

ATTEMPTING TO FOSTER BIOPHILIA THROUGH CARING FOR  
A COMMON PLANT

by

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## **Abstract**

Interacting with nature has been shown to have a number of benefits. Although indoor plants are arguably the most accessible source of nature contact in our indoor environment, there is a limited body of research into the effects of interacting with indoor plants. The purpose of the present research was to assess the effects of interacting with a plant from seed until shortly after the plant sprouts above the soil. Participants were assigned to either a sprout or no-sprout group. It was expected that participants in the sprout group would experience the greatest increase in well-being, a stronger sense of connection, and greater presence of meaning in their lives. Contrary to expectations, there were no significant differences between the groups; however there was some indication that participants in the sprout group experienced an increase in guilt and a stronger sense of searching for meaning. Implications and methodological constraints are discussed.

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With the tools I have gained and the experience I have acquired, I look forward to my next adventure.

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## Introduction

Recent estimates indicate that the average individual in North America spends as much as 90% of their time indoors with this number increasing to 98% for Canadians during the winter months (Klepeis et al., 2001; Wilford, Shoeib, Harner, Zhu & Jones, 2005). However, for the better part of our evolutionary past, we not only spent the majority of our time outdoors, we relied on natural elements for our survival and although this is still true today, we have become increasingly unaware of the process through which our modern world is constructed. Research indicates that despite our move away from the outdoors, people are generally happier when outside in a natural environment (Nisbet & Zelenski, 2011; MacKerron & Mourato, 2013). This finding is often attributed to an adaptation towards an affinity with life and lifelike processes, or biophilia, developed through our co-evolution alongside the natural world (Wilson, 1984). Despite our move away from the outdoors, natural elements such as images of nature and plants are routinely included in our indoor environments. Offices and apartments with a view are a coveted commodity. When faced with a windowless office, people are far more likely to adorn their offices with plants or images of nature (Bringslimark, Hartig, & Patil, 2011). It may be that we are looking to reconnect with our past relationship with the natural world. Perhaps, on some level, we are aware of the benefits and interconnectivity that exist between us and nature. The purpose of the present research is to explore the effects of taking part in the unfolding life of a common plant with a focus on how it affects our well-being and our perception of all living things or life.

Over the past hundred years with the rise of industrial farming and densely populated cities, humans have become increasingly disconnected with nature. We are often disconnected in terms of our sense of belonging, and even our awareness of the naturally derived building blocks that make-up all of our modern comforts. It is no longer uncommon to encounter a situation whereby an individual leaves their home, drives to the underground parking within their office building where they spend their day in an environment with little to no contact with the outdoors. Despite our current lifestyle, evidence now points to the multifaceted benefits of contact with nature. Contact with nature has been shown to lead to faster recovery from illness (Ulrich, 1993), increased well-being and vitality (Nisbet, Zelenski & Murphy, 2011), greater creativity (Atchley, Strayer & Atchley, 2012), and improved concentration for children with attention deficit hyperactive disorder (Faber Taylor & Kuo, 2009). A meta-analysis revealed consistently improved energy as well as decreased anxiety, anger, fatigue, and sadness associated with outdoor activity (Bowler, Buyung-Ali, Knight, & Pullin, 2010). Individuals with major depressive disorder have demonstrated increased memory and mood after interacting with nature (Berman, et al., 2012) and the greening of vacant urban lots has been associated with decreases in certain types of crime including violent crime (Branas, et al., 2011). Although we tend to think of ourselves as outside of nature, we are intimately connected and reliant upon the natural world as are all of the living organisms on this earth.

Nature, in its broadest sense can be thought of as including all living biota as well as those elements that make up the contours of the earth as we know it. The biophilia hypothesis posits that humans are innately drawn and intimately connected to nature

(Wilson, 1984). While there is a fairly large body of evidence supporting this theory as it relates to outdoor nature encounters (Frumkin, 2001; Kellert & Wilson, 1993; Keniger, Gaston, Irvine, & Fuller, 2013) if the hypothesis is correct, we would similarly expect beneficial effects from encounters with indoor plants. As it stands, the importance of indoor plants is increasingly recognized. Indoor plants have been shown to increase pain tolerance (Lohr & Pearson-Mims, 2000; Park & Mattson 2008; 2009), decrease stress (Lohr, Pearson-Mims, & Goodwin, 1996; Park & Mattson, 2008), increase the aesthetic appeal of a space (Dijkstra, Pieterse, & Pruyn, 2008; Fjeld, 2000), and increase an individual's sense of autonomy and connection to nature (Weinstein, Przybylski, & Ryan, 2009). Further, employees in a windowless office have been found to be roughly five times more likely to bring plants into their workspace than those with windows (Bringslimark, et al., 2011). While neither conclusive nor exhaustive in explaining the effects of indoor plants, these studies lend support to the idea that humans have an “innate tendency to focus on life and lifelike processes” (Wilson, 1984 p. 1).

However, several gaps exist within the research on indoor plants. For example, a recent review of the literature revealed that 15 out of 21 experimental or quasi-experimental studies reviewed were published by journals outside of the domain of psychology despite the gap in knowledge in terms of the psychological effects of indoor plant exposure (Bringslimark, Hartig, & Patil, 2009). Although those in the horticultural domain have advanced our understanding greatly, there is much room for the employment of methodological techniques and measures from the social sciences. After reviewing methodological issues in horticultural research, Shoemaker, Relf and Lohr (2000) suggest that including methodologies and measures employed in the social

sciences is the only way forward to gain a better understanding of the effects of indoor plants on the human condition.

The effects of indoor plants on mood and well-being in general have yet to be fully explored as many of the studies either never tested the effects specifically or found inconsistent or non-significant results. Although mood effects were found among individuals participating in a study spanning three months (Burchett, Torpy, Brennan, & Craig, 2010) other studies using a relatively short plant exposure condition failed to find any significant mood differences (Adachi, Rohde, & Kedle, 2000; Larsen, Adams, Deal, Kweon, & Tyler, 1998; Shibata & Suzuki, 2001). It is important to note that in each of the above mentioned studies, the conditions were designed to assess the effects of the presence or absence of indoor plants and did not examine the effects of interacting with the plants. It may be that any mood benefits attributable to the presence of indoor plants are only expressed after longer exposure times. However, it is not yet known whether interacting and caring for an indoor plant would affect mood.

Finally, there is much room for an exploration of the extent of our relationship with nature. Although some have sought to examine the effects of indoor plants with reference to their aesthetic appeal (Dijkstra, et al., 2008), the biophilia hypothesis suggests we may have a subconscious tendency to recognize the inseparability between us and nature or all of life through our encounters with nature. Although this recognition may have atrophied to a point in the modern urban human, it is unlikely that the “biophilic learning rules”, which were developed over the course of evolution, have been replaced (Kellert & Wilson, 1993, p. 31-32). It may therefore be possible to reconnect to this sense of connection with all of life through manipulation of a nature encounter.

Kellert (2012) proposed that our ability to reason is developed through our contact and understanding of our ever changing natural environment and that a connection to nature could be fostered through education and interaction with nature. It therefore stands to reason that caring for a plant may enhance our awareness of our innate connection with all living things or life. As indoor plants are arguably one of the most accessible nature encounters available, it is important to explore the effects of this relationship. Most research on indoor plants' effects excludes any direct interaction between participants and plants. Many used self-watering pots or had individuals outside of the research, care for the plants. While this ensured greater control over the health of the plants, it prohibited an examination of the effects of caring for the plant. The proposed study is unique in that I will attempt to create an environment, that asks people to care for a plant, thereby creating a situation where there is a greater potential to develop an emotional connection to the plant in an attempt to facilitate a more overt awareness of our connection with nature and life in general. However, in our modern lives, replete with all the noise contained within a normal day, it may take more than simply watering a plant to bring biophilia to our awareness.

Kellert (1993) suggests that individuals place great value on living organisms in our assessment of the aesthetic experience of nature. Kellert goes on to explore the idea that a static experience of nature, say for example a landscape devoid of movement, is not nearly as compelling as one in which there is the promise of movement, as in a landscape including animals. Plants tend to grow at a rate only perceivable over the course of weeks or months, perhaps thereby limiting our ability to recognize and affiliate with the life process of a plant. However, the time between germination to shortly after a plant

sprouts above the soil stands as an exception. I propose that the combined effects of witnessing the movement of the plant as it sprouts and the active participation, through the act of planting the seed and watering the soil, will be enough to break through the noise of everyday life and prompt people to report a stronger sense of overlap between themselves and their conception of life and the universe.

### **Nature Exposure and Indoor Plants**

We now have scientific evidence to back up the long held belief that nature has restorative properties. Scenes of nature are consistently preferred over scenes of built environments across age, gender, and culture (Ulrich, 1993). Nature has been cited as speeding up the restoration of post-operative health (Park & Mattson, 2009; Ulrich, 1984) and restoring attention (Berman, Jonides, & Kaplan, 2008). Despite the advances in knowledge we are also at a point in history where people are spending the majority of their lives indoors. Nature and built environments do not necessarily need to be mutually exclusive as is demonstrated by our strong affinity for including trees and plants in our urban landscapes and potted plants in our interior landscapes. Research supports the notion that including these elements within our built environment has similar benefits to being outdoors. For example, compared to patients with a view of a brick wall, patients with views of nature had shorter duration of hospitalization, fewer postsurgical complications, used fewer analgesics, and received fewer documented negative comments from their nurses (Ulrich, 1984). People have also reported greater satisfaction and well-being (Kaplan 1993; 2001), reduced stress, and restored attention (Hartig, Evans, Jamner, Davis, & Garling, 2003) when in the presence of a view of nature.

In the footsteps of Ulrich (1984), the effect of indoor plants on pain and in hospital settings has been examined (Dijkstra, et al., 2008; Lohr & Pearson-Mims, 2000; Park & Mattson, 2008; 2009). Similar to the biophilia hypothesis, Ulrich (1993) proposed that we have certain aesthetic preferences for differing natural vistas based on an evolutionary advantage these scenes provide. For example, it has been demonstrated that in general people prefer scenes with a moderate number of trees and with a degree of openness, or savannah-like scenes (for a review, see Ulrich, 1993). Heerwagen and Orion (1993), among others, argue that over the course of our evolution we developed a set of cues with regards to our surroundings that helped us to quickly identify ideal habitats. Our current landscape preferences may be based on these survival-enhancing cues. Ulrich furthered this idea by proposing that aesthetically appealing views of nature could lower stress levels. His idea was supported when he found that individuals randomly assigned to a hospital room with a view of a forested area had a shorter hospitalization and required fewer pain medications for the duration of their stay (Ulrich, 1984). In order to test whether this same result could be replicated with indoor plants, Lohr & Pearson-Mims (2000) measured how long individuals would hold their hand in ice water in an office-like setting either with plants, non-plant objects (ex. a painting), or nothing at all. They found that a greater proportion of people were willing to hold their hands in the ice water for the maximum amount of time in the room with the plants. Using photos of hospital rooms with and without plants Dijkstra and colleagues (2008) found that the hospital rooms with plants were rated as less stressful and more attractive. They concluded that the reduction in stress was mediated by the perceived attractiveness or aesthetic quality of the room. Using a similar methodology to that of Ulrich (1984),

Park and Mattson (2008; 2009) conducted two studies on hospitalized post-surgical patients. Room design and view were held constant with the main varying factor being a room with or without plants. Consistent to both studies, they found that patients required fewer strong analgesics, had lower systolic blood pressure, lower heart rate, rated lower pain intensity, pain distress, and fatigue, and rated the rooms with plants as more appealing and comfortable. They also found that the length of hospitalization for those in rooms with plants was significantly shorter than for those in rooms without plants (2009). Although the experiment was designed such that patients were not required to care for the plants, in many instances the patients started caring for the plants after they became well enough to do so. Indoor plants have also been associated with fewer health complaints such as headaches and dry throats compared to similar rooms without plants (Fjeld, 2000). Although Fjeld noted he was unable to rule out a possible air purification confound related to the plants, air samples were taken and revealed no significant differences between conditions thus supporting the notion that the health effects were possibly due to decreased stress in response to the presence of plants. These results lend credence to the idea that we have a stress reduction response when in the presence of natural elements such as views of nature and indoor plants.

Although there is support that the perceived attractiveness of indoor plants mediates the relationship between their presence and a reduction in perceived stress (Dijkstra, 2008), the biophilia hypothesis alludes to a more rich relationship between humanity and nature in the context of aesthetics. Kellert (1993, p. 49) noted that living organisms, especially the “charismatic megavertebrate species”, are the most highly valued natural element in terms of aesthetic preference. Perhaps this is due to our ability

to witness their life and vitality through their movements and behaviours, which we may relate to our shared experience of the phenomena, that is life. There is also the argument to be made that larger herd animals would have signalled a viable living environment to our ancestors (Heerwagen & Orion, 1993). This cue of viability may live on in the modern human as an aesthetic preference. Although we cannot at this time explain the exact nature of this preference, there may be some evidence of this process at work within the research on indoor plants as well. For example, floral arrangements tend to be rated as more attractive than foliage plants (Adachi et al., 2000; see also review Bringslimark et al., 2009). The growth of a foliage plant would not likely be discernible over a short period of time. Many flowering plants, if seen during their flowering period, undergo a very visible change. Furthermore, flowers often signal the future presence of various fruits, vegetables, and honey. While watching a non-nature related video, participants were exposed to either foliage plants or flowering plants (Adachi et al., 2000). Participants in the flowering plant condition rated the room as more attractive than those in the foliage plant condition. Although it is unlikely that any of the flowering plants would have perceptibly changed over the course of exposure, the flowers may have been at varying degrees of development. This detail however, was not discussed in the paper. Patients involved in the research by Park & Mattson (2008; 2009) would have been in the presence of flowering plant for a longer period, at which time flowers may have bloomed, however Park & Mattson made no distinction between the effects of flowering and foliage plants nor did they describe the development of the flowering plants over the duration of the study.

There is also some indication that the presence of plants in a work environment can affect productivity (Daly, Burchett, & Torpy, 2010; Larsen, et al., 1998; Lohr, et al., 1996; Raanaas, Evensen, Rich, Sjostrom, & Patil, 2011; Shibata & Suzuki, 2002; 2004). However, the results are certainly unclear and in some instance contrary to one another. Daly and colleagues (2010) found a significant difference in academic performance among classrooms with indoor plants compared to classrooms without in two out of three schools included in their study. However, in another study examining differences among Taiwanese students, no differences were found in academic achievement, although it was found that students in a classroom with limitedly visible indoor plants had fewer hours of sick leave as well as fewer instances of misconduct (Han, 2009). Shibata & Suzuki (2002; 2004) explored the effects of plants on people's performance on an association task and found that only the women were significantly affected. Raanaas et al. (2011) attempted to assess whether plants in a simulated office environment affect executive functioning by having participants complete the Reading Span Task (RST) either in the presence or absence of indoor plants. Each participant completed three trials of the task (baseline, after 15 minutes of proofreading, and after a five minute break). Their results suggest that the plants did have some restorative properties, however the effects were not consistent across trials. Raanaas and colleagues (2011) expected that the five-minute break in the presence of the plants would have had the greatest restorative effects. However, no significant differences in performance were found between trials two and three with respect to condition. While the preceding examples point to the benefits of exposure to indoor plants on productivity others have found no effects (Rich, 2007) and even negative effects (Larsen, et al., 1998). Differences in methodology may explain

some of the contradictory results. Productivity as measured through creative tasks may produce different results than productivity requiring a greater degree of focus when in the presence of plants (Larsen et al., 1998). Although none of the studies explicitly asked participants to interact with the plants, it is unclear whether those individuals involved in studies with a longer plant exposure time, did interact with the plants to some degree and how that may have influenced productivity. Finally, as is stated by Larsen and colleagues (1998), although the biophilia hypothesis presupposes an advantage to being connected to nature, high productivity as is measured in modern standards may not constitute the most desirable human condition.

### **Connection to Nature and Well-Being**

Kellert (1993) maintains that the biophilia hypothesis necessarily asserts a connection with nature contains within it the possibility of enhancing well-being or more specifically “the possibility for achieving individual meaning and personal fulfillment” (p. 21). While nature connection, and well-being have been assessed through experimental manipulation of nature exposure (Kaplan, 2001; Nisbet & Zelenski, 2011.) few studies, if any, have explored whether caring for an indoor plant can affect either connection to nature or well-being.

### ***Measuring Nature Connection***

An individual’s perceived relation to nature can impact their sense of concern for the environment, perceptions of connection to nature, and even behaviour (Mayer & Frantz, 2004; Nisbet, Zelenski, & Murphy, 2009; Schultz, 2001; Schultz, Shriver, Tabanico, & Khazian, 2004). Tam (2013) reviewed a number of measures designed to assess an individuals’ connection to nature whose convergent validity lead to the

conclusion that connection to nature can be viewed as one broad construct encompassing aspects of emotion and cognition. For example, the Nature Relatedness Scale (NR: Nisbet, et al., 2009), described by Tam (2013) as a multidimensional scale measuring various emotional and cognitive aspects of connection to nature, was found to correlate strongly with pro-environmental behaviour and subjective well-being. NR aims to assess an individual's degree of connection to the natural world in terms of a relatively stable trait. The NR scale consists of several questions designed to determine the degree to which an individual enjoys nature, understands the importance of nature in its entirety, and recognizes an interconnection among all living things. NR predicts self-identification as an environmentalist, purchase of products identified as ethical, love of animals, and environmental concern (Nisbet et al., 2009). NR has also been shown to predict aspects of well-being including positive affect, vitality, life satisfaction, and eudaimonic dimensions of psychological well-being (PWB) including autonomy, personal growth, and purpose in life (Nisbet, et al., 2011). Further, Howell, Dopko, Passmore, and Buro (2011) found that a connection to nature (as measured through NR and the Connectedness to Nature Scale: Mayer & Frantz, 2004) was consistently associated with both psychological and social well-being. These findings reinforce Kellert's (1993) assertion of a link between an affinity with nature and well-being.

The inclusion with nature in self scale (INS: Schultz, 2002) stands as a visual representation of the degree to which an individual experiences their self as inclusive of nature. Inclusion with nature consists of such components as connectedness with nature, caring for nature, and commitment to protecting nature. It is essentially the degree to which a person's self-schema is indivisible from nature. The inclusion with nature in self

scale (INS) was developed based a scale used to assess the degree of closeness in interpersonal relationships by Aron, Aron & Smollan (1992). Individuals who view themselves as being indivisible from nature tend to engage in more pro-environmental behaviours as well as have a greater degree of concern for the biosphere (Schultz, 2002; Schultz, et al., 2004). A recent review of connection to nature measures revealed that the INS measure was the least correlated of all connection to nature measures and did not predict well-being or pro-environmental behaviour as well as other measures (Tam, 2013). After ruling out psychometric problems, Tam (2013) tentatively concluded that the INS might capture a different aspect of connection to nature, namely one that is cognitive rather than emotional. Further, the possibility exists that the INS may be a better indicator of a state level connection to nature rather than at the trait level. There may be some support for this as Nisbet and Zelenski (2011) found that inclusion of nature into one's self-schema was higher among individuals who participated in an outdoor walk along a river in an urban environment as compared to individuals who walked indoors.

Similar to the connection to nature construct is the degree to which individuals' possess environmental concern. An individual's sense of concern for the environment has been found to predict pro-environmental behaviours (Milfont, Duckitt, & Cameron, 2006; Schultz et al., 2005). Schultz (2001) outlined three themes into which individuals fall in terms of their environmental concern. These themes, or concerns, are meant as a representation of the degree to which they are included within an individual's notion of self. Concern beyond the self, including not only other humans but other living things, is referred to as biospheric concern, and is related to a greater degree of concern for plants, animals, and marine life. Biospheric concern is related to a greater degree of pro-

environmental behaviour as well as stronger sense of a self inclusive of nature (Mayer & Frantz, 2004; Schultz, et al., 2004). Concern primarily focused on self-interest or self-enhancement, referred to as egoistic concern, is related to a greater degree of concern for the personal consequences of environmental degradation. Finally, concern focused at the community level, is referred to as altruistic concern, and is related to a greater degree of concern for other people. Environmental concern is not a completely stable trait, but rather is malleable. Schultz (2000) asked individuals to either objectively or subjectively examine a photo including various natural elements. The subjective condition consisted of taking the perspective of the subject in the photo (either human or animal).

Participants in the perspective-taking condition rated higher biospheric and altruistic concern when taking the perspective of an animal being harmed by pollution. Taking the perspective of an animal negatively affected by pollution led to a greater degree of environmental concern with respects to plants, animals, as well as other human beings. There were no significant differences between the two conditions for those individuals who viewed photos of humans and nature or animals in nature in neutral contexts. It appears as though changes in environmental concern were most pronounced in a perspective-taking task involving negative emotions (Schultz, 2000). According to the biophilia hypothesis, it is conceivable that biospheric concern would also be high among individuals taking the perspective of any kind of scene involving natural elements. However, these individuals were merely viewing a photo for a short period of time. Perhaps a greater degree of immersion is required to affect environmental concern. Although there is some indication that environmental concern can be affected under

certain circumstances, we do not know the effects of a more immersive interaction with nature on environmental concern.

### ***Nature Exposure and Well-Being***

Exposure to nature in varying forms has been shown to positively affect an individual's sense of well-being (Kaplan, 2001; Nisbet et al., 2011). Kaplan (2001) found that individuals with views of natural elements from their place of residence in general rated higher levels of well-being than those with views of built environments. Nisbet and colleagues (2011) found that taking a class with a focus on the environment (for example, biology or environmental sciences) corresponded to a buffering against a reduced sense of vitality over the fall term experienced by those in classes without an environmental focus. Over the same period of time, individuals in the non-environmental classes experienced a decrease in their sense of relation to nature while those in the environmental classes experience an increase. The difference in vitality experienced between the groups was interpreted as being due to their sense of relation to nature. In addition, an individual's sense of connection to nature has been shown to positively predict well-being (Mayer & Frantz, 2004; Nisbet et al., 2011).

Research on well-being has led to the distinction of hedonic and eudaimonic well-being. Hedonic well-being represents that which provides a sense of pleasure and happiness whereas eudaimonic well-being represents that which brings us closer to realizing our own true potential (Ryan & Deci, 2001). More specifically, hedonic well-being is described as a subjective description of an individual's level of positive affect, negative affect, and life satisfaction. Hedonic well-being is commonly described as

happiness. Research exploring the effects of indoor plants on psychological factors, such as mood, have primarily focused on aspects of hedonic well-being with varying results.

Adachi and colleagues (2000) used a subset of feeling scales from the BI-Polar Form of the Profile of Mood States (POMS-BI; Lorr & McNair, 1984), which assesses the degree to which people identify with various mood states. Individuals were asked to rate their agreement on 24 adjectives, two positive and two negative, corresponding to six different moods. For example, a measure of anxious mood consisted of the adjectives ‘tense’, ‘anxious’, ‘composed’, and ‘relaxed’. Certain moods included adjectives such as ‘friendly’, ‘playful’, and ‘agreeable’, which are more pro-social in nature and may be thought of as measuring eudaimonic well-being, were also included. However, the results were analyzed by calculating a numerical value for each mood and therefore do not permit an examination of eudaimonic well-being in isolation. With respects to the moods experienced by participants under varying plant conditions, Adachi and colleagues (2000) results were contrary to expectation. Whereas individuals reported a greater degree of annoyance during the condition with a floral arrangement as compared to the no plant condition, individuals in the floral condition rated a greater degree of feeling agreeable than in the foliage condition.

Although the POMS-BI aims to assess positive and negative affect, research by Svrvakic, Przybeck, and Cloninger (1992) suggest that the measure is more suitable for assessing the presence or absence of a depressed mood. It is therefore possible that Adachi and colleagues (2000) failed to find the expected results due to the inability of a relatively short indoor plant exposure to affect states of depressive mood. Burchett and colleagues (2010) also employed the POMS measure and found a significant decrease in

negative affect in an office setting three months after the introduction of plants. Perhaps a more sensitive measure of positive and negative affect is required to accurately measure any differences due to being in the presence of an indoor plant under conditions of short exposure.

In a third example, children were asked questions regarding their well-being based on a well-being measure developed by Kaplan in her 2001 study, however no significant differences were noted between the children in the room with plants as compared to those in the room without plants (Han, 2009). It is important to note however, that the measure designed by Kaplan (2001) was used with an adult population within the United States. It is therefore unclear whether the validity and reliability of the scale extends to a population made up of youth outside of the United States.

Mixed results associated with indoor plants and affect may indicate effects due to measurement error. In order to measure any differences in affect after a relatively short indoor plant exposure, perhaps a more precise metric of state positive and negative affect is required. It is also possible that merely being in the presence of an indoor plant for a short period of time is not sufficient enough to have a demonstrable effect on well-being. In each of the above-mentioned instances, none of the participants were instructed to interact with the plant in any way. Perhaps caring for an indoor plant will affect well-being in a different manner. Although various studies have examined the effects of mood, and to a lesser extent well-being in general, while in the presence of plants, no studies to the knowledge of this author, have sought to explore the effects of caring for a plant on hedonic or eudaimonic well-being.

Eudaimonic well-being occurs when an individual is acting in such a way that is “congruent with their deeply held values” (Ryan & Deci, 2001, p. 146). Trait-level eudaimonic well-being has been popularly operationalized as the degree to which an individual values autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance (Ryff, 1989) and has been associated with markers indicating a more robust immune system and greater physical health (Ryff, Singer, & Love, 2004). Nisbet and colleagues (2011) found that autonomy, personal growth, and purpose in life were positively correlated with an individuals’ trait-level sense of connection to nature. Further to this, Weinstein and colleagues (2009) found that the degree to which individuals felt present, i.e. their sense of being immersed, in a plant filled room positively influenced their intrinsic aspirations, sense of autonomy, and sense of nature relatedness relative to individuals who felt equally immersed in a room without plants. Both studies point to the possible interplay between nature and aspects of eudaimonic well-being. Kellert (1993) maintains that our connection to nature contains within it the possibility of achieving meaning. It is therefore conceivable that this connection may be associated with our sense of eudaimonic well-being or the degree to which we are acting in accordance to a deeply held value of nature, especially among those individuals who place great value on nature. Steger, Frazier, Oishi, and Kaler (2006, p. 81) define meaning as “the sense made of, and significance felt regarding, the nature of one’s being and existence”. The perception of leading a meaningful life or the search for meaning can be thought of as inherent to eudaimonic well-being. Perceived lack of meaning in life has been associated with depression and anxiety whereas meaning is positively associated with happiness (Debats, van der Lubbe, & Wezeman, 1993). It

seems possible that playing a role in the emergence of life in the form of planting a seed and witnessing it sprout could affect an individual's sense of personal well-being or those aspects of eudaimonic well-being that make life seem meaningful.

### **Human and Nature Relational Tendencies**

The purpose of the present research was to explore the effects of caring for a bean plant from seed until shortly after germination in an attempt to facilitate a nature connection and affect well-being. Kellert (1993) outlined 9 tendencies with regards to a human nature connection: utilitarian, naturalistic, ecologicistic-scientific, aesthetic, symbolic, humanistic, moralistic, dominionistic, and negativistic. The proposed research involved the exploration of three of the nine tendencies, namely the naturalistic, moralistic, and dominionistic tendencies.

The naturalistic dimension encompasses the sense of wonder and awe that are often described and associated with respects to nature and natural processes. At its most basic level the naturalistic dimension is simply the enjoyment of contact with nature. There is some indication that exposure to indoor plants can affect mood (Adachi, Rohde, & Kendle, 2000; Lohr & Pearson-Mims, 2002). However, these results are mixed. Further, while there is evidence that nature immersion can induce a sense of wonder and awe (Nisbet & Zelenski, 2011) no one has yet tested whether caring for a plant can produce similar results. It was therefore expected that individuals would experience a sense of wonder, awe, and general increase in positive affect upon reflecting on their recently sprouted bean plant.

Similar to the naturalistic dimension, the moralistic dimension also encompasses an awe-like perception, however those with a moralistic view of nature, experience nature

as completely interconnected. Within these individuals, there is recognition of nature as being connected to the whole. Although we may perceive with our primary senses a separation between humans, nature, and various natural elements, at a fundamental level, these separations do not exist. The moralistic mode of perceiving the self as deeply interconnected with all living things is reflected in the recently developed metapersonal dimension of the self-construal model (MPS; DeCicco & Stroink, 2007). The metapersonal self differs from both the independent self who values standing out from those around them, and the interdependent self who places high value on their relationship to other human beings. People who identify with the metapersonal self tend to exhibit a stronger concern for the biosphere in general and a stronger tendency towards pro-environmental behaviour (Arnocky, Stroink, & DeCicco, 2007). However, the metapersonal self-construal extends beyond simple identification with nature. The metapersonal self is one who sees all of life as connected, that is life including the broader universe as well as all living things on this planet. Ultimately, they see themselves as an extension of all that is. The metapersonal self also encompasses an affinity towards that which is transcendental or spiritual in nature (Arnocky, Stroink, & DeCicco, 2007). Similarly, the moralistic dimension also encompasses a sense of “order and meaning in life” (Kellert, 1993, p. 59). Wilson (1993) suggests that although biophilia may be atrophied in modern Western cultures, the unconscious affinity remains. It may therefore, be possible to trigger this unconscious affinity and perhaps the moralistic dimension of the human nature connection through interacting with nature. It was expected that individuals who experienced successful germination of their bean plant would be primed towards experiencing this moralistic tendency as expressed by a

stronger sense of inclusion of nature, life, and universe in self and higher levels of positive mood, especially among those with a strong connection to nature or self identification with the metapersonal self.

Kellert describes the dominionistic tendency as the ability to dominate nature in such a way as to make our own survival attainable. Our agricultural industry could be conceived of as a modern equivalent to this dimension. Each season brings with it new challenges for farmers as they attempt to maintain crop yields and their livelihood. Within the biophilia hypothesis exists biophobia, or a fear or aversion towards natural elements, which may hamper our survival. Biophobia has been demonstrated in a variety of contexts. For example, many studies have found that humans have a stronger and more pervasive aversion towards potentially dangerous creatures such as snakes and spiders than to non-dangerous creatures and objects, even when presented subliminally (see Ulrich, 1993). It is hypothesized that avoiding such creatures created an evolutionary advantage. While the failure to germinate a bean seed would hardly constitute a biophobic experience, it is reasonable to assume that the inability to dominate nature would produce a negative experience. The ability to grow plants from seed is the ability to dominate nature in such a way as to produce food and ensure survival. It was therefore expected that those individuals who fail to successfully grow a bean plant would experience a decreased sense of well-being.

### **The Present Research**

The aim of the present research was to examine the effects of caring for a plant from seed until shortly after germination through a two-part study. Participants were asked to complete a set of questionnaires in the Carleton University Happy Lab (CUHL)

at which time they also planted a bean seed. They took the plant home and cared for it for approximately one week at which time they received an email notification reminding them to sign-up and complete the second portion of the study which consisted of an online questionnaire. This study was exploratory in nature.

### **Hypotheses**

Hypothesis 1. I expected that individuals whose bean sprout successfully broke the soil at *Time 2* would experience a greater sense of hedonic well-being, specifically higher positive affect, serenity, ‘soft fascination’, and vitality than was reported at *Time 1*. In contrast, I expected that individual’s sense of hedonic well-being in the *non-sprout* group would either be the same from *Times 1* to *2* or they would experience a reduction in hedonic well-being.

Hypothesis 2. I expected that individuals whose bean sprout successfully broke the soil at *Time 2* would experience a stronger sense of biospheric concern, inclusion with nature, inclusion with life in general and would report a higher presence and lower search for meaning in their lives than those whose beans did not sprout.

Hypothesis 3. I expected an interaction between both nature relatedness and the metapersonal self-construal and group (i.e. *sprout* and *no-sprout*) such that those individuals with higher levels of NR and MPS would experience the greatest change in happiness from *Time1* to *Time 2* under the *sprout* condition.

## **Method**

### **Participants**

Participants were recruited to participate in ‘Time1\_Personality and Plants’ in one of three ways. The majority of participants were recruited from the Carleton University

undergraduate psychology and neuropsychology pool through the SONA system. The initial plan included recruiting only those participants who had completed mass testing, however due to poor sign-ups, it was decided that the recruitment criteria should be broadened to include all individuals eligible for course credit through the SONA system (57.85%,  $n = 70$ ). Further to this, participants were recruited through an advertisement on Kijiji as well as through posters (and/or word of mouth) placed around Carleton Campus (Kijiji;  $n = 51$ ). For the sake of simplicity the four participants recruited through posters and/or word of mouth were grouped under ‘Kijiji’ when exploring whether there were any differences between these two samples. All participants were asked to complete a series of questionnaires at two separate times as well as care for a bean plant for approximately one week. Participants were made aware of the time requirements prior to signing up for the study.

A total of 121 participants completed *Time 1* of this two-part study. The mean age of the sample was 22.03 years,  $SD = 4.58$ . A greater number of women (72.7%,  $n = 88$ ) participated than men ( $n = 33$ ). The majority were first (26.4%) and second (23.1%) year students, from a variety of disciplines at Carleton University. However, 19% of participants ( $n = 23$ ) left this response blank either because they did not wish to disclose their education status or because this question did not apply. The majority of participants indicated having spent most of their youth in a city (60.3%,  $n = 73$ ) and currently reside in a city (74.4%,  $n = 90$ ). An equal number of participants indicated having houseplants (46.3%,  $n = 56$ ) versus not having any (48.8%,  $n = 59$ ). Those who indicated having houseplants reported having, on average, 5 houseplants. On a scale from one (no experience) to five (very experienced), on average participants reported a moderate level

of experience caring for plants ( $M = 2.92$ ,  $SD = .98$ ). The majority of Kijiji participants (66.67%,  $n = 34$ ) indicated that they were students with 26 indicating Carleton University, 6 Ottawa University, 1 Algonquin College, and one other completing a Masters program at an undisclosed University. The remaining Kijiji participants ( $n = 17$ ) left this section of the questionnaire blank. The study advertisement was posted under the 'other' category within the 'job search' section on Kijiji. However, no information was collected on what type or whether participants were employed.

A total of 102 participants completed *Time 2* ('Time 2\_Personality and Plants') of this two-part study. Of these, 57 were originally recruited through SONA, 41 were recruited through Kijiji and all 4 individuals recruited through the posters participated in *Time 2*. An equal proportion of participants recruited through SONA and Kijiji ended up in the *sprout* versus *no-sprout* groups. There were no demographic differences between the participants recruited through Kijiji and SONA, including age differences.

### **Materials**

**Bean plant.** The bean seeds and soil were obtained from a local organic farm. Participants were also provided with a pot and tray for their bean plants (see photo: Appendix J).

**Demographics.** All participants were asked questions regarding gender, age, where they grew up, and where they presently live. They were also asked about their experience with gardening and caring for plants and whether they currently have any indoor plants (Appendix A).

**Manipulation check.** As part of a manipulation check at *Time 2*, participants were asked questions regarding their contact with the plant and the room in which they placed the plant (Appendix E).

**Hedonic well-being.** The Positive and Negative Affect Scale (PANAS; Watson, et al. 1988; Appendix B) was used to assess high arousal positive and negative affect. Participants were asked to rate the extent to which they related to set of 30 adjectives ‘right now’ on a five-point Likert scale from 1 (very slightly or not at all) to 5 (extremely). Ratings of ten adjectives such as ‘interested’, ‘excited’, and ‘alert’ were used to compose a mean positive affect (PA) score (*Time 1*,  $\alpha = .87$ ; *Time 2*,  $\alpha = .93$ ). Similarly, ratings of ten adjectives such as ‘irritable’, ‘ashamed’, and ‘hostile’ were used to compose a mean negative affect (NA) score (*Time 1*,  $\alpha = .87$ ; *Time 2*,  $\alpha = .91$ ). In addition to the 20 positive and negative affect adjectives, two subscales from PANAS-X (Watson & Clark, 1994) were included to assess low arousal positive and negative affect. Serenity (three adjectives; *Time 1*,  $\alpha = .83$ ; *Time 2*,  $\alpha = .87$ ) and guilt (six adjectives; *Time 1*,  $\alpha = .91$ ; *Time 2*,  $\alpha = .88$ ) were assessed using such adjectives as ‘calm’ and ‘blameworthy’ respectively. Finally, three additional adjectives, ‘fascinated’, ‘curious’ and ‘in awe’, were included in order to obtain a measure of ‘soft fascination’ (*Time 1*,  $\alpha = .75$ ; *Time 2*,  $\alpha = .75$ ). Kaplan (1995) theorized the restorative properties of nature are in part due to its ability to create “soft fascination”. The latter three adjectives represent an ad hoc scale used to assess fascination. Using this measure, Nisbet and Zelenski (2011) found that individuals rated a greater degree of fascination after walking outside compared to walking indoors.

A measure of vitality was also included in order to measure the degree to which individuals perceive subjective vitality and energy. The Vitality Scale (Ryan & Frederick, 1997; Appendix C) consists of seven questions rated on a seven-point Likert scale from 1 (not at all true) to 7 (very true). Participants were asked to indicate the degree to which various statements are applicable right now. Questions such as ‘I feel alive and vital’ and ‘I feel energized’ were used to derive a vitality score for each individual (*Time 1*,  $\alpha = .91$ ; *Time 2*,  $\alpha = .90$ ).

**Personality.** The Metapersonal Self (MPS) Scale (Decicco & Stroink, 2007) consists of 10 statements rated on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Statements such as ‘I believe that no matter where I am or what I’m doing, I am never separate from others’, ‘My sense of inner peace is one of the most important things to me.’ and ‘I feel a sense of responsibility and belonging to the universe.’ were used to obtain a mean rating of the metapersonal self-construal for each individual ( $\alpha = .66$ ). In addition to this scale, the Interdependent Self-Construal scale (Singelis, 1994;  $\alpha = .54$ ) and the General Belongingness Scale (Malone, Pillow, & Osman, 2012;  $\alpha = .94$ ) were included (Appendix D). The latter two scales were used in order to divert attention away from the MPS scale thereby reducing any potential demand characteristics.

**Connection with Nature.** To measure the degree to which individuals self-rate as connected with nature two different scales were employed. The first, the Nature Relatedness scale short-form (NR-6: Nisbet, et al., 2009; Appendix F) is a six item subset of the NR scale which measures an individuals perceived connection to nature in terms of affect and experience. The NR-6 was included in mass testing, however in order to

complete this project by the required deadline, the recruitment criteria was broadened to include individuals who had not completed mass testing. To compensate for this change, the NR-6 was included in the *Time 1* questionnaire packet. Only two participants completed *Time 1* prior to the inclusion of the NR-6 within the *Time 1* procedure. The NR-6 scale asks participants to rate six statements using a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) with higher scores indicating a stronger connection to nature. Items include “I always think about how my actions affect the environment”, “My connection to nature and the environment is a part of my spirituality”, and “I feel very connected to all living things and the earth”. A total NR score was then calculated for each individual as an average of the six questions ( $\alpha = .85$ ). The short-form of the questionnaire was chosen because I believe that including the full scale as part of the questionnaire packet administered at *Time 1* would be overly revealing of the intention of the experiment. Thus in order to reduce potential demand characteristics, the NR-6 was embedded in the Big Five (personality) Inventory (John & Srivastava, 1999).

The second scale included to measure connection to nature was the Inclusion with Nature in Self Scale (INS; Schultz, 2002; Appendix F) and Modified Inclusion in Self Scales. The original scale was developed by Aron et al. (1992) and was used to measure closeness in interpersonal relationships. The INS scale positively correlates with pro-environmental behaviour and concern for the biosphere (Schultz, 2002). The scale consists of seven different options. Each option consists of an image of two overlapping circles varying in distance from one another. In each of the options, the word ‘self’ is within one of the circles and the words ‘nature’ is within the other circle. The distances

between the two circles range from completely separate, representing a complete lack of inclusion, to completely overlapping, representing complete inclusion. In order to measure inclusion with the universe and life two additional ‘inclusion in self’ scales were created, by replacing the word ‘nature’ with ‘life’ and ‘universe’ respectively. In each instance participants were asked to describe their relationship with nature/life/universe ‘right now’.

**Environmental Concern.** The environmental concern scale (EC) measures the nature of a person’s environmental concern (Schultz, 2001; Appendix G). The scale is made up of 12 one word items each ranked on a seven-point Likert scale ranging from 1 (not important) to seven (supreme importance). The overarching question is “I am concerned about environmental problems because of the consequences for...” followed by one of the items. The scale is divided into three subscales: biospheric, egoistic, and altruistic. The biospheric subsection measures concern with regards to the person’s concern for all living things. This subsection includes such items as “animals”, “plants”, “marine life” and “birds” ( $\alpha = .93$ ). The egoistic subsection measures a person’s environmental concern with regards to him or herself. For example, items within this subsection include “me”, “my future”, “my lifestyle” and “my health” ( $\alpha = .92$ ). The altruistic subsection measures a person’s environmental concern based on the costs and benefits to others and includes items such as “all people”, “children”, “people in my community” and “my children” ( $\alpha = .89$ ). A mean was created for all participants across each subsection.

**Meaning.** Meaning was measured in terms of presence and search using the Meaning of Life Questionnaire (MLQ; Steger, Frazier, Oishi, & Kaler 2006; Appendix

H). Presence has been found to correlate positively with other well-being indicators such as life satisfaction and joy, whereas search for meaning has been found to positively correlate to fear and sadness (Steger, et al., 2006). Participants were asked to rate the degree to which they agree with various statements from 1 (absolutely untrue) to seven (absolutely true). The presence subscale consists of such statements as “I understand my life’s meaning” and “My life has a clear sense of purpose” ( $\alpha = .92$ ). The search subscale consists of such statements as “I am looking for something that makes my life feel meaningful” and “I am seeking a purpose or mission for my life” ( $\alpha = .89$ ).

### **Procedure**

This was a two-part study. All participants in the laboratory session (*Time 1*) were tested individually or in groups of up to six on campus in the CUHL. Once there, each participant was seated at a table where they were asked to complete an informed consent. Participants were once again informed that this was a two-part study and they were expected to complete both portions. Participants were informed that the purpose of the first portion of this study (*Time 1*) was to explore the relationship between various personality measures and caring for a plant. At this time, they were also informed that the purpose of the questions administered at *Time 2* was to expand on the information gathered at *Time 1* by examining various mood states and the individual’s sense of self.

Each participant was then given a unique identifier within his or her questionnaire packet. They were not made aware of the purpose of this number, however it was used to identify their data from *Times 1* and *2* while keeping their names and student numbers separate from the data. Student numbers were collected in order to match data collected

from *Times 1* and *2*. Students' names and student numbers have been kept in a password protected file separate from all questionnaire responses.

Participants were then asked to fill out the Nature Relatedness Scale (NR-6; Nisbet et al., 2009) embedded in the Big Five (personality) Inventory (John & Srivastava, 1999), the Bem Sex-Role Inventory (Bem, 1974; used to distract participants from the true nature of the study), the Vitality Scale (Ryan & Frederick, 1997), the Positive and Negative Affect Schedule (*PANAS*; Watson, et al. 1988) with added questions to assess soft fascination, two measures of self-construal (Self-Construal Scale; Singelis, 1994; MPS; Decicco & Stroink, 2007), the General Belongingness Scale (Malone, et al., 2012), and demographic questions (including their student numbers). After filling out the questionnaire, a researcher demonstrated how to plant the bean seed. Each participant was given a pot with soil, a plate for the pot, and the bean seed and asked to plant their seed. Each participant then watered his or her newly planted bean seed as instructed by the researcher. Verbal information regarding the lifecycle and how to care for a bean plant was included for each participant. The researcher then informed the participants that they would be contacted through email within approximately one week with information on participating in *Time 2*. The participants were then partially debriefed, thanked, and directed to take their bean plant home, place it in a space where they would encounter it regularly, and water it according to the given instruction. *Time 1* took approximately 30 minutes to complete.

All participants were contacted by email within ten days of completing *Time 1* with a reminder to sign up for *Time 2* regardless of whether their bean plant had sprouted or not. The email instructed them to complete the questionnaire within Qualtrics

preferably when they were near their plant or shortly after having looked at their plant. Participants were informed that it was preferable if they completed the second set of questionnaires as soon as possible. They were informed that they have a maximum of three days to complete *Time 2*. A final reminder email was sent out one day prior to the deadline.

Upon following the Qualtrics link, participants were once again asked for their student numbers in order to link the data from *Time 1* for each individual. A unique identification code was embedded within the SONA link to Qualtrics as an added safeguard for linking the data. For those participants who were not Carleton University students, the unique identifier found within their questionnaire packets was embedded within the Qualtrics link sent to their email accounts for a similar purpose. After clicking the agree button on the online informed consent, each participant was asked questions regarding whether and when their plant sprouted, the location of their plant, the amount of contact they had with their plant over the course of the study, and their experience with plants in order to check for congruency between the two groups.

Participants were randomly grouped to either a *sprout* group or *no-sprout* group based primarily on whether they obtained a viable bean seed or not and whether their bean seed sprouted within the 10-13 days prior to their participation in *Time 2*. Neither the researchers nor the participants were aware of whether a particular participant had received a viable bean seed. The bean seeds used within this study have a success rate of approximately 80% during the summer months. However, testing of the seeds during the winter months yielded a success rate of approximately 30%. As such, the distribution of *sprout* versus *no-sprout* is unevenly divided throughout the duration of the study with an

increasing proportion of individuals in the *sprout* condition as the days lengthen. In an attempt to control this discrepancy, a total of 20 bean seeds were painted with clear nail polish, which dramatically increased the length of time between planting and germination thereby increasing the number of participants within the *no-sprout* group. Despite this measure the *sprout* condition (62%  $n = 63$ ) makes up the greater proportion of participants (*no-sprout*;  $n = 39$ ). The majority of participants in the *sprout* group reported that their plant first sprouted roughly 5-6 days after planting (79.4%  $n = 50$ ). Overall, the majority of participants reported placing their plant near a window (79.4%  $n = 81$ ) either in their bedroom (36.3%  $n = 37$ ), living room (27.5%  $n = 28$ ), or kitchen (24.5%  $n = 25$ ) and completed the second time point when in the presence of their plant (58.8%  $n = 60$ ).

All of the participants were then asked to complete the MLQ (Steger, et al., 2006) followed by the Vitality scale, the EC scale (Schultz, 2001), INS (Schultz, 2002) and modified versions, and finally the PANAS including the soft fascination questions. Prior to the final debrief, participants were given the option to provide feedback regarding this study as a way of obtaining potentially useful feedback (General Information: Appendix I). Each participant was prompted to send in a photo of their plant after completing *Time 2*. Participants were informed that they would be eligible for a draw with a monetary reward once the photo of their plant (whether it had sprouted or not) was received by the principal researcher. This was used as both an incentive to increase the participation rate of *Time 2* and as a measure of control in order to ensure that the participants' conception of 'sprout' was the same as mine. A total of 79 photos were sent in ranging from no sprout ( $n = 33$ ) to varying stages of sprout growth ( $n = 46$ ). All photos correspond to the

participant's answer regarding whether their plant sprouted or not. Finally, all participants were thanked for their participation, fully debriefed, and provided with a web link with information on how to continue to care for their bean plants should they choose to do so. On average *Time 2* took participants approximately 15-minutes to complete. Those participants who completed *Time 1*, but did not sign up for *Time 2* have now received the full debriefing via email.

## Results

### Data Cleaning

Prior to running data analyses, the data were screened for outliers and normality<sup>1</sup>. Participants were asked to “Please describe in your own words what you think the study is about” upon completing *Time 2* as their responses may have been influenced by their knowledge of the general hypothesis. A total of 5 participants (out of 102) accurately guessed that there were likely two conditions and that it was likely that mood and connection would be affected by whether the plant sprouted or not. The analyses were run both including and excluding these individuals and no differences were found as such these individuals have been included within the final analyses.

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<sup>1</sup> Boxplots revealed a number of outliers within the mood indicators both in *Time 1* and *Time 2*. All data points were transformed into z-scores and using the commonly accepted cut-off ( $z = \pm 3.29$ ) one outlier was identified within the distribution of NA ratings at *Time 1* ( $z = 3.32$ ) and another at *Time 2* ( $z = 3.73$ ). Assessment of histograms, boxplots, normal and detrended Q-Q plots of the standardized distributions of each measure revealed that the distributions of NA and guilt ratings were severely positively skewed at both *Time 1* (NA:  $S = 1.933$ ,  $SE = .378$ ; guilt:  $S = 1.722$ ,  $SE = .378$ ) and *Time 2* (NA:  $S = 1.726$ ,  $SE = .378$ ; guilt:  $S = 1.743$ ,  $SE = .378$ ). In addition, all three subscales of environmental concern were severely negatively skewed (biospheric:  $S = -.935$ ,  $SE = .378$ ; egoistic:  $S = -1.397$ ,  $SE = .378$ ; altruistic:  $S = -1.196$ ,  $SE = .378$ ). These findings were consistent for both groups (i.e. *sprout* versus *no-sprout*). However, neither transformations nor bringing univariate outliers within range resulted in a normal distribution for any of the affected variables. Further to this, none of the transformations affected the outcome. As such, the untransformed data was used in the analyses of the hypotheses.

### **Hypothesis 1**

In order to assess the first hypothesis examining whether there were any mood differences from *Time 1* to *Time 2* based on *Sprout* condition, a mixed ANOVA was employed. It was expected that individuals in the *sprout* group would experience an increase in positive affect, serenity, fascination, and vitality relative to their ratings of these same measures at *Time 1*. It was also expected that individuals in the *no-sprout* group would experience either no change in mood from *Times 1* and *2* or an increase in negative affect and guilt as well as a decrease in the above mentioned hedonic well-being indicators.

There were no significant *Sprout* x *Time* interactions for any of the variables under consideration (Table 1). However, the *Sprout* x *Time* interaction for the guilt subscale of PANAS was approaching significance,  $F(1,100) = 2.92, p = .09, \eta_p^2 = 0.03$ , with participants within the *sprout* group indicating an increase in guilt from *Times 1* and *2* (Figure 1), a pattern that contradicted the hypothesis.

Table 1

*Means, Standard Deviations, and F-values of mood variables by Sprout condition for the Positive and Negative Affect scale (and sub-scales) and the Vitality scale*

Mood	Time 1				Time 2				F
	Sprout (n=63)		No-Sprout (n=39)		Sprout (n=63)		No-Sprout (n=39)		
	M	SD	M	SD	M	SD	M	SD	
Positive Affect	3.30	0.76	3.28	0.72	2.97	0.95	2.87	0.87	0.29
Negative Affect	1.62	0.66	1.42	0.65	1.76	0.69	1.65	0.76	0.48
Serenity	3.46	0.96	3.86	0.95	3.19	0.97	3.53	1.04	0.11
Guilt	1.49	0.64	1.48	0.84	1.70	0.70	1.47	0.72	2.92*
Fascination	2.88	0.93	2.77	0.86	2.51	0.91	2.27	1.04	0.41
Vitality	4.61	1.31	4.60	1.25	4.51	1.14	4.56	1.24	0.07

\* $p = .091$

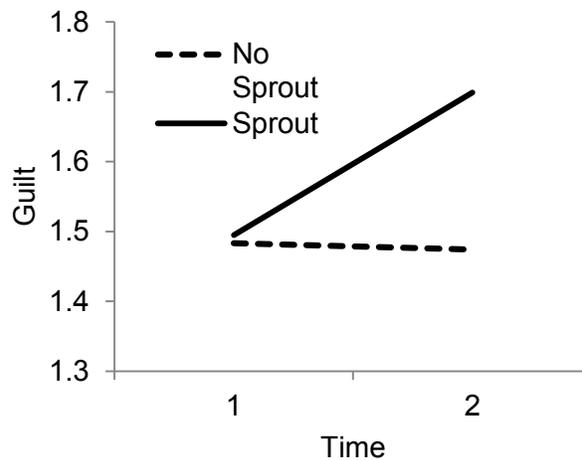
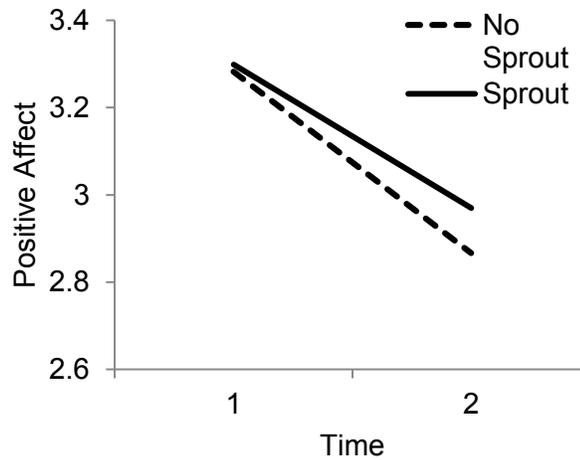


Figure 1. *Time 1 and Time 2 mean ratings on guilt sub-scale of PANAS for individuals in the sprout group or no-sprout group.*

There were significant main effects of *Time* for positive affect, negative affect, serenity, and fascination (Figures 2-5). Where participants in both conditions reported a decrease in PA from *Times 1* and 2,  $F(1,100) = 21.30, p < .001, \eta_p^2 = 0.18$ ; an increase in NA,  $F(1,100) = 1.65, p = .004, \eta_p^2 = 0.08$ ; a decrease in serenity,  $F(1,100) = 21.30, p < .001, \eta_p^2 = 0.09$ ; and a decrease in fascination,  $F(1,100) = 17.79, p < .001, \eta_p^2 = 0.15$ . In general, participants experienced a decrease in positive mood and an increase in negative mood irrespective of condition. There was also a significant difference between groups for serenity at *Time 1*,  $t(100) = 2.08, p = .04$ , where individuals within the *sprout* group rated their perceived serenity (right now) significantly lower than individuals in the *no-sprout* group. Although the trend remained the same, the difference between groups was no longer significant at *Time 2*,  $t(100) = 1.67, p = .10$ .



*Figure 2.* *Time 1* and *Time 2* mean ratings on positive affect sub-scale of PANAS for individuals in the *sprout* group or *no-sprout* group.

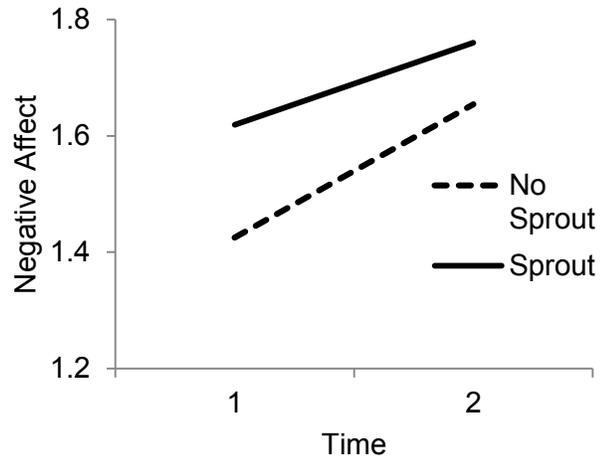


Figure 3. Time 1 and Time 2 mean ratings on negative affect sub-scale of PANAS for individuals in the *sprout* group or *no-sprout* group.

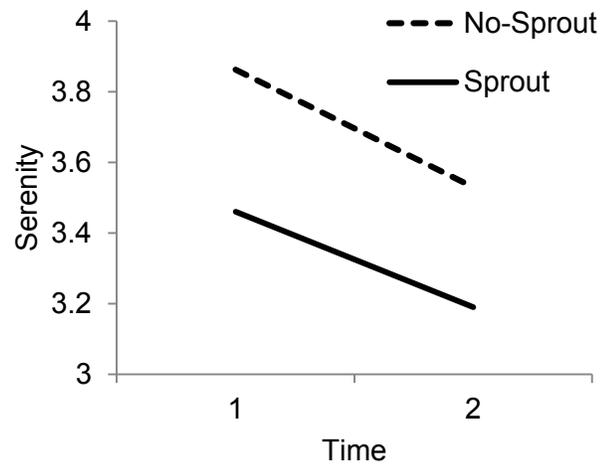


Figure 4. Time 1 and Time 2 mean ratings on serenity sub-scale of PANAS for individuals in the *sprout* group or *no-sprout* group.

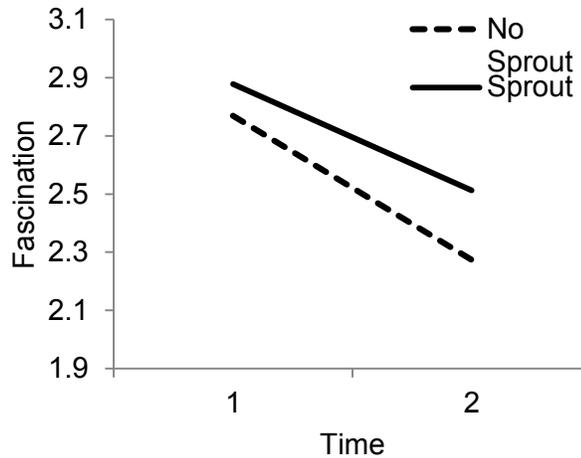


Figure 5. Time 1 and Time 2 mean ratings on the three-item measure of fascination for individuals in the *sprout* group or *no-sprout* group.

## Hypothesis 2

The second hypothesis, exploring whether there were any differences between *Sprout* conditions for variables assessing individuals' perceptions of meaning and inclusion, was tested using independent samples *t*-tests. I expected that individuals from the *sprout* group would rate a higher sense of presence of meaning in life, inclusion of nature in self, inclusion of life in self, and inclusion of universe in self. I also expected that the *no-sprout* group would rate a higher sense of search for meaning.

Contrary to expectation, there were no significant differences between the two groups at *Time 2* for any of the dependent variables (Table 2), although the items measuring search for meaning was approaching significance. Individuals within the *sprout* group ( $M = 26.30$ ,  $SD = 5.64$ ) rated their perceived search for meaning significantly higher than those in the *no-sprout* group ( $M = 23.46$ ,  $SD = 7.89$ ;  $t(100) = 2.12$ ,  $p = .04$ ,  $d = .41$ ). However, after accounting for the fact that the two groups were not homogeneous, the *p*-value fell just below the  $p < .05$  cut-off ( $p = .06$ ).

Table 2

*Means, Standard Deviations, and t-values of inclusion and meaning variables by Sprout condition*

Dependent Variable	Sprout (n=63)		No-Sprout (n=39)		<i>t</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Biospheric Concern	6.00	0.96	5.81	1.22	0.84
INS	3.62	1.57	3.97	1.53	1.12
ILS	4.86	1.65	5.05	1.76	0.56
IUS	3.92	1.88	3.69	1.78	0.61
Presence	24.60	6.22	24.69	7.48	0.07
Search	26.30	5.64	23.46	7.89	1.96

*Note.* *t*-value for heterogeneous groups reported for search for meaning in life; INS = Inclusion of Nature in Self; ILS = Inclusion of Life in Self; IUS = Inclusion of Universe in Self; Presence = Presence of meaning in life; Search = Search for meaning in life.

### **Hypothesis 3**

Lastly, I expected that Nature Relatedness and Metapersonal Self Construal would moderate mood ratings such that those individuals who strongly identify with the above constructs would experience the greatest impact on positive affect based on their *Sprout* condition. A hierarchical regression analysis was used in order to examine whether this effect was in fact present. Positive affect difference scores (PA<sub>diff</sub>) were calculated by subtracting the PA mean for each individual for *Time 2* from their PA mean

at *Time 1*. The difference scores were used as the dependent variable measuring the relative change in positive affect from *Time 1* to *Time 2*<sup>2</sup>.

Bivariate analysis indicated that irrespective of condition NR ( $M = 3.32$ ,  $SD = .92$ ) was, as expected, positively (and moderately) correlated to both *Time 1* PA,  $r(100) = .31$ ,  $p = .002$  and *Time 2* PA,  $r(100) = .21$ ,  $p = .03$ , but there was no correlation to PADiff ( $M = 0.36$ ,  $SD = .79$ ). There was also a positive and moderate correlation between NR and MPS ( $M = 4.46$ ,  $SD = .95$ ),  $r(100) = .59$ ,  $p < .001$ . Similarly, moderate correlations were found between MPS, *Time 1* PA  $r(102) = .49$ ,  $p < .001$  and *Time 2* PA  $r(102) = .33$ ,  $p = .001$ . However there was no correlation between MPS and the positive affect difference scores (See Table 3; See Table 10 in Appendix K for complete summary of bivariate correlations among all variables).

Table 3

*Correlations at the zero-order level between Nature Relatedness (NR), positive affect at Times 1 (PA1) and 2 (PA2), positive affect difference scores (PADiff) and Metapersonal-Self Construal (MPS)*

Variable	NR	PA1	PA2	PAdiff	MPS
NR	1.00				
PA1	.31*	1.00			
PA2	.21*	.56**	1.00		
PAdiff	.04	.28*	-.63**	1.00	
MPS	.59**	.49**	.33**	.08	1.00

\* $p < .05$ , \*\* $p < or = .001$

<sup>2</sup> Prior to the regression analysis, both predictors (NR and MPS) were centered and *Sprout* condition was affect coded (-1, 1).

Contrary to initial expectations, but congruent with the bivariate analysis, neither NR nor *Sprout* explained any significant portion of the variance in the PAdiff scores when entered as Step 1 of a hierarchical regression analysis,  $R^2 = .005$ ,  $F(2,97) = 0.23$ ,  $p = .80$ . This was followed by Step 2, which included the product of the interaction term made up of the centered NR value and *Sprout* condition, which also proved not significant,  $\Delta R^2 = .03$ ,  $F(1,96) = 2.62$ ,  $p = .11$ . There were no significant main effects of NR or *Sprout* and there was no significant NR x *Sprout* interaction (Table 4).

Table 4

*Summary of hierarchical regression analyses examining predictability of positive affect difference scores by degree of Nature Relatedness (NR) and Sprout condition*

Predictors	R <sup>2</sup>	F	ΔR <sup>2</sup>	B	SE	sr <sup>2</sup>
PAdiff						
Step 1:	.07	0.23				
<i>Sprout</i>				-.04	.08	.002
NR				.03	.09	.001
Step 2:	.18	2.62	.03			
NR x <i>Sprout</i>				-.15	.09	.027

Similar to the NR findings, the overall model including the effects of MPS and *Sprout* condition on PAdiff was not significant ( $R^2 = .009$ ,  $F(2,99) = 0.44$ ,  $p = .65$ ) at Step 1 of the hierarchical regression analysis nor was the model including the interaction term made up of the centered MPS value and *Sprout* condition,  $\Delta R^2 = .02$ ,  $F(1,98) = 2.24$ ,  $p = .14$ . There were no significant main effects of MPS or *Sprout*. The MPS x *Sprout* interaction was also not significant (Table 5).

Table 5

*Summary of hierarchical regression analyses examining predictability of positive affect difference scores by degree of Metapersonal Self Construal (MPS) and Sprout condition*

Predictors	R <sup>2</sup>	F	ΔR <sup>2</sup>	B	SE	sr <sup>2</sup>
PA <sub>diff</sub>						
Step 1:	.09	0.44				
Sprout				-.05	.08	.003
MPS				.06	.08	.006
Step 2:	.18	2.24	.02			
MPS x Sprout				-.13	.08	.022

Although the PA<sub>diff</sub> scores were a seemingly appropriate method for analyzing the relative change in PA, the failure to find a significant correlation between PA<sub>diff</sub> and NR prompted an exploration of the relationship between NR and PA at *Times 1* and *2* as well as MPS and PA at *Times 1* and *2*<sup>3</sup>. Four separate hierarchical regression analyses were performed using PA means from *Times 1* and *2* as the dependent variables and NR and MPS respectively as the potential moderator. In all four instances, *Sprout* and the centered predictor were entered first followed by the appropriate interaction term (please see Table 7 and Table 8 in Appendix K for a complete summary).

Congruent with expectations, the analysis demonstrated that NR significantly predicted PA at both *Times 1* and *2* such that individuals high in NR also rated higher PA. However, the relative contribution of NR to PA at *Time 2* dropped to just below significance. Neither *Sprout* condition nor the interaction between *NR* and *Sprout* contributed significantly to the model at either time point. MPS was also found to be a

<sup>3</sup> Nature Relatedness has been found to correlate to self-reports of positive affect in numerous instances (Nisbet & Zelenski, 2009; Nisbet et al., 2011; Howell, et al., 2011).

significant and positive predictor of PA at both *Times 1* and *2*. The relative contribution of MPS to the model was somewhat lower at *Time 2* than at *Time 1*. Neither *Sprout* condition nor the interaction between MPS and *Sprout* contributed significantly to the model at *Time 1* or *Time 2*.

Each of the *Time 1* and *2* mood subscales (NA, vitality, guilt, serenity, and fascination) was similarly entered as the outcome variable in a hierarchical regression analysis in order to examine whether a similar pattern emerged (see Table 9, Appendix K for bivariate correlations). There were no significant *Sprout* x NR or *Sprout* x MPS interactions for any of the outcome variables. As expected, there was a positive linear relationship between NR and vitality as well as NR and fascination, such that individuals high in NR also reported more vitality and fascination equally at both *Times 1* and *2*, indicating that the same pattern as seen with PA did not extend to the relationship between NR and vitality or fascination. There was no relationship between NR and NA, guilt, or serenity. Individuals who rated higher on MPS also tended to report more vitality, serenity, and fascination equally at both *Times 1* and *2*. There was no significant relationship between MPS and NA. There was also no significant relationship between MPS and guilt at *Time 1*, however at *Time 2* individuals higher in MPS reported less guilt. Once again, the trend of a weakened relationship between MPS and PA found at *Time 2* versus *Time 1* was not seen with the other mood subscales.

### **Supplementary Exploration**

Participants were asked to provide feedback at *Time 2* including any questions they may have had regarding the nature of the study. As this was the online portion, it was deemed necessary to provide space for participant feedback should they choose to do

so. Although there was no intention of using this information within the thesis document itself, information provided by the participants tended to support the notion that a certain number (perhaps only a small subset) of individuals anecdotally responded to the *Sprout* condition as was hypothesized. For example, a small number of individuals reported (unprompted) the pleasure and/or meaning they derived from caring for their sprouted plant. Conversely, although a few individuals from the *no-sprout* group reported what could be interpreted as disappointment, overall those who provided feedback did so in a light hearted manner (Table 6; see Appendix K for a complete list of participant feedback to the question “Is there anything else you would like to tell us about this study [either Time 1 or 2]”).

Table 6

*Participant feedback by sprout group*

Sprout	Feedback
	<ul style="list-style-type: none"> <li>• Interesting, made me think about environmental problems</li> <li>• I researched how to keep the plant going and I am excited (to get some beans).</li> <li>• I will watch (the plant) several times a day. It makes me feel meaningful and excited to do that.</li> <li>• I'm looking forward to it producing some beans:)</li> <li>• It's been a lot of fun watching my bean grow!</li> <li>• Throughout the study I went through some tough situations and having the plant to look after was uplifting.</li> <li>• It was a lot of fun taking care of the plant</li> <li>• I was happy to see it sprout!</li> <li>• It reminded me to smell the roses occasionally, and now I want to get a few houseplants haha!</li> <li>• My plant is growing happy and healthy in home :)</li> </ul>
No-Sprout	Feedback
	<ul style="list-style-type: none"> <li>• No sprout :(</li> <li>• It didn't sprout :(</li> <li>• It's still hiding in the soil though.</li> <li>• Even though my plant didn't grow, I loved taking care of it!!!</li> <li>• Attached is a picture of my (unfortunately un-sprouted) plant.</li> <li>• He has unfortunately not sprouted!</li> <li>• I named my plant Steve. Like me, he doesn't like waking up.</li> </ul>

## Discussion

The biophilia hypothesis suggests that we have a natural tendency towards life and lifelike processes. Previous research examining the effects of nature has provided support for the idea that nature plays a greater role in our well-being than overtly recognizable. It is not completely clear however, whether the beneficial effects of nature are limited to being outdoors immersed in a natural environment or whether they can be extended to indoor nature experiences. In an effort to gain a better understanding of the effects of watching an indoor plant sprout, I had participants grow a string bean plant from seed. I expected that those individuals who were able to witness their plants growth would ultimately find the experience pleasant and thus would rate their mood as more positive at a second time point than those participants whose plant did not sprout. Similarly, I expected that the individuals with a sprouted bean plant would rate their perceived presence of meaning, concern for the biosphere, and connection to nature and life as higher than those without a sprouted bean plant. Finally, I expected that the changes I indicated would be more strongly prevalent within individuals who reported a stronger connection to nature and a stronger perception of the interconnectedness of life. Although there was some anecdotal and qualitative evidence in support of mood effects, the numerical data did not support any of my proposed hypotheses.

### Nature and Well-Being

Outdoor nature exposure has demonstrable importance (Atchley, Strayer & Atchley, 2012; Bowler, Buyung-Ali, Knight, & Pullin, 2010; MacKerron & Mourato, 2013), however the vast majority of us spend a great amount of our time indoors (Klepeis et al., 2001). As such, it is important for us to understand what impact indoor nature

exposure may have on our sense of well-being. Exposure to plants indoors has been associated with various positive health outcomes such as increased tolerance for pain both in a controlled environment and in a natural setting (Lohr & Pearson-Mims, 2000; Park & Mattson 2008; 2009). Indoor plants have also been associated with a decrease in perceived stress as well as an increase in the perceived aesthetics of any given room (Lohr, Pearson-Mims, & Goodwin, 1996; Dijkstra, Pieterse, & Pruyn, 2008; Fjeld, 2000). However, there is not a great deal of evidence to support the idea that indoor plant exposure has similar mood effects as that of outdoor immersion nor do the results of the present study support this idea.

Nisbet and Zelenski (2011) found that after 17 minutes of exposure to an outdoor nature environment versus an indoor non-nature environment, participants in the outdoor environment rated their mood as significantly more positive. Under similar exposure times, various researchers have failed to find any significant and/or positive differences between groups in an indoor plant versus no-plant condition (19 minutes: Adachi, et al., 2000; 13 minutes: Shibata & Suzuki, 2001; 20-30 minutes: Larsen, et al., 1998). Although there are some legitimate methodological concerns with the above mentioned research, including but not limited to sample size, it may be that potted plants in an indoor environment do not have the same effect on mood as being immersed in an outdoor nature setting. Conversely, Burchett and colleagues (2010) found that after three months of exposure to indoor plants in an office setting, the office employees rated significantly less negative affect than at baseline, indicating that indoor plants may indeed confer benefits where our mood is concerned. The different outcomes may be due to the relative obscurity of a few plants against the backdrop of our everyday busy lives.

It may take a substantial amount of time before we begin to notice and appreciate plants in our surroundings. Plants are fairly small in size and in general grow at an imperceptible rate. Kellert (1993) suggests that our ability to connect with plants and animals might be intertwined with our ability to recognize our similarities, for example the fact that we are all living organisms that grow.

In an attempt to assess whether there would be mood effects after witnessing an indoor plant grow over an extended period of time, I had participants plant and care for a bean seed for approximately one week. It was expected that those participants who witnessed their bean seed sprout, and the subsequent relatively fast growth rate of their plant over the following few days, would experience a heightened sense of fascination and positive affect. However, this was not the case. In fact, in general all participants saw a significant decrease in positive affect as well as an increase in negative affect from the first time point to the second. Further, there were no differences between groups on any of the mood indicators at the second time point. Although anecdotally a number of participants reported experiencing a degree of pleasure from their sprouted plant, numerical analyses of the measures used did not support any mood effects.

The results of this study appear to suggest that the limited exposure to one small plant for the duration of one week may simply not be enough to break through the noise of everyday life. In contrast to the present findings, Weinstein, Przybylski, and Ryan (2009), using a relatively short indoor plant exposure scenario, found that the degree to which individuals felt immersed in a plant filled room affected their degree of connection to nature and autonomy. Further to this, the individual's sense of being immersed in the plant filled room enhanced their generosity and intrinsic aspirations relative to those who

felt equally immersed in a room void of plants. As the degree of immersion was not measured in this present study, there is no way to explore whether this may have had an impact on the present findings. Weinstein and colleagues included a measure of positive affect, however it is important to note that the positive affect measure was not an outcome variable, but rather was included as a control. Although they did find that individuals within the plant filled room reported more positive affect, perhaps the measure they used was better suited to detecting the type of positive affect differences brought on by a plant manipulation. Positive affect was measured as the degree to which participants felt joy, happiness, pleasure, and fun/excitement with regards to their condition. In contrast, the positive affect measure included within this study assessed the degree to which participants felt alert, determined, proud, strong, etc. In future studies examining potential mood effects of a plant condition it may be necessary to focus on specific aspects of positive affect, such as pleasure or joy, as indoor plant exposure may have a targeted effect on positive affect.

Weinstein and colleagues also asked participants to take a 5-minute period of relaxation in their respective lab rooms (i.e. plants versus none) after completing mood and other filler questionnaires, and before completing the questions of interest. This imposed break within a laboratory setting may have given the participants a chance to reflect on their surroundings and ‘take it all in’ in a way that may have been missing in the present study. Participants in the present study completed the *Time 2* portion in a relatively short amount of time in an environment of their own choosing. It may be that the small bean plant was not a very salient object within the environments the individuals found themselves in upon participating in *Time 2* in contrast to a laboratory setting

including four plants and little else beside a computer and office furniture (as was the case with Weinstein et al., 2009).

In addition to the questionnaires, a few open ended questions were included at the end of the *Time 2* portion of the experiment in order to gather some feedback. The information obtained anecdotally supports the idea that there may be a certain subset of the sample that did experience some mood effects due to the presence or absence of a bean sprout at *Time 2*. For example, participants reported experiencing a degree of happiness, excitement, and pleasure from caring for their plant. One individual reported that it “was uplifting” to look at her plant and she perceived it as helping her through some “tough situations”. Another individual reported she watches her plant regularly and it makes her “feel meaningful and excited to do that”. Conversely, individual feedback from people without a sprout contained a certain amount of disappointment, but was generally light hearted. For example, six of the seven individuals who provided feedback from the *no-sprout* group merely mentioned that their plant had not yet sprouted with an emoticon indicating a sad face, the word ‘unfortunately’, or with a humorous remark. The remaining one individual provided feedback of a positive nature despite the fact that her bean seed did not sprout. The feedback provides some support for the idea that certain individuals experienced a degree of pleasure from witnessing their bean seed sprout. There is also some support for the idea that the mood measures included within this study lacked the correct descriptors for capturing the effects of condition. Based on participant feedback more appropriate descriptors may include adjectives such as happy, uplifting, disappointing, etc. Future researchers examining the potential mood effects of plants may well be advised to determine more specifically which descriptors most

accurately reflect sentiments aroused by plants. One method for obtaining this information may be through providing open-ended questions regarding mood after a similar type of a plant versus no-plant experiment. This information may provide some explanation regarding the overall inconsistent finding for mood effects with regards to plants, but does not explain the overall decrease in positive mood and increase in negative mood experienced by the vast majority of participants in the present study.

One possible explanation for the general downward trend in positive mood and upward trend of negative mood may be the initial novelty of the experiment. The requirements of this study, planting a bean seed, during the winter months, in a laboratory setting, were an assumingly novel experience for the participants. The novelty of the experience may have momentarily inflated their sense of positive mood. Asking participants to forecast their anticipated excitement upon seeing their bean seed sprout may have been a useful measure in order to gain a better understanding of what may have been at play in the relatively ubiquitous decrease in positive mood. Nisbet and Zelenski (2011) found that individuals tended to underestimate the positive effects of walking out in nature, however in this instance participants may have overestimated any mood effects based on the anticipation of having a fully developed bean plant. The thought of the matured bean plant may have been more of a mood enhancer than the actual bean sprout. Perhaps a measure of mood later on in the plants development would have yielded different results. For example, it would be interesting to assess participant's moods after the plant has flowered and produced string beans. A bean may be perceived as more rewarding than simply the sprout. Further to this, the photos sent in by the participants revealed that a large proportion of participants within the *sprout* group had plants that had

already grown by 5-10cm. This finding was confirmed by the response to the question asking participants when their plant sprouted. The initial intention of the project was to attempt to capture the moment when participants first saw their plant sprout as this is the point in time when the growth of the plant is the most perceptible. Although it could very well be that a small bean plant is not enough to have an impact on mood, it is as of yet unclear whether these findings are partially due to the fact that for the most part, participants plants had already slowed in perceptible growth by the time they completed the second time point of this study.

Further to this, the relatively social nature of the *Time 1* scenario in contrast to the *Time 2* scenario may also account for the decrease in mood experienced by the majority of participants. The vast majority of *Time 1* sessions took place with a single participant, however each participant interacted with the experimenter. Sandstrom and Dunn (2014) found that the number of weak tie interactions an individual has within a day can directly influence their perceived happiness and sense of belonging. For instance, individuals who had many impromptu interactions with acquaintances in a classroom setting reported more happiness. Further to this, Sandstrom and Dunn (2013) also found that these results extended to interactions with a stranger. Individuals instructed to make eye contact, smile, and make brief conversation with a barista reported more positive and less negative affect than those who were instructed to be efficient. The simple act of interacting with another individual during the first time point may have unexpectedly acted as a mood enhancer. The majority of participants reported that they were beside their plant upon completing *Time 2* and that their plants were placed in a room in their

house. It is therefore likely that they were alone, which may account for the overall lower self-reported happiness at the second time point.

The only mood by time interaction approaching significance was for those items measuring participant's self-reported feelings of guilt. Individuals in the *sprout* group experienced an increase in guilt from *Time 1* to *2* whereas those individuals in the *no-sprout* group reported similar levels of guilt at *Times 1* and *2*. It is difficult to attribute the increase in guilt solely to the condition as the effect size is fairly small and the p-value is greater than the standard cut-off. However as it is the only interaction approaching significance and is contrary to expectations, it seems worthwhile to note.

Participants in the *sprout* group also reported their level of search for meaning in life as greater than those in the *no-sprout* group, although there were no differences between the groups with regard to presence of meaning in life. Search for meaning has been associated with negative moods such as fear, shame, and sadness (Steger et al., 2006) and was expected to be more prominent among those in the *no-sprout* condition. Search for meaning has also been associated with indicators of maladaptive functioning such as rumination and depression and has been generally considered as an indication of less meaning in one's life and therefore less satisfaction with one's life (Steger et al., 2008). The finding that participants in the *sprout* group reported a stronger sense of searching for meaning in their lives is somewhat surprising given the previous associations between searching for meaning and maladaptive functioning. Witnessing the beginning phases of the lifecycle of a bean plant seems to have enhanced the saliency of the meaning inherent to the process, however not by affecting the perception of presence of meaning, but rather the sense of searching for meaning. More recent research

examining meaning at different stages of life and the interplay between presence and search for meaning may shed some light on these findings.

Although, in general search for meaning is more strongly associated with negative well-being indicators, some have suggested that life stage may play a role in whether searching for meaning is adaptive or maladaptive. For example, presence and search for meaning have been shown to be different throughout an individual's development with higher levels of presence of meaning in older adults and higher levels of search for meaning during emergent adulthood (Steger, Oishi, & Kashdan, 2009). Steger and colleagues (2009) found that although search for meaning was consistently correlated to lower levels of positive mood and higher levels of negative mood, this was most apparent for older adults. With this in mind, perhaps it is not surprising that individuals in the *sprout* group reported higher levels of search for meaning. The majority of participants could be characterized as being in the emergent adulthood phase of life. The sprout may have prompted them to think about meaning in life, but their sense of searching for meaning may be more pronounced at this phase of their lives. In a scenario with inherent meaning, such as witnessing the beginning phases of a plants life, it would be interesting to see whether older adults would respond by becoming more aware of those things that give their life meaning or the presence of meaning in their lives.

Further to this a few studies have since demonstrated an association between presence of meaning and search for meaning in life (Dezutter et al., 2014; Steger, Oishi, & Kesibir, 2011). For example, Dezutter and colleagues (2014) found that individuals high in both presence and search for meaning also tended to score higher on measures of psychological and eudaimonic well-being in contrast to individuals low in presence, but

high in search for meaning. Similarly Steger et al. (2011) found that presence of meaning was more strongly associated with self perceived life satisfaction when individuals also reported higher levels of search for meaning. They concluded that it may be that individuals actively searching for meaning in life find meaning relevant information and situations more salient. However, this research may indicate that this relationship is bi-directional in that meaning relevant situations can make an individual's perception of searching for meaning more salient.

Searching for meaning in life may be quite beneficial among emerging adults as well as those who perceive presence of meaning in their lives. Although this may be a spurious finding and thus must be interpreted cautiously, the overall higher ratings on search for meaning among those with a sprout may suggest that witnessing the plant grow was perceived as a meaningful experience prompting participants to think about their lives and thus influencing their perceived search for meaning. The similarity in perceived presence of meaning between the groups may suggest that the increase in search for meaning was not necessarily maladaptive in nature as it has been found to be in low presence, high search scenarios (Dezutter et al., 2014). The possibility also exists that successfully caring for something could account for the differences between the two groups rather than the sprout itself. In other words, perhaps it was not necessarily nature that prompted people to report higher levels of search for meaning in life, but rather the act of caring for something. In future studies, one could compare the different responses of participants receiving a sprouted plant versus those who planted their seed and cared for it until it sprouts. Receiving and 'caring' for inanimate versions of nature such as rocks may also shed some light on this distinction. Finally, another option may be to

compare the effects of caring for a living creature (i.e. a plant) versus an animated creature such as an application that allows you to grow and care for a computerized plant. These examples may serve as a method for better understanding the effects of nature versus caring as well as caring for a living example of nature versus caring for an inanimate version of nature.

### **Nature, Connectedness, and Interconnection**

Of the nine dimensions of connection to nature, suggested by Kellert (1993), the moralistic can be conceived of as that which describes the perception that all things are purposefully connected. This sense of connection, although perhaps dormant, is believed to be a part of us all. The degree to which participants felt connected to nature, life, and the universe were measured as was nature relatedness and the degree to which individuals perceived a connection among all things. The latter two measures include aspects of the moralistic dimension in that both scales hint at and directly speak to a connection of a spiritual or transcendental quality. It was expected that individuals who witnessed their seed sprout would report a stronger connection to nature, life, and the universe and greater concern for the biosphere. However, there were no differences between the groups on any of the four measures. I also expected that individuals who perceived a stronger relationship with nature and who identified more strongly with the metapersonal self construal would experience more prominent changes in positive affect with participants in the *sprout* condition reporting the greatest increase in positive affect and participants in the *no-sprout* condition reporting the greatest decrease in positive affect. Although it was indeed true that individuals who more strongly identified with the

metapersonal self and nature relatedness also generally reported the highest levels of positive affect, this was true regardless of *Sprout* condition.

One possible explanation for the lack of differences between groups may be that the two groups were too similar. The *no-sprout* group was included to act as a comparison group under the assumption that it would function similar to a non-nature condition. However, within this group there was still a certain amount of interacting with nature as participants planted their bean seeds themselves and may have still been hopeful upon completing the *Time 2* portion of the study that their plant would sprout. Further to this, some participants may have enjoyed the experience regardless of the fact that their seed did not sprout as was indicated by unprompted feedback from a participant in the *no-sprout* group, “Even though my plant didn't grow, I loved taking care of it!!!” It is possible that others had a similar experience and did not communicate it.

It is also possible that the sprouted bean plant did not generally have any effect on the participant's sense of connection to nature, life, or the universe because it was not a very immersive experience. Nisbet and Zelenski (2011) found individuals participating in a nature walk, as opposed to a walk indoors, reported a stronger sense of connection to nature. However, the finding was mediated by the positive mood precipitated by the nature walk. In some respects then, it follows that since the participants of this study did not experience any increase in positive mood regardless of condition, there would be no differences in terms of their sense of connection to nature. The inclusion of the measures examining a sense of connection to life and the universe and biospheric concern were exploratory in nature based on the concepts espoused by Kellert (1993) regarding the moralistic dimension. The results of this study do not lend support to the idea that

interacting with an indoor plant in a small and rather simple way can in any way influence a person's perceived connection to life and lifelike processes. However, this conclusion must be tempered by the recognition that the sample was limited in size and was primarily made up of city dwelling university students.

Congruent with previous findings (e.g. Nisbet, et al., 2011), nature relatedness positively predicted positive affect such that individuals who scored higher on the NR scale also tended to report higher levels of positive affect at both the first and second time point. Similarly, positive affect at both time points was positively associated with the degree to which the individual identified with the metapersonal self construal. The metapersonal self is constructed as the individual sees others and experiences events as an expression of their own self. In the context of nature, this would translate as the individual experiencing nature as their own self and thus any damage to the natural world would be perceived as damage to the self. Specifically speaking, the metapersonal self extends beyond nature to encompass all things including, but not limited to, elements of nature, of society, and elements of creation itself. Theoretically, individuals with a strong sense of metapersonal self would take precaution to act in such a way that is beneficial to all life, in so far as they are able to do so, as their concept of self takes into account all there is. The metapersonal self can also be conceived of as having a spiritual or transcendent connection to the world around them. The metapersonal self is a relatively new measure of self construal and has been found to correlate positively to pro-environmental behaviour. As far as I am aware, this is the first study examining the relationship between the metapersonal self and positive affect. Evidence from this study

suggests that a person's conception of connectedness to the world around them may play a role in their perceived sense of positive affect more generally.

### **Limitations**

This research has several limitations. Primarily, there was a lack of congruency between the first and second time points, which may have affected the results. *Time 1* took place in a laboratory setting unfamiliar to the participants whereas the second portion of the study was completed online in a setting of their own choosing. For the most part, participants indicated completing the online portion near their plants, which they had placed in various rooms within their homes. In addition, the first portion of the study was conducted in a setting which necessitated a casual interaction with at least one other person, namely a stranger, whereas there is very little direct information regarding the situation encountered by *Time 2* participants. Both the novelty of the experience at the first time point and the causal social interaction with a stranger may have served to augment positive affect relative to the *Time 2* experience.

In addition, participants were asked to rate their mood 'right now' (at both time points) in order to ascertain state level measures of mood. However, in future studies of this nature it may be wise to frame the question in such a way as to include the previous week as well. Doing so may mitigate the potentially mood enhancing effects of the novel and social nature of *Time 1*. Further to this, as was mentioned previously, participants in the *sprout* condition had sprouts at various stages of development from newly sprouted plants to plants roughly 10cm in height. For those individuals with a plant at a more advanced stage of development, any excitement regarding their sprout, if they experienced any at all, may have worn off by the time they participated in *Time 2*.

Asking participants to rate their mood over the course of the past week may serve as a more complete indicator of their experience with their plant. Another possible method for overcoming this particular limitation may be to ask for daily mood ratings over the course of the week that could then be matched to the sprouting of the bean seed.

In order to maintain congruency with regards to time, all participants were emailed with the link for the online portion ten days after participating in *Time 1* with participants completing *Time 2* anywhere from ten to thirteen days after initial planting. However, the viable bean seeds sprouted anywhere from five to ten days after initial planting. The first few days after the plant sprouts is the period of time where the growth of the plant is most noticeable. Kellert (1993) noted that we have a strong preference for scenes including large mammals. Based on this he proposed that our ability to connect to lifelike processes may be dependent upon our ability to relate to the natural elements in our surroundings. For example, the movement of a large mammal may increase our ability to connect with it as we share that commonality. With this in mind, it may be advisable to invite participants to complete the online portion starting at the fifth day post planting. Although there would be less congruency with regards to when participants complete *Time 2*, there may a greater proportion of participants who complete *Time 2* shortly after their plant sprouts.

Another potentially limiting factor within this study is the lack of a control group. Plenty of research has found demonstrable differences between groups in nature conditions versus non-nature conditions for example, rooms with views of nature versus non (Ulrich, 1980), images containing nature versus built environments (Weinstein et al., 2009), or nature videos versus non-nature videos (Mayer, Frantz, Bruehlman-Senecal, &

Dolliver, 2009). However, in this study the control condition may have also served as a nature condition to a degree. Although individuals in both the *sprout* and *no-sprout* group demonstrated a general trend towards higher negative mood at *Time 2* relative to *Time 1*, the reasons for this are not clear. It may be that all participants reported lower negative mood and higher positive mood at the first time point due to the anticipation of receiving a bean plant. Including a non-nature control group could provide more information with regard to this particular outcome. Although the *no-sprout* group was meant to serve as a control condition, it would be interesting to observe what differences, if any, would be experienced by a group of individuals who are not under the impression that they are getting a plant. It seems advisable for future studies examining the effects of a nature condition to ensure that a non-nature comparison group is also included.

As is common with many psychology studies, the pool from which participants were drawn was primarily composed of university students. Participants were also recruited through an online job search forum. However, they were of a similar age to the student population and in many instances were themselves university and college students. This particular limitation applies more specifically to the generalizability of the results indicated a stronger search for meaning in life for those individuals in the *sprout* group. Search for meaning in life has been found to be higher among university aged individuals or during emergent adulthood (Steger, et al., 2009). It is therefore unknown if a replication of this experiment with an older or younger population would yield similar results.

All participants were aware prior to commencing the study that the study involved planting a bean seed and caring for it for approximately one week. It is therefore

unknown the degree to which participants sought out this experiment in order to plant and obtain a bean seed. Anecdotally speaking, a number of participants appeared fairly excited about receiving a bean plant, which again may have contributed to the high positive affect low negative affect ratings at *Time 1* relative to *Time 2*. It may be that participants were more excited over the idea of a bean plant than they were with the sprout itself. Including a measure in the laboratory portion assessing anticipated mood upon witnessing their plant sprout, and perhaps its later development (including first flower and first bean), may be useful control measures for understanding why in general participants experience higher levels of negative affect and lower levels of positive affect between the two time points. It may also be interesting to continue to collect mood ratings from participants in both groups as the plant matures to the point of producing beans. Participant's initial mood ratings may be influenced by the prospect of harvesting beans.

Lastly, participants were also asked to provide feedback regarding the study in general. Unexpectedly a number of participants reported sentiments in line with the expected outcomes of the study despite the fact that the data did not support the hypotheses. These results should be interpreted with caution however, as this study was not qualitative in nature. Important questions that arise from the qualitative information obtained from this study include: Are those that expressed an affinity for their plant in anyway different from the rest in terms of their connection to nature? Do they share any commonalities at all? Research indicates that nature relatedness corresponds to a willingness to participate in pro-environmental behaviour (Nisbet et al., 2009). Would this also be true for those individuals reporting an affinity with their plant? In research

where logistical constraints may preclude obtaining a large enough sample size to examine potentially small effects it may be advisable to include qualitative approaches in order to obtain valuable information that may be missed using strictly quantitative methods.

### **Implications**

Nature has been shown to positively affect physical and mental well-being (see Frumpkin, 2001, for a review). However, bearing in mind the above mentioned limitations, the results of this study add to the small body of evidence demonstrating that limited exposure to indoor plants may not have the ability to enhance mood. These findings stress the importance of having access to green spaces within urban areas. As our cities continue to grow, we need to ensure that city planners take into consideration the health benefits of nature in and around our cities. Although indoor plants may have beneficial effects under certain conditions, it is not clear that they are as effective at promoting happiness and psychological well-being as more immersive nature experiences such as spending time in urban parks.

The results of the effects of condition (*sprout* versus *no-sprout*) were limited, however there is some suggestion that caring for and interacting with a plant in this manner may increase an individual's perceived search for meaning in life. Searching for meaning in the context used for this study has been associated to both positive and negative well-being indicators predicated on an individual's perception of already having a degree of meaning in their life. Although the limitations of this study preclude any firm conclusions, it seems plausible that there is meaning inherent to witnessing a plant sprout, which is ultimately the beginning phase of emergent life. As planting a bean seed is a

common exercise used by elementary school teachers it may be wise to explore the children's experiences in more detail. For example, it would be interesting to note whether the children's conception of meaning changes before and after participating in this type of project. Would there be any differences between those children whose plant sprouted versus those whose plant did not? How would discussing meaning during this type of project affect their perceptions of meaning? The process of planting and growing a bean may have broader teaching applications than simply biological in nature.

Considering the numerous positive well-being indicators associated with perceived meaning in one's life, and the possibility that growing a plant from seed could prompt people to think about meaning, growing a plant from seed may serve as a simple and inexpensive tool for planting the seeds of meaning in the young developing mind as well as for those people who feel that there is a lack of meaning in their lives.

Finally, the general trend towards a less positive mood at *Time 2* versus *Time 1*, points to the importance of maintaining congruency in a time-series study. Where mood is concerned, research suggests that casual interactions with strangers can have a strong positive impact (Sandstrom & Dunn, 2013). It may therefore be advisable, when exploring mood as an outcome in a time-series study, to ensure that this is taken into account. Where logistical constraints prohibit having participants return to the laboratory setting at repeated time points other controls, such as including daily mood measures should be included in order to account for the possible mood enhancing effects of interacting with the experimenter in the laboratory setting.

## **Conclusions**

It appears that the same sentiments aroused when immersed in a natural setting are not necessarily those aroused after interacting with a plant through the early phases of growth. Despite the lack of quantitative evidence, there is some indication that certain individuals do find meaning and joy through the unfolding life of a plant. This research raises interesting yet unanswered questions about why certain individuals report something as simple as witnessing a bean seed sprout as impressionable, why some do not, and what methods would be best employed to capture this potentially small effect. There is also some indication that our affinity and sense of connection to nature and our conception of the interconnectivity of all life seem to be intertwined to a degree with our sense of happiness. Regardless of our overt awareness, nature sustains us. First and foremost physiologically, however there is also a degree of sustenance at a more subtle and psychological level. Perhaps the inability to demonstrate this in a research context has more to do with our limited capacity to assess the sentiments experienced through such a small occurrence against the backdrop of all the normal demands of everyday life.

### References

- Adachi, M., Rohde, C. L. E., & Kendle, A. D. (2000). Effects of floral and foliage displays on human emotions. *HortTechnology*, 10, 59–63.
- Arnocky, S., Stroink, M., & DeCicco, T. (2007). Self-construal predicts environmental concern, cooperation, and conservation. *Journal of Environmental Psychology*, 27, 255-264. <http://dx.doi.org/10.1016/j.jenvp.2007.06.005>
- Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, 63, 596-612. <http://dx.doi.org/10.1037/0022-3514.63.4.596>
- Arnett, J. J. (2007). Emerging adulthood: What is it, and what is it good for?. *Child development perspectives*, 1, 68-73. <http://dx.doi.org/10.1111/j.1750-8606.2007.00016.x>
- Atchley R.A., Strayer D.L., & Atchley P. (2012). Creativity in the wild: improving creative reasoning through immersion in natural settings. *PLoS ONE* 7(12): e51474. <http://dx.doi.org/10.1371/journal.pone.0051474>
- Berman, M.G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological science*, 19, 1207-1212. <http://dx.doi.org/10.1111/j.1467-9280.2008.02225.x>
- Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, 140, 300–305. <http://dx.doi.org/10.1016/j.jad.2012.03.012>
- Bem, S. L., (1974). The measurement of psychological androgyny. *Journal of Consulting*

*and Clinical Psychology, 42*, 155-162.

- Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health 10*, 456. <http://dx.doi.org/10.1186/1471-2458-10-456>
- Branas, C. C., Cheney, R. A., MacDonald, J. M., Tam, V. W., Jackson, T. D., & Ten Have, T. R. (2011). A difference-in-difference analysis of health, safety, and greening vacant urban space. *American Journal of Epidemiology, 174*, 1296-1306. <http://dx.doi.org/10.1093/aje/kwr273>
- Bringslimark, T., Hartig, T., Patil, G. (2009). The psychological benefits of indoor plants: a critical review of the experimental literature. *Journal of Environmental Psychology, 29*, 422-433. <http://dx.doi.org/10.1016/j.jenvp.2009.05.001>
- Bringslimark, T., Hartig, T., & Patil, G.G. (2011). Adaptation to windowlessness: do office workers compensate for a lack of visual access to the outdoors? *Environment and Behaviour, 43*, 469-487.  
<http://dx.doi.org/10.1177/0013916510368351>
- Burchett, M. D., Torpy, F., Brennan, J., & Craig, A. (2010). *Greening the Great Indoors for Human Health and Wellbeing*. Final Report to Horticulture Australia Ltd., Sydney, Aust. Retrieved August 12, 2013 from <http://www.tpr.com.au/research-papers/health-benefits/217-office-health-and-plants3>
- Cohen, K., & Cairns, D. (2012). Is searching for meaning in life associated with reduced subjective well-being? Confirmation and possible moderators. *Journal of Happiness Studies, 13*, 313-331. <http://dx.doi.org/10.1007/s10902-011-9265-7>

- Daly, J., Burchett, M., & Torpy, F. (2010). Plants in the classroom can improve student performance. *National Interior Plantscape Association*.
- Decicco, T., & Stroink, M. (2007). A third model of self-construal: The metapersonal self. *International Journal of Transpersonal Studies, 26*, 82-104.
- Debats, D. L., van der Lubbe, P. M., & Wezeman, F. R. A. (1993). On the psychometric properties of the Life Regard Index (LRI): A measure of meaningful life. *Personality and Individual Differences, 14*, 337–345.  
[http://dx.doi.org/10.1016/0191-8869\(93\)90132-M](http://dx.doi.org/10.1016/0191-8869(93)90132-M)
- Dezutter, J., Waterman, A. S., Schwartz, S. J., Luyckx, K., Beyers, W., Meca, A., Kim, S.Y., Whitbourne, S.K., Zamboanga, B.L., Lee, R.M., Hardy, S.A., Forthun, L.F., Ritchie, R.A., Weisskirch, R.S., Brown, E.J., & Caraway, S. J. (2014). Meaning in Life in Emerging Adulthood: A Person-Oriented Approach. *Journal of personality, 82*, 57-68. <http://dx.doi.org/10.1111/jopy.12033>
- Dijkstra, K., Pieterse, M. E., & Pruyn, A. (2008). Stress-reducing effects of indoor plants in the built healthcare environment: the mediating role of perceived attractiveness. *Preventive Medicine, 47*, 279-283. <http://dx.doi.org/10.1016/j.ypmed.2008.01.013>
- Faber Taylor, A., & Kuo, F. E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders, 12*, 402–409.  
<http://dx.doi.org/10.1177/1087054708323000>
- Fjeld, T. (2000). The effect of interior planting on health and discomfort among workers and school children. *HortTechnology, 10*, 46–52.
- Frumkin, H. (2001). Beyond toxicity: Human health and the natural environment. *American Journal of Preventive Medicine, 20*, 234–240.

[http://dx.doi.org/10.1016/S0749-3797\(00\)00317-2](http://dx.doi.org/10.1016/S0749-3797(00)00317-2)

- Han, K.T. (2009). Influence of limitedly visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environment and Behaviour, 41*, 658-692. <http://dx.doi.org/10.1177/0013916508314476>
- Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*, 109-123. [http://dx.doi.org/10.1016/S0272-4944\(02\)00109-3](http://dx.doi.org/10.1016/S0272-4944(02)00109-3)
- Heerwagen, J.H. & Orion, G.H. (1993). Humans, habitats, and aesthetics. In S. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 73–137). Washington, DC: Island Press.
- Howell, A. J., Dopko, R. L., Passmore, H.-A., & Buro, K. (2011). Nature connectedness: Associations with well-being and mindfulness. *Personality and Individual Differences, 51*, 166-171. <http://dx.doi.org/10.1016/j.paid.2011.03.037>
- John, O. P., & Srivastava, S. (1999). The big five inventory. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (p. 132). New York: Guilford Press.
- Kaplan, R. (1993). The role of nature in the context of the workplace. *Landscape and Urban Planning, 26*, 193-201. [http://dx.doi.org/10.1016/0169-2046\(93\)90016-7](http://dx.doi.org/10.1016/0169-2046(93)90016-7)
- Kaplan, R. (2001). The nature of the view from home: Psychological benefits. *Environment and Behavior, 33*, 507-542.
- <http://dx.doi.org/10.1177/00139160121973115>
- Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework.

*Journal of Environmental Psychology*, 15, 169–182.

[http://dx.doi.org/10.1016/0272-4944\(95\)90001-2](http://dx.doi.org/10.1016/0272-4944(95)90001-2)

Kellert, S. R., & Wilson, E. O. (1993). *The biophilia hypothesis*. Washington, DC: Island Press.

Keniger, L.E., Gaston, K.J., Irvine, K.N., & Fuller, R.A. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health*, 10, 913-935. <http://dx.doi.org/10.3390/ijerph10030913>

Kim, E., & Mattson, R. H. (2002). Stress recovery effects of viewing red-flowering geraniums. *Journal of Therapeutic Horticulture*, 13, 4–12.

Klepeis, N. E., Nelson, W. C., Ott, W. R., Robinson, J. P., Tsang, A. M., Switzer, P., Behar, J. V., Hern, S. C., Engelmann, W. H. J. (2001). The national human activity pattern survey (NHAPS): a resource for assessing exposure to environmental pollutants. *Journal of Exposure Analysis and Environmental Epidemiology*, 11, 231-252. [http://dx.doi.org/1053-4245/01/\\$17.00](http://dx.doi.org/1053-4245/01/$17.00)

Larsen, L., Adams, J., Deal, B., Kweon, B.S., & Tyler, E. (1998). Plants in the work-place: the effects of plant density on productivity, attitudes, and perceptions. *Environment and Behavior*, 30, 261–281.

<http://dx.doi.org/10.1177/001391659803000301>

Lohr, V. I., & Pearson-Mims, C. H. (2000). Physical discomfort may be reduced in the presence of interior plants. *HortTechnology*, 10, 53–58.

Lohr, V. I., Pearson-Mims, C. H., & Goodwin, G. K. (1996). Interior plants may improve worker productivity and reduce stress in a windowless environment. *Journal of Environmental Horticulture*, 14, 97–100.

- MacKerron, G., and Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change*. Online before in print.  
<http://dx.doi.org/10.1016/j.gloenvcha.2013.03.010>
- Malone, G. P., Pillow, D. R., & Osman, A. (2012). The General Belongingness Scale (GBS): Assessing achieved belongingness. *Personality and Individual Differences*, 52(3), 311-316. <http://dx.doi.org/10.1016/j.paid.2011.10.027>
- Mayer, F. S., & Frantz, M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, 24, 503-515. <http://dx.doi.org/10.1016/j.jenvp.2004.10.001>
- Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior* 41, 607-643. <http://dx.doi.org/10.1177/0013916508319745>
- Milfont, T. L., Duckitt, J., & Cameron, L. D. (2006). A cross-cultural study of environmental motive concerns and their implications for pro-environmental behavior. *Environment and Behavior*, 38, 745-767.  
<http://dx.doi.org/10.1177/0013916505285933>
- Nisbet, E. K., & Zelenski, J. M. (2011). Underestimating nearby nature: affective forecasting errors obscure the happy path to sustainability. *Psychological Sciences*, 22, 1101-1106. <http://dx.doi.org/10.1177/0956797611418527>
- Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale: linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, 41, 715-740.  
<http://dx.doi.org/10.1177/0013916508318748>

- Nisbet, E. K., Zelenski, J. M. & Murphy, S. A. (2011). Happiness is in our nature: exploring nature relatedness as a contributor to subjective well-being. *Journal of Happiness Studies*, *12*, 303-322. <http://dx.doi.org/10.1007/s10902-010-9197-7>
- Park, S.H., & Mattson, R. H. (2008). Effects of flowering and foliage plants in hospital rooms on patients recovering from abdominal surgery. *HortTechnology*, *18*, 563–568.
- Park, S.H., & Mattson, R. H. (2009). Therapeutic influences of plants in hospital rooms on surgical recovery. *HortScience*, *44*, 102-105.
- Raanaas, R.K., Evensen, K.H., Rich, D., Sjostrom, G., & Patil, G. (2011). Benefits of indoor plants on attention capacity in an office setting. *Journal of Environmental Psychology*, *31*, 99-105. <http://dx.doi.org/10.1016/j.jenvp.2010.11.005>
- Rich, D. L. (2007). *Effects of exposure to nature and plants on cognition and mood: A cognitive psychological perspective*. Ithaca, NY: Cornell University.
- Ryan, R. M. & Deci, E.L. (2001). On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, *52*, 141-166. <http://dx.doi.org/10.1145/annurev.psych.52.1.141>
- Ryan, R. M., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality*, *65*, 528-565. <http://dx.doi.org/10.1111/j.1467-6494.1997.tb00326.x>
- Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of personality and social psychology*, *57*, 1069-1081. <http://dx.doi.org/10.1037/0022-3514.57.6.1069>
- Ryff, C. D., Singer, B. H., & Love, G. D. (2004). Positive health: Connecting well-being

with biology. *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences*, 359, 1383-1394. <http://dx.doi.org/10.1098/rstb.2004.1521>

Sandstrom, G. M., & Dunn, E. W. (2013). Is efficiency overrated? Minimal social interactions lead to belonging and positive affect. *Social Psychological and Personality Science*, 1948550613502990. <http://dx.doi.org/10.1177/1948550613502990>

Sandstrom, G. M., & Dunn, E. W. (2014). Social interactions and well-being: the surprising power of weak ties. *Personality and Social Psychology Bulletin*, 40, 910-922. <http://dx.doi.org/10.1177/0146167214529799>

Schultz, P. W. (2000). Empathizing with nature: The effects of perspective taking on concern for environmental issues. *Journal of Social Issues*, 56, 391-406. <http://dx.doi.org/10.1111/0022-4537.00174>

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, 21, 327-339. <http://dx.doi.org/10.1006/jevp.2001.0227>

Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In P. Schmuck & W. P. Schultz (Eds.), *Psychology of sustainable development* (pp. 62-78). Norwell, MA: Kluwer Academic.

Schultz, P., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology*, 24, 31-42. [http://dx.doi.org/10.1016/S0272-4944\(03\)00022-7](http://dx.doi.org/10.1016/S0272-4944(03)00022-7)

Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Frane`k, M.

- (2005). Values and their relationship to environmental concern and conservation behavior. *Journal of Cross-Cultural Psychology*, 36, 457–475.  
<http://dx.doi.org/.1177/0022022105275962>
- Shibata, S. & Suzuki, N. (2001). Effects of indoor foliage plants on subject's recovery from mental fatigue. *North American Journal of Psychology*, 3, 385–396.
- Shibata, S. & Suzuki, N. (2002). Effects of the foliage plant on task performance and mood. *Journal of Environmental Psychology*, 22, 265–272.  
<http://dx.doi.org/10.1006/jevpe.2002.0232>
- Shibata, S. & Suzuki, N. (2004). Effects of an indoor plant on creative task performance and mood. *Scandinavian Journal of Psychology*, 45, 373-381.  
<http://dx.doi.org/10.1111/j.1467-9450.2004.00419.x>
- Shoemaker, C. A., Relf, P. D., & Lohr, V. I. (2000). Social science methodologies for studying individuals' responses in human issues in horticulture research. *HortTechnology*, 10, 87–93.
- Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin*, 20(5), 580-591.  
<http://dx.doi.org/10.1177/0146167294205014>
- Steger, M. F., Frazier, P., Oishi, S., & Kaler, M. (2006). The meaning in life questionnaire: Assessing the presence of and search for meaning in life. *Journal of Counseling Psychology*, 53, 80. <http://dx.doi.org/10.1037/0022-0167.53.1.80>
- Steger, M. F., Oishi, S., & Kashdan, T. B. (2009). Meaning in life across the life span: levels and correlates of meaning in life from emerging adulthood to older adulthood. *The Journal of Positive Psychology*, 4, 43-52.

<http://dx.doi.org/10.1080/17439760802303127>

Steger, M. F., Oishi, S., & Kesebir, S. (2011). Is a life without meaning satisfying? The moderating role of the search for meaning in satisfaction with life judgments. *The Journal of Positive Psychology, 6*, 173-180.

<http://dx.doi.org/10.1080/17439760.2011.569171>

Svrakic, D. M., Przybeck, T. R., & Cloninger, C. R. (1992). Mood states and personality traits. *Journal of Affective Disorders, 24*(4), 217-226.

[http://dx.doi.org/10.1016/0165-0327\(92\)90106-G](http://dx.doi.org/10.1016/0165-0327(92)90106-G)

Tam, K.P. (2013). Concepts and measures related to connection to nature: similarities and differences. *Journal of Environmental Psychology, 34*, 64-78.

<http://dx.doi.org/10.1016/j.jenvp.2013.01.004>

Ulrich, R.S. (1984). View through a window may influence recovery from surgery. *Science 224*, 420–421.

Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. In S. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 73–137). Washington, DC: Island Press.

Watson, D., & Clark, L. A. (1994). *The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded Form*. Ames: The University of Iowa.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.

<http://dx.doi.org/10.1037/0022-3514.54.6.1063>

Wilford, B. H., Shoeib, M., Harner, T., Zhu, J., Jones, K. C. (2005). Polybrominated

Diphenyl Ethers in Indoor Dust in Ottawa, Canada: Implications for Sources and Exposure. *Environmental Science & Technology*, 39, 7027-7035.

<http://dx.doi.org/10.1021/es050759g>

Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.



**Appendix B: Positive and Negative Affect Scale (PANAS)**

Below is a scale which consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____	interested		_____	irritable
_____	distressed		_____	alert
_____	excited		_____	ashamed
_____	upset		_____	inspired
_____	strong		_____	nervous
_____	guilty		_____	determined
_____	scared		_____	attentive
_____	hostile		_____	jittery
_____	enthusiastic		_____	active
_____	proud		_____	afraid
_____	fascinated		_____	in awe
_____	curious		_____	blameworthy
_____	relaxed		_____	calm
_____	angry at self		_____	disgusted with self
_____	at ease		_____	dissatisfied with self

### Appendix C: Vitality Scale

Please respond to each of the following statements by indicating the degree to which the statement is true for you right now. Use the following scale:

Not at all true			Somewhat true			Very True
1	2	3	4	5	6	7

1. I feel alive and vital. \_\_\_\_\_
2. I don't feel very energetic \_\_\_\_\_
3. I feel so alive I just want to burst. \_\_\_\_\_
4. I have energy and spirit. \_\_\_\_\_
5. I am looking forward to each new day. \_\_\_\_\_
6. I feel alert and awake. \_\_\_\_\_
7. I feel energized. \_\_\_\_\_

### Appendix D: Personality Questionnaire

#### The Metapersonal Self (MPS) Scale

This is a questionnaire that measures a variety of feelings and behaviors in various situations. Listed below are a number of statements. Read each one as if it referred to you. Beside each statement write the number that best matches your agreement or disagreement, using the scale below.

Strongly Disagree	Disagree	Somewhat Disagree	Don't Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

- \_\_\_\_ 1. My personal existence is very purposeful and meaningful.
- \_\_\_\_ 2. I believe that no matter where I am or what I'm doing, I am never separate from others.
- \_\_\_\_ 3. I feel a real sense of kinship with all living things.
- \_\_\_\_ 4. My sense of inner peace is one of the most important things to me.
- \_\_\_\_ 5. I take the time each day to be peaceful and quiet, to empty my mind of everyday thoughts.
- \_\_\_\_ 6. I believe that intuition comes from a higher part of myself and I never ignore it.
- \_\_\_\_ 7. I feel a sense of responsibility and belonging to the universe.
- \_\_\_\_ 8. My sense of identity is based on something that unites me with all other people.
- \_\_\_\_ 9. I am aware of a connection between myself and all living things.
- \_\_\_\_ 10. I see myself as being extended into everything else.

**Interdependent Self Construal**

Please indicate your agreement with the following items using the rating scale below.

Strongly Disagree	Disagree	Somewhat Disagree	Don't Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

- \_\_\_\_ 1. I have respect for authority figures with whom I interact.
- \_\_\_\_ 2. It is important for me to maintain harmony within my group.
- \_\_\_\_ 3. My happiness depends on the happiness of those around me.
- \_\_\_\_ 4. I would offer my seat on a bus to an older person.
- \_\_\_\_ 5. I respect people who are modest about themselves.
- \_\_\_\_ 6. I will sacrifice my self-interest for the benefit of the group I am in.
- \_\_\_\_ 7. I often have the feeling that my relationships with others are more important than my own accomplishments.
- \_\_\_\_ 8. I should take into consideration my parents' advice when making education/career plans.
- \_\_\_\_ 9. It is important to me to respect decisions made by the group.
- \_\_\_\_ 10. I will stay in a group if they need me, even when I'm not happy with the group.
- \_\_\_\_ 11. If my brother or sister fails, I feel responsible.
- \_\_\_\_ 12. Even when I strongly disagree with the group members, I avoid an argument.

**General Belongingness Scale**

Please rate your agreement with the following items

Strongly Disagree	Disagree	Somewhat Disagree	Don't Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

- \_\_\_\_ 1. When I am with other people, I feel included.
- \_\_\_\_ 2. I have close bonds with family and friends.
- \_\_\_\_ 3. I feel like an outsider.
- \_\_\_\_ 4. I feel as if people do not care about me.
- \_\_\_\_ 5. I feel accepted by others.
- \_\_\_\_ 6. Because I do not belong, I feel distant during the holiday season.
- \_\_\_\_ 7. I feel isolated from the rest of the world.
- \_\_\_\_ 8. I have a sense of belonging.
- \_\_\_\_ 9. When I am with other people, I feel like a stranger.
- \_\_\_\_ 10. I have a place at the table with others.
- \_\_\_\_ 11. I feel connected with others.
- \_\_\_\_ 12. Friends and family do not involve me in their plans.

**Appendix E: Time 2 Participant Instructions and Manipulation Check**

**Has your bean plant sprouted?**

Yes

No

**When did your plant first sprout?**

5-6 days after planting

7-8 days after planting

9-10 days after planting

Please take a moment to answer the following questions describing the location of your plant.

**In which room did you place your plant?**

Bedroom

Living room

Kitchen

Bathroom

Office

Other

**How much time have you spent in that room per day since placing your plant there?**

0-1 hour

1-2 hours

2-3 hours

3-4 hours

4+ hours

**Have you ever participated in a project where you were responsible for caring for a plant either in elementary school, high school, or elsewhere?**

Yes

No

### Appendix F: Nature Relatedness and Interconnectedness Questions

#### Nature Relatedness Scale short-form (NR-6)

For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think “most people” feel.

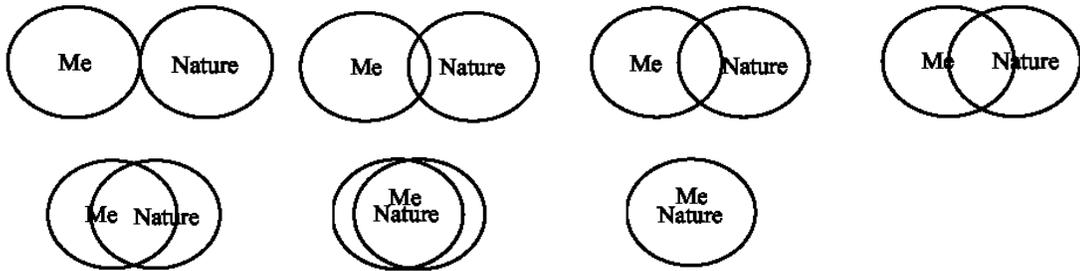
Disagree strongly	Disagree a little	Neither agree or disagree	Agree a little	Agree strongly
1	2	3	4	5

1. My ideal vacation spot would be a remote, wilderness area.
2. I always think about how my actions affect the environment.
3. My connection to nature and the environment is a part of my spirituality.
4. I take notice of wildlife wherever I am.
5. My relationship to nature is an important part of who I am.
6. I feel very connected to all living things and the earth.

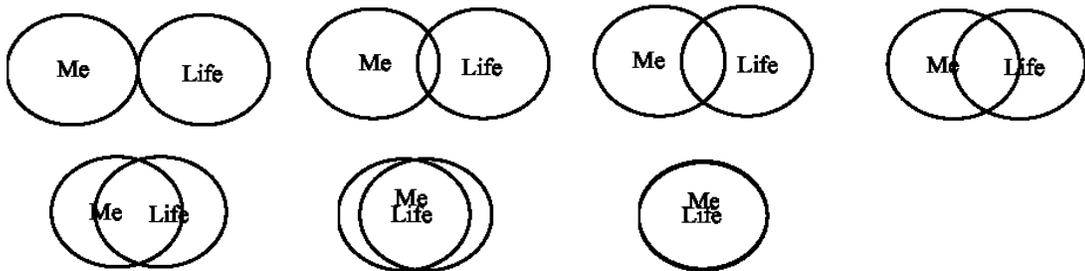
**Modified Inclusion with Nature in Self Scale**

Now we have some questions about your interconnectedness.

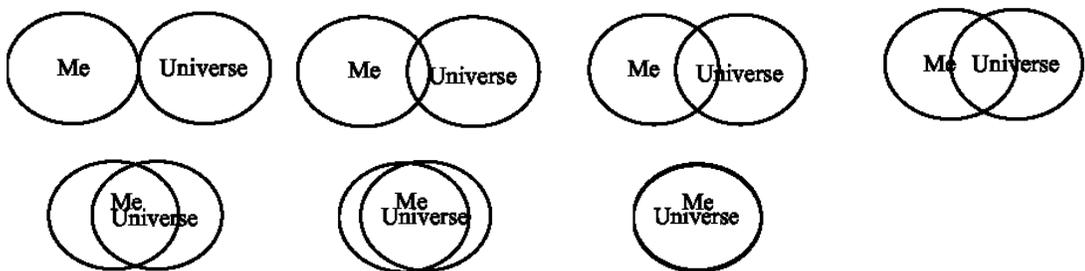
Please select the picture below that best describes your relationship with the natural environment. How interconnected are you with nature right now?



Please select the picture below that best describes your relationship with life in this moment. How interconnected are you with life right now?



Please select the picture below that best describes your relationship with the universe. How interconnected are you with the universe right now?



### Appendix G: Environmental Concern

People around the world are generally concerned about environmental problems because of their consequences that result from harming nature. However, people differ in the consequences that concern them the most. Please **rate each item** below from 1 (not important) to 7 (supreme importance) in response to the question:

I am concerned about environmental problems because of the consequences for \_\_\_\_\_

Please circle your response for each item	Not Important						Supreme Importance
1. Animals	1	2	3	4	5	6	7
2. Plants	1	2	3	4	5	6	7
3. Marine Life	1	2	3	4	5	6	7
4. Birds	1	2	3	4	5	6	7
5. Me	1	2	3	4	5	6	7
6. My future	1	2	3	4	5	6	7
7. My lifestyle	1	2	3	4	5	6	7
8. My health	1	2	3	4	5	6	7
9. All people	1	2	3	4	5	6	7
10. Children	1	2	3	4	5	6	7
11. People in my community	1	2	3	4	5	6	7
12. My children	1	2	3	4	5	6	7

### Appendix H: Meaning in Life Questionnaire

Please take a moment to think about what makes your life and existence feel important and significant to you. Please respond to the following statements as truthfully and accurately as you can, and also please remember that these are very subjective questions and that there are no right or wrong answers. Please answer according to the scale below:

Absolutely Untrue	Mostly Untrue	Somewhat Untrue	Can't Say True or False	Somewhat True	Mostly True	Absolutely True
1	2	3	4	5	6	7

- \_\_\_\_\_ 1. I understand my life's meaning.
- \_\_\_\_\_ 2. I am looking for something that makes my life feel meaningful.
- \_\_\_\_\_ 3. I am always looking to find my life's purpose.
- \_\_\_\_\_ 4. My life has a clear sense of purpose.
- \_\_\_\_\_ 5. I have a good sense of what makes my life meaningful.
- \_\_\_\_\_ 6. I have discovered a satisfying life purpose.
- \_\_\_\_\_ 7. I am always searching for something that makes my life feel significant.
- \_\_\_\_\_ 8. I am seeking a purpose or mission for my life.
- \_\_\_\_\_ 9. My life has no clear purpose.
- \_\_\_\_\_ 10. I am searching for meaning in my life.

**Appendix I: General Information**

Please answer the following questions very briefly in the space provided.

1. Do you have any questions that you would like answered about the study? If so, what?
2. Has there been anything about the study that was disrupting, puzzling, or that you wondered about?
3. Please describe in your own words what you think the study is about.
4. Is there anything else you would like to tell us about this study (either Time 1 or 2)

**Appendix J: Photo by Condition**

Sprout:



No-Sprout:



**Appendix K: Supplementary Results****Hierarchical Regression Results**

Table 7

*Summary of hierarchical regression analyses examining predictability of positive affect by degree of Nature Relatedness (NR) and Sprout condition*

Predictors	R <sup>2</sup>	F	ΔR <sup>2</sup>	B	SE	sr <sup>2</sup>
PA1						
Step 1:	.31	5.27**				
Sprout				.03	.07	.001
NR				.25**	.08	.10
Step 2:	.32	0.65	.006			
NR x Sprout				-.07	.08	.006
PA2						
Step 1:	.23	2.60*				
Sprout				.07	.09	.006
NR				.22**	.10	.05
Step 2:	.24	0.62	.006			
NR x Sprout				.08	.11	.006

\* $p < .10$ , \*\* $p < .05$

Table 8

*Summary of hierarchical regression analyses examining predictability of positive affect by degree of Metapersonal Self Construal (MPS) and Sprout condition*

Predictors	R <sup>2</sup>	F	ΔR <sup>2</sup>	B	SE	sr <sup>2</sup>
PA1						
Step 1:	.49	15.97***				
Sprout				<.001	.07	<.001
MPS				.38***	.07	.24
Step 2:	.50	0.19	.001			
MPS x Sprout				.03	.07	.002
PA2						
Step 1:	.34	6.32**				
Sprout				.05	.09	.002
MPS				.32**	.09	.11
Step 2:	.37*	2.89	.03			
MPS x Sprout				.16*	.09	.03

*Note.* Although the interaction was approaching significance at *Time 2*, assessment of simple slopes indicated that *Sprout* was not significantly associated with *PA* at low or high values of *MPS*

\*  $p < .10$ , \*\*  $p < .05$ , \*\*\*  $p < .001$

Table 9

*Bivariate correlations among mood indicators, nature relatedness, and metapersonal self construal*

Variables	NR	MPS	NA	VS	SE	GU	FA
NR	—	.31*	.01	.45*	.11	.09	.33*
MPS	.31*	—	-.10	.54**	.33*	.01	.30
NA	.13	-.09	<b>.74**</b>	-.43*	-.48*	.70**	-.04
VS	.31	.33*	-.35*	<b>.68**</b>	.59**	-.40*	.44*
SE	.07	.21	-.54**	.46*	<b>.54**</b>	-.46*	.22
GU	.05	-.09	.84**	-.39*	-.44*	<b>.76**</b>	.05
FA	.28	.33*	.001	.44*	.05	.02	<b>.31</b>

Note. Correlations for *Time 1* mood indicators are reported above the diagonal; those for *Time 2* are reported below the diagonal; bold-type (diagonal) reports correlation between respective *Time 1* and *Time 2* mood indicators; NR = Nature Relatedness; MPS = Metapersonal Self Construal; VS = Vitality Scale; SE = Serenity; GU = Guilt; FA = Fascination

\*  $p < .05$ , \*\*  $p < .001$

**Time 2 feedback to question:**

Is there anything else you would like to tell us about this study (either Time 1 / or 2)?  
(**T** = statement entered in Table 6)

**SPROUT**

- the sprout is big, strong and growing fast; interesting, made me think about environmental problems **T**
- I had a lot of fun with it. I researched how to keep the plant going and I am excited. I also purchased sweet peas for planting, and plan on buying a bleeding heart tree soon. **T**
- It reminded me to smell the roses occasionally, and now I want to get a few houseplants haha! **T**
- It took me a while to decide where to put this. I knew growing a plant needs sun, air and water. I also controlled the temperature. Finally, I put it very close to balcony, but not the outside. (coz Canada is cold). I will watch it several times a day. It makes me feel meaningful and excited to do that. **T**
- I'm looking forward to it producing some beans:) **T**
- I traveled across the border with the plant, which I almost got fined for!
- I may upload my picture a little late because my computer cpu close to full
- It's been a lot of fun watching my bean grow! I will have to move it to the garden in the spring because it is getting too big! **T**
- it was a lot of fun taking care of the plant **T**
- i think is cool, i like my plant :)
- Throughout the study I went through some tough situations and having the plant to look after was uplifting. **T**
- for time 1, would be better if you had a plastic bag so i could take the plant home without spilling soil.
- In time 1, it was hard to carry the plant around for the remaining of the day in different classes. Maybe next time if a ziploc bag with soil and the bean could be handed for the participants to plant the bean at home. This way it's less likely for an accident to occur.
- My plant grew continues to grow at a rapid pace.
- My plant is sprouting and visibly healthy
- What's it actually about?
- I was happy to see it sprout! **T**
- Thanks for the bean!
- My plant is growing like a weed!
- nope. other than that i am happy to participate and help you better understand whatever it is your trying to understand. I'm sure all in all it's for a good cause one way or another and also thankyou.
- I have an anxiety disorder. I am, however, a very happy person when I am not feeling anxious due to my disability. Also, the plant was not by a window but I have a bachelor apartment and a sunlamp I put on in the mornings most days.
- My plant is growing happy and healthy in home :) **T**

**NO-SPROUT**

- Watered the plant nearly everyday for a week and nothing. Logically doesn't add up if there wasn't a deception. Hence the control group question.
- I think the study was very interesting
- Why didn't my bean grow?
- Please rig the draw so that I win the \$100.
- my seed broke in half after the third day
- Why didn't my plant sprout :(
- well I wish I had more time to care for my plant before doing Time 2. I really wanted the plant to grow! I feel like the plant is a reflection of me and I don't want to give up so I will continue to water it.
- Fun study! Now tell my bean to grow ;)
- I named my plant Steve. Like me, he doesn't like waking up. **T**
- Did i get a plant dud? lol I still have faith it'll grow!
- I planted strawberry seed in the same pot to keep Mr.Bean some company. Strawberry grow but bean did not.
- My bean may not have been buried deep enough
- No sprout :( **T**
- It didn't sprout :( **T**
- It's still hiding in the soil though **T**
- Even though my plant didn't grow, I loved taking care of it!!! **T**
- Attached is a picture of my (unfortunately un-sprouted) plant. **T**
- He has unfortunately not sprouted! **T**

Table 10  
*Bivariate correlations among all variables*

Variable	NR	MPS	PA	NA	GU	SE	FA	VS	INS	ILS
NR	--	.59**	.33**	-.07	-.03	.09	.22*	.24*		
MPS	.59**	--	.51**	-.12	-.15	.25*	.39**	.53**		
PA	.21*	.33**	<b>.56**</b>	.001	-.16	.34**	.63**	.74**		
NA	-.01	-.20*	-.17	<b>.59**</b>	.83**	-.56**	.11	-.27*		
GU	-.06	-.21*	-.25*	.54**	<b>.63**</b>	-.50**	-.08	-.38**		
SE	.17	.29*	.31**	-.38**	-.40**	<b>.55**</b>	.18*	.50**		
FA	.29*	.34**	.43**	.12	-.03	-.06	<b>.43**</b>	.45**		
VS	.24*	.39**	.59**	-.27**	-.33**	.41**	.43**	<b>.68**</b>		
INS	.66**	.45**	.21*	.004	.08	.09	.18	.15	--	
ILS	.25*	.39**	.36**	-.25*	-.32**	.33**	.19	.47**	.34**	--
IUS	.34**	.42**	.19	-.05	.03	.17	.05	.14	.59**	.36**
BIO	.59**	.34**	.27*	.06	.04	-.05	.24*	.19	.50**	.27*
MLQP	.25*	.47**	.43**	-.30*	-.40**	.46**	.13	.55**	.18	.56**
MLQS	-.17	-.06	-.09	.18	.18	-.25*	.06	-.21*	-.13	-.26*

Note. Correlations for *Time 1* mood indicators are reported above the diagonal; those for *Time 2* are reported below the diagonal; bold-type (diagonal) reports correlation between respective *Time 1* and *Time 2* mood indicators; NR = Nature Relatedness; MPS = Metapersonal Self Construal; PA = Positive Affect; NA = Negative Affect; VS = Vitality Scale; SE = Serenity; GU = Guilt; FA = Fascination, INS = Inclusion of Nature in Self; ILS = Inclusion of Life in Self; IUS = Inclusion of Universe in Self; BIO = Biospheric Concern; Presence = Presence of meaning in life; Search = Search for meaning in life.  
 \*  $p < .05$ , \*\*  $p < .001$

