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THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY IN GREEN SPACE AND HUMAN HEALTH AND WELLBEING: AN ECOLOGICAL DYNAMICS PERSPECTIVE

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ABSTRACT

Lifestyle diseases such as obesity, diabetes, and cardiovascular diseases are on the increase worldwide. This study examines the distinctive effects of exercise in green space compared to other contexts. There is growing evidence that physical activity in nature has considerable positive effects on human health far beyond those benefits assumed by physical activity alone, despite a reduction in opportunities for green exercise. A systematic literature review was undertaken to examine the evidence on the importance of physical activity in green space from different theoretical sub-disciplines including psychiatry, psychology, outdoor education, sport and exercise psychology and leisure, and recreation. Thematic categories were created to establish the effects of green space and green exercise on different yet inter-linked aspects of human health and well-being, both physical as well as mental. Our systematic review led us to apply ideas from a new theoretical perspective that contributes to existing understanding of how physical activity in green spaces (green exercise) might provide physical benefits and enhance mental health and wellbeing. This perspective, known as Ecological Dynamics, focuses on the relationship between the individual and environment in providing a functional explanation for the enhancement of physical and mental health and wellbeing. From this study it is theoretically rationalised that physical activity in green space, compared to other popular contexts, is more effective in enhancing physical and psycho-social wellbeing.

Keywords: *Physical activity, human health and wellbeing, green space, green exercise, Ecological Dynamics.*

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1. INTRODUCTION

There is growing evidence from disciplines such as psychiatry, ecology, psychology, architecture and planning, medicine, health, leisure and recreation that contact with nature and physical activity in nature (green exercise) have considerable positive effects on human health (Barton & Pretty, 2010; Brymer, 2009a; Brymer & Oades, 2009; Gorrell, 2001; Leather, Pyrgas, Beale, & Lawrence, 1998; Maas, Verheji, de Vries, Spreeuwenberg, Schellevis, & Groenewegen, 2009; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Maller & Townsend, 2006; Maller et al., 2008; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009a; Reser, 2008; Townsend & Moore, 2005). In a recent review of the health benefits of exposure to nature Maller et al. (2008) stated: 'That the natural environment is a key determinant of health is unquestionable' (p. 5). While increases in physical activity enhance various health dimensions, the benefits of green exercise cannot be explained by increased physical activity alone. These observed benefits seem be directly linked to the relationship between human beings and nature (Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008). Paradoxically, development of an urbanised lifestyle has reduced opportunities to interact with the natural world since industrial revolution, a trend which is continuing (Maller, et al., 2008; Townsend & Moore, 2005).

Research focusing on young people also shows that they are spending less time outdoors (Hofferth & Sandberg, 2001; Rydberg, 2007a, 2007b). Hofferth and Sandberg (2001) reported that American children under the age of 12 years spent on average 34 minutes a week outdoors compared to 12 hours a week watching television. Between 1997 and 2003 the proportion of 9-12 year olds who spent time playing outside declined by 50 percent (StGeorge, 2007). Louv (2008) considered this disconnection a crisis which he termed "Nature Deficit Disorder." The aim of this article is to outline how physical activity in the natural world might enhance health. First, we outline current knowledge on the human health and wellbeing benefits of physical activity in green spaces. Second, we will present a theoretical perspective from ecological dynamics to offer an explanation on how these benefits might occur.

The Health Benefits of Green Exercise

Psychologists and philosophers have recognised the importance of the natural world to human health and wellbeing (Deloria, 1994; Dewey, 1958; Harvey, 2000; Jung, 2008; Marano, 2008; Watts, 1970; Watts, 2003). In recent years, the relationship between the natural world and health has been explored from various perspectives. Examples include ecopsychology, outdoor education and recreation, wilderness and adventure experiences, green exercise, psychiatry, public health

and horticulture (Brymer & Cuddihy, 2009; Brymer, Schweitzer, & Sharma-Brymer, 2010; Doucette, Ransom, & Kowalewski, 2007; Duncan, 1998; Herzog & Strevey, 2008; Noddings, 2006; Wilson, 1984). Researchers have described the health benefits of viewing nature (Leather, et al., 1998), interacting with nature (Kaplan & Talbot, 1983), green spaces in urban environments (Tzoulasa et al., 2007), brief encounters in nature (Hull, 1992; Woolley, 2003) and extended encounters in nature (Hull & Michael, 1994) and even the benefits of exposure to actual nature as compared to virtual nature and (Mayer, et al., 2009a). In the following sections we review literature that focuses on the role of the natural world for the development of positive health.

Exposure to nature has been shown to improve health and wellbeing (Brymer, Cuddihy, & Sharma-Brymer, 2010; Nisbet, Zelenski, & Murphy, 2011; Pretty et al., 2007; Wolsko& Hoyt, 2012), relieve stress and provide a restorative experience (Leather, et al., 1998; Wolsko & Hoyt, 2012), increase positive mood (Korpela, Kytta, &Hartig, 2002; Maller, Townsend, Pryor, Brown, & St Leger, 2006), enhance life skills (Mayer & Frantz, 2005), reduce mental fatigue and increase concentration (Maller, et al., 2008) and reduce the tendency for aggressive behaviour (Kuo & Sullivan, 2001). Mayer, Frantz, Bruehlman and Dolliver (2009b) reported on three studies that examined the effects of exposure to nature on positive affect and the ability to reflect on a life problem. A comparison was done between a 15-minute walk in a natural setting and urban context, as well as watching a video of nature and watching a video of an urban setting. They found that both emotional wellness and the ability to reflect on a life problem were enhanced by exposure to actual and virtual nature, compared to urban settings. The influence of actual nature was most acute.

Adventurous activities undertaken in green spaces have also been linked with psychological and emotional benefits (e.g. Brymer & Oades, 2009; Brymer & Schweitzer, 2012) and many programmes are intentionally designed to provide an environment for enhancing psycho-emotional issues such as communication, self-esteem, self-efficacy and self-confidence (Hattie, Marsh, Neill, & Richards, 1997). An early research finding, focusing on using wilderness activities for improving self-concept recommended long and continued wilderness participation (Schreyer, Williams, & Haggard, 1990). Duncan (1998) reported that natural settings can also enhance self awareness and acceptance. However, he stated that measuring and understanding the psychological benefits of visiting wilderness areas remains one of the least developed and understood bodies of knowledge about wilderness.

Researchers have addressed various issues of childhood and youth behaviour, and established positive links between physical activity in nature and improved behaviour (Banderoff & Scherer, 1994; Han, 2009; Humberstone& Lynch, 1991; Kuo & Taylor, 2004; Louv, 2009; Noddings, 2006; Riebel, 2001;

Robertson & Kiewit, 1998; Russell, 2002, 2003). Exploration in the outdoors, gardens, backyards, parks, wilderness and many such environments are said to encourage and nurture curiosity, engagement, focused learning, mindfulness and reflective practice (Han, 2009; Pretty et al., 2009; Said, 2006; Stolar, 2009; Ungar, Dumond, & Mcdonald, 2005; Wells, 2000). Taylor and others (Kuo & Taylor, 2004; Taylor, Kuo, & Sullivan, 2001) have also demonstrated that engagement with nature positively influences concentration and behaviour of children diagnosed with Attention Deficit Disorder. Research is also finding that opportunities to interact with nature in childhood are important for the promotion of positive psycho-emotional behaviours for future adults. For example, Mayer and Frantz (2005) considered that opportunities to connect with nature in childhood promote the value of green spaces for refuge from stress and anxiety (Mayer & Frantz, 2005).

Green exercise has also been shown to decrease anxiety and depression. For example, MacKay & Neill (2009) investigated the relationship between state anxiety and exercise intensity, reporting that higher degrees of perceived greenness of the exercise environment were associated with greater reductions in state anxiety. However, exercise intensity and duration did not impact state anxiety. Another research project that compared a walk in nature with a walk in a shopping centre demonstrated that the former significantly counteracted depression and increased self-esteem (Barton, Hine & Pretty, 2009). Kaplan et al. (2009) showed that an hour's walk in a park at any time of year can increase attention and memory by twenty percent. Pretty, Hine and Pretty (2007) found that a regular walk in an urban green space can increase subjective experiences of mental and emotional wellbeing. Harris (2009) reported that gardening provided an opportunity to develop self-esteem in refugee and migrant communities in Queensland.

Natural environments have been shown to produce an altered state of consciousness (ASC). Research by Kjellgren and Buhrkall (2010) demonstrated that being immersed in the natural environment produces a greater ASC than exposure to a simulated environment. Phenomenological analysis identified six categories of positive experiences: intensified sensory perception; a feeling of harmony and union with nature; well-being and quality of life; renewed energy and awakening; a 'here and now' thinking and a 'sense of tranquillity.' Peak experiences, (described as states of optimal mental health and wellbeing), wilderness experiences and adventure experiences possess elements that can evoke transpersonal experiences (Roscoe, 2009). These experiences can range from momentary events with minimal lasting effect to intense events with life-transforming consequences. Peak experiences are often characterised by awe and reverence, a feeling that the world is unified, ineffability, and a sense of bliss and ecstasy (Brymer, 2005; Davis, 1998). Schreyer, Williams and Haggard (1990)

highlighted that such values were important in the process of effective self-concept formulation. They concluded by indicating that wilderness settings are important for the enhancement of wellbeing.

In summary, research is demonstrating considerable evidence that the green element in non-human nature has a profound influence on human physical/mental health and wellbeing. Exposure to virtual nature, opportunities to view nature through a window, experiences of brief encounters with nature, programs that emphasise extended encounters with nature and even bringing nature indoors seems to be beneficial for mental health and wellbeing and wellbeing. However, it is difficult to determine how nature-based activities enhance health and how we can best use nature-based activities in preventative psycho-physical medicine (Fjortoft, 2001; Korpela&Ylen, 2007; Maas, et al., 2008; Velarde, Fry, & Tveit, 2007). Investigations into the role of green exercise have often relied on explanations that focus on the form (colour or physical appearance) of nature (Bodin & Hartig, 2003; MacKay & Neill, 2009). In the following sections we outline a theoretical perspective that complements and adds to our understanding of how physical activity in green spaces (green exercise) might encourage positive mental health and wellbeing. This perspective is termed ecological dynamics which opens up the possibility for a functional explanation for the enhancement of mental health and wellbeing.

An Ecological Dynamics Approach

"Ecological dynamics" is a framework capturing the integration of key ideas of learning in ecological psychology and dynamical systems theory (Warren, 2006). Ecological dynamics is concerned with understanding change in human behaviour over different timescales. It is a popular model of learning and development in a variety of fields including human movement science, psychology and physical education (Araújo & Davids, 2011; Chow, Davids, Hristovski, Araújo, &Passos, 2011; Davids, Button, & Bennett, 2008). An ecological dynamics approach emphasises the importance of the interaction between an individual and the environment. Here we develop the proposition that the ecological dynamics model is ideally suited to explaining how green exercise enhances effective psycho-emotional development.

Ecological dynamics has an inherent foundation in the complexity sciences, motivating a view of the learner as composed of many independent but interacting subsystems (physical, cognitive, social, emotional, etc.). We propose that an ecological dynamics model, predicated on an interactive relationship between the learner and environment, provides a more functional approach than some traditional models which contain an inherent 'organismic asymmetry' (Dunwoody, 2006). Araújo and Davids (2011) argued that the concept of

organismic asymmetry refers to an inherent bias in science for seeking explanations of human performance and behaviour based on internal mechanisms and referents. For example, cognitive psychology typically focuses on the role of conscious mental life, with little reference to the role of the environment in shaping behaviours. This biased tendency is avoided by considering the individual-environment relationship as the relevant scale of analysis for understanding humna development. Adopting the person-environment relationship as a scale of analysis for understanding the development of psychological health provides an opportunity to address the role of individual differences. From this perspective, a more substantive emphasis needs to be placed on understanding how learning emerges from each individual as they attempt to satisfy a range of personal, task and environmental constraints impinging upon him/her at any moment in time (Davids, Button & Bennett, 2008). A key aspect of ecological psychology, affordances, might be useful to explain how interaction with the natural world in the form of green exercise provides an essential conduit to effective promotion of positive health.

Traditionally, the concept of affordances in ecological psychology simply describes opportunities for action that combine the objective nature of the environment with the subjective nature of an individual (or organism) (Gibson, 1979; Sanders, 1993). Affordances from this perspective are neither objective nor subjective as they exist based on characteristics of both the individual and the environment. More recently, affordances have been recognised as environmental opportunities that invite action (Withagen, de Poel, Araujo, & Pepping, 2012). What this suggests is that theoretical perspectives that focus on the form and shapes of nature (how nature looks) might be limited as a theoretical explanation. Instead ecological dynamics proposes that the function of nature is a more effective medium for analysis (Said, 2012). Further the functional aspects of the natural world actually invite or encourage particular actions.

This traditional understanding of affordances as proposed by Gibson has been enhanced in more recent times through combining ecological psychology with dynamic system theory and the development of ecological dynamics. From an ecological dynamics perspective the notion of affordances can be extended beyond opportunities for physical action to include opportunities for a variety of human experiences including those from the social, cognitive and emotional domains. In this way affordances might be useful for understanding how physical activity in green spaces enhances mental health and wellbeing.

2. METHODS AND MATERIALS

Keeping the central focus on the benefits of physical activity in green spaces on human health a systematic literature search was undertaken. Literature was

searched over a period of approximately 40 hours in 2012 using search engines such as Academic Research Library, BioDigest, PsychINFO, Medline, Meditext and Academic Search Elite. The databases used included the Queensland University of Technology library, Google Scholar and Google Advanced Search. Key words that were used for the literature search were green exercise, outdoor physical activity, outdoor recreation for health benefits, being in green space, greenery for human health, being in nature for health reasons, ecological benefits on human health, nature and human health, human health and nature. Over 500 hundred different sources were pooled together for further synthesis.

After screening the abstracts of 500 different sources 50, including original research articles, research reports and research-based books, were separated for a detailed analysis to see if the research studies were suitable for the use of our study. A final analysis of the selected 50 sources yielded 26 studies that were reported as original research in peer-reviewed journals. Among these 13 each of qualitative and quantitative studies have been utilised for this paper.

Within the group of published journal articles, the first criterion was to identify the author/s' positive emphasis on the element of green space linked with human health in general, and secondly, their assertion of health benefits of physical activity in green space. Both these criteria created a broad scope to place the orientation of the study with green space not being limited to outdoor environment, natural world, greenery, green woods or indoor environments with the presence of green space. It included both actual and virtual environments with a green element in them. The literature search yielded a rich range of journal articles dedicated to the demonstration of the relationship between benefits of physical activity in green space, engagement with green space and improvement in health. The diversity of the articles included nature-based physical activity, urban landscape and design, benefits of green space on children's wellbeing, and traditional health benefits from green space. Within the group of conference papers, reports, magazine articles, books, book chapters and web resources, the criterion was once again to identify the positive health benefits of physical activity in green space. The information was scrutinised to classify under thematic categories. Thematic categories with separate headings such as Human health and nature in general, Human health, physical activity and nature, Health benefits of being in nature, Green exercise and health, Physical activity in Green space and outcomes. Key focus of each source under each of these categories was noted down to refocus the literature search on one topic – that is, establishing the case of health benefits of physical activity in green space from an ecological dynamics perspective.

3. RESULTS & DISCUSSION

An analysis of experimental studies, both qualitative and quantitative, reveals two major themes that support the thesis that green exercise is beneficial for health. The first supports the physical affordances notion in that physical activity in green spaces provides an opportunity for more varied action. The second shows that physical activity in green spaces supports a psycho-emotional restoration.

From a physical perspective it is the physical opportunities apparent in the natural world that supports physical health. As an example a nature scene with mountains in the distance and trees in the foreground could be described in terms of what it looks like or it could be described in terms of what it offers for human interaction (e.g. opportunities to climb, jump, swing and so forth). A given environment will have specific properties and opportunities that invite action; however a person perceives, utilises and shapes these opportunities for action from their own unique perspective. For example, two learners in a wood would be working with the same environmental properties but differences in limb length and body length would result in different perceptions and actions. Objectively, a tree might have climbing affordances but because of different body sizes, emotional readiness or age not all children will be able to take advantage of the affordance. Equally cultural expectations might limit a person from perceiving the climbing affordance. The same crag might present different affordances for movement for someone with short limbs as opposed to someone with long limbs. At the same time an action that is simple to undertake in dry conditions, such as climbing a small boulder, might present different complexities when wet. Affordances are not static they change as a function of time and context. For example exhausted learners perceive inclines to be steeper than when they are not exhausted (Bhalla & Proffitt, 1999). This variety and complexity of possible opportunities for action invites interaction and therefore increases physical health.
From a mental health perspective these same physical affordances invite focus and remove noise. For example, mindfulness or the experience of non-judgemental presence has also been associated with positive mental health and wellbeing and in particular eudaimonic wellbeing (Shaver, Lavy, Saron, & Mikulincer, 2007). Hedonic wellbeing describes the state of "feeling good" whereas eudaimonic wellbeing describes a more "functional" experience of life satisfaction and an experience of living a fulfilled life (Howell, Dopko, Passmopre, & Buro, 2011). Mindfulness has been defined as a state of consciousness that involves a particular non-judgemental awareness and attention. Brown and Ryan (2003) define mindfulness as "an enhanced attention to and awareness of current experience or present reality" (p.822). They continue by asserting that the attention and awareness is an "open or receptive awareness" (p. 822). Mindfulness has been credited with the ability to disengage individuals from automatic thoughts and encouraging healthy behaviours. While research in this area is still young, studies are reporting that the natural world provides a rich

array of sensory possibilities that invite mindfulness (Rothaupt & Morgan, 2007). Howell et al. (2011) reported on two studies that attempted to investigate the relationship between wellbeing, mindfulness and feelings of connection to nature. While they could not determine cause and effect they did determine that "higher degrees of connectedness to nature were associated with greater wellbeing and greater mindfulness" (p. 169). Although mindfulness is typically associated with a deliberate act of mindfulness cultivation, Jacob, Jovic, & Brinkerhoff (2009) argue that mindfulness can also spontaneously arise from environmental cues. From this perspective being in nature can trigger mindfulness affordances and experiences of total engagement, non-judgement and being at one with the natural world (Brymer & Gray, 2010a, 2010b; Mayer & Frantz, 2004).

In summary, Gibson (1979) theorised that the natural environment affords more intense and varied activity than standardised environments. However, Gibson's focus was on physical affordances. The ecological dynamics approach empathises the multi-dimensionality of human beings and recognises that affordance theory also allows for other opportunities such as social and emotional affordances. As such the ecological dynamics model extends the ecological psychology concept of affordances to show that the natural environment affords more intense and varied opportunities to enhance mental health and wellbeing. Beyond this observation, research suggests that the natural world is unique in that the affordances are also more challenging and more complex than those afforded through man-made environments.

4. CONCLUSIONS

Green exercise or physical activity in green spaces has been associated with positive Physical/mental health and wellbeing benefits. Traditional theoretical perspectives focus on explaining why physical activity in green spaces might enhance mental health and wellbeing and emphasise the role of the innate connection between humans and the natural world, the restorative effects of nature and the experience of being part of something larger. Ecological dynamics adds to current perspectives by theorising how physical activity in green spaces might enhance mental health and wellbeing. From this perspective the natural world is described in terms of the affordances for psycho-emotional and physical interactions it offers to each individual. Further work is needed to understand how the natural world might uniquely provide more challenging, complex, varied and intense affordances. There is a need to explain how individuals are invited to experience a broad range of perceived pleasurable and non-pleasurable emotions and to experience undertaking actions despite these emotions. Equally it is important to investigate how the complexity of affordances might also support

other opportunities to enhance psycho-emotional health and wellbeing characterised by mindfulness, non-judgement, peace and calm.

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