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How the Body Moves the Mind: Exploring the Effects of Perspective of Physical Sensation on Embodied States and Perception

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HOW THE BODY MOVES THE MIND: EXPLORING THE EFFECTS OF PERSPECTIVE OF PHYSICAL SENSATION ON EMBODIED STATES AND PERCEOTION

by

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ABSTRACT

The purpose of this thesis is to explore how surface engagement through touch affects perception of stimuli and mood. Researchers have found psychological, physiological and cognitive benefits associated with exposure to and interaction with nature. Stress Reduction Theory with Psychoevolutionary framework, and Attention Restoration Theory are often used to explain and interpret results. However, studies that focus on individuals with negative perspectives of nature find a positive affective response to nature is not universal. Rather, individuals respond differently based on their own experience with nature. Childhood exposure and culture have been found to influence attitudes towards nature. Theories of embodied cognition emphasize the importance of previously learned associations and embodied states have been found to influence judgment, experience of emotions, and physiological states. To assess whether an individual's attitude towards nature influences the embodiment of a positive or negative state, participants were randomly assigned to come into physical contact with one of four surfaces with their feet: grass, fake grass, dirt and cement. Individuals affective, cognitive and physical relationship with nature was measured with the Nature Relatedness Scale. Change in perception of neutral stimuli and mood before and after surface exposure were measured. Results suggested surfaces influenced mood in different ways, however the effects on perception were unclear. A participant's perspective of nature did not seem to influence mood change depending on surface type. Future research is needed to assess whether the shift in mood was based on metaphors of language, priming from surface texture, or a result of complex interaction between bodily sensations and cognition.

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INTRODUCTION

Interaction with or exposure to nature has been found to offer humans an array of benefits. The most notable benefits arise in the realms of physiological responses as well as cognitive functioning and well-being. However, other more abstract benefits, classified as social and spiritual have also been identified from nature interaction (Keniger, Gaston, Irvine, & Fuller 2013). A meta-analysis of the benefits associated with nature interaction cleanly classified the different types of benefits, in addition to various categories of interactions with nature into indirect, incidental, to intentional interactions (Keniger et al., 2013). Indirect interactions occur separate from full submersion in the environment, such as window views or virtual images (Keniger et al.,2013; Lottrup, Stigsdotter, Meilby, & Claudi, 2015; Ulrich, 1934; Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991). Incidental interactions include coincidental exposure to nature while undergoing other pursuits, such as driving or walking in nature, or plants incorporated indoors (Cackowski & Nasar, 2003; Keniger et al., 2013). Interacting with nature by choice is considered intentional, such as hiking or gardening (Keniger et al., 2013).

Improved mood, job satisfaction, better stress recovery, and smoother recovery in hospital stays arise from even indirect and incidental interactions (Cackowski & Nasar, 2003; Lottrup et al., 2015; Maller et al., 2006; Maller, Townsent, Pryor, Brown, & Leger, 2006; Ulrich, 1934; Ulrich et al., 1991). Other studies have associated nature interaction with increased social cohesion (Keniger et al., 2013; Kuo & Sullivan, 2001). Crime rates were found to be significantly lower in inner city neighborhoods with high and medium vegetation compared to those with low vegetation. Crime rates were significantly different even when controlling for confounding variables such as income (Kuo & Sullivan, 2001). The decrease in crime was

thought to be associated with reduced mental fatigue triggered by nature that may in turn reduce negative behavior (Kuo & Sullivan, 2001).

Many researchers reference Stress Reduction Theory using Psychoevolutionary framework and Attention Restoration Theory as explanations for the benefits associated with human nature interactions (Kuo & Sullivan, 2001; Lottrup et al., 2015; Ulrich, 1934; Ulrich et al., 1991). However, many studies fail to acknowledge the subjective nature of a restorative activity, fail to create fair comparisons between urban and natural environments, and often do not encompass individuals with diverse attitudes towards nature when collecting data. The urban and natural environments are classified as two distinct categories of environments and thus must possess different environmental qualities. For example, nature possesses different types of sounds and visuals than the urban environment does. Ensuring the qualities of the environments are equivalent is important for comparative research.

An environment interacts with a person via all available sensory inputs thus understanding the results of engaging other senses with nature in addition to vision is also important. The visual aspect of nature has certainly been isolated, studied in a laboratory setting, and found to be beneficial (Ulrich et al., 1991). Additionally, researchers have found natural sounds offer better stress recovery, and improved mood when compared to no sound, talking or urban sounds (Benfield, Taff, Newman, & Smyth, 2014). However, no other sense interactions have been isolated and assessed regarding nature interaction or exposure. To understand how the senses work together to elicit environmentally related responses, it may be fruitful to investigate responses while isolating sensory exposure.

Utilizing a different lens, theories of embodied cognition propose that an organism's responses are complexly influenced by the whole system: mind, body and environment (Wilson, 2002). Nature based responses would be developed over time through experience, involving the whole cognitive system. The mind and body act together to experience and generate emotion which can also be influenced by the environment (Wilson, 2002). The memory of previous experience in a specific environment is stored in the body, mind and the environment. The system can be primed by aspects of the environment that trigger the affect associated with it to be embodied and reexperienced (Wilson, 2002). Embodiment has been proven to influence judgement, experience of emotions and physiological states (Körner, Topolinski, & Strack, 2015; Wilson, 2002). Looking at the effects that arise through interaction or exposure to nature utilizing the framework of embodied cognition could provide a more flexible explanation of human-nature responses, inclusive of individuals who prefer the urban environment.

Theoretical Trends of Positive Human Response to Environment

Stress Reduction theory by Ulrich integrates Psychoevolutionary framework to build a framework explaining the benefits associated with nature interaction (Ulrich, 1983; Ulrich et al., 1991). According to these ideas' humans evolved in the natural environment and therefore have developed stress related responses to certain environmental stimuli depending on features present in the environment (Ulrich, 1983; Ulrich et al., 1991). Responses to natural environments are considered to be similar to emotional expressions, such as happiness or sadness, which arise and are expressed similarly across cultures. The process that underlies cross-cultural emotional displays is much like what Ulrich believed framed responses to the natural environment. Ulrich

proposes that emotional displays are "unconsciously triggered and initiated emotional responses- not 'controlled' cognitive responses" (Ulrich, 1983). Thus, from these perspectives, certain characteristics of the environment should elicit feelings of fear leading to avoidance, while others elicit positive emotions leading to approach or appreciation (Ulrich, 1983).

Visual characteristics identified by Ulrich to be relevant in preference for natural views are: moderate to high complexity where an easily recognizable focal point or pattern exists, easily perceivable depth, ground surface that is easy to navigate or "homogeneous" (Ulrich, 1983) in texture with a vista present and no noticeable threats to well-being. A vista deepens a human's sense of curiosity on the basis that exploration is possible and safe, manifested in nature through the curves of rivers or viewpoints that offer a curved perspective providing a lot of spatial information (Ulrich, 1983). Ulrich also adds the presence of water increases environmental preference further, although it is less important than the other characteristics (Ulrich, 1983). These characteristics were developed during human history in nature, these scenes are thought to be beneficial to survival and are nonthreatening thus are stress reducing eliciting positive affective responses (Ulrich, 1983). According to Ulrich evolution ensured humans find certain aspects of the environment to be stress reducing because of the potential for survival and well-being that is associated with those environmental qualities. With stress being an emotion motivating behavior the reduction in stress associated with environmental characteristics and well-being would guide humans to spend more time in those areas (Ulrich, 1983). However, it is possible an urban environment could also meet the criteria of the visual characteristics mentioned above.

Accordingly, if humans are innately driven to respond to nature positively then the percentages of people who spend time outside should be extremely high due to associations between affect and experience. A study focused on Americans relationship with nature found that time spent outdoors has been on a decline for children and adults (Kellert, Case, Escher, Witter, Mikels-Carrasco, & Seng, 2017). The majority of adults reported spending less than ten hours a week outside and were satisfied doing so. Among those, 34% of blacks, 23% of whites, 22% of Hispanics and 19% of Asians reported spending less than two hours outside (Kellert et al., 2017).

Various factors were found to influence disconnection from the natural environment such as the built environment, technology, competing priorities, less dependence on nature directly, and changing expectations of how much time is considered normal to spend outside (Kellert et al., 2017). Racial differences were found in interest for activities, concerns for safety in nature and reported indoor-oriented versus outdoor-oriented hobbies. The most preferred activities across all races were the most manicured (Kellert et al., 2017). Individuals reported high interest in museums, zoos and aquariums, and walking outdoors, however, racial differences were found in interest for hiking and camping (Kellert et al., 2017). Individual preferences, which exist on a spectrum, such as disgust sensitivity, fear expectancy and desire for modern comforts, were found to influence individual desire to interact with nature in both recreational activities and career selection (Bixler & Floyd, 1997). Regardless of race all humans evolved in a natural environment therefore should feel the need to engage with the environment and do so accordingly. Racial differences in activity selection, time spent outdoors and concerns for safety along with the importance of sensitivity to disgust, comfort, and fear highlight the influence of

society and culture in developing preferences for and responses related to the natural environment (Bixler & Floyd, 1997; Kellert et al., 2017).

Attention Restoration Theory takes a slightly different approach to explaining the benefits that are associated with nature interaction. Kaplan's explanation can be more easily generalized across environments and activities aside from those inherently related to nature. According to Attention Restoration Theory, positive effects that arise from nature interaction come from the way the environment affects attention mechanisms (Kaplan, 1995). Kaplan does discuss directed attention and fatigue of attentional mechanism from an evolutionary standpoint in a paper evaluating both Stress Reduction Theory and Attention Restoration Theory (Kaplan, 1995). However, evolutionarily programmed responses are not the focus of Kaplans explanation. A human whose attention is influenced by various factors of the environment, rather than just one, would be "less vulnerable to surprises" (Kaplan, 1995). The ability to focus the majority of one's attention on one thing in order to accomplish complex problem-solving is important. However, it is also important to be aware of surrounding events that could provide hints on the status of well-being, such as sounds. Therefore, attention mechanisms may have been adaptive for guiding behavior (Kaplan, 1995).

It is important to note that Kaplan discusses the importance of subjective factors of experience in determining what fits the criteria of restorative. Kaplan makes note of the importance of fascination in defining an experience as restorative, as well as compatibility, a sense of being away, and extent (Kaplan, 1995). A restorative environment must be compatible with an individual's desires, needs and fascinations. The extent of the environment must create a sense of being away through environmental complexity with the presence of elements that gently

steer the mind away from everyday life (Kaplan, 1995). Of the four factors, fascination, compatibility, a sense of being away and extent, which are all highly subjective in individual perception, compatibility was found to be the most essential predictor of restorativeness regardless of age or gender (Scopelliti & Giuliani, 2004). The salience of compatibility emphasizes the importance of attitudes towards nature, developed through experience and social influences, in determining whether or not the natural environment is restorative for a particular individual. This is essential considering not all individuals associate positive affective responses with nature, or have a desire to interact with it. A snake might elicit fear for many, but fascination for other individuals depending on how the snake is incorporated into cognition based on learning and experience. For example, individuals who associate snakes with positive religious symbols may see a snake and experience fascination leading to a different behavioral response than fear (Kaplan, 1995). Additionally, an individual that has acquired positive hands on experience with snakes, such as a zoo keeper or pet owner, may respond with approach rather than avoidance behavior.

Unfortunately, many studies considered the category of the environment rather than the qualities of the environment when collecting data and designing experiments. In a study analyzing stress recovery after exposure to natural and urban environments six environments were compared, two natural and four urban (Ulrich, 1991). Both natural environments had no people or animals. The urban environments ranged from heavy to light automobile traffic on the same street, and heavy pedestrians to few pedestrians (35 people walking past per minute to 7 people walking past per minute) (Ulrich, 1991). In this case, based on the environments that participants were exposed to it is clear why nature offered significantly greater benefits than the

urban environment; the two environments were not necessarily comparable at an attention capturing level.

In order to create a fair comparison between an urban and natural environment to assess restorativeness or stress recovery, it is essential that the urban environment possesses similar attention capturing qualities, or lack thereof, as the comparative natural environment- especially since it is fairly easy to find or create an urban environment that mirrors the natural environment in factors related to attention, such as noise and busyness. Other researchers assessing restorative qualities of experience offer alternative restorative urban environments. Suggestions that could create an equivalent comparison included: visiting a historical or art museum, spending time in a restaurant, watching a movie, meeting people at home, reading a book, and listening to music (Scopelliti & Giuliani, 2004). Inequivalent comparisons make interpretations of results unclear. Therefore, drawing a conclusion on how and why nature is found to be beneficial is difficult, especially when nature plays many different roles in society across cultures.

Reconceptualizing Theoretical Application

Theories of embodied cognition differ from traditional information processing theories by placing importance on the mind-body system and environment in cognition. In 2002 Wilson distinguished the following claims from the embodied cognition literature in her discussion of the concept: "(1) cognition is situated; (2) cognition is time-pressured; (3) we off-load cognitive work onto the environment; (4) the environment is part of the cognitive system; (5) cognition is for action; (6) off-line cognition is body based" (Wilson, 2002). Rather than responding in a set evolutionary way, learning and experience shapes the responses generated by the mind-body

system. Embodied cognitive processing would be adaptive by nature across many different environments and situations. Stress Reduction Theory with Psychoevolutionary framework on the other hand, would be most adaptive for human survival in a stable natural environment

Before directly applying these concepts to nature related responses a general understanding of each and how they interact must first be established. Situated cognition is based on the necessity that cognitive processes are influenced by constant inputs and outputs while navigating the environment and generating responses (Wilson, 2002). Cognition occurs in the environment; thus, inputs and outputs in the mind-body-environment interaction influence cognitive processes. Time pressure in cognition involves utilizing cognitive shortcuts to generate situationally adaptive behavior (Wilson, 2002). Humans often utilize the ability to think or plan before acting, however there are certain instances when the time is not available thus a response must be generated immediately. In evolutionary history cognitive shortcuts may have been utilized in situations, such as fight or flight scenarios, that involve another organism (Wilson, 2002). Additionally, humans tend to utilize the environment to lessen the amount of cognitive work required to complete a task (Wilson, 2002). Interestingly attention capacities and limited working memory are motivators of off-loading cognition to the environment (Wilson, 2002).

Cognition occurs within a human who is receiving information constantly from a changing environment thus the environment is also an active part of the cognitive system. The mind-body system and environment communicate information constantly to influence cognitive processing (Wilson, 2002). Each action a body produces is coupled with additional interactions with the environment. The understanding of cognitive processes is limited when mental processing is viewed as detached from the environment and the body. Another claim from

embodied cognition literature is that cognition is for action and developed to help an organism act in an adaptive manner (Wilson, 2002). Rather than strict evolutionarily developed and set responses, a human will form responses and mental representations based on previous experiences. The cognitive process guides action in a rather "indirect, flexible, and sophisticated strategy" (Wilson, 2002). Mental metaphors adaptively arise because they assist in decision making for organisms who have limited attentional capacities, however they do not determine a set response as flexibility and learning is inherently important (Wilson, 2002). The last claim associated with embodied cognition theories is that cognition that is considered off-line, thus separate from the environment, is based in the body (Wilson, 2002). Mental imagery, working memory, episodic memory, implicit memory as well as reasoning and problem-solving abilities make use of the sensorimotor system to function. Abstract functions in the brain such as those just mentioned activate relevant pathways in the sensory and motor system causing a change in bodily state (Wilson, 2002).

Routes to Embodiment

Researchers have utilized various routes to embodiment, either independently or combined: direct state induction, modal priming and sensorimotor simulation (Körner et al., 2015). Each of these routes can influence embodiment with relatively little and unconscious effort although experience and learned associations unique to an individual also influence embodied states (Körner et al., 2015). Direct state induction occurs when the body or mindset is directly altered to influence judgements. Altering the state, either physical or mental in turn influences the judgements that follow; however, it is the associations a person has with the state

that guides the judgements. In a study assessing movement direction with judgements, direction of movement was found to influence judgements that followed (Fayant, Muller, Nurra, Alexopoulos, & Palluel-Germain, 2011). Additionally, arm flexion or extension manipulation was found to influence participant's judgments of like and dislike of neutral stimuli (Cacioppo, Priester, & Berntson, 1993).

Modal priming involves activating or manipulating certain sensorimotor states that will in turn influence participant access to abstract concepts on the basis that representations are also constructed in the body (Körner et al., 2015; Schaefer, Denke, Heinze, & Rotte, 2013). For example, the texture of objects held while making judgements have been found to influence perception by priming the mind to associate the texture of the object with the quality of the interaction (Schaefer et al., 2013). In a study assessing the effects of modal priming, participants were provided either a rough or smooth object and asked to judge social interactions. Participants that handled a rough rather than smooth object rated social interactions to be less harmonious (Schaefer et al., 2013). In this case it is the metaphorical priming of a certain body state or sensation that triggers application of abstract concepts to a situation.

Sensorimotor simulation on the other hand utilizes a shared pathway between cognition and motor control to influence cognition (Glenberg & Kaschak, 2002). In the case of language, areas in the brain involved in speech production become active when passively listening to verbal stimuli (Fadiga, Craighero, Buccino, & Rizzolatti, 2002). Observing tactical interactions effects brain function in a similar way however, areas of the brain relevant to tactical manipulation become active in this case (Buccino, Binkofski, Fink, Fadiga, Fogassi, Gallese, & Freund, 2001). Using an fMRI to access brain activity, participants viewed a video of a hand

interacting with a ball and a cup without actually interacting with the object. Brain activity mirrored activity as if the participants were handling the objects themselves (Buccino et al., 2001). The body becomes active because of the association between that bodily state and the original experience, a consequence of the brain-body system. The change in body state triggers a reexperience of the state that it is associated with it (Körner et al., 2015). Physical simulation of posture has been found to play a role in access to positive or negative recall as well (Michalak, Mischnat, & Teismann, 2014). In a sample focused on depressed patients, those whose posture was manipulated to be slumped recalled more negative words. Depressed participants in the upright posture had a balanced recall of positive and negative words (Michalak et al., 2014).

The Natural Environment as a Route to Embodiment

Perception of nature is based on previous direct or indirect experiences with nature and is influenced socially by culture and other individuals (Zhang, Howell, & Iyer, 2014). In a study assessing the relationship between connectedness to nature and engagement with natural beauty, researchers found that individuals who are connected to nature "are more satisfied with life, reporting greater happiness and positive affect" (Zhang et al., 2014). However, an individual's level of engagement with natural beauty plays a role in mediating the relationship between psychological well-being and individuals' connectedness to nature (Zhang et al., 2014). Connectedness encompasses the cognitive view of the self as connected to the natural world; however reported connectedness is not stable across stations (Zhang et al., 2014). Engagement with natural beauty focuses on emotional and physiological arousal related to nature, such as feelings of awe or "a lump in my throat" (Zhang et al., 2014). According to this study in order to

be receptive to the benefits associated with nature interaction or exposure one must be cognitively and emotionally attuned to respond positively in nature (Zhang et al., 2014).

Theories of embodied cognition may suggest that engagement mediated the positive effects because engagement strengthens the development of mental representations, which in this case are likely positive as the engagement is voluntary. Therefore, individuals who engage with and are connected to nature may be more readily primed by its stimuli. Priming effects could cause an individual to spend more time in the environment where a positive state is embodied causing increased positive affect overall, in addition to other benefits. In regard to the potential benefits offered by nature, embodiment theories claim emotional states remain in the brain-body system even after experience has passed. These memories are drawn on again in future experiences within that environment where positive associations lead to positive embodied states and vice versa (Tiba, 2018). Olfactory, gustatory and tactical aspects of an environment can influence cognitive processes upon interaction with the brain-body system (Eskine, Kacinik, & Prinz, 2011; Schaefer et al., 2013; Schnall, Haidt, Clore, & Jordan 2008). Bitter taste and disgusting smells were found to influence moral judgments (Eskine et al., 2011; Schnall et al., 2008). Interestingly, individuals who were more conscious of their own internal bodily processes were the most susceptible to the influence of sensory disgust on moral judgements (Schnall et al., 2008). In the case of well-being benefits from nature interaction, it was individuals who had a conscious emotional connection to nature that experienced the most well-being benefits (Zhang et al., 2014).

Another predictor for connectedness to nature and the environmental benefits that follow is culture (Zhang et al., 2014). Previous experience with stimuli determines the embodied state

that will follow, therefore different cultural influences and values should influence how obtainable benefits from the environment are for certain individuals. Different cultures value the environment and aspects of it differently in addition to utilizing the natural environment in different ways. Researchers found that Americans score higher than Chinese participants on the trait nature connectedness, which is said to be relatively stable over time (Tam, 2013). The difference in scores could be attributed to different cultural values internalized by the individuals, as well as different affordances for interactions (Tam, 2013). Additionally, researchers created a research design based on an American study analyzing the benefits associated with running in a natural or urban environment. In Japan, regardless of setting, participants experienced the same amount of benefits whereas the American counterpart found exercise in nature, rather than an urban environment, offered additional benefits (Keniger et al., 2013; Kerr, Fujiyama, Sugano, Okamura, Chang, & Onouha, 2006). The difference in results showcases the influence of culture in determining responses to the natural environment and access to environmental benefits.

Childhood experience with nature was also found to play a role in the development of attitudes towards nature (Bixler & Floyd, 1997). Individuals with the least childhood experience felt the most fear in natural environments with a tendency to associate negative reactions with wildlife environments. Negative wildlife environmental reactions included anxiety from expected exposure to objects or situations that are considered fearful, emotional discomfort from exposure to disgust inducing stimuli and physical discomfort due to preference for indoor comforts, such as showers and temperature control (Bixler & Floyd, 1997). It is possible that these negative associations with nature were learned through social embodiment via mirroring

parental or cultural behaviors and attitudes (Bixler & Floyd, 1997). Moreover, lack of childhood exposure to nature would likely correlate with negative parental attitudes towards nature because the parent did not value nature enough to expose their child. Regardless of whether a negative attitude was learned through parents, society, or previous experience, a negative state is embodied in such individuals when exposed to sensations of the natural environment. Embodying a state associated with negative affective responses such as fear, disgust and discomfort limits the individual's receptivity to the benefits nature offers others. Benefits could arise from reconstructing associations with the natural environment through positive experience or by simply looking elsewhere for a more compatible restorative experience.

The relevance of experience, culture and childhood exposure concerning development of attitudes towards nature goes hand in hand with aspects of embodied cognition. Engagement with the natural environment would increase established associations with the natural environment therefore more embedded representations and memories means more triggers for embodying a particular state in the specific environment. Repeated engagement with nature, especially when voluntary, means the individual likely possesses a positive perspective of nature leading to more positive states more often and an overall increased sense of well-being.

Expanding the Literature

This study will add to the limited literature on how the body passively influences cognition and attempts to delve deeper into the mechanisms motivating nature related responses using a different framework. With or without action the body senses its environment, constantly providing sensory feedback which informs the brain on the body's state, therefore information on

the sensing body is equally as important for developing embodied cognition literature as the acting body is (Borghi & Cimatti, 2010).

Additionally, the visual aspect of nature interaction and exposure along with the benefits that follow have been well studied, both virtually and in reality (Cackowski & Nasar, 2003; Lottrup et al, 2015; Maller et al., 2006; Ulrich, 1934; Ulrich et al., 1991). Therefore, it is important to investigate the effects that may follow from nature interaction with other senses. This study delves into the physical aspect of engaging with nature, investigating how tactical interaction with various surfaces influences mood and perception. The fact that visual and auditory interaction are found to be significantly beneficial means that interacting through touch may have effects motivated by similar or different mechanisms (Benfield et al., 2014; Ulrich et al., 1991).

The primary purpose of this study is to investigate how tactile exposure to various surfaces from the environment influences perception and mood. The change of the state embodied will be assessed by a change in mood and participants attributing either a positive or negative interpretation to neutral and slightly positive images after interaction with assigned surface. The shift in interpretation will be dependent on preexisting perceptions of the natural environment. Based on theories of embodied cognition it is likely that exposing the body to a specific sensation should prime the neural pathways or activate mental metaphors associated with that sensation and environment in turn altering mood, and emotional perception which leads to the following hypothesis:

Exposure to different surfaces will influence mood and perception either positively or negatively with the direction of the shift determined by the individuals preestablished perspective of the environment.

METHOD

Participants

UCF students, over the age of 18 were recruited through SONA. Students received course credit or extra credit for a course for participation in the study.

Materials

Brief Mood Introspection Scale (BMIS): Open sourced mood scale which addresses current mood using 16 adjectives such as lively, sad, gloomy, nervous, calm. Participants indicated how well each adjective indicated current mood by answering either definitely do not feel, do not feel, slightly feel or definitely feel. This scale measured pleasant-unpleasant mood, arousal-calm mood as well as positive-tired and negative-calm mood using the adjectives. Additionally, overall mood was measured using a numerical scale from -10 to 10, -10 is the very unpleasant, 10 is very pleasant. All of the mood scales have satisfactory factor validity. Cronbach's alpha reliability for the various mood scales ranged from .76 to .83, the Aroused-Calm mood scale has the lowest reliability. (Mayer & Gaschke, 1988). See Appendix A for the scale.

Neutral images from the International Affective Picture System (IAPS): Images consisted of a combination of people, scenes, or objects. When compiling the picture data base researchers selected images that would evoke emotional reactions which vary regarding valence, from pleasant to unpleasant, and arousal, from calm to excited (Lang, Bradley, & Cuthbert, 2008). Images that evoked the most neutral reactions were used in this study as well as a few slightly positive images. Images were selected based on mean arousal and valence scores that fall in a

neutral or slightly positive category between high and low arousal and high and low valence. Images with the lowest standard deviation while meeting standards to be considered neutral or slightly positive were used in order to ensure the positive or negative bias attributed to the images is because of the exposure to natural sensation. The average mean score of valence for all of the images was 5.44, scores ranged from 4.55 to 6.46 and the average standard deviation for all of the images was 1.34. The object only images had an average valence mean of 5.07, scores ranged from 4.55-5.38 and had an average standard deviation of 1.08. The average arousal ratings for the images over all was 3.33, scores ranged from 1.76 to 5.09 and had an average standard deviation of 1.97. The most neutral, object only images had an average arousal rating of 2.65, ranged from 1.76 to 3.22 and had an average standard deviation of 1.89. The images have been categorized using self-reports from participants as well as by measuring physiological responses when participants view the images. Data have been accumulated regarding emotional reactions to these images for children, adults and college students and regardless of how the photos are grouped, responses have found to stay stable over time (Lang et al., 2008).

Self-Assessment Manikin Scale (SAM): The SAM scale is an affective rating scale used by researchers when assessing the IAPS images (Lang et al., 2008). The scale assesses three dimensions: arousal, valence and dominance but because each image has a separate score for all of the three dimensions the dominance dimension will be excluded as it is not relevant for the research question at hand. Additionally, the dominance dimension was found to be the least influential in perception of the images (Lang et al., 2008). Arousal ranges from calm to excited while valence ranges from pleasant to unpleasant. The SAM scale was found to be both highly reliable (r=.94) and consistent upon assessing the difference in mean scores of multiple

experiments which used the same images, no significant differences were found between the mean ratings over time or between participants (Lang et al., 2008).

Nature Relatedness Scale: Measures individual's relatedness to nature, which is considered to be trait like because across time and situations it remains generally stable. This scale encompasses the affective, cognitive and physical relationship between individuals and nature. The scale consists of 21 items based on three factors, NR-self, NR-perspective and NR-experience. Cronbach's alpha for the scale in full was .87 meaning that the scale has high internal consistency and test-retest correlations were .85 meaning the NR measure is fairly stable (Nisbet, Zelenski, & Murphy, 2009). See Appendix B for the scale. Test items include questions such as:

My relationship to nature is an important part of who I am.

I don't often go out in nature.

I enjoy being outdoors, even in unpleasant weather.

The thought of being deep in the woods, away from

civilization, is frightening.

Demographic Scale: A questionnaire asking basic background information of participants such as zip code growing up, education level, major, age, race and gender was used in order to better identify participants. See Appendix C for the scale.

Additional Questions: Additional questions will be included for potential use in post hoc analysis. The questions include zip code where most time was spent growing up and how often the participant doesn't wear shoes. See Appendix C for questions

Design and Procedure

A 2 (Surface Exposure: No Exposure, Exposure) x 4 (Surface: Real Grass, Fake Grass, Dirt, Concrete) mixed design was utilized with Surface Exposure serving as a within-subjects variable and Surface serving as a between-subjects variable. Potential participants with allergies to grass or dirt were excluded from participating in the study.

Before starting the experiment, participants were presented with the informed consent form and asked if they had any questions. After providing consent, participants were asked to fill out the Brief Mood Introspection Scale and rate a group of images on the Self-Assessment Manikin in order to get a measurement of response prior to interaction with the randomly assigned surface. Participants were asked to remove their shoes, stand on the surface, fill out the Brief Mood Introspection Scale and rate a different, equally balanced image group. Next, participants were invited to sit down and complete the Nature Relatedness Scale and Demographics questionnaire. All procedures occurred in the laboratory with windows closed.

RESULTS

Data screening procedures were implemented. Participants who did not complete both shoes on and shoes off conditions or respond to the mood questionnaire were excluded from the data analysis. To examine specific pairwise differences between the means, LSD post hoc tests were utilized.

General Demographics

There were 82 participants, 31 were male 49 were female. Ages ranged from 18-55 with a mean age of 20. Twenty-seven participants identified as white, 15 identified as black or African American, eight identified as Asian, one as Native Hawaiian or Pacific Islander, 26 Hispanic, Latino or Spanish descent, four participants identified as other and one failed to answer the question.

A one-way ANOVA was conducted on the NRS scores for self, experience and perspective to compare means across surface conditions and see if any conditions differed significantly in nature related attitudes. There were no significant differences between group means on the NRS dimension of Perspective ($F(3, 77)= 1.56$, $p=.21$) or Experience ($F(3,77)=1.70$, $p=.17$). However, there were significant differences between groups in the NR-self dimension ($F(3, 77)= 3.02$, $p=.04$). Post hoc comparisons using the LSD test found that only participants in the cement condition ($M=25.76$, $SD= 5.24$) differed significantly from the dirt condition ($M=30.87$, $SD=5.67$).

Analysis for Surface and Mood

In order to determine if surface type had an influence on overall mood, a one-way between-subjects ANCOVA was performed with surface as the independent variable and overall

mood change as the dependent variable. Mood change scores were calculated by subtracting the pre-interaction with surface mood score from the post-interaction mood score. The first measure of mood was used as a covariate to account for differences in initial mood states prior to starting the experiment. As seen in Figure 1, there was a significant effect of surface on overall mood ($F(3,81)=3.86$, $p= .01$, $\eta^2= .13$). Post hoc comparisons using the LSD test found that change in overall mood in the grass condition ($M= 1.55$, $SD= 4.32$) was significantly different than the change in overall mood in the cement condition ($M=-1.76$, $SD=3.73$) and dirt condition ($M=-1.43$, $SD=3.10$). The overall mood change in the fake grass condition (M=.50, SD= 2.12) differed significantly from cement condition ($M=-1.76$, $SD=3.73$). Participants in the grass condition experienced the most positive shift in overall mood after surface interaction. Participants in the dirt condition experienced a more negative shift in mood, while participants in the cement condition had the most negative shift in mood after surface interaction. Fake grass ($M=.50$, $SD= 2.12$) on the other hand seemed to have a relatively little effect on overall mood.

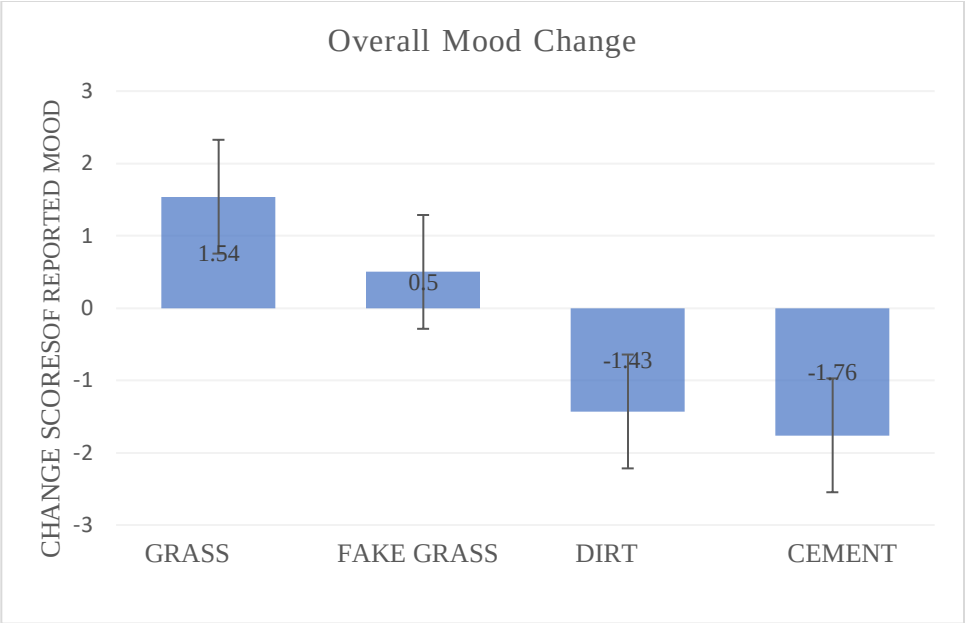


Figure 1: Change of Reported Mood Based on Surface Exposure

Two other dimensions of mood were calculated according to the BMIS scoring manual to determine if certain aspects of mood were influenced by the surfaces: pleasant to unpleasant mood and aroused to calm mood. Change scores were calculated subtracting the pre-surface ratings from post-surface ratings. The pre-surface ratings were used as a covariate. A one-way between-subjects ANCOVA was performed with surface as the independent variable and the change in pleasant to unpleasant mood as the dependent variable. There was a significant effect of surface on the pleasant to unpleasant dimension of the BMIS ($F(3,81)=3.58$ $p=.01$, $\eta^2= .12$). Post hoc comparisons using the LSD test found the mean score in the grass condition ($M=6.86$, $SD=3.85$) differed significantly from the cement condition ($M=2.86$, $SD= 4.77$) and the dirt condition ($M=3.11$, $SD= 6.44$) As can be seen in Figure 2, overall participants in the grass group reported the highest pleasant mood after interaction, fake grass indicated second most pleasant mood ($M=5.79$, $SD=3.85$). Participants in the dirt condition ($M=3.11$, $SD= 1.05$) reported less

pleasant mood and participants in the cement condition (*M*=2.86, *SD*= 1.05) had the most unpleasant mood. A one-way between-subjects ANCOVA was conducted on the aroused to calm dimension of mood using initial ratings of calmness as the covariate and surface type as the independent variable, no significant differences were found ($F(3, 81)= .32$, $p=.81$, $\eta^2= .01$).

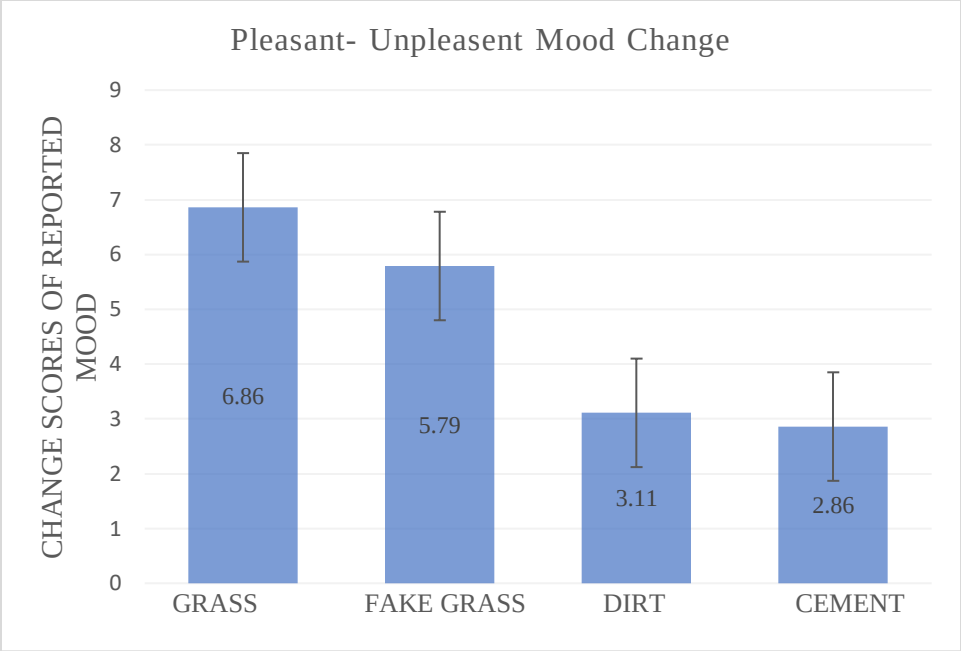


Figure 2: Change of Reported Pleasant- Unpleasant Mood Based on Surface.

Mood Adjectives and Surface

Next the BMIS was broken down by change scores for each adjective. Change scores were calculated subtracting the pre-interaction score from the post-interaction score. A one-way between-subjects ANCOVA was conducted to determine a statistically significant difference between surfaces for each mood adjective in the BMIS, only significant adjectives are reported here.

There was a significant effect of surface on 'sad' after controlling for initial sad scores ($F(3,81)= 3.16$, $p= .03$). There is a significant difference between the grass and cement conditions ($p=.01$), the fake grass and cement conditions ($p=.04$) and the cement and dirt conditions ($p=.01$). As seen in figure 3, the estimated marginal means showed participants in the grass condition ($M=-.24$), fake grass condition ($M= -.21$) and dirt condition ($M=-.30$) became less sad upon surface exposure. Participants in the cement condition became more 'sad' upon surface exposure ($M=.16$).

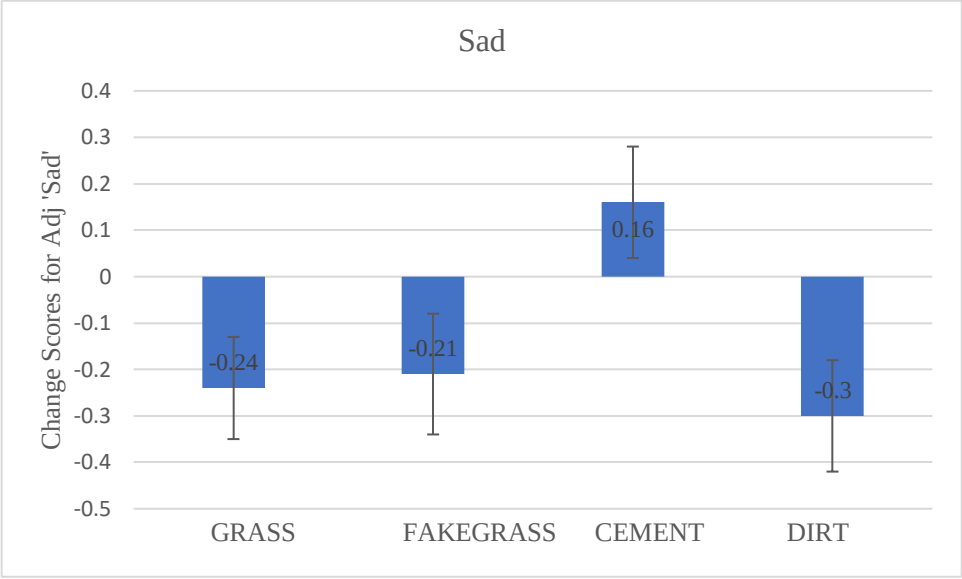


Figure 3: Change Scores for the Adjective 'Sad' Based on Surface

There was a significant effect of surface on 'grouchy' after controlling for initial grouchy scores ($F(3,81)=5.51$, $p= .002$). There was a significant difference between the grass and cement conditions ($p=.001$), the grass and dirt conditions ($p=.02$) and the fake grass and cement conditions ($p=.004$). As seen in Figure 4, comparing the estimated marginal means showed participants in the grass condition ($M=-.34$) and fake grass condition ($M=-.26$) became less

grouchy upon surface exposure. Participants in the cement condition (*M*=2.8) and dirt condition (*M*=.06) became more ‘grouchy’ with surface exposure.

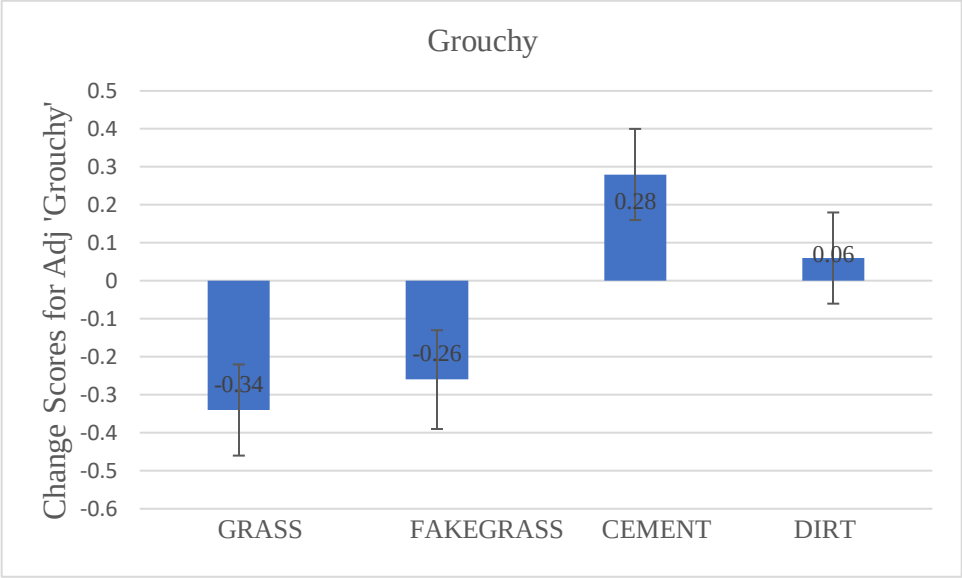


Figure 4: Change Scores for the Adjective ‘Grouchy’ Based on Surface

There was a significant effect of surface on ‘lively’ after controlling for initial lively scores ($F(3,8)=3.09$, $p=.03$). There were significant differences between the fake grass and cement conditions ($p=.02$) and fake grass and dirt conditions ($p=.01$). As seen in Figure 5, comparing the estimated marginal means showed participants in the grass condition (*M*= .32) and fake grass condition (*M*=.49) became more ‘lively’ with surface exposure. Participants in the cement (*M*=-.05) and dirt (*M*=-.08) conditions became less ‘lively’ with surface exposure.

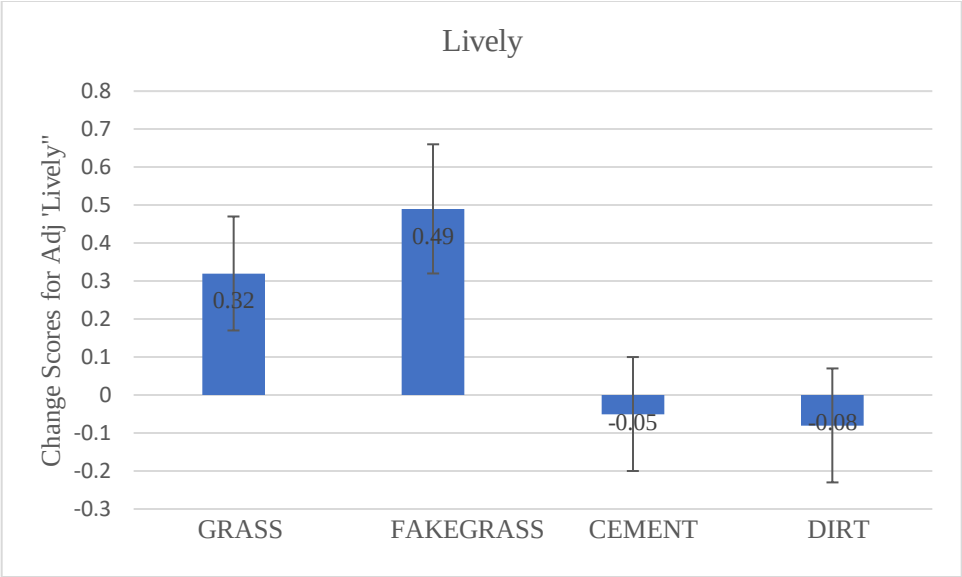


Figure 5: Change Scores for the Adjective 'Lively' Based on Surface

There was a significant effect of surface on 'happy' after controlling for initial happy scores ($F(3,8)=3.25$, $p=.03$). There was a significant difference between the grass and cement conditions ($p=.006$) as well as grass and dirt conditions ($p=.02$). As seen in Figure 6, comparing the estimated marginal means showed participants in the grass ($M= .41$) and fake grass ($M=.15$) conditions became more 'happy' with surface exposure. Participants in the cement ($M= -.17$) dirt ($M=-.10$) conditions became less 'happy' with surface exposure.

Figure 6: Change Scores for the Adjective 'Happy' Based on Surface

Analysis for Difference in Image Scores between Surfaces

A one-way between-subjects ANOVA was performed with surface as the independent variable and valence change scores as the dependent variable in order to compare the effect of surface on the valence scoring dimension of the IAPS images. Surface did not have a significant effect on valence ratings for the IAPS images ($F(3,81) = .88$, $p = .45$, $\eta^2 = .03$). However, a one-way between-subjects ANOVA was conducted with surface as the independent variable and change scores on the arousal dimension of IAPS ratings as the dependent variable. Surface was found to have a significant effect on arousal ratings for the images ($F(3, 81) = 5.95$, $p = .001$, $\eta^2 = .19$). Post hoc comparisons using the LSD test indicated the grass condition ($M = -3.91$, $SD = 16.20$) differed significantly from fake grass condition ($M = -17.73$, $SD = 13.94$). Additionally, the fake grass condition was significantly different from both the cement ($M = .75$, $SD = 12.17$) and dirt conditions ($M = .48$, $SD = 18.45$). As seen in Figure 7, participants in the fake grass

condition became the most calm after interacting with the surface followed by real grass. Dirt and cement conditions on the other hand experienced an increase in arousal.

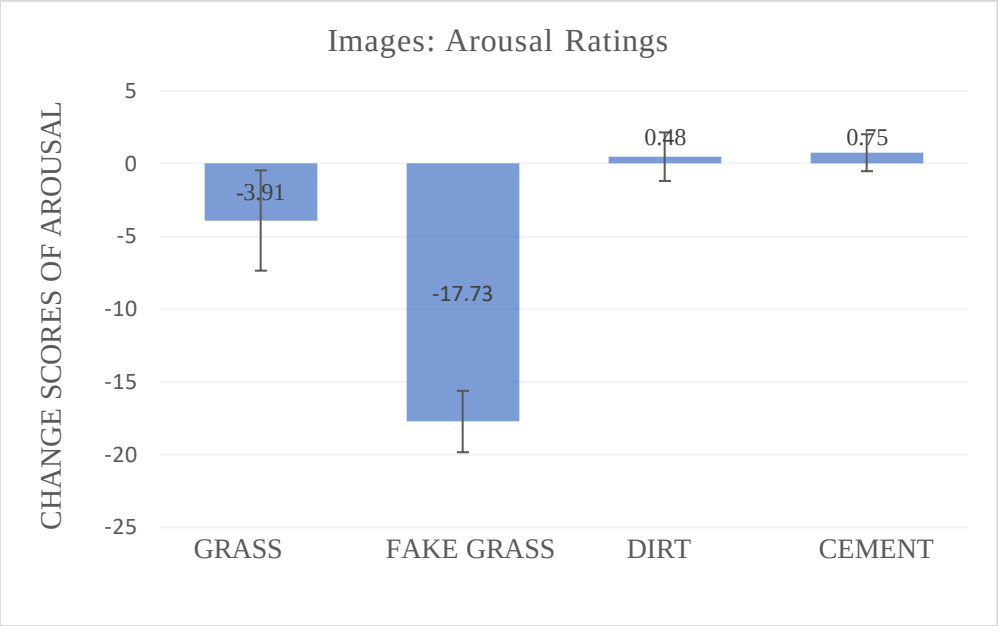


Figure 7: Change Scores for Arousal Ratings for All Images Based on Surface

In order to eliminate possible effects of slightly positive images, or images with people, which may elicit slightly more subjective ratings, separate change scores were calculated for object only images. These images had the most neutral scores and lowest standard deviation. Pre-surface interaction scores were subtracted from the post-surface interaction scores. A one-way between-subjects ANOVA was conducted with surface as the independent variable and object image change scores as the dependent variable. Surface had a significant effect on arousal scores for the IAPS object only images (F=(3,81)= 3.54, p=.02, η^2= .12). Post hoc comparisons using the LSD test found that scores in the fake grass condition (M=-5.09, SD=1.74) differed significantly from all other conditions: grass (M=.49, SD= 8.97) cement (M=1.69, SD= 5.82) and

dirt (*M*=1.49, *SD*= 1.61). As seen in Figure 8, even when only the most neutral images were used, participants in the fake grass condition still became calmer. However, participants in the grass condition experienced an increase in arousal as well as participants in the dirt and cement conditions. Another one-way between-subjects ANOVA was conducted with surface as the independent variable and valence change scores for object only images as the dependent variable. Surface was still not found to have a significant effect on valence ratings in the 3 conditions (F=(3,81)= 1.57, p=.20, η^2= .06).

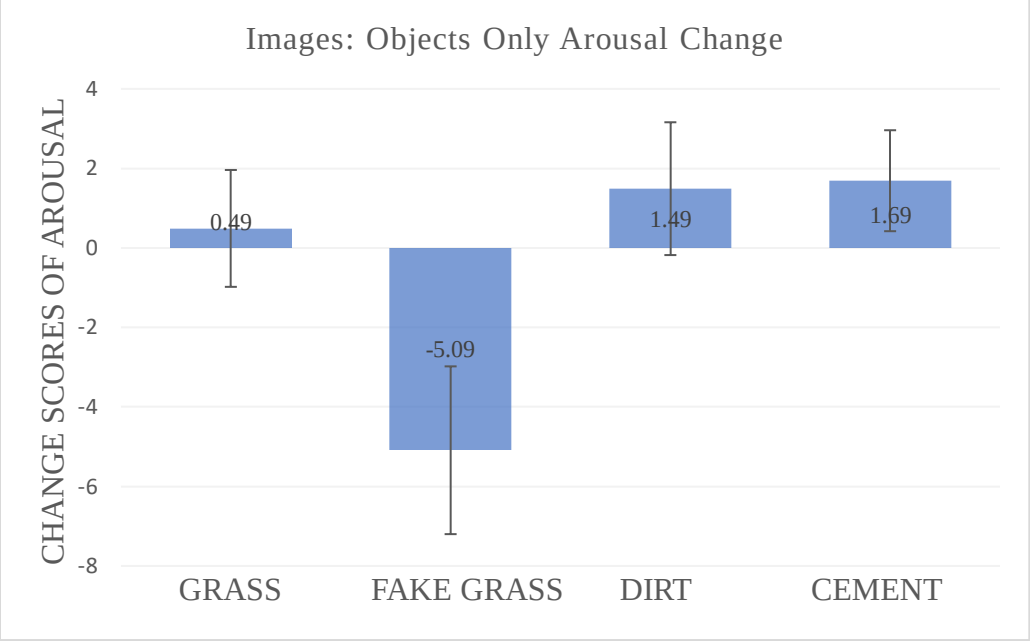


Figure 8: Change Scores for Arousal Ratings on Object Only Images Based on Surface

Analyzing the Relationship between Nature Perspective and Mood

A Pearson correlation was run to assess if the various dimensions within the Nature Relatedness Scale were related to shift in overall mood. There was no correlation between overall mood and scores on the self-dimension of the NRS [r=.02, n= 81, p= .85]. No correlation

was found between overall mood and the experience dimension of the NRS [r=-.06, n= 81, p= .61]. There was no correlation found between overall mood and the perspective dimension of the NRS [r=.08, n= 81, p=.5]. The file was split by surface type and another correlation was run however no significant differences were found between conditions either.

Analyzing the Relationship between Nature Perspective and Image Ratings

In order to assess if participant perspective of nature was related to the change in image ratings, a Pearson correlation was utilized. Arousal was the only dimension analyzed because it was the only dimension with significant differences across groups. There was no correlation found between the change scores of the IAPS ratings on the arousal scoring dimension and scores on the NRS perspective [r=-.07 n= 81, p= .55]. NRS self-scores were not correlated with arousal ratings [r=.03, n= 81, p= .77]. NRS experience scores were not correlated with arousal ratings [r=-.10, n= 81, p= .38].

DISCUSSION

The hypothesis that tactile interaction with different surfaces will influence mood and perception was tested. It was predicted that each individual's preestablished perspective of the natural environment would determine whether the shift was positive or negative in the various conditions. Mean scores for change of mood based on surface type in 2 of the 3 dimensions calculated from the BMIS mood measure differed significantly, thus the hypothesis was partially supported- surface type did influence mood. However, only participants in the fake grass condition differed significantly from those in the other surfaces on the arousal dimension of scoring for the neutral IAPS images. Therefore, the influence of surface interaction on perception is unclear. There was no correlation between participant perspective of nature and the change in mood or perception, which did not support the hypothesis.

Findings were partially consistent with previous research that found visual, auditory and activity centered interaction with nature to elicit positive affective responses (Benfield et al., 2014; Maller et al., 2006; Ulrich, 1934; Ulrich et al., 1991). On the contrary, there was no significant differences in the aroused to calm dimension of mood after surface exposure. This finding is inconsistent with Ulrich's work that explains restoration from nature is due to a calming effect created when attention capacities are allowed to recover (Ulrich, 1983; Ulrich et al., 1991). However, it is important to note that Ulrich's research focused on the visual aspect of interaction with nature which may elicit different effects than tactical interaction (Ulrich et al., 1991). Other previous research focused on activities such as gardening or exercising in nature where enjoyment of the task may have influenced mood change (Keniger et al., 2013). The present study focused on passive interaction with nature without any task orientation that could

have influenced results and still found similar effects, even when considering individuals' perspective and previous experience with nature. Conversely, the participants in the dirt condition, which is also considered natural, experienced a negative shift in overall mood. The qualities of the surface rather than the category played a role in the effects that followed. This highlights the importance of equal comparisons when selecting stimuli to represent certain environmental categories, such as natural or urban. Out of the four surfaces, cement is considered the most commonly encountered urban surface. For overall mood, the cement condition experienced the most negative shift thus the present study supports previous literature regarding urban environments as less beneficial than natural environments (Kaplan, 1995; Ulrich, 1934, Ulrich et al., 1991). To create a better understanding of the different effects of environments categorized as natural and urban, including a surface that is urban yet pleasant, such as carpet or foam flooring, could be fruitful for future research.

Participant relatedness to nature, comprised of previous experience, emotional connection and view of self in relation to the environment, was not correlated with mood or ratings of neutral stimuli. Therefore, the hypothesis that a positive or negative state would be embodied and projected to the stimuli based on individual perception of nature was not supported. Additionally, fake grass was the only surface condition where participants reported significantly different ratings to the neutral images after surface interaction, yet participants in the fake grass condition had the least shift in mood after interaction. Previous studies show that mood should influence perception. A negative mood should lead to more negative judgements and vice versa for positive moods (Sinclair & Mark, 1992). It is likely that the images were not a good measure of perception which may have led to the lack of significant differences between surface conditions.

It is also possible that the limited number of participants per condition lessened the available power to detect a significant correlation. Image scores did trend in the direction of significant differences across the other conditions. It is possible the surfaces may not have influenced mood significantly enough to in turn influence perception in the present study. The majority of humans rely most heavily on visual senses for navigating so it is possible that visual exposure to nature produces a stronger or more predictable effect than physical exposure.

Based on the pleasant to unpleasant mood change scores it is likely that participants considered grass the most pleasant surface, followed by fake grass, dirt, then cement. This could explain why dirt had a negative mood change even though it is a natural surface, as it may have been perceived as less pleasant. Additionally, increased reported experience of the adjectives 'lively' and 'happy' in the grass condition, decreased experience of the same adjectives in the dirt and cement condition, and a reported increase in 'grouchy' in dirt and cement conditions may be a reflection of the pleasant versus unpleasant perception of surface interaction.

Embodiment or Evolution

From an embodied cognition perspective, it seems participants did not heavily incorporate their own previous experience to determine mood change. However, the similarity in response to each surface may signify the presence of mental models associated with surfaces across participants. Due to the complexity of mental models and their development, whether the models arose due to similarity of texture perception across participants, or context of surface interaction is unclear. As mentioned previously the shift in mood may be based on perceiving the surface as positive or negative in the case of context, and pleasant or unpleasant in the case of

texture perception. The results of the present study seem to be in line with previous research that found the texture of an object in the hands, either rough or smooth, influenced perceived cohesion of interaction (Schaefer et al., 2013). Context related mental metaphors associated with the natural environment may be rooted in language. Perhaps a mental metaphor between dirt, or 'dirty' and negative, or 'dirty' and bad, caused the negative shift based on surface type regardless of perspective of nature. In the case of cement, it is possible a metaphor exists connecting the hard surface to difficulty, leading to a negative shift also.

Within the present population, the majority of participants identified as White or of Latino or Hispanic descent, and most grew up in the United States. Therefore, the likelihood is increased that a culturally crafted mental metaphor could be identified in this participant pool. Using a different, more culturally varied population may answer the question of whether the mental metaphor is formed on a cultural and learned, or evolutionary basis. Participants in both the dirt and cement condition experienced a greater increase in reported 'grouchiness' compared to the grass condition. The direction of change in the adjectives based on surface type provides support for a culturally shared perspective of the dirt and cement surface as negative and the grass and fake grass as positive. For future research, obtaining participant surface ratings on a pleasant to unpleasant scale in addition to assessing individual perspectives of nature may create a better understanding of the mechanisms at work.

From the perspective of Stress Reduction Theory with Psychoevolutionary framwork the grass condition may have had a better adaptive value compared to dirt and cement conditions (Ulrich, 1983). The perceived adaptive value may have determined the shift in affect regardless of previous experience with nature. During evolution, grassy areas may have often been

characterized by trees with fruit for gathering or more animals to hunt, thus eliciting an automatic positive affective response (Ulrich, 1983). Additionally, when discussing preferred qualities of the environment, Ulrich mentions pathway qualities (Ulrich, 1983). Grass would likely have better traction than loosely packed dirt. Subconscious weighing factors for decision making developed during evolution may have influenced participant judgements. The increase in the ratings of the adjective 'lively' in the grass and fake grass conditions may have been due to movability of the surface. However, the increase in liveliness could have also been due to interacting with a surface that is perceived as actually being alive. Although the fake grass was not actually alive the association between grass and live plant may have still transferred over.

Mental models that persist across participants regardless of nature perspective and experience support Psychoevolutionary framework by linking language evolution to the natural environment. However, without fully understanding the mechanisms at play and cultural differences, caution is warranted. It is probable that nature related language evolved differently in different cultures thus a Psychocultural Theory may better explain results from a culturally varied participant pool. Ultimately, Chinese and American participants were found to score differently in the realm of nature connectedness, which highlights cultural differences in nature perspectives (Tam, 2013). Shared perspective across a culture would likely translate into language development, dictating how nature is incorporated into the language. Evolution in, and experience with nature during human development may have been the cause of rooting nature in language. However, the structure of the roots may have grown to vary across cultures that interact with and utilize the environment differently. Ulrich mentions that approach and avoidance behaviors are motivated by perceiving environmental qualities as adaptive or not

(Ulrich, 1983). Similarly, research focused on embodied cognition has found that avoidance and approach movement, moving away from or closer to a stimulus influences judgement (Fayant et al., 2011). Aspects of navigating the natural environment during evolution may still take a toll on cognitive processes, with or without awareness.

Conclusion

Overall, the present study shows that tactical interaction with a natural or urban surface through passive touch does influence mood, although its effects on perception are unclear. The present study isolates the passive touch aspect of interaction with the environment. The visual aspect has been heavily studied, therefore it is important to shed light on responses that arise from engaging other senses with nature. Touch is an important aspect of the human experience; thus, it would prove useful to understand the effects of different surfaces and textures on cognitive processes and well-being at a deeper level. Natural surfaces being the most pleasant and beneficial in both the realm of vision, sound and touch in comparison to an urban counterpart highlights the importance of incorporating nature into everyday life (Benfield et al., 2014; Ulrich, 1983; Ulrich et al., 1991). Obviously, increasing greenery in urban environments is ecologically responsible therefore important. However, a deeper understanding may discover humans actually prefer incorporating urban with natural elements in an environment, rather than a preference for the natural instead of the urban environment.

The flexibility of embodiment theories makes it a more attractive choice for explaining the responses associated with nature interaction rather than a more rigid evolutionary based explanation. The mechanisms that lay behind theories of embodied cognition would enable an

organism to adapt to constantly changing environments. The framework of Psychoevolutionary Theory and Stress Reduction Theory on the other hand would only enable human survival in a nature centered environment. While humans did evolve in nature, the setting was not the same across human evolution. Humans evolved to have different skin tones, along with other bodily features in order to increase survival in specific environments. Generating responses utilizing embodiment would likely ensure human survival in a tundra, desert, forest or grass land where structures viewed as adaptive can shift with surroundings, experience and learning. Structures considered adaptive may be very different for an individual who lives in a tundra and one who lives in a grass land. Language evolved differently across the globe as well. Therefore, lingual evolution and the mental metaphors that arose may be rooted in physical evolution and have happened to persist similarly over time however, they may vary across cultures whose nature-based language evolved differently due to interacting with and using the environment differently.

Looking at the results as a whole, it is important to note other variables that may have influenced results, address points for future research, and limitations. On average, participants were exposed to the randomly assigned surface for 15 minutes. However, potential novelty effects, surface temperature conduction, slight height differences of surfaces and social desirability bias could have impacted results. Although the surfaces, with the exception of fake grass, are encountered often, it is possible that presence in the lab created a novelty effect that influenced responses. The effect of surface interaction found in the present study may be an initial novel reaction rather than a response that persists over time. Further investigation of whether the effect persists over time would be fruitful for future research. The laboratory was temperature controlled throughout the experiment however, each surface does conduct

temperature differently. Slight differences of temperature may have played a role in the detected effects of surface on mood and judgement.

Participant movement was quite limited in the present experiment. Participants were limited to a 20 inch by 14 inch area for surface interaction which provides enough space for standing on the surface. Movability of surface may be an influencing factor, if participants had more room to engage with the surface, or experience surface interaction with more of the body via sitting, results may be different. Additionally, the grass surface was 3 inches higher than the dirt and fake grass surfaces that were more flat to the floor. Therefore, the participants who interacted with the grass surface may have experienced an additional positive 'boost' by the increase of height upon exposure, in addition to the pleasant surface interaction. Nevertheless, the cement condition was 2.5 inches higher than the fake grass and dirt surfaces so also provided a slight boost in height, yet participants did not experience a positive shift in mood. The dirt and fake grass surfaces were also the same height but did not produce the same effects. The present study did not include a social desirability scale therefore it is not possible to account for participants that may have been biased to respond in a desired manner when analyzing results. The lack of correlation between perspective of nature and surface-based responses could be because some participants behaved the way they thought others might on a surface rather than how they really felt. Furthermore, sensitivity to touch varies throughout the body. Participants experienced surface interaction with their feet, which are less sensitive to touch than other parts of the body such as the hands. The palm of the hand, not including the finger tips that are more sensitive, is almost twice as sensitive as the sole of the foot when detecting touch (Mancini,

Bauleo, Cole, Lui, Porro, Haggard, & Iannetti, 2014). Participant responses may be different if a more sensitive body part were engaged during interaction.

Implications

Understanding the influence of tactical surface interaction on human responses could prove useful in various industries. Incorporating green surfaces in urban environments when possible could prove fruitful for societal well-being. Additionally, incorporating more natural elements in urban spaces equates to a step towards a healthier environment overall. However, it also highlights the shift society has experienced as a whole away from nature towards technology. Providing society the opportunity to engage with nature while also accomplishing necessary urban and technology related tasks may create a healthier society as a whole. Increased exposure to nature may shift societies view of what constitutes a 'normal' amount of nature interaction, which has changed since technology use increased and was also found to influence an individual's amount of environmental interaction (Kellert et al., 2017). Incorporating green space in urban environments and increasing green space availability may influence children's decisions to engage with the outside environment rather than technology. This decision could lead to a physically healthy change that translate to increased well-being and environmental concern.

Moreover, the importance of an equal balance in urban and green space corresponds to the importance of a healthy balance of reality and virtual reality in a world constantly embracing technological advances. Many Americans reported their ability and desire to interact with nature was limited by technology and other aspects of the constantly moving and demanding urban

society (Kellert et al., 2017). Although there are pros and cons associated with urban and natural living, maintaining a balance between both is essential. With a technological shift still underway and people experiencing benefits from interacting with the natural environment in addition to relying on it for survival, it is important to consider the importance of a healthy balance between technology based urban societies and nature, as well as technologically generated nature experiences and real nature experiences.

Virtual realities provide a riveting visual experience that can be enjoyable for users and the sensation of touch may aid in making the experience more immersive and enjoyable. However, the relevance of the sensation of touch in guiding responses highlights the importance of not shifting entirely to virtual realities or relying on them heavily. Although realism is certainly achievable in virtual displays and virtual reality as a whole, people may prefer reality instead. Emirates, a popular airline, is actively shifting away from windows on a plane towards wall projections for efficiency among other reasons (British Broadcasting Corporation, 2018). A shift away from windows and towards virtually generated visual experiences may influence anxiety levels in humans or led to problems due to a disconnect from what is really outside to what is identified with cameras and projected, among other health and safety concerns (British Broadcasting Corporation, 2018). Disconnecting from reality and relying on virtual displays may have unforeseen negative effects on humans, which could influence well-being, decision making and various other human responses.

APPENDIX

APPENDIX A:
BRIEF MOOD INTROSPECTION SCALE (BMIS)

Brief Mood Introspection Scale (BMIS)

by John D. Mayer

INSTRUCTIONS: Circle the response on the scale below that indicates how well each adjective or phrase describes your present mood.

(definitely do not feel) (do not feel) (slightly feel) (definitely feel)

XX X V VV

Lively	XX X V VV	Drowsy	XX X V VV
Happy	XX X V VV	Grouchy	XX X V VV
Sad	XX X V VV	Peppy	XX X V VV
Tired	XX X V VV	Nervous	XX X V VV
Caring	XX X V VV	Calm	XX X V VV
Content	XX X V VV	Loving	XX X V VV
Gloomy	XX X V VV	Fed up	XX X V VV
Jittery	XX X V VV	Active	XX X V VV

Overall, my mood is:

Very Unpleasant — Very Pleasant

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

Please Note: The "Overall, my mood is" section is usually omitted, although some people use it and fold it into the overall score.

Original Citation: Mayer, J. D., & Gaschke, Y. N. (1988). The experience and meta-experience of mood. Journal of Personality and Social Psychology, 55, 102-111. [Scoring instructions are described there]

Some Other Articles that Have Used the Scale:*

- Examination of the paths between personality, current mood, its evaluation, and emotion regulation. Kokkonen, Marja; Pulkkinen, Lea; European Journal of Personality, Vol 15(2), Mar-Apr 2001. pp. 83-104.
- Resolution of lexical ambiguity by emotional state. Halberstadt, Jamin B.; Niedenthal, Paula M.; Kushner, Julia; Psychological Science, Vol 6(5), Sep 1995. pp. 278-282.
- Intrusive thoughts as determinants of distress in parents of children with cancer. Hall, Martica; Baum, Andrew; Journal of Applied Social Psychology, Vol 25(14), Jul 1995. Special issue: Rumination and intrusive thoughts. pp. 1215-1230.
- Mood inductions for four specific moods: A procedure employing guided imagery vignettes with music. Mayer, John D.; Allen, Joshua P.; Beauregard, Keith; Journal of Mental Imagery, Vol 19(1-2), Spr-Sum 1995. pp. 151-159.
- Mood-congruent judgment over time. Mayer, John D.; Hanson, Ellen; Personality & Social Psychology Bulletin, Vol 21(3), Mar 1995. pp. 237-244.

*The scale has been used in many other articles; I do not have a comprehensive list at this time. If you know of other uses, I would be delighted to hear of them.

APPENDIX B:
NATURE RELATEDNESS SCALE

Nature Relatedness Scale

Instructions: 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.

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

1. I enjoy being outdoors, even in unpleasant weather. ____
2. Some species are just meant to die out or become extinct. ____
3. Humans have the right to use natural resources any way we want. ____
4. My ideal vacation spot would be a remote, wilderness area. ____
5. I always think about how my actions affect the environment. ____
6. I enjoy digging in the earth and getting dirt on my hands. ____
7. My connection to nature and the environment is a part of my spirituality. ____
8. I am very aware of environmental issues. ____
9. I take notice of wildlife wherever I am. ____
10. I don't often go out in nature. ____
11. Nothing I do will change problems in other places on the planet. ____
12. I am not separate from nature, but a part of nature. ____
13. The thought of being deep in the woods, away from civilization, is frightening. ____
14. My feelings about nature do not affect how I live my life. ____
15. Animals, birds and plants should have fewer rights than humans. ____
16. Even in the middle of the city, I notice nature around me. ____
17. My relationship to nature is an important part of who I am. ____
18. Conservation is unnecessary because nature is strong enough to recover from any human impact. ____
19. The state of non-human species is an indicator of the future for humans. ____
20. I think a lot about the suffering of animals. ____
21. I feel very connected to all living things and the earth. ____

APPENDIX C:
DEMOGRAPHICS AND ADDITIONAL QUESTIONS

What is your age in years? _____

Please indicate gender

Male

Female

Other

What year in school are you currently in?

Freshman

Sophomore

Junior

Senior

Graduate Student

What is your major? _____

Please select the race you best identify with:

White

Black or African American

American Indian and Alaska Native

Asian

Native Hawaiian and Other Pacific Islander

Hispanic, Latino or Spanish descent

Other _____

What zip code or city did you spend most of your time in growing up? _____

To the nearest hour, how long do you typically spend with your shoes off? (0-24) _____

APPENDIX D:
IRB APPROVAL FORM

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Matthew G Chin** and Co-PI: **Kathryn Satoski**

Date: **December 18, 2018**

Dear Researcher:

On 12/18/2018 the IRB approved the following human participant research until 12/17/2019 inclusive:

Type of Review:	UCF Initial Review Submission Form Expedited Review
Project Title:	How the Body Moves the Mind: Exploring the Influence of Physical Sensation on Embodied States and Perception
Investigator:	Matthew G Chin
IRB Number:	SBE-18-14625
Funding Agency:	
Grant Title:	
Research ID:	N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

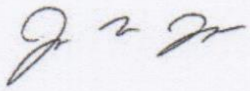
If continuing review approval is not granted before the expiration date of 12/17/2019, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

This letter is signed by:



Signature applied by Racine Jacques on 12/18/2018 12:56:50 PM EST

Designated Reviewer

APPENDIX E: INFORMED CONSENT

Permission to Take Part in a Human Research Study

UNIVERSITY OF CENTRAL FLORIDA

Title of research study: How the Body Moves the Mind: Exploring the Effects of Perspective of Physical Sensation on Embodied States & Perception

Investigator: Principal Investigator: Matthew Chin; Co-Investigator: Kathryn Satoski

Key Information: The following is a short summary of this study to help you decide whether or not to be a part of this study. More detailed information is listed later on in this form.

Why am I being invited to take part in a research study?

We invite you to take part in a research study because you are 18 years or older and have signed up through SONA. The study will earn participants 1 SONA credit. Individuals who are allergic to natural materials such as grass or dirt will be excluded from the study. Please read this form carefully and ask any questions you may have before agreeing to take part in the study.

Why is this research being done?

The purpose of this study is to better understand physical sensations and cognition. Generally studies focus on an acting body rather than a sensing body, the present study will contribute to the limited knowledge of the role of the sensing body in embodied cognition.

How long will the research last and what will I need to do?

Participation in the study will last about 40 minutes, 1 SONA point will be given for taking part in the study. You will be asked to stand on a specific surface, rate your mood and rate various images from happy-unhappy and excited-calm. You may be asked to remove your shoes and stand on the surface. Additionally, you will be asked to complete a quick survey about nature relatedness and complete a demographics questionnaire.

More detailed information about the study procedures can be found under ***"What happens if I say yes, I want to be in this research?"***

Is there any way being in this study could be bad for me?

There are no serious risks associated with participating in this study. However, potential discomfort from exposure to natural surfaces (i.e grass or dirt) is possible.

Will being in this study help me any way?

We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include gaining a better understanding of how the self is viewed in relation to the natural world. Additionally, participants may gain an understanding of how aspects of the environment influence cognition.

What happens if I do not want to be in this research?

Your participation in this study is voluntary. You are free to withdraw your consent and discontinue participation in this study at any time without prejudice or penalty. Your decision to participate or not

participate in this study will in no way affect your continued enrollment, grades, employment or your relationship with UCF or the individuals who may have an interest in this study.

Your alternative to participating in this research study is to not participate.

Detailed Information: The following is more detailed information about this study in addition to the information listed above.

What should I know about a research study?

- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.
- You can ask all the questions you want before you decide.

Who can I talk to?

If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research team: contact Kathryn Satoski via email: ksatoski@knights.ucf.edu, via telephone: 407-350-7714 OR contact Matthew Chin via email matthew.chin@ucf.edu.

This research has been reviewed and approved by an Institutional Review Board ("IRB"). You may talk to them at 407-823-2901or irb@ucf.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research subject.
- You want to get information or provide input about this research.

How many people will be studied?

A maximum of 200 participants will be recruited for this study.

What happens if I say yes, I want to be in this research?

Participation in the present study will take about 30 minutes and you will only be asked to interact with the researcher. The study will take place in lab within the Psychology building on UCF's main campus from January to March 2019.

Experimental procedures: You will be asked to stand on a specific surface, rate your mood and rate various images from happy-unhappy and excited-calm. You may be asked to remove your shoes and stand on the surface. Additionally, you will be asked to complete a quick survey about nature relatedness and complete a demographics questionnaire before leaving the lab.

The surface you will get will be chosen by chance, like flipping a coin. Neither you nor the researcher will choose what surface you will get before arrival. You will have a one in four chance of being given each surface.

What happens if I say yes, but I change my mind later?

You can leave the research at any time it will not be held against you. Participants who withdraw from the study will still receive SONA credit.

What happens to the information collected for the research?

Efforts will be made to limit the use and disclosure of your personal information. We cannot promise complete secrecy. Only researchers will have access to identifiable information and data such as your SONA ID, which will be kept confidential. Organizations that may inspect and copy your information include the IRB and other representatives of this organization.

Your information or samples that are collected as part of this research will not be used or distributed for future research studies, even if all of your identifiers are removed.

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