LUNDS UNIVERSITET

Department of psychology

Can human empathy and connectedness for plants be enhanced?

Kan människans empati och samhörighet med växter förstärkas?

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Abstract

Human attitudes toward nature are fundamental for preserving earth's ecosystems. This study investigated the malleability of human empathy and connectedness to specific plants. We randomly assigned participants (N = 106, *Mean age* = 32.7, SD = 16.0) to one of three different induction conditions, and measured trait general empathy and connectedness to nature, as well as state empathy and connectedness to plants before and after participants read one paragraph presenting a specific orientation towards plants. Condition one described decorative plants, condition two described plants responding to the participants, and condition three described participants becoming a plant. Contrary to our hypotheses, state empathy and connectedness to plants increased for all three conditions. There was no effect of gender (male vs females) on the pre- to post-induction increases in state empathy and connectedness for plants. In conclusion, our findings indicate that empathy and connectedness for plants can be enhanced using different induction orientations. This suggests that human-plant interactions may be a good platform for investigating how humans can relate to nature.

Key words: Empathy, Connectedness, plant, perspective, induction, randomized controlled trial

Sammanfattning

Mänskliga attityder är fundamentala för att bevara jordens ekosystem. Denna studie undersökte sambandet mellan mänsklig empati och upplevelsen av samhörighet med naturen, mer specifikt, med specifika växter. Undersökningen baserades på enkäter och den statistiska analysen gjordes med rmANOVA. Deltagarna (N = 106, *medelålder* =32,7 SD =16,0) bedömde sin empati och upplevelse av samhörighet med naturen, samt sin nuvarande empati och upplevelse av samhörighet med naturen efter att ha läst en av tre slumpmässigt tilldelade paragrafer om växter, samt graden av upplösning av egot och hur levande beskrivningen av paragraferna var. Paragraferna beskrev alla ett rum med växter men hade som mål att framkalla olika perspektiv gentemot växterna. Det första stycket beskrev dekorativa växter, det andra stycket beskrev växter som deltagarna var mer sensoriellt kopplade till och det tredje stycket beskrev deltagarna som blev en växt. I motsats till våra hypoteser rapporterade inte kvinnor högre nivåer av empati än män, och empatin och samhörigheten med växten ökade inte efter att ha läst paragrafen. Dock fanns det en signifikant skillnad i kvinnlig kontra manlig empati före paragrafen, och högre nivåer av vad som mättes före och efter rapporterades i samtliga paragrafer. Sammanfattningsvis undersökte denna studie effekten av olika perspektiv på empati och samhörighet med en växt, samt könsskillnader i empati, men våra hypoteser stöddes inte.

Nyckelord: Empati, tillhörighet, växt, perspektiv, induktion, randomiserad kontrollerad studie

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Can human empathy and connectedness for plants be modified or enhanced?

Human impact on nature has undoubtedly caused significant harm, but there is also a growing recognition of the importance of our connection to the natural world. As we increasingly recognize the value of biodiversity and the critical role that healthy ecosystems play in supporting human life, there is a growing sense of empathy and connectedness toward nature. An increasing number of people are beginning to appreciate the beauty and wonder of the natural world, and are becoming more aware of the ways in which our actions impact the environment (Kellert, 2005). This awareness is leading to a shift in attitudes and behaviors, with many individuals and communities as has been seen with Fridays for future, taking steps to reduce their negative impact on nature and to promote sustainable practices that preserve biodiversity and protect ecosystems (Sabherwal. et al., 2021)

There is no question that humans and plants are significantly different from each other. Humans are emotionally disconnected from plants compared to other species which they share physical similarities to. However, recent studies have shown that plants show complex, flexible cognitive processes parallel to humans and other animals, such as communicative processes involving creativity, compositionality and dialects (Bonato et al., 2021). Furthermore, complexities of plant responses, that is, plants' ability to react and adapt to an ever-changing environment, has also been recorded. For example, plants interacting with kin and non-kin and as well as showing meaning making activities. (Bonato et al., 2021). As plants are brainless systems, their meaning making is not based on ideas. Rather it is the decoding of "chemical words" based on interactions with the environment (Bonato et al., 2021). Findings suggest that there might be a universal process underlying communication which humans, animals and plants share. This could potentially shed new light on the ability of brainless organisms such as plants and alter humans' perception of them (Bonato et al., 2021).

One could wonder how human-plant relationships would look like if humans were able to clearer grasp the state of plants. Through technological development, new forms of human-plant interactions are taking form. For example, VR technology can put you in the perspective of a plant. Other technological developments can give you information about the state of the plant and show in real time how it is responding to its environment (Yin et al., 2021). Sensor arrays and digital image acquisitions of organic chemicals that plants release will make it possible to study mechanisms underlying plant behavior (Bonato et al., 2021). Khait et al. (2023) conducted an experiment showing that plants experience stress when

subjected to various forms of damage, such as insufficient water supply. The study revealed that these plants emit vibrational signals, which serve as a means of communication with other plants. This development in human-plant interactions might alter people's perspectives of plants.

One implication of this study is to examine whether different perspectives of human-plant interactions have an impact on humans' sense of state connectedness and empathy for plants, which could have very powerful implications for society. By fostering a deeper sense of empathy and connectedness toward nature, one can remember that we are in fact one part of nature and that we can work to ensure that our impact on the natural world is positive and sustainable, supporting the health and well-being of both people and the natural environment of the planet (Soga, 2016).

Connectedness to nature

Nature envelops us in its presence, intricately intertwined with every aspect of our lives. Our actions, no matter how small or grand, bear a connection to the natural world. It binds itself to our existence, forging an intimate relationship that transcends mere materialism. We are not only connected to nature in a tangible sense, but we also experience a profound emotional bond, characterized by empathy and a sense of unity. Yet, how do we define this profound connectedness to nature? In the realm of the Psychology of Sustainability (2002), Schultz delves into the concept of connectedness to nature. He portrays it as the extent to which an individual incorporates nature into their cognitive framework of self. Those lacking connectedness to nature fail to acknowledge its significance within their own identity. Moreover, Aldo Leopold (1949) argues that true connectedness with nature demands perceiving nature as not only a part of oneself but also as a cherished member of their family and circle of friends. Schultz further describes this relationship as a fundamental aspect of human-nature interactions, corroborated by Schultz's (2000) experiments on perspective-taking and its influence on our connection with the natural world. Thus, the term "connectedness to nature" emerges as a multifaceted concept, necessitating an integration of nature within one's self and extending it to their nearest companions. But what exactly is perspective in this context?

Tikly et. al. (2020) argues that perspective taking is considering another person's view of something and understanding it. Davis (1994) wrote "this pattern generally supports the view that instructions to imagine the affective state of a target frequently trigger a process which ends in the offering of help to that target". Where any activity between the environment and humans that decreases the perceived separation between them, makes one

feel more biospheric concern. It can be anything from a hike in the woods to interaction with animals. In a later study, Schultz (2001) expanded on this when he found that when participants reduced their separation from nature thereby increasing their biospheric concern for nature, they imagined themselves in various environments. It was then later argued (Schultz et al., 2004) that the connection an individual feels towards nature can be implicit, as well as explicit. The use of imaging techniques that might support individuals to become more aware of nature at a more conscious level requires the ability to take the perspective of nature. Perspective taking is thus fundamental to re-orienting to nature with empathy, and cultivation of biospheric concern.

Empathy

As the planet is the home to approximately 8.7 million different types of plant and animal species, not all of them tend to arouse emotions of the same nature or intensity in humans. While empathy has been widely studied in human-to-human and human-to-animal contexts, the study of human-to-plant empathy has received very little attention. In their recent study, Miralles, Raymond & Lecointre (2019) examined polygenetic proximity, empathy and compassion. Their results confirmed that empathy and compassion towards other species decreases with evolutionary divergence. That is, the further the phylogenetic distance between humans and other species, the less humans feel empathy and compassion towards that other species. One can then ask the question if our ability to connect emotionally with other organisms is restricted to a certain perimeter, in which plants are not included. One can also speculate if this lack of empathy has something to do with human behaviors that result in ecocide and overexploitation of the natural environment, especially since it has been shown that empathy plays a central role in moral reasoning, motivation of prosocial behaviors, and inhibits aggression towards others (Decety & Lamm, 2006). We believe that one way to understand more about the concept of empathy is to look at where it is lacking.

The topic of empathy has had a long-standing presence in academic discourse and ambiguity still remains regarding the construct. In their comprehensive review article, Cuff and colleagues (2014) sought to provide clarification on the topic by collating a diverse range of 43 definitions. To the best of our knowledge, most of them conceptualize empathy with terms such as a “self-other-merging” manifested through “an understanding” and/or “experience of another’s affective state”. Whether this merging is purely cognitive (such as through an understanding), affective (such as through shared feelings), or both, is one of the most discussed aspects of empathy (Cuff at al., 2014). This aspect will be discussed further below, but first a clarification of related concepts will be outlined.

Empathy and other related concepts

Sympathy is a closely related concept to empathy. The main distinction between empathy and sympathy can be explained as "feeling with", versus "feeling for" (Cuff et al., 2014). Sympathy includes a feeling of concern for another, while empathy is more about being attuned to another's feelings. Thus, they are different emotions with different functions. Differences in neurological processes also support this notion (Decety & Michalska, 2010).

Compassion is another concept that is often confused with empathy. Compassion can be understood as a feeling that results in a subsequent desire to help (Cuff et al., 2014). It is more related to sympathy, as it is more focused on another's plight. Same goes for tenderness, another concept associated with empathy, a feeling often elicited by the delicate and defenseless. Here as well, the elicited feeling is linked to a vulnerability of the target (Cuff et al., 2014). Clearly these concepts are related and somewhat hard to orientate. To the best of our knowledge, empathy is not about a subsequent behavior related to the feeling, or feelings of pity, but more about the actual practice of cognitively and emotionally understanding the other.

Cognitive and emotional aspects of empathy. One of the most discussed aspects of empathy is whether it is a cognitive or emotional concept (Cuff et al., 2014). Both emotional and cognitive empathy are understood as distinct constructs that closely interact with each other (Cuff et al., 2014). Cognitive empathy is closely related to theory of mind; an individual's capacity to represent the internal mental state of another individual, such as thoughts, desires, beliefs, intentions and knowledge (Blair, 2005). Decety & Lamm (2006) states that:

> By means of imagination, we come to experience sensations, which are generally similar to, although typically weaker than, those of the other person. This capacity to engage in role taking has been theoretically linked to the development of empathy, moral reasoning, and more generally, prosocial behavior (s. 1151).

This view is shared by Decety and Sommerville (2004) who suggest that self and other-representations are closely interconnected and might account for the capacity to empathize and identify with others.

Emotional empathy is understood as the affective component or emotional response elicited by a stimulus (Cuff, 2014). It can be elicited automatically or through a manipulation of cognitive elements, such as through imagination (Lamm, Batson and Decety, 2007). A

clear perspective is that of Strayer (1987), suggesting that the affect is the content of empathy while cognitive empathy is the process through which this content is formed. Therefore, it appears that via imagination and sensations, we experience both cognitive and affective components of empathy as a way to understand and feel connected with others.

With regard to human-environment interactions, studies have investigated the relationship between sense of self and environmental concern through perspective-taking activities. For example, Berenguer (2007) conducted research in which students were instructed to take the perspective of a tree or a bird. This resulted in more positive attitudes towards the environment, greater helping behavior, and an increased allocation of funds towards environmental projects led by a student association. This suggests that cognitive empathy may be a key component of environmental awareness and empathy for non-human living entities. This demonstrates how these two features of empathy might interact when promoting ecological awareness and interdependence.

Self-other merging in empathy. While definitions vary regarding the cognitive and affective aspects, almost all of them agree on the notion that empathy at the very least includes a self and another, and some kind of fusion of the two (Cuff et al., 2014). Some definitions claim that this understanding and experience, characterizing empathy, must manifest without a confusion between self and the other. Other definitions imply a minimal distinction between the two. Most conceptualisations indicate that the self and the other are distinct in the concept of empathy (Cuff et al. 2014). This level of self-other awareness is what separates empathy from emotional contagion. With empathy, the observer is aware that the feeling is a result of perceiving emotion in the other. With emotional contagion, this awareness is lacking and the feeling is believed to be the observer's own (Cuff et al. 2014). This is an important distinction to be made regarding the fusion between the self and the other in the concept of empathy.

Studies in cognitive neuroscience have confirmed that there appears to be some blending between oneself and the other in the experience of empathy. For example, when individuals are asked to assume the perspective of another, shared neural circuits are activated for both oneself and the other (Decety & Lamm, 2006). Thus, there is a brain basis for experiencing empathy with others, emphasizing a similar emotional connection between the self and the other.

Jackson, Brunet, Melzoff & Decety (2006) discovered that other's experiences are processed the same as our own and that the degree of brain activation depended upon the degree of separation, such as holding a self-perspective or other-perspective. One can then

ask if an increase of empathy might occur in a human-plant interaction where the self and the other are more clearly merged, such as through a self perspective.

Empathy and gender. There has been inconclusive documented gender differences in empathy levels between men and women. Tam (2013) showed that females empathize with the natural world more than males, as a result of being more socialized to value other beings' needs. However, no such effect has been detected in several meta-analytic studies (Whitburn et al., 2019, Capaldi et al., 2014), with no correlation between being female and empathy towards nature, as well as acting towards the greater good of nature. This effect or lack thereof has however not been studied with participants reading a paragraph intended to induce a shift in human orientation towards plants.

Ego dissolution

Tagliazucchi et al (2016) define ego dissolution as a sense of unity with nature. Human brain functional connectivity between neurons increases in brain networks associated with self-awareness and introspection, and is associated with decreased separation between self and environment. These feelings have been induced using several different methods, such as videos (Soliman et al., 2017) and virtual reality (Spangenberger et al., 2022). This is however not technology that we or most other everyday people have access to. It would thus be interesting if similar results occur by imagining, after reading a paragraph.

Exposure to nature

The idea that humans need exposure to nature is well known. Wilson (1984) proposed the *biophilia hypothesis*, which states that since humans evolved in natural environments, we have an inherent need for contact with nature, which may have positive effects on our well-being and cognitive functioning. Proponents of the biophilia hypothesis argue that exposure to natural environments, such as parks, forests, or green spaces, can help reduce stress and enhance our sense of connection to the world around us.

Hartig et al. (2010) defines the term *nature* as “a broad category of natural environments and features of those environments, such as single trees or plants”. Nature could be visualized via photographs, virtual nature and other imagery. In our study, we are focusing the attention of participants to a photograph of a single plant as a basis for investigating how different information can induce greater empathy towards and connectedness with plants.

There have been different ways to experimentally test if people feel a connection to plants and nature. Soliman et al. (2017) showed a significant effect on nature relatedness when participants viewed nature with immersive videos. In another study that used virtual

reality (VR) technology, Spangenberger et al. (2022) found that the greater the immersion when becoming a tree, the greater participants felt nature relatedness. The value of immersion has also been noted by Witmer and Singer (1998), where a small positive correlation was found. This raises the question of how much empathy and nature connectedness participants could feel when their attention is directed by reading a text about nature and plants that supports and taking the perspective of a tree.

This question grew to become our hypothesis. As people take different perspectives of human-plant interactions, will they report higher levels of state connectedness and empathy towards plants? Most people are aware of the decorative functions of plants, representing a more common perspective of human-plant interactions today. However, plants can also respond to their environments in subtle and robust ways which are not always sensorially registered by humans. Furthermore, when considering the human capacity for embodied cognition (Schultz, 2000), another perspective is the fusion of human self with the surrounding plants, an experience of self as integrated and embodied with other living entities. Given these different perspectives, we used brief written text to induce three different human-plant inductions. This type of human-plant induction has not been reported in the scientific literature and thus warrants further scientific investigation.

The goal of this study

Our goal was to examine whether the induction of three different perspectives of human-plant-interactions (i.e., decorative, responsive, and embodied) would impact participants' sense of state empathy and connectedness towards specific plants. Since women tend to report higher trait empathy compared to men, we also examined the effect of gender (male vs female) on changes in empathy for specific plants.

Hypothesis 1: We expected that, compared to both the decoration and responsive conditions, the human-plant embodied condition would be associated with a significantly larger increase from pre- to post-induction in *connectedness* for plants.

Hypothesis 2: We expected that, compared to both the decoration and responsive conditions, the human-plant similarity condition would be associated with a significantly larger increase from pre- to post-induction in *empathy* for plants.

Hypothesis 3: We expect that, compared to males, women would report significantly greater increases in empathy for plants from pre- to post induction.

Furthermore, we take an exploratory look at self-reported vividness and ego-dissolution to examine if they have any effect on state empathy and state connectedness to specific plants.

Methods

Participants

Participants were recruited via social media platforms and text messages. A snowball selection was used, by asking on social media and by text message asking participants if they could share it on their social media. One hundred and twenty-five adults (62 female, 43 male and 1 non-binary) participated in the online survey administered via Qualtrics software. The gender of a number of participants who withdrew before they told their gender from the study (N = 19) was not reported. Of the remaining 106 participants, M_{age} = 32.7 years, SD = 16.0. The survey was conducted in English only. Participants were not paid to participate and did not get class credit for participation. Informed consent was obtained from each potential participant prior to providing any survey responses. The responses were collected between 17-25 of April 2023. The ethics of this study was approved by the Psychology Department of Lund University.

Procedures

Participants were given an introduction block on an online platform using Qualtrics that explained the purpose of the study and what measures would be used. They were informed that no personal information would be collected, that data collected would be averaged and analyzed in groups, and that all responses would be kept anonymous. Participants were informed that by beginning the survey they would imply their consent to participate and that they could cancel their participation at any time of their choosing. Participants were also advised to find a quiet setting in which they would not be interrupted while completing the survey. They were asked to answer the questions truthfully, and were informed that the study would take approximately 10 minutes to complete.

The next block had 5 questions: age, gender, whether the participant was living in an urban or rural area or they weren't sure, how many plants were in the room the participants did the survey in, measured from zero to more than five. We assessed participant's *current engagement with nature* with a single question using a 5-point Likert scale that ranged from none at all to a great deal. The next two blocks consisted of the Connectedness to Nature Scale (CNS), and the Toronto Empathy Scale (TEQ) which are included in the appendix.

The following block contained a color photograph of two rubber plants (see appendix) together, with two questions of our own on a 11-point Likert scale, measuring how much empathy they felt toward the plant and how connected they felt toward it. Both the scales ranged from 0 (none at all) to 10 (a great deal). Then participants were randomly assigned to one of three possible induction paragraphs. Either a decorative one (functioning as a control group), a responsive one or one where the participant became the plant, see appendix. Thereafter, the participants were once again shown the photograph of the rubber plants and the set of questions. The next block contained questions about how vividly the participants could imagine the paragraphs as well as if they experienced a dissolution of self or ego reading the paragraph. For both questions a 5 point Likert scale was used, ranging from not at all (1) to extremely well (5) for the vividness question and from none to completely on the self dissolution question. The final block of the survey included a message thanking participants for taking the time to answer the questions. Additionally, participants were provided with a means of contacting the researchers if they were interested in seeing the final results of the study. Participants completed the surveys on their own electronic devices.

Measures

At pre-induction only, we administered the Connectedness to Nature Scale (CNS; Mayer & McPherson Frantz, 2004) and Toronto Empathy Scale (TEQ; Spreng, McKinnon, Mar, and Levine 200), as well as targeted questions constructed by the experimenter.

The Connectedness to Nature Scale (CNS) is a validated and reliable scale (Mayer & McPherson Frantz, 2004) that assesses trait levels of feeling emotionally connected to the natural world. It consists of 14 items that are scored using a Likert scale that ranges from 1 to 5, where 1 = strongly disagree and 5 = strongly agree. We computed McDonald's omega as a measure of internal reliability for the TEQ and CNS. The CNS showed good internal reliability, Omega = 0.870.

The Toronto Empathy Questionnaire (TEQ) consists of 16 items that assess empathy as a primarily emotional process, and has been shown to be a valid and reliable tool (Korman, & Garfinkle, 2013). It is scored using a Likert scale with a range from 0 to 4, where 0 = never and 4 = always. The TEQ was scored 0-4 but was coded 1-5 when collecting data so we transformed it back to 0-4. The question alternatives for connectedness to the plant pre was 0-10, but 1-10 post so we set the ones scored at 0 and 1 both on 1. When grouping the data, we calculated the mean for CNS and sum for TEQ. The TEQ showed good internal reliability, Omega = 0.805.

Two experimenter-constructed single-item questions that assessed state connectedness and empathy towards the plants, ranging from 0-10 (0: None at all, 5: A moderate amount 10: A great deal) were administered both before and after the induction. At post-induction only, we assessed how vividly participants' could imagine the plant interaction described in each induction paragraph, ranging from 1 to 5 (1: None at all, 5: Extremely well), and degree of ego-dissolution experienced by the participants while reading the paragraphs on a scale from 1 to 5 (1: None to 5: Strongly).

Induction text

We used three different paragraphs, one each in the three conditions to which participants were randomly assigned. Each paragraph described a different human-plant interaction. Each of the paragraphs started with the words "Imagine that…", enhancing the importance of imagination and perspective taking while reading the text. Paragraph number 1 represented the control condition, highlighting a human-plant interaction that is common, namely, seeing a plant as a decorative object. In this condition, there is a clear separation between the reader and the plant, and no emotional information from the plant was communicated or shared with the reader. The second condition used text that focused on plant responses. In this condition, emotional information was communicated by the plant as it responded to the interaction and to the environment around it. The reader is induced to feel more emotionally connected to the plants through the senses. The third paragraph represented the embodied condition. This condition focused on a completely embodied human-plant interaction, where the reader enters the perspective of the plant. In this paragraph, emotional information was communicated to the reader directly through the perspective of the plant.

The paragraphs were created with help from ChatGPT. We used the initial output of ChatGPT and modified the resultant text to create three distinct paragraphs with different induction orientations. See appendix for the three paragraphs and the questions we created.

A pilot study was done with 6 people who read the paragraphs and gave feedback on how to improve them. Each participant read only one paragraph each, and was asked "How realistic was the paragraph, what does it make you feel, is there anything you would change?" Afterwards we had six additional people read and evaluate the changes the participants from the pilot study proposed. The aim was to collect people's thoughts and feelings about the paragraphs, and adjust them if they induced feelings of pity or desire to help the plants, which are more associated with other related concepts rather than empathy. One participant reported feeling sorry for the plant while reading the text, especially when reading about the state of

the plant as sometimes not having enough water and nutritions. Because of this, we tried to balance it out by also enhancing that the plant sometimes would also have enough water and nutrition. In this way, the paragraphs didn't skew emotionally in a certain direction.

Data analysis

We computed the means and standard deviations (*SD*) for the CNS and TEQ, as well as the experimenter created one-item scales. A repeated-measures analysis of variance (rmANOVA) with 3 groups (ie., 3 induction paragraphs) by two time points (pre and post-induction) was used to examine changes in state empathy and connectedness towards plants. A follow-up independent samples t-tests were used to investigate differential change from pre- to post-induction for state connectedness and empathy. We used $p < .05$ as the alpha level for significant results and report effect size measures.

To analyze the effect of gender (male vs female) on our primary outcome variables, we added gender as a covariate to our rmANOVA models. We excluded the one person who answered Non-binary/third gender. The data analysis was conducted with jamovi version 2.3.21.

Ethical consideration

The authors and supervisor read the Ethical Review Act (2003:460) concerning the ethical conduct of research involving humans. The Psychology Department at Lund University approved the research protocol and provided ethical approval for this study.

Results

Preliminary results

We implemented a Pearson's product correlation analysis to examine the relationship between trait connectedness to nature and trait empathy at baseline (pre-induction), and found a significant positive correlation ($r = 0.33$, $p = 0.002$). Furthermore, we observed a positive correlation between age and connectedness to nature ($r=0.30$, $p=0.004$), but not between age and empathy ($r=-0.15$, $p=0.14$).

Using an independent-samples t-test, we detected gender differences between NCS scores and TEQ scores at baseline . The Mann-Whitney U-test found significantly higher trait empathy in females vs males, but no difference on trait connectedness to nature. See table 1.

Table 1

Gender differences in trait connectedness to nature (CNS) and trait empathy (TEQ)

		Statistic	p		Effect Size
Mean NCS	Mann-Whitney U	696	0.14	Rank biserial correlation	0.18
Sum TEQ	Mann-Whitney U	562	0.001	Rank biserial correlation	0.41

Table 2

Demographics and characteristics

	Condition	N	Mean	SD	Minimum	Maximum
Age	Becoming	27	31.26	14.18	21.00	70.00
	Responsive	29	27.52	10.80	20.00	68.00
	Decorative	28	36.36	17.79	21.00	70.00
Engage nature	Becoming	28	3.21	1.03	2.00	5.00
	Responsive	29	3.21	1.08	1.00	5.00
	Decorative	28	3.39	0.91	2.00	5.00
Nr plants	Becoming	28	2.57	1.06	1.00	4.00
	Responsive	29	2.76	1.21	1.00	4.00
	Decorative	28	2.64	1.09	1.00	4.00

Table 3

Genders distributed over the three conditions

Gender	Condition	Counts	% of Total	Cumulative %
Male	Becoming	11	12.9 %	12.9 %
	Responsive	10	11.8 %	24.7 %
	Decorative	14	16.5 %	41.2 %
Female	Becoming	17	20.0 %	61.2 %
	Responsive	19	22.4 %	83.5 %
	Decorative	13	15.3 %	98.8 %
Non Binary	Becoming	0	0.0 %	98.8 %
	Responsive	0	0.0 %	98.8 %
	Decorative	1	1.2 %	100.0 %

Primary results

Hypothesis 1: effect of condition on state connectedness for plants

The rmANOVA did not result in an interaction of condition (3 different induction paragraphs) by time (pre vs post-induction) on state connectedness with plants. There was, however, reported a main effect of time on connectedness change for plants. Hence, connectedness for plants increased from pre- to post-paragraph reading for all three

conditions. See table 4 & 5. There was no main effect of the three conditions on state connectedness.

Table 4

Change in self-reported connectedness and empathy for plants, across the three conditions.

	Condition	Pre plant Empathy	Post plant Empathy	Pre Plant Con	Post plant Con
Mean	Becoming	4.07	4.71	3.30	4.11
	Responsive	3.79	4.62	1.97	3.83
	Decorative	4.36	5.33	3.61	5.07
Median	Becoming	4.00	5.00	2.00	3.00
	Responsive	3.00	4.00	1.00	3.00
	Decorative	5.00	5.00	3.50	5.00
Mode	Becoming	1.00 [a]	7.00	1.00	3.00
	Responsive	1.00 [a]	1.00	1.00	1.00
	Decorative	5.00	5.00	1.00	8.00
Standard deviation	Becoming	2.58	2.62	2.76	2.64
	Responsive	2.19	2.86	1.52	2.83
	Decorative	2.33	2.34	2.53	2.67

[a] More than one mode exists, only the first is reported

Table 5

Repeated-measures ANOVA results for state connectedness with plants

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p

RM Factor 1	85.42	1	85.42	38.60	< .001	0.32
RM Factor 1 ✻ Condition	6.23	2	3.12	1.41	0.25	0.03
Residual	177.02	80	2.21			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η^2_p**
Condition	57.4	2	28.7	2.72	0.07	0.06
Residual	844.9	80	10.6			

Note. Type 3 Sums of Squares

Hypothesis 2: effect of condition on changes in state empathy for plants

As shown in Table 6, the rmANOVA did not yield an interaction of condition by time for state empathy for plants. However, there was a main effect of time on state empathy for plants, but not for condition.

Table 6

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
RM Factor 1	29.32	1	29.31	25.32	< .001	0.23
RM Factor 1 ✻ Condition	1.07	2	0.53	0.46	0.63	0.01
Residual	93.76	81	1.15			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
Condition	10.8	2	5.38	0.47	0.62	0.01
Residual	921.0	81	11.37			

Note. Type 3 Sums of Squares

Hypothesis 3: effect of gender on changes in state empathy for plants

An independent samples t-test showed no significant differences between gender and change in state empathy for plants, pre-post induction. See table 7.

Table 7

Independent Samples T-Test

		Statistic	df	p
T2-T1 empathy	Student's t	0.19 [a]	81.0	0.84
T2-T1 connectedness	Student's t	-1.56	80.0	0.12

Note. H_a $\mu_{Group\ 1} \neq \mu_{Group\ 2}$

[a] Levene's test is significant ($p < .05$), suggesting a violation of the assumption of equal variances

Group Descriptives

	Group	N	Mean	Median	SD	SE
T2-T1 empathy	1	35	0.85	1.00	1.00	0.17
	2	48	0.79	0.00	1.81	0.26
T2-T1 connectedness	1	35	1.02	1.00	2.11	0.35
	2	47	1.76	1.00	2.11	0.30

Exploratory results

We used vividness of imagination of the content described in the paragraph as a covariate in our rmANOVA model for state changes. As shown in Table 8, we found an interaction between vividness and connectedness with plants by time. However, there was no such interaction with vividness for state empathy for plants, as shown in Table 9.

Table 8

Interaction effect between connectedness for plants and vividness

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
RM Factor 1	0.57	1	0.57	0.27	0.60	0.003
RM Factor 1 ✻ Paragraph	3.14	2	1.57	0.75	0.47	0.01
RM Factor 1 ✻ New Vividness	12.40	1	12.40	5.95	0.01	0.07
Residual	164.61	79	2.08			

Note. Type 3 Sums of Squares

No interaction effect was seen between state empathy for plants and vividness scores when using vividness as a covariate in the rmANOVA (see table 9).

Table 9

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
RM Factor 1	0.61	1	0.61	0.52	0.47	0.007
RM Factor 1 ✻ Paragraph	0.60	2	0.30	0.26	0.77	0.006
RM Factor 1 ✻ Vividness	0.62	1	0.62	0.53	0.46	0.007

Residual	93.14	80	1.16			

Note. Type 3 Sums of Squares

We also asked participants to report on ego-dissolution after reading each paragraph. When ego–dissolution was entered as a covariate to the rmANOVA model, there was an interaction between dissolution and connectedness for plants and ego-dissolution, as shown in table 10. We observed a similar pattern of results for state empathy for plants as shown in Table 11.

Table 10

Within Subjects Effects

	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η^2_p**
Connectedness	2.05	1	2.05	1.15	0.28	0.01
Connectedness ✻ Condition	3.12	2	1.56	0.88	0.41	0.02
Connectedness ✻ Dissolution	14.14	1	14.14	7.99	0.006	0.09
Residual	137.97	78	1.77			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
Condition	44.1	2	22.04	3.29	0.04	0.07
Dissolution	312.5	1	312.52	46.70	< .001	0.37
Residual	521.9	78	6.69			

Note. Type 3 Sums of Squares

Table 11

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
RM Factor 1	1.39e-6	1	1.39e-6	1.29e-6	0.99	0.00
RM Factor 1 ✻ Condition	0.72	2	0.36	0.33	0.71	0.008
RM Factor 1 ✻ Dissolution	8.82	1	8.82	8.21	0.005	0.09
Residual	84.87	79	1.07			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
Condition	5.37	2	2.68	0.33	0.71	0.009
Dissolution	285.87	1	285.87	36.08	< .001	0.31
Residual	625.94	79	7.92			

Note. Type 3 Sums of Squares

We also found a significant positive association between pre- to post-induction increases in state connectedness and state empathy towards plants, ($r=0.61$, $p<0.001$).

We also explored whether the number of plants people had in their room before reading the paragraphs. We found that the number of plants was positively associated with greater trait connectedness to nature ($r=0.31$, $p=0.003$) and trait empathy ($r=0.26$, $p=0.01$).

Discussion

The goal of this study was to examine whether inducing three different perspectives of human-plant interactions (i.e., decorative, responsive, and embodied) would modify participants' sense of state connectedness and empathy for plants. We also investigated whether participants self-reported gender had an effect on changes in state empathy for plants. The main finding was a significant increase in state connectedness and empathy for plants following all three inductions, without differential changes between induction conditions. Regarding state empathy for plants and gender, there was no evidence for gender differences in changes in state empathy for plants following within all three inductions.

Regarding the first hypothesis, while there was no evidence of an interaction between the three induction conditions and time (pre, post induction), there was a significant increase in state connectedness scores from pre to post for each of the three induction conditions. The findings suggest that despite taking the perspective of the plant during the embodied

condition, participants did not automatically report a greater outcome in state connectedness with plants as compared to the other two induction conditions that focused on decorative and responsive features of plants. One explanation may be that it is not easy or intuitive to incorporate natures' perspective into the cognitive framework of self. One might only be able to "accept" the first-person perspective in the paragraph (before entering the perspective of the plant). This feature was similar across all three induction conditions, and may be responsible for similar increases in state connectedness and empathy following all the induction conditions. As for the responsive condition, the human reader and the plant were intended to feel more connected sensorially. Despite taking on this perspective, it might still be a challenge to imagine it.

For hypothesis two, there was no interaction of the induction condition by time, but there was a main effect of time on state empathy for plants across each of the three conditions. Furthermore, there were no between group effects on the three different conditions. These results suggest that each of the three induction conditions produced significant increases in state empathy for plants. The findings show that even though there is a more evident self-other merging in the embodied cognition, as the reader takes on the perspective of the plant, participants did not report a larger increase in state empathy for plants compared to the control conditions. Hence, the degree of perspective taking (cognitive empathy) did not change the empathic outcome. It is possible that simply re-orienting attention to plants was sufficient to activate state empathy for plants. The fact that the embodied condition did not produce a greater empathetic response might also be because the paragraph induced feelings of emotional contagion rather than empathy which, according to previous studies, is a different feeling. Another implication is that participants in our sample had a low threshold for activation of empathy and connectedness. We do not know if this is related to cultural or ecological awareness in Swedish adults or to other causes.

For hypothesis three, the findings revealed gender differences in self-reported trait empathy and actual empathic outcomes. Females reported significantly higher trait empathy than males. However, no significant differences in state empathy for plants was found between males and females. These findings correspond with previous meta studies, showing that gender does not moderate empathy for nature, in this case plants. It is plausible that females tend to rate themselves higher on trait empathy compared to men, but their actual empathic response towards plants is comparable to that of men. This highlights differences in trait vs state measures in general and specifically in this context of relating to plants.

Conversely, men may rate themselves lower on trait empathy, yet their actual empathetic response towards plants is aligned with that of females. This could suggest that respondents may construct cognitive self-images that influence their self-reported trait scores, which may not necessarily correspond to their actual emotional outcomes. It is possible that individuals conform to prevailing societal norms or stereotypes, which influence their self-perceptions and subsequent self-reporting. Additionally, the findings might indicate that when individuals encounter situations that are unfamiliar, such as emphasizing with non-human entities like plants, both genders may exhibit similar levels of state empathy. This could be a reason why females score higher than males on trait empathy but equally on nature connectedness traits.

The interaction between connectedness and vividness suggests that the relationship between pre-connectedness and post-connectedness scores vary as a function of vividness of imagination. Hence, the degree of which the participants could imagine the paragraphs influenced their state connectedness with plants. In comparison to connectedness, there was no evidence of an interaction between state empathy for plants and vividness. This could be a potential difference between these two psychological constructs. It could also mean that empathy is not based on vividness of imagination.

An almost equally strong interaction effect between connectedness and ego dissolution, as well as empathy and ego-dissolution, was reported. This might indicate that ego-dissolution is an underlying factor moderating the change in both state connectedness and state empathy for plants.

Limitations

This study had several limitations. First, we could not measure human-plant interactions in real life. We provided a picture of a plant instead and asked how much empathy and connectedness respondents would feel towards this particular plant. We can not assume that this method will produce similar responses as viewing plant in vivo. It is difficult to have a human-plant interaction with a plant on a screen that one has not interacted with before, and thus our study might underestimate responses towards plants in a real life setting. It would have been interesting to see how the respondent feels about their own plants rather than the plant in the picture, or a certain plant that they pass on their way to their job/school or plants in general.

Additionally, because the before and after induction measurements were very short and taking place immediately before and after the paragraph, the respondents might have guessed what the study was about and provided responses influenced by demand

characteristics (ie, what the participants think the experimenters want to see happen in the study). This would explain why the paragraphs in all three conditions resulted in an increase in empathy and connectedness. Another issue is that the immediate post-induction measurements might not actually say anything about the change in attitudes, because it simply might not change immediately. One way to address this issue would be to have the post measurements a few days later. However, this would affect the control of the study as influences outside experimenter control might impact how participants respond.

The study did not consider the participants prior experience with ego-dissolution, which may have influenced their responses in the embodied condition where participants imagined themselves as a plant. Previous studies (Spangenberger et al., 2022; Ahn et al., 2016) have used a similar approach involving the induction of experience through paragraphs. However, the paragraphs we created may not have been immersive enough for participants to truly empathize with the plant's perspective, or the environment in which they completed the survey may have been distracting. Although we instructed participants to answer the survey in a quiet room, it is possible that this instruction was not followed.

Conducting the experiment in a controlled environment that was the same for all participants would have likely reduced the number of participants who dropped-out from the study after completing baseline questionnaires. However, recruiting participants for a controlled setting would have been more challenging as it would require booking a specific room and limiting availability to specific times of the day. By conducting the survey online, participants had the flexibility to choose when they wanted to complete it, which may have contributed to higher participation rates.

A major limitation of the survey was the disparity in the nature connectedness question between the pre and post measurements. The number of alternatives differed, with the pre-question offering 11 alternatives ranging from 0 to 10, while the post-question provided 10 alternatives ranging from 1 to 10. This discrepancy had a substantial impact on the results because an uneven number of alternatives resulted in a completely neutral middle option. In contrast, with an even number of alternatives, such as 10 or 12, there is never a completely neutral alternative, and participants are always required to express a preference. We made adjustments to the data to address this issue.

Unfortunately, we were unable to explore the potential impact of the number of plants in the room where participants completed the survey, which could have been an interesting factor to examine. During our testing phase, we observed that the choice of measurement

scales and the conditions under which the questionnaires were administered could have influenced the obtained results. It is worth noting that different results may have emerged under alternative conditions and scales of measurement.

In addition, we did not measure the participants' perception of how realistic the paragraphs were. Although we measured vividness of imagination and ego-dissolution, other participant perceptions might have been important contributors to responses to the induction. Future studies might add a qualitative question, such as “How did you feel while reading the paragraph”. Which would have strengthened the validity of the study, enabling triangulation for the study. Unfortunately, because of time implications we were unable to use this method.

Future research

Exploring different perspectives when embodying the plant would have been an intriguing avenue to investigate. In our study, our primary focus was on the induction that asked participants to merge with the plant. The purpose of the plants as decoration was to serve as a control group. Consequently, we only included the responsive condition to enhance the study's validity by encouraging participants to consider various functions that plants can have. In future research, it would be interesting to include alternative perspectives, such as assuming the perspective of an insect on the plant or experiencing the plant's perspective while the plant is in motion. Ahn et al. (2016) have highlighted that incorporating movement that aligns with the object being embodied might have a more pronounced impact on nature connectedness compared to solely adopting the object's perspective.

Additionally, it would be valuable to examine whether using VR technology would have a greater impact on nature connectedness and empathy compared to reading the paragraphs and envisioning the setting mentally. Both methods have limitations in that they do not engage all the senses that one would experience in nature itself. While studies have demonstrated that pictures and videos can be reasonable substitutes for the healing effects of nature (Soliman et al., 2017), nothing truly replicates the full sensory experience of being in nature. But more research in this field could lessen the differences between these settings, and maybe take steps toward enhancing sensitivity to ecosystems and increasing engagement in solving the climate crisis. Another approach would be to ask participants to conduct the experiment in an undisturbed setting or conduct the experiment in a controlled environment. The first alternative would then be the control group. By exploring these variations, we could gain further insights into the impact of different sensory modalities and settings on participants' nature connectedness.

It is important to consider that individuals may not always have the opportunity to engage with nature directly, such as spending time in a forest or reading paragraphs about nature. This raises an intriguing question: if people are not consistently exposed to nature-related experiences or information, what impact does it have on their empathy or connection towards plants? Furthermore, if any resulting empathy or connection is temporary and does not persist beyond the initial exposure, what does it imply for taking action on climate-related issues? It would thus be interesting if future research does studies on longitudinal results of taking the perspective of plants. If the results dissipates right after, it highlights the need for additional research on the subject. The usage of these studies, and this one too can be used to help society combat the problem that is climate change.

Conclusion

This study showed that there is a significant relation between induction of different orientations to plants and state empathy and connectedness to plants, respectively. However, when testing ego dissolution and vividness of the paragraphs insignificant results were reported. This shows that there are many factors that influence if we feel empathy or connectedness towards specific plants.

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Appendix

Survey

Nature connectedness and empathy

Start of Block: Introduction

Hello! We are two students writing our bachelor thesis in psychology at Lund University. In this study we are interested in investigating peoples relationship with nature.

All responses in this survey will be treated confidentially. No other information than your responses will be collected. You will remain anonymous. By answering this survey, you give consent for your responses to be collected in the study. Please remember you can cancel the survey at any time if you wish to do so, for any reason.

Please note that you must be 18+ to respond to this survey.

Instructions

If possible, please do the study in a quiet location or where you are not disturbed. Answer the questions as truthfully as you can. Please make sure the answer reflect what you are feeling in the moment.

The whole survey takes about 10 minutes to answer

How old are you?

_____

What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer not to say (4)

Are you living in an urban or rural area?

- ○ Urban (1)
- ○ I'm not sure (2)
- ○ Rural (3)

How many plants are in your room right now?

- ○ 0 (1)
- ○ 1-2 (2)

- 3-4 (3)
- 5+ (4)

How much would you say you engage with nature?

- None at all (1)
- A little (2)
- A moderate amount (3)
- A lot (4)
- A great deal (5)

When someone else is feeling excited, I tend to get excited too.

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Always (5)

Other people’s misfortunes do not disturb me a great deal.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

It upsets me to see someone being treated disrespectfully.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I remain unaffected when someone close to me is happy.

- ○ Never (1)
- ○ Rarely (2)

- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I enjoy making other people feel better.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I have tender, concerned feelings for people less fortunate than me.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)

- ○ Always (5)

When a friend starts to talk about his\her problems, I try to steer the conversation towards something else.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I can tell when others are sad even when they do not say anything.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I find that I am “in tune” with other people’s moods.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I do not feel sympathy for people who cause their own serious illnesses.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I become irritated when someone cries.

- ○ Never (1)
- ○ Rarely (2)

- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I am not really interested in how other people feel.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I get a strong urge to help when I see someone who is upset.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)

- ○ Always (5)

When I see someone being treated unfairly, I do not feel very much pity for them.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I find it silly for people to cry out of happiness.

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

When I see someone being taken advantage of, I feel kind of protective towards him\her.

- ○ Never (1)

- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

I often feel a sense of oneness with the natural world around me.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I think of the natural world as a community to which I belong.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)

- ○ Agree (4)
- ○ Strongly agree (5)

I recognize and appreciate the intelligence of other living organisms.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I often feel disconnected from nature.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

When I think of my life, I imagine myself to be part of a larger cyclical process of living.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I often feel a kinship with animals and plants.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I feel as though I belong to the Earth as equally as it belongs to me.

- ○ Strongly disagree (1)
- ○ Disagree (2)

- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I have a deep understanding of how my actions affect the natural world.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I often feel part of the web of life.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)

- ○ Strongly agree (5)

I feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force’.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Like a tree can be part of a forest, I feel embedded within the broader natural world.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

My personal welfare is independent of the welfare of the natural world.

- ○ Strongly disagree (1)
- ○ Disagree (2)

- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Please look at this picture before answering the following questions.

Please look at this picture before answering the following questions.

How much empathy do you feel towards the plant right now?

- ○ 1: None at all (1)

- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5: A moderate amount (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10: A great deal (10)

How interconnected do you feel towards the plant right now?

- ○ 0: none at all (1)
- ○ 1 (2)
- ○ 2 (3)
- ○ 3 (4)

- 4 (5)
- 5: a moderate amount (6)
- 6 (7)
- 7 (8)
- 8 (9)
- 9 (10)
- 10: a great deal (11)

In the following part you will be assigned a paragraph. Make sure that you read the paragraph slowly and if possible, in a quiet location where you are not disturbed.

Imagine that you are walking into a room. As you enter the room, you notice that there is an arrangement of plants in front of you. Your gaze moves from one plant to the other, as you take in the varying shades of green presented before you. You decide to walk up to the arrangement and pause in front of one of the plants. As you look down, you notice the plant's intense green color. That it brings color to the room. You see the plant’s tall and sturdy stems reaching towards the ceiling, with broad and glossy leaves branching out in all directions. You proceed to the next plant. Notice that this plant is a bit taller, with a more dense figure to it. The texture of its leaves are more fine and dry, and the color also green. As you are looking closer on its leaves, you know that its color and composition tells you about the state of the plant - how healthy it is at the moment, and sometimes, how weak it is. Notice also how there are flowers growing next to it, presenting themselves as a colorful set of petals. As you lean closer to the plant, you recognize its fresh scent. You hold in the scent as you lean back, before leaving the room.

Imagine that you walk into a room. As you enter the room, you notice that there is an arrangement of plants in front of you. Your gaze moves from one plant to the other. You decide to walk up to the arrangement and pause in front of one of the plants. Notice how the leaves of the plant turn towards you as you encounter it, reacting to your presence. You know that if you would touch it, it would enfold around your fingers. You soon continue to the next plant. As you hold its leaf in your hand, notice how the plant reacts to your touch by emitting an ambient, bioluminescent light. Natural patterns and fractals become more visible before your eyes as you move your thumb across its surface. Notice how you can not only feel the texture of the leaves, but clearly see the fibers and grains holding them together more clearly. As you lift one of its leaves closer to your ear, you hear a subtle sound. You know this is the sound of the state of the plant, telling you how healthy and sometimes how weak it is at the moment. After listening to the plant for some time, you lean back and proceed to leave the room.

Imagine that you are walking into a room. As you enter the room, you notice that there is an arrangement of plants in front of you. You decide to walk up to one of the plants. As you stand in front of the plant and proceed to put one of its leaves in your hand, notice how the boundaries between you and the plant start to dissolve, as if through a switch of energy. Notice how you start to feel a oneness with the plant, as you are merging into its consciousness. You feel the textures and colors of the plant as if they are your own skin, and the twinkling sensations of the sunlight hitting your body. Feel the intricate pattern of fractals that hold you together, stretching and growing towards the light. You feel the anchoring feeling of your roots digging down into the soil, steered by the pull of gravity. Notice the feeling of water and nutrients flowing through your body provided by the soil around you, and sometimes the feeling of not getting enough of it. Notice also how you can sense the environment around you, such as the chemical balance of other plants around you, or the feeling of something coming closer to you. After some time, you return to your own consciousness again. Once you do so, you withdraw your hand from the leaf and proceed to leave the room.

Please look at this picture before answering the following questions.

Please look at this picture before answering the following questions:

How much empathy do you feel towards the plants right now?

- ○ 1: None at all (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)

- ○ 5: Moderate (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10: A great deal (10)

How interconnected do you feel towards the plants right now?

- ○ 1 None at all (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 Moderate (5)
- ○ 6 (6)
- ○ 7 (7)

- ○ 8 (8)
- ○ 9 (9)
- ○ 10 A great deal (10)

How vividly could you imagine the paragraph?

- ○ Not at all (1)
- ○ Somewhat (6)
- ○ Moderately (3)
- ○ Quite well (4)
- ○ Extremely well (5)

Did you experience a dissolution of self or ego while reading the paragraph?

- ○ None (1)
- ○ Slightly (2)
- ○ Moderately (3)
- ○ Strongly (4)

○ Completely (5)