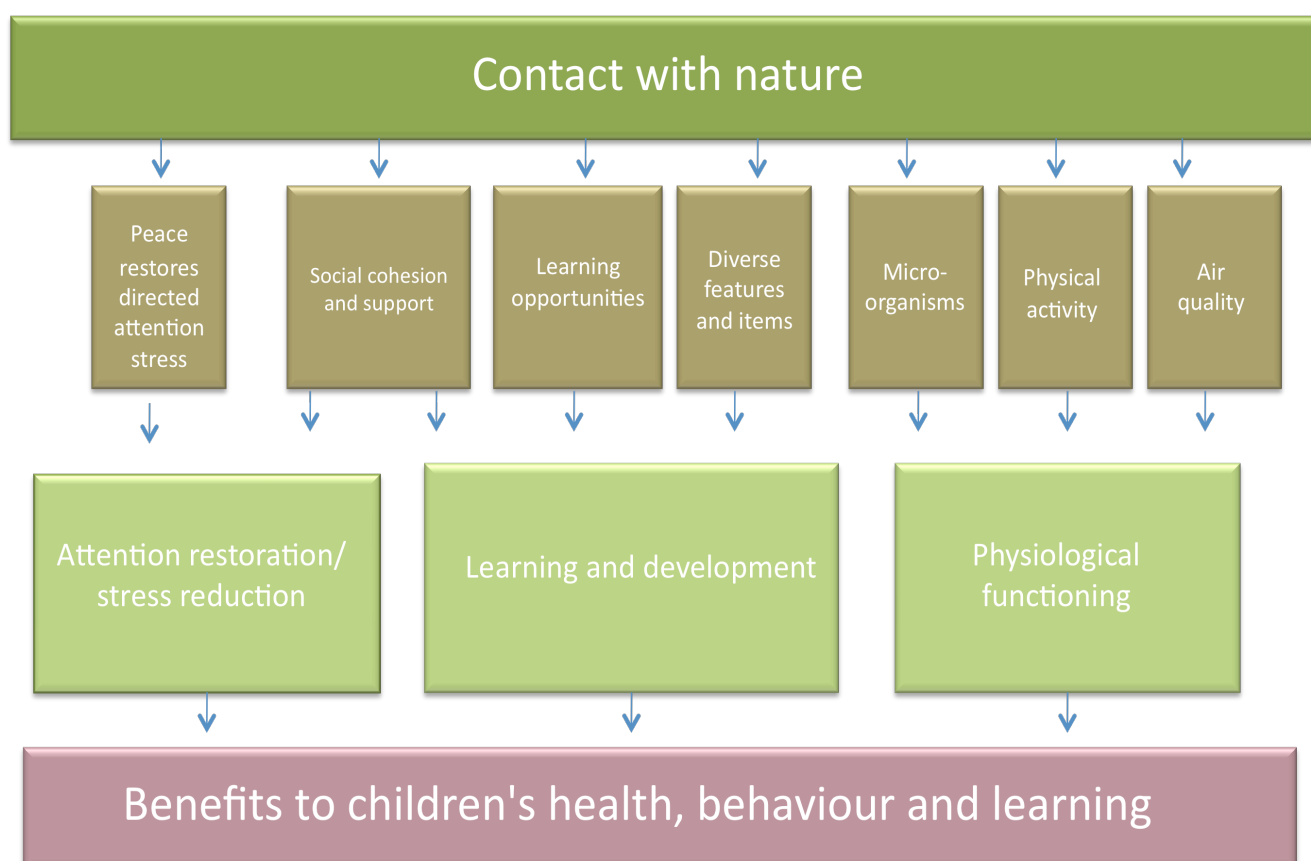


on children experiencing, or at risk of delinquent or antisocial behaviour. The meta-analysis indicated the wilderness programs were effective in reducing antisocial and delinquent behaviour.

## How does nature nurture?

Research is only just beginning to unpack the mechanisms through which nature is beneficial to health, learning and behaviour. While the concept that nature provides restoration for mental fatigue arising from prolonged attention arose in the 1990s, more recent theories have been proposed, for example the provision of physiological benefits from nature, such as inhaling or ingesting beneficial soil bacteria. A model proposing the mechanisms through which nature is likely to benefit children is detailed in Figure 1 and a brief synopsis of potential mechanisms follows.

**Figure 1: Proposed mechanisms through which nature contacts benefits children health, behaviour and learning.**



### Natural restoration: the role of nature in reversing fatigue

The very nature of modern day existence, which often requires extended periods of concentration, is proposed by Kaplan<sup>62</sup> to lead to 'direct attention fatigue'. This fatigue,

generated by prolonged mental efforts, is thought to lead to problems such as irritability, decreased inhibition control, reduced problem solving skills, high distractibility, diminished decision making ability and less appropriate social behaviour<sup>62</sup>. The Attention Restoration Theory proposes that connection with nature is beneficial for correcting attention fatigue and the related impaired performance<sup>62</sup>. A recent study supporting the Attention Restoration Theory concluded that a walk in the park and viewing nature led to improved directed attention ability of adults<sup>63</sup>. It is thought that this mechanism, and the impact that nature may have on reducing stress<sup>64</sup>, leads to improved mental and physical health for those that engage with nature.

While the restorative benefit of nature proposed by Kaplan does not specifically address children's behaviour, the restorative mechanism is also likely to explain the benefits evidenced for children who spend more time with nature.

### **No two snowflakes are the same: nature provides varied learning environments**

Evidence indicates that nature-based play areas are advantageous for learning as they provide more varied opportunities for children's learning and development. The impact of redesigning a pre-school environment within the Iowa State University with natural materials and landscape elements was examined via video recordings and field notes<sup>65</sup>. In this study, additional developmental behaviours were exhibited in children who were provided with nature-based play space than those displayed in the traditional play space.

### **Socially preferable: the desire for and benefits of nature-enhanced environments**

Desire for nature in communities is strong<sup>66</sup>. Research suggests that communities with more nature possess superior social cohesion and support than communities with more barren neighbourhoods. Tree and grass cover have been systematically linked to many social ecological benefits including stronger ties among neighbours, greater sense of safety and adjustment, more supervision of children in outdoor spaces, healthier patterns of children's play, more use of neighbourhood common spaces, fewer incivilities, fewer property crimes, and fewer violent crimes<sup>67</sup>. Through strong social support, children in neighbourhoods with more nature may benefit from reduced stress and additional opportunities for self-discipline and personality development.

## **The good dirt: nature provides important micro-organisms**

Research suggests a physiological pathway exists through which contact with nature may be beneficial. Exposure to specific bacteria in the natural environment is thought to increase serotonin (a chemical supporting happy emotions) release, decrease anxiety and support learning. Microbiology researchers found that ingesting *Mycobacterium vaccae* (a natural soil bacterium which people likely ingest or breathe when they spend time in nature) leads to increased serotonin release and decreased anxiety in animal experiments<sup>68</sup>. Indeed, injection of this killed bacteria was shown to enhance quality of life in patients with cancer<sup>69</sup>. Furthermore, Matthews and Jenks<sup>70</sup> recently reported that mice ingesting *Mycobacterium vaccae* were better able to negotiate a maze than mice not receiving the bacteria. This effect was replicated after the bacteria was removed from the diet, however was not evident three weeks after the ceasing of the bacteria diet, suggesting a temporary effect from the bacteria. Matthews and Jenks postulated that improved learning environments could be created in schools when children are provided with outdoors where *Mycobacterium vaccae* is present; due to the impact that the bacteria may have on decreasing anxiety and improving the ability to learn new tasks<sup>70</sup>.

## **How can we reconnect kids with nature?**

Research to date is yet to investigate the impact of loss of contact with nature; however this is important to consider given that increasing innovations and modernisation has led to environments devoid of nature. Not only are nature-based areas such as wetlands and bushlands (and even gardens and ovals) threatened by urban development, but concerns about maintenance costs, water conservation and safety and liability fears are stripping away nature from neighbourhoods<sup>71</sup>. Grass is being replaced by paving or artificial grass, trees being felled to avoid falling branches, and landscapes are being left bare. In addition to this, children are discouraged from embarking on adventures to parks and fields due to safety concerns by parents<sup>72</sup>. To ensure children remain 'safe', children are encouraged to stay at home. Artificial environments surround youth.

Encouragingly, various programs exist throughout western countries aimed at encouraging children to spend more time in outside in nature. For instance, the Western Australian Nature Play website<sup>73</sup> encourages families to start nature clubs, provides nature resources and links and offers suggestions for activities to support children's interaction with nature. In the United States, the Society for Public Health Education led a meeting to assist with

identifying programs that reconnect children with nature<sup>74</sup>. Eight programs were identified; all designed to promote children to learn about and interact with nature.

Commencement of programs designed to reconnect children with nature are encouraging, however as many of the programs have only recently commenced, few evaluations of their impact have been completed. The Children and Nature Network evaluated 72 childhood nature promotion programs held throughout the US and Canada; a representative from each evaluation organisation completed an online questionnaire. Nearly 70% of respondents reported they believe their nature program had reached more than 1000 children (with an estimated total of between 900 000 and 1 500 000 children reached). The programs had resulted in at least 500 new nature clubs for families, school gardens, nature play areas and community gardens for children. At least one program evaluation indicates success in increasing physical activity by promoting nature play. The School Green Gym program, held in Doncaster England, involved children in nine schools attending 60 – 90 minute after school sessions involving environment-based activities on the school grounds and in nearby open spaces. The evaluation results indicated that that after ten weeks in the program children's weekend physical activity levels increased significantly from 142 to 189 minutes. In addition children's score in psychosocial and overall physical health scores increased<sup>75</sup>.

### **Further research**

While the research surrounding the relationship between nature contact and children's health, behaviour and development is encouraging, interpretation of the research is constrained by some research limitations such as the use of quasi-experimental or cross-sectional designs, small sample sizes or sampling bias. More research is needed to assess repeatability, scope and generalisability to other populations. New childhood nature promotion programs offer ideal opportunities for in-situ research studies to explore the impact of additional nature contact on children. Despite the limitations of research to date, sufficient evidence is available to conclude that contact with nature provides support for children's health, behaviour and learning.

### **Conclusions**

Every effort is needed to address the health and behavioural issues faced by so many youth today. Current behaviours of many children, such as excessive time in screen-based activity

and minimal time outside, do not augur well for their health. Providing and promoting contact with nature to support children's attentional restoration, stress reduction, learning and development as well as their physiological functioning is a relatively cost-effective approach; an approach likely to lead to enhancement of children's health, behaviour and learning.

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