THE LIFE-SUSTENANCE HYPOTHESIS: UNDERSTANDING HUMAN-NATURE CONNECTION BY INTEGRATING ROUSSEAU'S PHILOSOPHY TO CONTEMPORARY SYSTEMS BIOLOGICAL VIEWPOINTS

Irina Salmi

ABSTRACT: This paper develops the life-sustenance hypothesis to explain the multifaceted phenomenon of the human-nature connection. It is based on an interpretation of Jean-Jacques Rousseau's philosophy brought into contemporary times via recent multidisciplinary research and theoretical underpinnings. Rousseau suggested that humans have two innate, instinctive drives he called *amour-de-soi* and *pitié*—a self-preservative drive, and its enlargement, an inclination to help other living beings in distress. The life-sustenance hypothesis is rooted in a systems biological framework situating humans as interconnected parts within a nested system of life. Corresponding to Rousseau's drives, this interconnectedness is suggested to give rise to the dynamics between two life-preserving orientations that guide our manners-of-being in the world: a self-sustaining and a 'life-sustaining' orientation shared by all organisms, albeit manifested differently. The experience of nature connectedness, along with altruistic impulses, are proposed to be human manifestations of the life-sustaining orientation. Moreover, in line with Rousseau's philosophy, it is posited that the modern, individualistic lifestyle has given rise to an imbalance between these orientations leading to problems in prosociality, proenvironmentalism, and overall well-being. One means by which to regain balanced manners-of-being might be to enhance our nature connectedness. Possible physiological indicators for the hypothesis are explored.

KEYWORDS: human-nature connection, nature connectedness, altruism, biophilia, Jean-Jacques Rousseau, systems thinking

1. INTRODUCTION

1.1 The aim of the paper

Human-nature connection (HNC) is currently being studied exponentially in several fields of science. Research has shown wide-ranging effects on our well-being, prosociality, and pro-environmental inclinations.[1] Explaining the existence and effects of HNC theoretically has been a topic of less interest. The most cited theoretical frameworks date back decades, and recently, several authors have called for an update to them.[2]

In this paper, such an update is posited by introducing a systems-based theoretical framework called the life-sustenance hypothesis which suggests that humans and other life-forms are oriented to sustain life as a whole via (1) self-sustenance, tending toward self-preservation, and (2) life-sustenance, tending toward sustaining other life. The hypothesis is, in fact, based on much older theorising than the current frameworks: An interpretation of Jean-Jacques Rousseau's (1712-1778) philosophy. I attempt to bring his thinking to current times by reviewing contemporary research and theory that could ground his philosophy (I also provide references to contradictory studies when appropriate). The current theoretical basis for the views of Rousseau is found in systems biology.

At the fundamental level concerning the mind-body problem, this paper will follow 'naturalistic monism',[3] where mind and matter are viewed as 'different sides of the same coin': Neither causes the other nor can be reduced into the other—they are one, from different viewpoints. Thus, whatever is described in physical

---

[1] Barragan-Jason, Gladys, Michel Loreau, Claire de Mazancourt, Michael C Singer, and Camille Parmesan. 'Psychological and Physical Connections with Nature Improve Both Human Well-Being and Nature Conservation: A Systematic Review of Meta-Analyses.' *Biological Conservation* 277 (2023).

[2] For example: Diehm, Christian. 2020. *Connectedness to Nature, Deep Ecology, and Conservation Social Science*. Lanham, MD: Lexington Books. (Henceforth cited as Connectedness).
Recent responses to the call include: f.ex. Hurly, Jane, and Gordon J Walker. 'Nature in Our Lives: Examining the Human Need for Nature Relatedness as a Basic Psychological Need.' *Journal of Leisure Research 50*, no. 4 (2019): 290–310 and Robinson, Jake M, and Martin F Breed. 'The Lovebug Effect: Is the Human Biophilic Drive Influenced by Interactions between the Host, the Environment, and the Microbiome?' *The Science of the Total Environment 720* (2020). (Henceforth cited as Lovebug).

[3] Jylkkä, Jussi, and Henry Railo. 'Consciousness as a Concrete Physical Phenomenon.' *Consciousness and Cognition 74* (2019).

terms is not meant to 'cause' anything mental, but rather be indicative of its existence.

This paper aims to offer a possible explanation for the phenomenon of human-nature connection and its wide-ranging effects. So far, many of the existing theories have concentrated on only some aspects of human-nature connection: either, for example, the positive effects on our health, or, our proenvironmentality. Here, the attempt is to draw these aspects under one theoretical hypothesis—one that is not totally opposed to the existing frameworks, but rather can to some extent be integrated with them.

1.2 HNC research in a nutshell

Physical contact with nature (i.e., exposure) brings about many beneficial effects on us and our behaviour. Psychological, subjective experiences of nature connectedness often enhance these effects.[4] Nature exposure and subjective nature connectedness are mutually empowering.[5] However, they can influence also separately, with varying effects.[6] In this paper, I will refer to the combination of these interrelated phenomena with the term 'human-nature connection' (HNC).

Nature connectedness research consists of several parallel concepts and measures that correlate strongly: it is suggested that they share an underlying basis. Furthermore, nature connectedness seems to be a multidimensional concept. Several suggestions exist for these dimensions: For example, 'emotional' (emotional inclinations and love for nature), and 'cognitive' (representations of and interest in nature).[7] In addition, nature connectedness is described both as a

[4] Chang, Chia-hen, Brenda B Lin, Xiaoqi Feng, Erik Andersson, John Gardner, and Thomas Astell-Burt. 'A Lower Connection to Nature Is Related to Lower Mental Health Benefits from Nature Contact.' *Scientific Reports 14*, no. 1 (2024); Liu, Yongbo, Anne Cleary, Kelly S Fielding, Zoe Murray, and Anne Roiko. 'Nature Connection, pro-Environmental Behaviours and Wellbeing: Understanding the Mediating Role of Nature Contact.' *Landscape and Urban Planning 228* (2022).

[5] Barragan-Jason, Gladys, Claire de Mazancourt, Camille Parmesan, Michael C Singer, and Michel Loreau. 'Human–Nature Connectedness as a Pathway to Sustainability: A Global Meta-analysis.' *Conservation Letters 15*, no. 1 (2022): e12852-n/a.

[6] Martin, Leanne, Mathew P White, Anne Hunt, Miles Richardson, Sabine Pahl, and Jim Burt. 'Nature Contact, Nature Connectedness and Associations with Health, Wellbeing and pro-Environmental Behaviours.' *Journal of Environmental Psychology 68* (2020).

[7] Tam, Kim-Pong. 'Concepts and Measures Related to Connection to Nature: Similarities and Differences.' *Journal of Environmental Psychology 34* (2013): 64–78

temporary state of mind and a more stable trait-like feature.[8] Frequently, nature connectedness is defined as an immersive experience of 'oneness with the natural world'.[9] This multifacetedness of the concept is not addressed by the existing theories in a satisfactory manner.

HNC studies have been mainly conducted in Western countries, and its existence as a global phenomenon has been questioned.[10] Current theoretical frameworks have not addressed this issue, nor have they addressed the relationship between altruism and nature connectedness: Prosociality, altruism, and proenvironmentality have been shown to correlate positively, and nature connectedness mediates the relation.[11] Providing a possible explanation for these interrelations and their connection to overall well-being is at the heart of the life-sustenance hypothesis.

1.3 Existing theoretical frameworks for HNC

Aldo Leopold (1887-1946) pioneered the concept of HNC. He wrote: 'a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise'.[12] Leopold emphasized the tendency toward preserving or sustaining life. Currently, the most often referred framework for HNC is the biophilia hypothesis developed by biologist E.O. Wilson (1929-2021). It suggests that the versatile well-being benefits of HNC result from us satisfying an innate, evolutionary adaptive need to affiliate with nature.[13] Relatedly, an often-mentioned framework is the savanna hypothesis, where the nature to be affiliated with is, specifically, the kind that resembles the savannas

[8]; Whitburn, Julie, Wayne Linklater, and Wokje Abrahamse. 'Meta-analysis of Human Connection to Nature and Proenvironmental Behavior.' *Conservation Biology 34*, no. 1 (2020): 180–93.

[9] ; Mayer, F.Stephan, and Cynthia McPherson Frantz. 'The Connectedness to Nature Scale: A Measure of Individuals' Feeling in Community with Nature.' *Journal of Environmental Psychology 24*, no. 4 (2004): 503–15

[10] Gallegos-Riofrío, Carlos Andres, Hassan Arab, Amaya Carrasco-Torrontegui, and Rachelle K Gould. 'Chronic Deficiency of Diversity and Pluralism in Research on Nature's Mental Health Effects: A Planetary Health Problem.' *Current Research in Environmental Sustainability 4* (2022).

[11] Otto, Siegmar, Pamela Pensini, Sarah Zabel, Pablo Diaz-Siefer, Elliot Burnham, Claudia Navarro-Villarroel, and Alexander Neaman. 'The Prosocial Origin of Sustainable Behavior: A Case Study in the Ecological Domain.' Global Environmental Change 69 (2021).

[12] Leopold, Aldo. 1949. *A Sand County Almanac*. New York: Oxford University Press.p.224.

[13] Wilson, Edward O. 1984. *Biophilia*. Cambridge, MA: Harvard University Press.

on which our ancestors lived and relied.[14]

In research concerning the personal benefits of HNC, the stress reduction theory (SRT) and the attention restoration theory (ART) are also often referred to. SRT argues that improved well-being during nature exposure results from decreased stress-responses.[15] ART asserts that nature exposure helps reduce attentional fatigue, which in turn leads to improved cognitive functioning and positive affect.[16]

Regarding the proenvironmental benefits of nature connectedness, the deep ecology movement has been influential. The founder of the movement, Arne Næss, was influenced by the works of Aldo Leopold. Næss rejects atomistic individualism according to which human beings are radically separate from the rest of the world, and contrasts this 'shallow ecology' with what he calls 'deep ecology'. Overcoming atomistic individualism leads to an 'Ecological Self', where nature becomes part of self-identity. The separation between 'me' and nature leads to narrow, excessive selfishness, to which the 'Ecological Self' proposes an alternative. Næss proposed a relational 'total-field image' of the world, where organisms are like 'knots' in the biospherical net of coexistence. Nature connectedness is the deep realization of this coexistence.[17]

---

[14] Ulrich, Roger S. 1993. 'Biophilia, Biophobia, and Natural Landscapes.' In *The Biophilia Hypothesis*, edited by Stephen R. Kellert and Edward O. Wilson, 73–137. Washington, DC: Island Press.
For criticisms of these hypotheses, see f.ex. Rathmann, Joachim, Kalevi M Korpela, and Philipp Stojakowits. 'Pleistocene Hypothesis – Moving Savanna Perceptual Preference Hypothesis Beyond Savanna.' *Frontiers in Psychology 13* (2022); Joye, Yannick, and Andreas deBlock. ''Nature and I Are Two': A Critical Examination of the Biophilia Hypothesis.' *Environmental Values 20*, no. 2 (2011): 189–215; Haga, Andreas, Niklas Halin, Mattias Holmgren, and Patrik Sörqvist. 'Psychological Restoration Can Depend on Stimulus-Source Attribution: A Challenge for the Evolutionary Account?' *Frontiers in Psychology 7* (2016): 1831–1831.

[15] Ulrich, Roger S, Robert F Simons, Barbara D Losito, Evelyn Fiorito, Mark A Miles, and Michael Zelson. 'Stress Recovery during Exposure to Natural and Urban Environments.' *Journal of Environmental Psychology 11*, no. 3 (1991): 201–30.

[16] Kaplan, Stephen. 'The Restorative Benefits of Nature: Toward an Integrative Framework.' *Journal of Environmental Psychology 15*, no. 3 (1995): 169–82. Criticism f.ex. Joye, Yannick, and Siegfried Dewitte. 'Nature's Broken Path to Restoration. A Critical Look at Attention Restoration Theory.' *Journal of Environmental Psychology 59* (2018): 1–8.

[17] Næss, Arne. 1973. 'The Shallow and the Deep, Long-Range Ecology Movement.' *Inquiry 16*: 95–100.Criticisms: f.ex. Plumwood, Val. 'Nature, Self, and Gender: Feminism, Environmental Philosophy, and the Critique of Rationalism.' *Hypatia 6*, no. 1 (1991): 3–27. (Henceforth cited as Shallow & Deep).

1.4 The procedure of the paper

This paper is an empirically informed philosophical paper. It is distinctly transdisciplinary, using research or theory in such fields of science as systems biology, psychology, endochrinology, and neuroscience.

To start, I will introduce shortly my interpretation of Rousseau's philosophy. My starting point is his deep appreciation of our nature connectedness and the consequences of its contemporary deterioration. I will not argue at length for the validity of this interpretation, but pursue it elsewhere.[18] Here, the main focus is on bringing his thinking to current times.

I will then explore different strands of scientific theorizing, attempting to add to Rousseau's philosophy a contemporary perspective: I will view Erich Fromm's version of biophilia, systems biological thinking, research on non-egoistic altruism, homeostasis as the functional principle of all life, and the possible link between (1) the alleged disconnection from nature of modern, Western people and (2) their prolonged, excessive stress-responses.

I will during the process construct what I call the life-sustenance hypothesis, an empirically informed version of Rousseau's thinking. The hypothesis will be advanced in two levels: referring broadly to all life-forms, and zooming into how the hypothesis manifests in human beings. After its development, I will further review some contemporary research insightful for the life-sustenance hypothesis. In the conclusions, I summarise and consider some limitations and restrictions. The idea of this paper is to launch a different kind of multidisciplinary-based thinking concerning nature connectedness—it is by no means meant to comprehensively cover the whole issue. It is, however, a start: a start for some novel thinking on the matter.

2. JEAN-JACQUES ROUSSEAU AND 'DIFFERENT MANNERS-OF-BEING'

Rousseau was a firm proponent of nature's importance for us. According to him, humans can experience a state of '*harmony*', an immersive experience of oneness with nature where the limits of subject and object melt away to feel the unity of

[18] Salmi, Irina. *A Systems Approach to the Views of Jean-Jacques Rousseau on Nature Connectedness.* Under review.

all life.[19] The state of harmony corresponds to nature connectedness as an immersive state of mind.

Life as a seamless net of co-existence—resembling Næss' total-field image—was fundamental in the worldview of Rousseau: we cannot fully understand any living beings isolated from their constantly changing surroundings. Our thoughts, emotions, and actions are continually shaped by the environment and our expectations regarding it: we live embedded in our surroundings, and the surroundings profoundly shape how we become to be.[20]

Rousseau describes two innate, instinctive drives: *amour-de-soi* ('love-of-self') and *pitié* ('compassion'). *Amour-de-soi* refers to our innate, primitive drive for self-preservation that we share with all species. *Pitié* is an enlargement of *amour-de-soi,* inducing a compassionate reluctance to see others suffering and a directly felt, instinctive inclination to help those in need. As an expansion of *amour-de-soi*, *pitié* engenders caring for other beings in the same direct way as for our own well-being.[21] The origin of *pitié* is innate,[22] but the environment needs to support its development. Hence, education becomes important.[23]

Humans suffer from an imbalance between these drives, resulting in an internal conflict between the narrowly self-centered excessive interests of individuals and the interests of the surrounding life. In a balanced manner-of-being, this conflict would not arise: We would instinctively harm other life only as much as we need for self-preservational purposes. Especially modern individualism has created a constant and excessive prioritising of one's own gain

---

[19] Rousseau, Jean-Jacques. 1782c (1927). *The Reveries of a Solitary Walker*. Lenox Hill. 112–114, 138–143; Rousseau, Jean-Jacques and Kelly, Richard (Ed.) (2007). *Jean-Jacques Rousseau: Autobiographical, Scientific, Religious, Moral, and Literary Writings*. Dartmouth college press, University press of New England. 165–168. (henceforth cited as Moral writings).

[20] Rousseau, Jean-Jacques. 1761 (1997). *Julie, or the New Heloise: Letters of Two Lovers Who Live in a Small Town at the Foot of the Alps*. Dartmouth College Press. 418 (henceforth cited as Julie); Rousseau, Jean-Jacques 2012. *The Confessions of Jean-Jacques Rousseau: Complete*. The Floating Press. 474–475 (henceforth cited as Confessions); Rousseau, Jean-Jacques. 1762 (1979). *Emile: or On Education*. Basic Books. 62–63; 134–135 (henceforth cited as Emilé); Rousseau, Moral writings, 135, 189.

[21] Rousseau, Jean-Jacques. 1781 (1998). *Essay on the Origin of Languages and Writings Related to Music*. Translated and edited by John T. Scott. University Press of New England. 307; Rousseau, Emile, 41, 212–213, 235, 252–253 (henceforth cited as Origin of Languages); Rousseau, Moral writings, 179, 196, 201.

[22] Rousseau, Moral writings, 196.

[23] see Salmi, Irina. "Nature-connective educational architecting–an approach to education based on the life-sustenance hypothesis." *Humanities and Social Sciences Communications* 12.1 (2025): 1-9.

above others.[24] To clarify this, Rousseau introduced another concept of 'self-love', *amour-propre,* a modification of *amour-de-soi:* quite a human-specific phenomenon, born in societal circumstances of continuous competition, comparison, and social status worries, resulting in the excessive gathering of resources at the expense of others. Excessive *amour-propre* is harmful, for individuals and societies.[25]

The systems-based worldview of Rousseau is perhaps best illustrated in his description of the 'double relation with the world', revolving around the idea of 'different manners-of-being': '*There is a great difference between being bound to oneself and to a whole of which one forms a part*'.[26] The innate drives, *amour-de-soi*, and *pitié*, can be viewed to represent these different manners-of-being, reflected in all our thinking, behavior, emotions, and desires—our entire way of being. I suggest that these manners-of-being are best understood to function in a *continuum*, where they continuously fluctuate somewhere in between the extremes of (excessive) self-centeredness and a sense of oneness with the world. All the time, we exhibit both to varying degrees: central is, which one dominates. When *pitié* dominates, our *amour-de-soi* is expanded to strive for the sustenance of other life. *Amour-de-soi,* on the other hand, should dominate for example in life-threat situations. This kind of understanding of Rousseau's system of thought may resolve many seemingly self-contradictory statements by him.[27] He wrote: *it is impossible […] to give the same meanings to the same words. There is no language rich enough to furnish as many terms, turns, and phrases as our ideas can have modifications*'.[28] I suggest that these modifications can be understood as different dynamics of the orientations underlying our entire way of being.

In what follows, I will try to show that Rousseau, as I interpret him, was onto something that contemporary multidisciplinary science is cumulatively showing to possibly be the case. I will start by exploring the 'double relation with the world' in more depth. Erich Fromm's version of biophilia and the philosophy of

---

[24] Rousseau, Emilé, 41; 2012, 474–475; Rousseau, Confessions, 474–475; Rousseau, Moral writings, 196. "Modern individualism' is just the tip of the iceberg. The phenomenon originates in our developmental history as an extremely social and highly cognitive species.

[25] Rousseau, Emilé, 41, 212–213, 235, 252–253; Rousseau, Moral writings 179, 196.

[26] Rousseau, Origin of languages, 17.

[27] More on the matter in Salmi, Irina. *A Systems Approach to the Views of Jean-Jacques Rousseau on Nature Connectedness*. Under review.

[28] Rousseau, Emilé, 108

systems biology will be used here to bring Rousseau's ideas to empirically informed language, and even to enlarge them: Rousseau's *amour-de-soi* is shared by all life-forms, but he was only indicative with regard to the possible species-wide role of *pitié*.[29] Fromm and the systems biologists, however, are specific in taking what they call *integration* (along with self-sustenance) to be something shared by all life.

2. EVOLUTIONARY AND SYSTEMS BIOLOGICAL PERSPECTIVES

2.1. From Erich Fromm to systems biological viewpoints

Twenty years before Wilson introduced the biophilia hypothesis, the term *biophilia* was already coined by Erich Fromm. HNC researchers rarely mention Fromm, but he influenced the more-often-cited Arne Næss deeply. For Fromm, biophilia is an orientation toward 'love of life', opposing an orientation of 'indifference to life' (in its non-pathological forms). Biophilia and its counterpart underlie all processes in all life-forms, forming a total, entire way of being. Fromm's biophilia has two forms: (1) self-sustenance, the self-preservational tendency, and (2) a tendency to integrate and unite with other life.[30] The difference to Wilson's biophilia lies in scale: for Wilson, biophilia is an adaptation of the human species, for Fromm, it is shared by all life-forms.

Fromm's biophilia shares the systems-based worldview of Næss and Rousseau. The same worldview is also shared by evolutionary systems biology theorists. They acknowledge two essential tendencies of life (resembling Fromm's forms of biophilia): (1) 'individuation', a self-assertive, self-sustaining tendency to preserve individual autonomy, and (2) 'integration', a tendency to function as part of a larger whole. These tendencies are essential because life is constructed as multileveled, nested systems within systems, each of which is simultaneously a whole to its parts and parts of larger wholes. This 'double role' (resembling that of Rousseau's) results in the interplay between the (1) integrative tendency enabling functioning as part of a larger whole, and (2) the self-sustaining tendency enabling individual autonomy. Through these relational functions, life—bacteria,

[29] Rousseau, Confessions, 32.

[30] Fromm, Erich. 1964. *The Heart of Man: Its Genius for Good and Evil.* New York: Harper and Row. (henceforth cited as Heart of Man).

humans, ecosystems—dynamically maintains itself.[31]

Autonomy and integration have been approached in different ways. One of the most influential approaches is Humberto Maturana's and Francisco Varela's autopoiesis,[32] which has received both subsequent advancements and criticism. To the life-sustenance hypothesis, the most relevant approach is that of Alvaro Moreno and Matteo Mossio. They criticise the widespread assumption that autonomy is an adaptation by natural selection. Any evolutionary process needs a functional organisation of energy that keeps the process going, and according to Moreno and Mossio, autonomy provides this organisation required for selection to occur. Moreover, integration, according to them, is an integral *part of* autonomy, embedded in the self-constructing dynamics of the system: Thus, both autonomy and integration can be viewed as preconditions for natural selection.[33]

Systems biologists' self-sustaining autonomy resembles quite straightforwardly *amour-de-soi,* Rousseau's innate self-preservational orientation that all living beings share. The link between the tendency toward integration and *pitié*, however, needs a little more thought to evolve.

2.2 Developing the basic structure of the life-sustenance hypothesis

Corresponding to the self-sustenance orientation induced by tendencies to autonomy, the life-sustenance hypothesis suggests that the tendency toward integration induces an orientation toward *life-sustenance*. In its simplest, this life-sustenance orientation would manifest as *not harming other life without a self-preservational need to do so*.

Both orientations manifest species-specifically. In humans, the life-sustaining

---

[31] Boogerd, Fred, Frank J. Bruggeman, Jan-Hendrik S. Hofmeyr, and Hans V. Westerhoff. '1 - Towards Philosophical Foundations of Systems Biology: Introduction.' In *Systems Biology*, 3–19. Elsevier B.V, 2007; Capra, Fritjof, and Pier Luigi Luisi. *The Systems View of Life: A Unifying Vision*. Cambridge University Press, 2014.

[32] Maturana, Humberto R., and Francisco J. Varela. 1972. *Autopoiesis and Cognition: The Realization of the Living.* Boston Studies in the Philosophy of Science. Dordrecht: D. Reidel Publishing Company.

[33] Moreno, Alvaro, and Matteo Mossio. 2015. *Biological Autonomy: A Philosophical and Theoretical Enquiry.* Dordrecht: Springer; Moreno, Alvaro. 'A Systemic Approach to the Origin of Biological Organization.' In *Systems Biology*, 243–68, 2007.
For criticisms, see: Meincke, Anne Sophie. 'Autopoiesis, Biological Autonomy and the Process View of Life.' *European Journal for Philosophy of Science* 9, no. 1 (2019); Cusimano, Samuel, and Beckett Sterner. 'The Objectivity of Organizational Functions.' *Acta Biotheoretica 68*, no. 2 (2020): 253–69.

orientation manifests at least as (1) altruistic impulses[34], resembling *pitié*, and (2) experiences of nature connectedness (harmony) that induce pro-environmental inclinations: These are means by which our species halts unnecessary harming of other life. Self-sustenance, on the other hand, manifests as self-preservational functions such as hunger and stress-responses: direct needs and discomfort that demand alleviation. Analogously, and following Rousseau, altruistic impulses are suggested to be *direct needs* and discomforts that can be alleviated by responding to the needs of others.

Similar to *pitié* and *amour-de-soi*, the orientations are expressed in a continuum: we fluctuate somewhere in between (1) the dominantly life-sustaining end as altruistic impulses (*pitié*) and nature connectedness, and (2) the dominantly self-sustaining end as egoistically motivated actions. The fluctuation is continuously affected by interoception and the environment, but we also have personal baselines, typical ranges of fluctuation. These baselines vary between individuals and societies and change over time. Peaks to the extreme ends are rare. For example, harmony, where the whole sense of self disappears, cannot be held continuously: To eat and keep safe, attending to the world self-sustainingly is necessary. The extremities serve their purpose only temporarily.

Surroundings that promote individualism above life-sustenance convey excessive *amour-proprean* tendencies, but in settings supporting life-sustenance, *amour-de-soi* gives rise to *pitié*. Following Rousseau, I suggest that the modern, Western lifestyle induces an imbalance towards individualistic, *amour-proprean* baselines. Imbalance can appear also in non-human organisms: the crown of thorns starfish for instance can destroy whole coral reef ecosystems.[35]

Rousseau thought, that not only is this imbalance harmful to how we treat other life, but that it is harmful also to ourselves. Next, I will try to bring the notion of *pitié* to contemporary times using Darwin's[36] sympathetic instincts and de Waal's altruistic impulses as points of comparison. They both share the same directness as *pitié*. In evolutionary terms, the discussion centers around the

[34] de Waal, Frans B.M. 'Putting the Altruism Back into Altruism: The Evolution of Empathy.' *Annual Review of Psychology 59*, no. 1 (2008): 279–300. (Henceforth cited as Altruism)

[35] Wilson, David Sloan. 2019. *This View of Life: Completing the Darwinian Revolution*. 1st ed. New York: Vintage Books. (Henceforth cited as This View of Life)

[36] Darwin, Charles. 1871. *The Descent of Man, and Selection in Relation to Sex*. London: John Murray. (Henceforth cited as Descent of Man)

question of non-egoistic altruism. Altruistic impulses offer empirically informed theoretical support to Rousseau's idea of *pitié*. Together with Rousseau and the philosophers of systems biology, the varieties of the idea of non-egoistic altruism (expanded to concern also other species and life in general) give rise to the novel concept of the life-sustaining orientation.

2.3. From Darwin's sympathetic instinct to contemporary research on altruism

Charles Darwin also embraced a systems-based view of co-existence: Natural selection, in fact, only occurs in relation to the organism's environment.[37] Evolution theorists have long been preoccupied with why altruism—behaviour that benefits other organisms at a reproductive cost to oneself—prevails when evolution typically favors traits that enhance an organism's survival and reproduction. Often, altruism is explained with intrinsic egoism, the main explanations being kin selection and reciprocal altruism.[38]

Not all altruism, however, is easily reducible to egoistic motives. Darwin built altruism on 'sympathetic instincts': Direct feelings of pleasure or pain—not indirect, postponed gain such as reciprocal helping would offer.[39] Peter Kropotkin (1842-1921) expanded Darwin's idea of sympathetic instincts by suggesting 'mutual aid' as an evolutionary force along with 'mutual struggle'.[40]

Multilevel selection theory is one contemporary example of a non-egoistic theory for altruism. It proposes that selection occurs at more than one level of biological life: Selfish individuals tend to out-compete altruists within groups, but selfish groups are out-competed by dominantly altruistic groups. Appreciating the systems-based nested structure of life, multilevel selection theory considers us to be parts of larger and larger wholes: even the whole planet can be taken as a unit of selection.[41]

---

[37] Darwin, Charles. 2009 [1876]. *On the Origin of Species: By Means of Natural Selection*. 6th ed. Auckland: Floating Press.

[38] Okasha, Samir. 2020. 'Biological Altruism.' *The Stanford Encyclopedia of Philosophy* (Summer 2020 Edition), edited by Edward N. Zalta.

[39] Darwin, Descent of Man.

[40] Kropotkin, Peter. 1987 [1902]. *Mutual Aid: A Factor of Evolution*. London: Freedom Press.

[41] Wilson, This View of Life; Wilson, David Sloan, and Edward O. Wilson. 2007. *'Rethinking the Theoretical Foundation of Sociobiology*.' The Quarterly Review of Biology 82 (4): 327–348;
For criticisms, see for instance Gardner, A. 'Genetical Theory of Multilevel Selection.' *Journal of Evolutionary Biology 28*, no. 2 (2015): 305–19.

Current examples of research on non-egoist altruism include the studies of Michael Tomasello and his colleagues. They have detected an altruistic tendency not motivated by self-gain but rather a genuine care for the well-being of others already in 6-month-old children. Based on their research, they depict two intrinsic, co-existing inclinations: The selfish and the altruistic ones. Neither one explains the other, and both affect behavior.[42] These inclinations might be examples of Rousseau's *amour-de-soi* and *pitié*.[43]

Frans de Waal describes an altruistic impulse that in various species triggers spontaneous, disinterested caring in response to distress signals. Altruism can be learned and intentional, but de Waal suggests that these are also based on the initial impulse. Moreover, the existence of a genuinely altruistic impulse does not exclude egoistic altruism.[44] There is, however, a fundamental difference in these approaches (compare this to Næss' shallow and deep ecology): When the egoist approaches a situation with questions such as 'Why help?' and 'Why not harm?', the life-sustaining, non-egoistic approach asks 'Why not help?', and 'Why harm?'. In real-life choices, these motives mix and are rarely met as such.

Following Rousseau's thinking, the life-sustenance hypothesis would suggest that when not facing an either-or-choice, life-sustenance guides to respond to the distress signals—say, of thirsty hedgehogs on hot summer days, or hungry birds on harsh winters—without expecting egoistic benefits. The bare minimum is not harming other life without self-preservative needs. In practice, altruism originates from both egoistic and other-oriented motivations. Life-sustenance hypothesis is not opposed to egoistic altruism: kin selection and reciprocal altruism both fall somewhere between the dynamics of self-sustenance and life-sustenance, just like any other aspect of our being. Næss argues that also proenvironmental behaviour

---

However, as Jonathan Birch (2017) points out, the majority of evolution theorists nowadays suggest that kin and multilevel selection are complementary. (In Birch, Jonathan. 'Are Kin and Group Selection Rivals or Friends?' *Current Biology 29*, no. 11 (2019): R433–38.)

[42] Hepach, Robert, Amrisha Vaish, and Michael Tomasello. 'A New Look at Children's Prosocial Motivation.' *Infancy 18*, no. 1 (2013): 67–90.

[43] Proponents of egoistic altruism include for instance: Cialdini, Robert B, Mark Schaller, Donald Houlihan, Kevin Arps, Jim Fultz, and Arthur L Beaman. 'Empathy-Based Helping: Is It Selflessly or Selfishly Motivated?' *Journal of Personality and Social Psychology 52*, no. 4 (1987): 749–58; Pinker, Steven. 2012. *The Better Angels of Our Nature: The Decline of Violence in History and Its Causes.* New York, NY: Penguin.

[44] De Waal, Altruism. For criticisms, see: Carron, Paul. 'Ape Imagination? A Sentimentalist Critique of Frans de Waal's Gradualist Theory of Human Morality.' *Biology & Philosophy 33*, no. 3–4 (2018).

can result from either shallow, self-centered motives or deep, ecological motives. [45] What matters is which orientation dominates.

To sum up, it seems Rousseau's *pitié* could be grounded in contemporary research, although contradicting views exist. This is not, however, enough to ground his whole system of thought. Rousseau himself never discussed the orientations in a biologically-based way—he could not have, since the science of his time was not as advanced as ours is. Therefore, the next considerations, including how *amour-de-soi* and *pitié* could function physiologically, aim to further develop his ideas.

3. THE FUNCTIONAL PRINCIPLE: HOMEOSTASIS

3.1. Homeostasis as the regulatory function of all organisms

The physiological functioning of the orientations would have to be (1) something that we share with all life-forms, (2) that regulates the continuous fluctuations of responses to the environment, and (3) is involved in the 'total, entire way of being'. *Homeostasis* could potentially fulfill these terms.

Homeostasis takes care of the regulation of biological organisms. According to Antonio Damasio, life, characteristically, needs to be regulated optimally; otherwise, the development of the genetic apparatus is not even conceivable. Thus, homeostasis is a precondition of natural selection: something, that we share with all life-forms. Homeostatic processes maintain something within certain boundaries and, allegedly, underlie all activities, emotions, and even intellectual elaborations: i.e., the total, entire way of being.[46] Most familiar examples include blood pressure and body temperature. In neural organisms, brains have evolved to maintain homeostatic balance.[47]

Homeostatic regulation is responsible for self-preservation: for instance,

---

[45] Næss, Shallow & Deep.

[46] Damasio, Antonio. 2018. *The Strange Order of Things: Life, Feeling, and the Making of Cultures*. New York: Pantheon Books. (Henceforth cited as Strange Order)
For a systems-based view on homeostasis, see Rozenberg, G. S, T. D Zinchenko, and A. G Rozenberg. 'Hierarchy of Ecological Homeostasis as a Principle of Systemology.' *Biology Bulletin of the Russian Academy of Sciences 50*, no. Suppl 1 (2023): S109–17.

[47] Sapolsky, Robert M. 2004. *Why Zebras Don't Get Ulcers: The Acclaimed Guide to Stress, Stress-Related Diseases, and Coping*. 3rd ed. New York: Henry Holt. (Henceforth cited as Zebras)

hunger, thirst, and stress-responses function homeostatically. Analogously, the life-sustenance hypothesis suggests that homeostasis is also responsible for life-sustenance. This seems reasonable, if we take integration (and thus life-sustenance) as part of the autonomy (self-sustenance), following Moreno and Mossio. Rousseau, too, presumed *pitié* to originate from *amour-de-soi*. It makes sense that they would share the functional principle.

In practice, this means that in a sudden life-threatening situation, self-sustenance peaks high, while witnessing other life in distress induces a life-sustaining peak. Afterwards, homeostatic balance is restored. Deviations from homeostatic balance are felt as pain, suffering, dire need, threat, or loss.[48] Darwin's instinctive sympathy and Rousseau´s *pitié* function analogously: through a direct, good feeling when able to help, and a discomfort when unable to help. One could argue, that this would, hence, be an egoistic motive at rock bottom. However, Rousseau's view is more subtle: I suggest that rather, the discomfort functions as a signal – similar to hunger – that considering the surrounding life, something needs to be reacted to. Its fundamental purpose is not self-preservative but life-preservative.

Individuals' homeostatic baselines differ. Furthermore, the levels fluctuate constantly in response to the environment. A better term could, in fact, be allostasis, which allows for the ideal state to vary: The ideal state is different when safely sleeping, or when escaping a life threat. Analogously, the ideal states of life-sustenance and self-sustenance are different when in life-threatening situations, in peace, or witnessing the distress of others.[49]

In humans, self-preservational stress-responses are conducted largely via enhanced cortisol secretion released by the hypothalamus-pituitary-adrenal axis (HPA). Cortisol release aids in producing needed behavioral adaptations to survive situation-bound challenges (i.e., stressors). Not all stressors produce exactly similar responses. Cortisol either permits, stimulates, or suppresses

[48] Damasio, Strange Order.

[49] Sapolsky, Zebras. See also Sterling, Peter, and Joseph Eyer. 1988. 'Allostasis: A New Paradigm to Explain Arousal Pathology.' In *Handbook of Life Stress, Cognition and Health*, edited by S. Fisher and J. T. Reason, 629–649. New York: John Wiley & Sons

For the integration of the terms "homeostasis' and "allostasis', see McEwen, Bruce S, and John C Wingfield. 'What Is in a Name? Integrating Homeostasis, Allostasis and Stress.' *Hormones and Behavior 57*, no. 2 (2010): 105–11.

functions in several parts of the body, or prepares it to face future stressors. Most cells in the body have receptors for cortisol: most organs and physiological systems are sensitive to it, reacting differently to different stressors.[50]

So now that the functioning principle has a candidate, it is time to take a look at the alleged imbalance of the modern, Western people. Here, Rousseau's *amour-propre* intertwines closely with prolonged, excessive stress-responding, characteristic of our times. The aim of the next chapter is again to further develop Rousseau's ideas, to bring them into contemporary physical language. What happens in the body when *amour-propre* takes over?

3.2 The problematic stress-responding of modern western people

The stress-response allows organisms to adapt to life-threatening challenges. However, particularly (but not necessarily exclusively) in humans as a highly social species, the stress-response is also triggered by 'social self-preservation,' where stressors can be anything perceived as threatening to social esteem or status.[51] Note the similarity to *amour-propre*, which is also based on perceived threats to social status: a key ingredient in it is a 'need for recognition'.[52]

Additionally, for humans, stressors can be anticipatory. Our high cognitivity allows us to turn on stress-responses simply by thinking about a possible psychological insult far in the future.[53] Never actualising anticipations cause prolonged stress. Rousseau, too, suggested that one of the key developments that affected *amour-propre* to arise was what he called 'human reason', comparable to certain cognitive abilities of the human species.[54] The ability to anticipate future stressors might be one means in which this happened.

As a result of stress-responding, for example, long-term projects such as fertility are halted, the immune function is suppressed, as much energy as possible

---

[50] Sapolsky, Robert M. 'How Do Glucocorticoids Influence Stress Responses? Integrating Permissive, Suppressive, Stimulatory, and Preparative Actions.' *Endocrine Reviews 21*, no. 1 (2000): 55–89. (Henceforth cited as Glucocorticoids)

[51] Sapolsky, Zebras; Sapolsky, glococorticoids.

[52] Neuhouser, Frederick. 2008. *Rousseau's Theodicy of Self-Love: Evil, Rationality, and the Drive for Recognition*. Oxford: Oxford University Press.

[53] Sapolsky, glococorticoids.

[54] Rousseau, Jean-Jacques. 2010. *A Discourse on Inequality*. Open Road Integrated Media, Inc. ProQuest Ebook Central.

is mobilised as rapidly as possible, and senses and memory sharpen. In temporary situations, these reactions are valuable. However, a continuous and prolonged stress-response may be more damaging to the organism than the stressor itself, especially in psychological stress. This seems to be particularly a problem for modern, Western humans: something in modern life induces prolonged stress. The problem is not the stress-response *per se,* but the excessive social-psychological anticipatory stress in particular. [55]

Rousseau was worried about the influence of modernity, which was in his time only in its early stages. Furthermore, Rousseau considered our cognitive development and issues of social esteem to be core reasons why the harmful *amour-propre* has strengthened at the expense of *pitié*. I suggest the Western continuous, excessive stress-response is associated with Rousseau's excessive *amour-propre*, the harmful modification of self-preservative *amour-de-soi*. Initially, stress-responses also served self-preservative ends but the human species has extended it to be concerned with social status as well. In addition, *pitié* as a direct, basic need, may cause different kinds of ailments until homeostasis is restored. This might to some extent correspond to the physiological consequences of a prolonged, excessive social-psychological stress-response.[56]

If the life-sustenance hypothesis would be correct, we could assume to find some evidence that modern, Western life with excessive stress-responses would indeed be associated with the self-sustaining orientation to unhealthy proportions—amounting to excessively selfish acting. As the modern, Western lifestyle is often described as distinctly individualistic, this seems not too far-fetched. But are there any physiological signs of this development? Next, the aim is to explore what research has to say about the connection between stress-responses and egoistic approaches on the one hand, and the connection between life-sustaining approaches and the biomarkers of non-stressed states of being on the other.

---

[55] Sapolsky, Zebras; Sapolsky, Glucocorticoids.

[56] For a contemporary view on the relations between allostatic load (excessive stress), social factors, modern way of life, and well-being, see Schulkin, Jay. 2011. *Adaptation and Well-Being: Social Allostasis*. Cambridge: Cambridge University Press. ProQuest Ebook Central.

4. RESEARCH RELATED TO THE SELF-SUSTAINING ORIENTATION

Research has shown, that young children are primarily driven by other-oriented concerns, while older children and adults increasingly have more self-centered motives. By the age of 5, the social rewards for helping become important.[57] Simultaneously, the link between cortisol secretion and social stress strengthens: there is no effect of social stress on cortisol secretion during the first months of life but it appears later (at 16 months), and the peaks responding to anticipatory social stress elevate with slower recoveries as children age.[58] These studies, like most studies concerning social stress, are Western-based: future comparative cross-cultural research is needed in order to reach a fuller picture.

The effects of *acute* stress on prosocial decision-making have been studied extensively. The results are controversial with many factors mediating the relationship.[59] The relevance of these studies to life-sustenance hypothesis, however, is questionable because prosociality may also result from egoistic motives. After acute stress, prosociality may be evaluated as the best survival tactic—to 'tend-and-befriend' instead of '(freeze)-flight-or-fight'.[60]

---

[57] Hepach et al., A New look, and Hepach, Robert, Jan M. Engelmann, Esther Herrmann, Stella C. Gerdemann & Tomasello, Michael. (2023). Evidence for a developmental shift in the motivation underlying helping in early childhood. *Developmental Science, 26*(1), e13253.

[58] Strahler, Jana, Nadine Skoluda, Mattes B Kappert, and Urs M Nater. 'Simultaneous Measurement of Salivary Cortisol and Alpha-Amylase: Application and Recommendations.' *Neuroscience and Biobehavioral Reviews* 83 (2017): 657–77. ch 3.1.2

[59] Azulay, Hagar, Nitzan Guy, Yoni Pertzov, and Salomon Israel. 'Empathy Modulates the Effect of Stress Reactivity on Generous Giving.' *Frontiers in Neuroscience 16* (2022): 814789–814789; Freitas, Carolina Coelho Moniz de Campos, and Flávia de Lima Osório. 'Moral Judgment and Hormones: A Systematic Literature Review.' *PloS One 17*, no. 4 (2022): e0265693–e0265693; Singer, Nina, Julia Binapfl, Monika Sommer, Stefan Wüst and Brigitte M. Kudielka. 'Everyday moral decision-making after acute stress exposure: do social closeness and timing matter?'. Stress, 24:4 (2021a): 468-473; Singer, Nina, Monika Sommer, Stefan Wüst, and Brigitte M Kudielka. 'Effects of Gender and Personality on Everyday Moral Decision-Making after Acute Stress Exposure.' Psychoneuroendocrinology 124 (2021b); von Dawans, Bernadette, Julia Strojny, and Gregor Domes. 'The Effects of Acute Stress and Stress Hormones on Social Cognition and Behavior: Current State of Research and Future Directions.' *Neuroscience and Biobehavioral Reviews 121* (2021): 75–88.

[60] Taylor, Shelley E. 'Tend and Befriend: Biobehavioral Bases of Affiliation under Stress.' Current Directions in Psychological Science'. *A Journal of the American Psychological Society 15*, no. 6 (2006): 273–77.
While originally suggested to be gender-based, later research suggests that f.ex. attachment behaviour and socio-economic factors also play a role: Levy, Kenneth N, Jessica K Hlay, Benjamin N Johnson, and Courtney P Witmer. 'An Attachment Theoretical Perspective on Tend-and-Befriend Stress Reactions.' *Evolutionary Psychological Science 5*, no. 4 (2019): 426–39; Evetts, Cynthia. 'Fight or Flight Versus Tend and Befriend Behavioral Response to Stress.' *The American Journal of Occupational Therapy 71*, no. 4_Supplement_1 (2017): 7111505083-7111505083p1

A correlation between higher baseline cortisol levels and pathological selfishness (psychopathy, macchiavellism, narcissism) or lack of prosocialism has been found, but contrasting findings have also been reported.[61]

Causal inferences cannot be drawn from any of these studies, but they can guide future research on cortisol and selfishness. Because these examples give some preliminary grounds to suggest that cortisol might have something to do with selfishness, the link between stress-responses and *amour-prorpe* deserves, I think, some more specific concentration in the future. But what about the other end of the continuum, life-sustenance? What could be said of it in terms of contemporary research?

5. RESEARCH RELATED TO THE LIFE-SUSTAINING ORIENTATION

In terms of life-sustenance, several types of immersive experiences share common biomarkers. Therefore, a shared underlying basis for different self-transcendent experiences that share the feeling of being one with a larger whole has been suggested.[62]

Nature exposure, nature connectedness, and mindfulness induce calmer heart rates, breathing, brain waves, and lower cortisol levels. A connection between nature connectedness and mindfulness has been demonstrated.[63]

Together heart rates, breathing, and brain waves form a single dynamic

[61] Dane, Laura K, Peter K Jonason, and Marlene McCaffrey. 'Physiological Tests of the Cheater Hypothesis for the Dark Triad Traits: Testosterone, Cortisol, and a Social Stressor.' *Personality and Individual Differences 121* (2018): 227–31; Reinhard, David A, Sara H Konrath, William D Lopez, and Heather G Cameron. 'Expensive Egos: Narcissistic Males Have Higher Cortisol.' *PloS One 7*, no. 1 (2012); Wardecker, Britney M, William J Chopik, Onawa P LaBelle, and Robin S Edelstein. 'Is Narcissism Associated with Baseline Cortisol in Men and Women?' *Journal of Research in Personality 72* (2018): 44–49.

[62] Yaden, David Bryce, Jonathan Haidt, Ralph W Hood, David R Vago, and Andrew B Newberg. 'The Varieties of Self-Transcendent Experience.' *Review of General Psychology 21*, no. 2 (2017): 143–60. (henceforth cited as Self-transcendent Experience).

[63] Chang et al., Lower cortisol, and Desai, Radhika, Anisha Tailor, and Tanvi Bhatt. 'Effects of Yoga on Brain Waves and Structural Activation: A Review.' *Complementary Therapies in Clinical Practice 21*, no. 2 (2015): 112–18 (Henceforth cited as Effects of Yoga); Pascoe, Michaela C, David R Thompson, Zoe M Jenkins, and Chantal F Ski. 'Mindfulness Mediates the Physiological Markers of Stress: Systematic Review and Meta-Analysis.' *Journal of Psychiatric Research 95* (2017): 156–78 (henceforth cited as Mindfullness); Shuda, Quincy, Michael E Bougoulias, and Rebecca Kass. 'Effect of Nature Exposure on Perceived and Physiologic Stress: A Systematic Review.' *Complementary Therapies in Medicine 53*, (2020) (henceforth cited as Nature Exposure); Schutte, Nicola S, and John M Malouff. 'Mindfulness and Connectedness to Nature: A Meta-Analytic Investigation.' *Personality and Individual Differences* 127 (2018): 10–14.

system of brain-body oscillations.[64] They are related to cortisol secretion: calmer oscillations are associated with lower cortisol levels. Low cortisol levels, in turn, are related to both nature exposure and transcendental experiences.[65] All in all, it seems plausible to suggest that lower cortisol may be closely linked to the biomarkers of psychological nature connectedness and thus, life-sustenance.

Another question is how the brain areas regulating our sense of individuality react during life-threatening situations or in states of harmony. For example, the medial prefrontal cortex is suggested to 'stitch' together the sense of self—through processes such as self-awareness and self-reflection—from various sources.[66] In chronic stress, cortisol reallocates or suppresses the energetic resources of the medial prefrontal cortex. It is believed to coordinate additional stress-responses.[67] Cortisol also induces increased amygdala connectivity in the medial prefrontal cortex, which in turn has been suggested to reflect the facilitation of stress-induced self-evaluative processes.[68] Consequently, various kinds of self-concentration seem to be enhanced by cortisol secretion. Specified studies are

---

[64] Klimesch, Wolfgang. 'The Frequency Architecture of Brain and Brain Body Oscillations: An Analysis.' *The European Journal of Neuroscience 48, no. 7* (2018): 2431–53.
While there is strong evidence for this coherent oscillatory system, research indicates that it is not unified in all circumstances: Taggart, P, H Critchley, and P. D Lambiase. 'Heartbrain Interactions in Cardiac Arrhythmia.' *Heart (British Cardiac Society) 97*, no. 9 (2011): 698–708; Karjalainen, Suvi, Tuija Aro, and Tiina Parviainen. 'Coactivation of Autonomic and Central Nervous Systems During Processing of Socially Relevant Information in Autism Spectrum Disorder: A Systematic Review.' *Neuropsychology Review 34*, no. 1 (2024): 214–31.

[65] Pascoe et al., Mindfullness; Shuda et al., Nature Exposure; Antonelli, Michele, Grazia Barbieri, and Davide Donelli. 'Effects of Forest Bathing (Shinrin-Yoku) on Levels of Cortisol as a Stress Biomarker: A Systematic Review and Meta-Analysis.' *International Journal of Biometeorology 63*, no. 8 (2019) (Henceforth cited as Shinrin-Yoku): 1117–34; Kamei, Tsutomu, Yoshitaka Toriumi, Hiroshi Kimura, Hiroaki Kumano, Satoshi Ohno, and Keishin Kimura. 'Decrease in Serum Cortisol during Yoga Exercise Is Correlated with Alpha Wave Activation.' *Perceptual and Motor Skills 90*, no. 3 (2000): 1027–32.

[66] Josipovic, Zoran. 'Neural Correlates of Nondual Awareness in Meditation.' *Annals of the New York Academy of Sciences 1307*, no. 1 (2014): 9–18. (Henceforth cited as Nondual Awareness). For other possible neural indicators, see Yaden et al., Self-transcendent experience.

[67] McKlveen, J. M, B Myers, and J. P Herman. 'The Medial Prefrontal Cortex: Coordinator of Autonomic, Neuroendocrine and Behavioural Responses to Stress.' *Journal of Neuroendocrinology 27*, no. 6 (2015): 446–56; Wu, Jianhui, Shen Zhang, Wanqing Li, Shaozheng Qin, Yong He, Zhi Yang, Tony W Buchanan, Chao Liu, and Kan Zhang. 'Cortisol Awakening Response Predicts Intrinsic Functional Connectivity of the Medial Prefrontal Cortex in the Afternoon of the Same Day.' NeuroImage (Orlando, Fla.) 122 (2015): 158–65.

[68] Veer, Ilya M, Nicole Y.L Oei, Philip Spinhoven, Mark A van Buchem, Bernet M Elzinga, and Serge A.R.B Rombouts. 'Beyond Acute Social Stress: Increased Functional Connectivity between Amygdala and Cortical Midline Structures.' *NeuroImage (Orlando, Fla.) 57*, no. 4 (2011): 1534–41.

needed to understand better the connections.

Practicing mindfulness, in turn, induces reduced activity and connectivity in the medial prefrontal cortex.[69] Studies show a *decrease* in the activity of the nodes in the prefrontal cortex related to *non-dual* meditation with immersive experiences, but an *increase* in the activity of the same nodes related to meditation practices with the goal of '*increased self-awareness*'.[70]

Given the similarities between the biomarkers of different transcendental experiences—particularly of nature connectedness and meditation/mindfulness—I suggest that the state of immersive oneness with nature may have similar effects to brain activity as meditative practices.

Before it is time for conclusive remarks, I will briefly consider the systems-based assumption of us humans being seamless parts of the environment. There are several areas of research challenging the prominent Western idea of us being independent, isolated individuals separate from our social and natural environments. I will, in particular, explore the current research on synchronisation between individuals, and the effect of microbiota on us and our behavior. The aim of this consideration is to further develop some ideas that Rousseau himself only slightly hinted towards.

6. HUMANS AS PART OF THEIR ENVIRONMENT

6.1 Synchronisation

Rousseau argued that the manners-of-beings are contagious.[71] Fromm and Næss also suggested that biophilic orientations and narrow/Ecological selves are societally shared.[72] This could be simply about socialisation, which is deeply embedded in how we cognize, perceive, and act in the world. For example, Richard Nisbett and colleagues investigated the differences between Western, individualistic cultures and Eastern, less individualistic ones. According to them,

[69] Kraemer, Kristen M., Felipe A. Jain, Darshan H. Mehta, and Gregory L. Fricchione. 2022. 'Meditative and Mindfulness-Focused Interventions in Neurology: Principles, Science, and Patient Selection.' *Seminars in Neurology 42* (2): 123–135.
[70] Josipovic, Nondual Awareness.
[71] Rousseau, Julie, 249, 436.
[72] Fromm, Heart of Man; Diehm, Connectedness.

socialisation influences metaphysical views (concerning the nature of the world and causality), tacit epistemologies (what is important knowledge and how to attain it), and consequently, the development and application of certain cognitive processes at the expense of others: what is attended to, how events are explained or predicted.[73] Socialisation, thus, manifests in the total, entire way of being.

However, the contagiousness is not necessarily only due to socialisation. Rousseau advised leaving the city and seeking solitude when endeavoring to find harmony because, in nature, there are less dominantly *amour-proprean* people around.[74] Contemporarily, it has been shown that the physiological biomarkers of the orientations *synchronise* with those of other people: We constantly physically attune with others.[75] During social interactions, our autonomic nervous system responses and neural representations resonate with the states of other people. The decrease in cortisol levels calms down heart rates, breathing, and brainwaves.[76] All these features tend to synchronise: Indeed, *stress* is suggested to be contagious.[77]

Synchronisation is crucial for social cohesion: it is a basic evolutionary-based mechanism for facilitating empathy, affiliation, bonding, and cooperation, occurring from birth throughout life, specifically between closest ones but also

---

[73] Nisbett, Richard E, Kaiping Peng, Incheol Choi, and Ara Norenzayan. 'Culture and Systems of Thought: Holistic Versus Analytic Cognition.' *Psychological Review 108*, no. 2 (2001): 291–310.

[74] Rousseau, Julie, 249, 436

[75] Richerson, Peter J., and Robert Boyd. 2010. 'The Darwinian Theory of Human Cultural Evolution and Gene-Culture Coevolution.' In *Evolution Since Darwin: The First 150 Years*, edited by M. A. Bell, D. J. Futuyma, W. F. Eanes, and J. S. Levinton. Gruter Institute Squaw Valley Conference 2010: Law, Institutions & Human Behavior.

[76] Desai et al., Effects of Yoga; Shuda et al., Nature Exposure; Antonelli et al., Shinrin-Yoku; Smith, Ashley M, Timothy J Loving, Erin E Crockett, and Lorne Campbell. 'What's Closeness Got to Do with It? Men's and Women's Cortisol Responses When Providing and Receiving Support.' *Psychosomatic Medicine 71*, no. 8 (2009): 843–51.

[77] Buchanan, Tony W, Sara L Bagley, R. Brent Stansfield, and Stephanie D Preston. 'The Empathic, Physiological Resonance of Stress.' *Social Neuroscience 7, no. 2* (2012): 191–201; Herrando, Carolina, and Efthymios Constantinides. 'Emotional Contagion: A Brief Overview and Future Directions.' *Frontiers in Psychology 12* (2021): 712606–712606; Mayo, Oded, Michal Lavidor, and Ilanit Gordon. 'Interpersonal Autonomic Nervous System Synchrony and Its Association to Relationship and Performance – a Systematic Review and Meta-Analysis.' *Physiology & Behavior 235* (2021) (henceforth cited as Synchrony); Oberle, Eva, and Kimberly A Schonert-Reichl. 'Stress Contagion in the Classroom? The Link between Classroom Teacher Burnout and Morning Cortisol in Elementary School Students.' *Social Science & Medicine (1982)* 159 (2016): 30–37; Wethington, E. 2000. 'Contagion of Stress.' *Advances in Group Processes, 17*, 229–253. Bingley: Emerald Group Publishing Limited

between strangers.[78] Synchronisation has also been detected in non-human animals and between species.[79]

Rousseau noticed that *pitié* is more easily invoked when the being is similar or close to us:[80] Embodying and imagining suffering becomes easier. This enhances the synchronisation of autonomic responses, including empathetic ones.[81] Synchronicity is not unique to humans, but as a highly social species, we are especially suitable for it. Unfortunately, humans are also vulnerable to the reverse side of social bonding; ingroup favoritism, leading to racism and speciesism, and comparisons and competitiveness, leading to excessive *amour-propre.* Rousseau stated that *pitié* can be buried under distractions:[82] These distractions might be (1) the anticipations of social-psychological stressors and (2) the contagiousness of the biomarkers related to these stressors. Both impair the homeostatic balance through which the survival of the surrounding life and our own are maintained.

Nature exposure is not the sole means of finding harmony; it can be reached without physical exposure to nature and maintained also in urban and social contexts, but it is easier when exposed.[83] This becomes important when considering that 'nature exposure' in HNC research does not always indicate contact with actual nature but instead, mere pictures. Koivisto and colleagues have suggested that *top-down processing*—expectations guiding perception—might explain why even a false assumption of nature exposure can lead to calmer brain waves.[84] Already Rousseau acknowledged the power of our 'anterior impressions':

---

[78] Mayo et al., Synchrony. In contrast to this, Reindl et al. (2022) found that the autonomic nervous system and neural synchrony were positively related during competition but not during cooperation in adult-child-dyads.

[79] Pérez-Manrique, Ana, and Antoni Gomila. 'Emotional Contagion in Nonhuman Animals: A Review.' Wiley Interdisciplinary Reviews. *Cognitive Science 13, 1* (2022); Sundman, Ann-Sofie, Enya Van Poucke, Ann-Charlotte Svensson Holm, Åshild Faresjö, Elvar Theodorsson, Per Jensen, and Lina S. V Roth. 'Long-Term Stress Levels Are Synchronized in Dogs and Their Owners.' *Scientific Reports 9*, 1 (2019).

[80] Rousseau, Emilé, 225

[8181] De Waal, Altruism.

[82] Rousseau, Moral writings, 199; Julie, 64

[83] Rousseau, Moral writings, 175–203

[84] Koivisto, Mika, Enni Jalava, Lina Kuusisto, Henry Railo, and Simone Grassini. 'Top-Down Processing and Nature Connectedness Predict Psychological and Physiological Effects of Nature.' *Environment and Behavior 54*, no. 5 (2022): 917–45.

Expectations influence the responses to the environment.[85] Living as part of the ecology, predicting events and initiating reactions accordingly are pivotal. Sometimes, this procedure misfires. As stress-responses, also life-sustenance can function anticipatorily: If visiting a forest usually triggers stress release, simply the thought of visiting may induce a 'placebo effect'.[86]

6.2 Nature's role in the puzzle

Rousseau saw many benefits in mere nature exposure, and he also suggested that immersive experiences arise more easily in nature.[87] One explanation for nature exposure to have an independent influence on us without experiences of connectedness could be the multiple ways in which our gut microbiota affects us: We have coevolved in symbiotic homeostasis with microbiomes since the dawn of life, and perturbations in the microbiome can result in imbalances with severe consequences. The microbiota and the stress-response reciprocally affect one another. The gut microbiota also affects social behavior and psychological health.[88]

Microbiota is dependent on the inhabited environment. Humans living in industrialised societies have been exposed to less microbiota than before.[89] Gut microbiota varies between people living in different habitual areas.[90] Furthermore, we do not just 'receive' the effects of the environment; practicing meditation regularly helps regulate the gut microbiome.[91] Given the parallels

[85] Rousseau, Jean-Jacques. 1782a (1996). The Confessions. Wordsworth Editions, 109, 226 (henceworth cited as Wordsworth Confessions); Rousseau, Moral writings 194; Rousseau, Julie, 64; Rousseau, Emilé 327.
[86] Antonelli et al., Shinrin-Yoku
[87] Rousseau, Wordsworth Confessions, 226, 237, 448, 631; Rousseau, Moral writings, 189–200, 310; Rousseau, Emilé, 474.
[88] Liu et al., Understanding; Allen, Andrew P, Timothy G Dinan, Gerard Clarke, and John F Cryan. 'A Psychology of the Human Brain–Gut–Microbiome Axis.' *Social and Personality Psychology Compass 11*, no. 4 (2017): e12309-n/a; Bruckner, Joseph J, Sarah J Stednitz, Max Z Grice, Dana Zaidan, Michelle S Massaquoi, Johannes Larsch, Alexandra Tallafuss, Karen Guillemin, Philip Washbourne, and Judith S Eisen. 'The Microbiota Promotes Social Behavior by Modulating Microglial Remodeling of Forebrain Neurons.' *PLoS Biology 20*, no. 11 (2022): e3001838–e3001838.
[89] Robinson & Breed, Lovebug.
[90] Khine, Wei Wei Thwe. *Human Microbiota : Determining Dietary Factors on the Journey from Infants to Adults.* Dissertation, University of Turku, 2022.
[91] Sun, Ying, Peijun Ju, Ting Xue, Usman Ali, Donghong Cui, and Jinghong Chen. 'Alteration of Faecal Microbiota Balance Related to Long-Term Deep Meditation.' *General Psychiatry 36*, no. 1 (2023).

between the experiences of meditation and nature connectedness, it might not be implausible to suggest that nature connectedness functions similarly.

Synchronisation and our symbiosis with microbiota offer some examples that shed light on our starting point: Rousseau's (and others) suggestion that the environment we live in substantially affects the way we become to be. We are living embedded in our environments, like Næss' knots in the web of life.

Now, it is time to wrap up.

7. DISCUSSION AND CONCLUSIONS

This paper pursued to offer a possible explanation for the human-nature connection and its wide-ranging effects by constructing the life-sustenance hypothesis, based on Jean-Jacques Rousseau's philosophy and an extensive (but not comprehensive) review on relevant contemporary multidisciplinary science. The life-sustenance hypothesis suggests that humans and other life-forms have orientations that guide them to sustain life as a whole. These orientations include self-sustenance, tending toward self-preservation, and life-sustenance, tending toward sustaining other life than one's own. It was suggested, that nature connectedness exists because it is a species-specific manifestation of the life-sustaining orientation. *Nature exposure* was further suggested to generate beneficial effects on well-being, prosociality, and pro-environmentalism, because of (1) fewer anticipatory, social-psychological stressors around, (2) fewer people with excessive self-sustaining orientations to synchronise with, and (3) more contact with stress-reducing microbiota.

One route for a sense of oneness with the natural world to enhance the positive effects of nature exposure is that immersive experiences affect our microbiota, which in turn affects our stress levels, health, and prosociality. Moreover, immersive experiences represent peaks at the extreme end of the life-sustaining orientation, possibly able to affect the homeostatic baselines in the long run. This is what Rousseau suggested as well: one means for an excessively *amour-proprean* person to reach harmony is to find solitude in nature—later, when the balanced manner-of-being is more stabilised, one can live ceaselessly amidst society.[92] Like with blood pressure, there are personal baselines, but also certain

[92] Rousseau, Moral writings, 199.

ranges in which the baselines typically are 'healthy': not too high or too low. By changing something in one's lifestyle, these baselines can be influenced for the better—or, for worse. Similar thinking can be applied also to self-sustaining and life-sustaining orientations, given that they are understood to function homeostatically.

Excessive and prolonged stress-responses can lead to (1) physical and psychological health problems but also, if taken to represent *amour-propre*, (2) to the negligence of the non-egoistic prosocial and pro-environmental tendencies. That HNC alleviates this excessive, prolonged, social-psychological stress indicates a shift in the continuum towards the life-sustaining end. In this way, the life-sustenance hypothesis is able to address a wide range of the benefits of HNC: not just health benefits, but also the prosocial and proenvironmental effects. Moreover, it is able to provide a possible explanation for the multidimensionality of nature connectedness (due to life-sustaining orientation affecting the entire way of being), and it being both a state-like (harmony), and a trait-like (baselines of the orientations closer to the life-sustaining end) phenomenon.

From the perspective of life-sustenance hypothesis, also the alleged Western bias of HNC would make sense. A person can manifest balanced orientations without ever having experienced feelings of immersion. For example, people socialised to dominant life-sustenance instead of individualism may have never experienced immersion and yet, have achieved balanced manners-of-being. They may even not have any 'emotional connection' with nature. This does not, however, imply that life-sustenance would not manifest in some way or another in every culture: Cultural adaptation may have induced different manifestations. Multicultural research is needed.

Importantly, the life-sustenance hypothesis does not suggest that a stress-response would in all cases completely shut down the life-sustaining orientation—the situation is far more complex. In Rousseau's system, even in a life-threatening situation, *amour-de-soi* balanced by *pitié* would not induce *unneeded* harm. The excessive inhibition of life-sustenance is a response specifically to the social-psychological stressors: different stimuli initiate different kinds of stress-responses in different physiological systems, and prolonged excessiveness changes the

character of the responses (Sapolsky 2004).[93] Studies show that cortisol release, in particular, occurs especially in situations with 'high ego-involvement' (and novelty, low controllability, and predictivity).[94] Studies targeted to detect these physiological changes in detail are needed: How and when the *amour-proprean* imbalance physically appears has for now been only speculatory.

The overarching idea of the life-sustenance hypothesis is that for an organism to be healthy and well, contributing to the well-being of the whole it partakes is just as crucial as that of its parts. The impact is direct. Contributing to the well-being of other life—not harming without a self-preservational need, or helping those in need—would be as natural an impulse as contributing to one's own well-being. Analogously, not contributing (with means available) would lead to consequences on one's own well-being, especially when the situation is excessive and continuous: The distress accumulates, and the imbalanced state becomes more acute. Compare this to hunger, which can be borne in small doses without dire consequences. It is only in severe, excessive, and prolonged hunger that the most serious consequences appear. We already know that prolonged stress erodes well-being, and there seems to be some indication that prolonged stress could be related to enhanced selfishness. However, more research is needed to further investigate the connections.

Future studies should also consider the effects of other stress-related systems. For instance, it seems that in some stress-related occasions the autonomic nervous system activates but the HPA axis responsible for cortisol release does not.[95] In addition, the role of other hormones should be considered—Grahn and colleagues for instance have suggested that the oxytocinergic system works as a mediator of the anti-stress effects induced by nature.[96] However, oxytocin also plays a role in in-group favoritism, so its role in life-sustenance would need further

[93] Sapolsky, Zebras.

[94] Kirschbaum, Clemens, and Dirk H Hellhammer. 'Salivary Cortisol in Psychoneuroendocrine Research: Recent Developments and Applications.' *Psychoneuroendocrinology.* Oxford: Elsevier Ltd, 1994.

[95] Sapolsky, Zebras.

[96] Grahn, Patrik, Johan Ottosson, and Kerstin Uvnäs-Moberg. 'The Oxytocinergic System as a Mediator of Anti-Stress and Instorative Effects Induced by Nature: The Calm and Connection Theory.' *Frontiers in Psychology 12* (2021): 617814-.

investigation.[97]

Life-sustenance always happens *in situ*—in relation to the environment. Because of this, the life-sustenance hypothesis does not offer any solutions to generalised 'social dilemmas', examples of individual interests clashing with collective ones. What can be said, however, is that when one is present in such a situation, the balance between the orientations matters: A dominantly self-sustainingly oriented person will tend to pursue more than needed at the expense of others.

One aim of this paper was to integrate diverse strands of research and theory into a coherent whole. The life-sustenance hypothesis is still in its early stages, built on several hypothetical assumptions and leaving room for alternative interpretations. To refute for example the suggestion of the physiological manifestation of the excessive *amour-propre* (excessive, prolonged anticipatory social-psychological stress-response) in itself does not refute the systems biological basis of the life-sustenance hypothesis. Some of the viewpoints included in the hypothesis are still controversial and thus require more empirical support. Competing arguments and research have been referenced, primarily in footnotes, but a detailed evaluation of the hypothesis against these counterpoints is left for future work. For now, the strength of the hypothesis lies in its internal coherence. Much remains to be explored and refined.

Given the tremendous positive impact that HNC seems to potentially have on us, understanding the phenomenon downright to its roots would benefit practical implementations targeted to enhance our connectedness. Such practical implementations could regard for instance educational approaches, as described in Salmi (2025). In sum, I find it safe to say that Rousseau might have indeed been onto something interesting and worthwhile to explore more deeply—both philosophically and empirically—in the future.

The life-sustenance hypothesis is meant to function as a useful explanatory framework, providing one possible account for the existence of the multifaceted phenomena of human-nature connection, non-egoistic altruism, and their association with one another. Perhaps—hopefully—it will inspire some insightful

[97] De Dreu, Carsten K.W. 'Oxytocin Modulates Cooperation within and Competition between Groups: An Integrative Review and Research Agenda.' *Hormones and Behavior 61*, no. 3 (2012): 419–28.

research in the future.

ACKNOWLEDGEMENTS

The author would sincerely like to acknowledge Dr. Helena Siipi, Dr. Jarno Tuominen, and Professor Paula Salo for their valuable feedback and support throughout the development and writing of this paper. The idea of the life-sustenance hypothesis has emerged not only from interpretative and integrative readings but also from insightful conversations and comments shared by many thoughtful colleagues and friends, to whom all I am deeply grateful.

FUNDING STATEMENT

This work was supported by the Finnish Cultural Foundation under Grant 85222240, the Wihuri Foundation under Grant 00220325, and the Kone Foundation under Grant 202201416. The funders had no role in the design of the study, the collection, analysis, or interpretation of data, the writing of the manuscript, or the decision to submit the article for publication.

Department of Psychology and Speech-Language Pathology
University of Turku
Assistentinkatu 7, 20014 Turku, Finland.
https://orcid.org/0000-0001-6609-9478
Correspondence to: imsalm@utu.fi

REFERENCES

Allen, Andrew P, Timothy G Dinan, Gerard Clarke, and John F Cryan. 'A Psychology of the Human Brain–Gut–Microbiome Axis.' *Social and Personality Psychology Compass* vol. 11, no. 4, 2017: e12309-n/a. https://doi.org/10.1111/spc3.12309.

Antonelli, Michele, Grazia Barbieri, and Davide Donelli. 'Effects of Forest Bathing (Shinrin-Yoku) on Levels of Cortisol as a Stress Biomarker: A Systematic Review and Meta-Analysis.' *International Journal of Biometeorology* vol. 63, no. 8, 2019, pp. 1117–34. https://doi.org/10.1007/s00484-019-01717-x.

Azulay, Hagar, Nitzan Guy, Yoni Pertzov, and Salomon Israel. 'Empathy Modulates the

Effect of Stress Reactivity on Generous Giving.' *Frontiers in Neuroscience* vol. 16, 2022, pp. 814789–814789. https://doi.org/10.3389/fnins.2022.814789.

Barragan-Jason, Gladys, Claire de Mazancourt, Camille Parmesan, Michael C Singer, and Michel Loreau. 'Human–Nature Connectedness as a Pathway to Sustainability: A Global Meta-analysis.' *Conservation Letters* vol. 15, no. 1, 2022: e12852-n/a. https://doi.org/10.1111/conl.12852.

Barragan-Jason, Gladys, Michel Loreau, Claire de Mazancourt, Michael C Singer, and Camille Parmesan. 'Psychological and Physical Connections with Nature Improve Both Human Well-Being and Nature Conservation: A Systematic Review of Meta-Analyses.' *Biological Conservation* vol. 277, 2023. https://doi.org/10.1016/j.biocon.2022.109842.

Birch, Jonathan. 'Are Kin and Group Selection Rivals or Friends?' *Current Biology* vol. 29, no. 11, 2019: R433–38. https://doi.org/10.1016/j.cub.2019.01.065.

Boogerd, Fred, Frank J. Bruggeman, Jan-Hendrik S. Hofmeyr, and Hans V. Westerhoff. '1 - Towards Philosophical Foundations of Systems Biology: Introduction.' In *Systems Biology*, pp. 3–19. Elsevier B.V, 2007. https://doi.org/10.1016/B978-044452085-2/50003-6.

Bruckner, Joseph J, Sarah J Stednitz, Max Z Grice, Dana Zaidan, Michelle S Massaquoi, Johannes Larsch, Alexandra Tallafuss, Karen Guillemin, Philip Washbourne, and Judith S Eisen. 'The Microbiota Promotes Social Behavior by Modulating Microglial Remodeling of Forebrain Neurons.' *PLoS Biology* vol. 20, no. 11, 2022: e3001838–e3001838. https://doi.org/10.1371/journal.pbio.3001838.

Buchanan, Tony W, Sara L Bagley, R. Brent Stansfield, and Stephanie D Preston. 'The Empathic, Physiological Resonance of Stress.' *Social Neuroscience* vol. 7, no. 2, 2012, pp. 191–201. https://doi.org/10.1080/17470919.2011.588723.

Capra, Fritjof, and Pier Luigi Luisi. *The Systems View of Life: A Unifying Vision*. Cambridge University Press, 2014. https://doi.org/10.1017/CBO9780511895555.

Carron, Paul. 'Ape Imagination? A Sentimentalist Critique of Frans de Waal's Gradualist Theory of Human Morality.' *Biology & Philosophy* vol. 33, no. 3–4, 2018. https://doi.org/10.1007/s10539-018-9632-4.

Chang, Chia-Chen, Brenda B Lin, Xiaoqi Feng, Erik Andersson, John Gardner, and Thomas Astell-Burt. 'A Lower Connection to Nature Is Related to Lower Mental Health Benefits from Nature Contact.' *Scientific Reports* vol. 14, no. 1, 2024. https://doi.org/10.1038/s41598-024-56968-5.

Cialdini, Robert B, Mark Schaller, Donald Houlihan, Kevin Arps, Jim Fultz, and Arthur L Beaman. 'Empathy-Based Helping: Is It Selflessly or Selfishly Motivated?' *Journal of Personality and Social Psychology* vol. 52, no. 4, 1987, pp. 749–58.

https://doi.org/10.1037/0022-3514.52.4.749.

Cusimano, Samuel, and Beckett Sterner. 'The Objectivity of Organizational Functions.' *Acta Biotheoretica* vol. 68, no. 2, 2020, pp. 253–69. https://doi.org/10.1007/s10441-019-09365-9.

Dane, Laura K, Peter K Jonason, and Marlene McCaffrey. 'Physiological Tests of the Cheater Hypothesis for the Dark Triad Traits: Testosterone, Cortisol, and a Social Stressor.' *Personality and Individual Differences* vol. 121, 2018, pp. 227–31. https://doi.org/10.1016/j.paid.2017.09.010.

Damasio, Antonio. The Strange Order of Things: Life, Feeling, and the Making of Cultures. New York: Pantheon Books, 2018.

Darwin, Charles. The Descent of Man, and Selection in Relation to Sex. London: John Murray, 1871.

Darwin, Charles. *The Expressions of the Emotions in Man and Animals*. New York: D. Appleton and Company, 1897.

Darwin, Charles. *On the Origin of Species: By Means of Natural Selection*. 6th ed. Auckland: Floating Press, 2009 [1876].

von Dawans, Bernadette, Julia Strojny, and Gregor Domes. 'The Effects of Acute Stress and Stress Hormones on Social Cognition and Behavior: Current State of Research and Future Directions.' *Neuroscience and Biobehavioral Reviews* vol. 121, 2021, pp. 75–88. https://doi.org/10.1016/j.neubiorev.2020.11.026.

De Dreu, Carsten K.W. 'Oxytocin Modulates Cooperation within and Competition between Groups: An Integrative Review and Research Agenda.' *Hormones and Behavior* vol. 61, no. 3, 2012, pp. 419–28. https://doi.org/10.1016/j.yhbeh.2011.12.009.

Desai, Radhika, Anisha Tailor, and Tanvi Bhatt. 'Effects of Yoga on Brain Waves and Structural Activation: A Review.' *Complementary Therapies in Clinical Practice* vol. 21, no. 2, 2015, pp. 112–18. https://doi.org/10.1016/j.ctcp.2015.02.002.

de Waal, Frans B.M. 'Putting the Altruism Back into Altruism: The Evolution of Empathy.' *Annual Review of Psychology* vol. 59, no. 1, 2008, pp. 279–300. https://doi.org/10.1146/annurev.psych.59.103006.093625.

Diehm, Christian. Connectedness to Nature, Deep Ecology, and Conservation Social Science. Lanham, MD: Lexington Books, 2020.

Evetts, Cynthia. 'Fight or Flight Versus Tend and Befriend Behavioral Response to Stress.' *The American Journal of Occupational Therapy* vol. 71, no. 4_Supplement_1, 2017: 7111505083-7111505083p1. https://doi.org/10.5014/ajot.2017.71S1-PO1127.

Freitas, Carolina Coelho Moniz de Campos, and Flávia de Lima Osório. 'Moral

Judgment and Hormones: A Systematic Literature Review.' *PloS One* vol. 17, no. 4, 2022: e0265693–e0265693. https://doi.org/10.1371/journal.pone.0265693.

Fromm, Erich. The Heart of Man: Its Genius for Good and Evil. New York: Harper and Row, 1964.

Gallegos-Riofrío, Carlos Andres, Hassan Arab, Amaya Carrasco-Torrontegui, and Rachelle K Gould. 'Chronic Deficiency of Diversity and Pluralism in Research on Nature's Mental Health Effects: A Planetary Health Problem.' *Current Research in Environmental Sustainability* vol. 4, 2022. https://doi.org/10.1016/j.crsust.2022.100148.

Gardner, Andy. 'Genetical Theory of Multilevel Selection.' *Journal of Evolutionary Biology* vol. 28, no. 2, 2015, pp. 305–19. https://doi.org/10.1111/jeb.12566.

Grahn, Patrik, Johan Ottosson, and Kerstin Uvnäs-Moberg. 'The Oxytocinergic System as a Mediator of Anti-Stress and Instorative Effects Induced by Nature: The Calm and Connection Theory.' *Frontiers in Psychology* vol. 12, 2021: 617814-. https://doi.org/10.3389/fpsyg.2021.617814.

Haga, Andreas, Niklas Halin, Mattias Holmgren, and Patrik Sörqvist. 'Psychological Restoration Can Depend on Stimulus-Source Attribution: A Challenge for the Evolutionary Account?' *Frontiers in Psychology* vol. 7, 2016: 1831–1831. https://doi.org/10.3389/fpsyg.2016.01831.

Hepach, Robert, Amrisha Vaish, and Michael Tomasello. 'A New Look at Children's Prosocial Motivation.' *Infancy* vol. 18, no. 1, 2013, pp. 67–90. https://doi.org/10.1111/j.1532-7078.2012.00130.x.

Hepach, Robert, Jan M. Engelmann, Esther Herrmann, Stella C. Gerdemann & Tomasello, Michael. Evidence for a developmental shift in the motivation underlying helping in early childhood. *Developmental Science*, vol. 26, no. 1, 2023: e13253. https://doi.org/10.1111/desc.13253

Herrando, Carolina, and Efthymios Constantinides. 'Emotional Contagion: A Brief Overview and Future Directions.' *Frontiers in Psychology* vol. 12, 2021: 712606–712606. https://doi.org/10.3389/fpsyg.2021.712606.

Hurly, Jane, and Gordon J Walker. 'Nature in Our Lives: Examining the Human Need for Nature Relatedness as a Basic Psychological Need.' *Journal of Leisure Research* vol. 50, no. 4, 2019, pp. 290–310. https://doi.org/10.1080/00222216.2019.1578939.

Josipovic, Zoran. 'Neural Correlates of Nondual Awareness in Meditation.' *Annals of the New York Academy of Sciences* 1307, no. 1 (2014): 9–18. https://doi.org/10.1111/nyas.12261.

Joye, Yannick, and Andreas DeBlock. ''Nature and I Are Two': A Critical Examination

of the Biophilia Hypothesis.' *Environmental Values* vol. 20, no. 2, 2011, pp. 189–215. https://doi.org/10.3197/096327111X12997574391724.

Joye, Yannick, and Siegfried Dewitte. 'Nature's Broken Path to Restoration. A Critical Look at Attention Restoration Theory.' *Journal of Environmental Psychology* vol. 59, 2018, pp. 1–8. https://doi.org/10.1016/j.jenvp.2018.08.006.

Jylkkä, Jussi, and Henry Railo. 'Consciousness as a Concrete Physical Phenomenon.' *Consciousness and Cognition* vol. 74, 2019. https://doi.org/10.1016/j.concog.2019.102779.

Kamei, Tsutomu, Yoshitaka Toriumi, Hiroshi Kimura, Hiroaki Kumano, Satoshi Ohno, and Keishin Kimura. 'Decrease in Serum Cortisol during Yoga Exercise Is Correlated with Alpha Wave Activation.' *Perceptual and Motor Skills* vol. 90, no. 3, 2000, pp. 1027–32. https://doi.org/10.2466/pms.2000.90.3.1027.

Kaplan, Stephen. 'The Restorative Benefits of Nature: Toward an Integrative Framework.' *Journal of Environmental Psychology* vol. 15, no. 3, 1995, pp. 169–82. https://doi.org/10.1016/0272-4944(95)90001-2.

Karjalainen, Suvi, Tuija Aro, and Tiina Parviainen. 'Coactivation of Autonomic and Central Nervous Systems During Processing of Socially Relevant Information in Autism Spectrum Disorder: A Systematic Review.' *Neuropsychology Review* vol. 34, no. 1, 2024, pp. 214–31. https://doi.org/10.1007/s11065-023-09579-2.

Kirschbaum, Clemens, and Dirk H Hellhammer. 'Salivary Cortisol in Psychoneuroendocrine Research: Recent Developments and Applications.' *Psychoneuroendocrinology*. Oxford: Elsevier Ltd, 1994. https://doi.org/10.1016/0306-4530(94)90013-2.

Klimesch, Wolfgang. 'The Frequency Architecture of Brain and Brain Body Oscillations: An Analysis.' *The European Journal of Neuroscience* vol. 48, no. 7, 2018, pp. 2431–53. https://doi.org/10.1111/ejn.14192.

Koivisto, Mika, Enni Jalava, Lina Kuusisto, Henry Railo, and Simone Grassini. 'Top-Down Processing and Nature Connectedness Predict Psychological and Physiological Effects of Nature.' *Environment and Behavior* vol. 54, no. 5, 2022, pp. 917–45. https://doi.org/10.1177/00139165221107535.

Khine, Wei Wei Thwe. *Human Microbiota : Determining Dietary Factors on the Journey from Infants to Adults*. Dissertation, University of Turku, 2022. https://www.utupub.fi/bitstream/handle/10024/154767/AnnalesD1666Khine.pdf?sequence=1

Kraemer, Kristen M., Felipe A. Jain, Darshan H. Mehta, and Gregory L. Fricchione. 'Meditative and Mindfulness-Focused Interventions in Neurology: Principles, Science, and Patient Selection.' *Seminars in Neurology* vol. 42, no. 2, 2022, pp. 123–

135. https://doi.org/10.1055/s-0042-1742287.

Kropotkin, Peter. *Mutual Aid: A Factor of Evolution*. London: Freedom Press, 1987 [1902].

Leopold, Aldo. *A Sand County Almanac*. New York: Oxford University Press, 1949.

Levy, Kenneth N, Jessica K Hlay, Benjamin N Johnson, and Courtney P Witmer. 'An Attachment Theoretical Perspective on Tend-and-Befriend Stress Reactions.' *Evolutionary Psychological Science* vol. 5, no. 4, 2019, pp. 426–39. https://doi.org/10.1007/s40806-019-00197-x.

Liu, Richard T. 'The Microbiome as a Novel Paradigm in Studying Stress and Mental Health.' *The American Psychologist* vol. 72, no. 7, 2017, pp. 655–67. https://doi.org/10.1037/amp0000058.

Liu, Yongbo, Anne Cleary, Kelly S Fielding, Zoe Murray, and Anne Roiko. 'Nature Connection, pro-Environmental Behaviours and Wellbeing: Understanding the Mediating Role of Nature Contact.' *Landscape and Urban Planning* vol. 228, 2022. https://doi.org/10.1016/j.landurbplan.2022.104550.

Martin, Leanne, Mathew P White, Anne Hunt, Miles Richardson, Sabine Pahl, and Jim Burt. 'Nature Contact, Nature Connectedness and Associations with Health, Wellbeing and pro-Environmental Behaviours.' *Journal of Environmental Psychology* vol. 68, 2020. https://doi.org/10.1016/j.jenvp.2020.101389.

Maturana, Humberto R., and Francisco J. Varela. *Autopoiesis and Cognition: The Realization of the Living*. Boston Studies in the Philosophy of Science. Dordrecht: D. Reidel Publishing Company, 1972.

Mayer, F.Stephan, and Cynthia McPherson Frantz. 'The Connectedness to Nature Scale: A Measure of Individuals' Feeling in Community with Nature.' *Journal of Environmental Psychology* vol. 24, no. 4, 2004, pp. 503–15. https://doi.org/10.1016/j.jenvp.2004.10.001.

Mayo, Oded, Michal Lavidor, and Ilanit Gordon. 'Interpersonal Autonomic Nervous System Synchrony and Its Association to Relationship and Performance – a Systematic Review and Meta-Analysis.' *Physiology & Behavior* vol. 235, 2021. https://doi.org/10.1016/j.physbeh.2021.113391.

McEwen, Bruce S, and John C Wingfield. 'What Is in a Name? Integrating Homeostasis, Allostasis and Stress.' *Hormones and Behavior* vol. 57, no. 2, 2010, pp. 105–11. https://doi.org/10.1016/j.yhbeh.2009.09.011.

McKlveen, J. M, B Myers, and J. P Herman. 'The Medial Prefrontal Cortex: Coordinator of Autonomic, Neuroendocrine and Behavioural Responses to Stress.' *Journal of Neuroendocrinology* vol. 27, no. 6, 2015, pp. 446–56. https://doi.org/10.1111/jne.12272.

Meincke, Anne Sophie. 'Autopoiesis, Biological Autonomy and the Process View of Life.'

European Journal for Philosophy of Science vol. 9, no. 1, 2019. https://doi.org/10.1007/s13194-018-0228-2.

Moreno, Alvaro, and Matteo Mossio. *Biological Autonomy: A Philosophical and Theoretical Enquiry*. Dordrecht: Springer, 2015.

Moreno, Alvaro. 'A Systemic Approach to the Origin of Biological Organization.' In *Systems Biology*, 2007, pp. 243–68. https://doi.org/10.1016/B978-044452085-2/50013-9.

Næss, Arne. 'The Shallow and the Deep, Long-Range Ecology Movement.' *Inquiry* vol 16, 1973, pp. 95–100.

Neuhouser, Frederick. Rousseau's Theodicy of Self-Love: Evil, Rationality, and the Drive for Recognition. Oxford: Oxford University Press, 2008.

Nisbett, Richard E, Kaiping Peng, Incheol Choi, and Ara Norenzayan. 'Culture and Systems of Thought: Holistic Versus Analytic Cognition.' *Psychological Review* vol. 108, no. 2, 2001, pp. 291–310. https://doi.org/10.1037/0033-295X.108.2.291.

Oberle, Eva, and Kimberly A Schonert-Reichl. 'Stress Contagion in the Classroom? The Link between Classroom Teacher Burnout and Morning Cortisol in Elementary School Students.' *Social Science & Medicine (1982)* vol. 159, 2016, pp. 30–37. https://doi.org/10.1016/j.socscimed.2016.04.031.

Okasha, Samir. 'Biological Altruism.' *The Stanford Encyclopedia of Philosophy* (Summer 2020 Edition), edited by Edward N. Zalta, 2020. https://plato.stanford.edu/archives/sum2020/entries/altruism-biological

Otto, Siegmar, Pamela Pensini, Sarah Zabel, Pablo Diaz-Siefer, Elliot Burnham, Claudia Navarro-Villarroel, and Alexander Neaman. 'The Prosocial Origin of Sustainable Behavior: A Case Study in the Ecological Domain.' *Global Environmental Change* vol. 69, 2021. https://doi.org/10.1016/j.gloenvcha.2021.102312.

Pascoe, Michaela C, David R Thompson, Zoe M Jenkins, and Chantal F Ski. 'Mindfulness Mediates the Physiological Markers of Stress: Systematic Review and Meta-Analysis.' *Journal of Psychiatric Research* vol. 95, 2017, pp. 156–78. https://doi.org/10.1016/j.jpsychires.2017.08.004.

Pfattheicher, Stefan, Yngwie Asbjørn Nielsen, and Isabel Thielmann. 'Prosocial Behavior and Altruism: A Review of Concepts and Definitions.' *Current Opinion in Psychology* 44 (2022): 124–29. https://doi.org/10.1016/j.copsyc.2021.08.021.

Pérez-Manrique, Ana, and Antoni Gomila. 'Emotional Contagion in Nonhuman Animals: A Review.' *Wiley Interdisciplinary Reviews. Cognitive Science* vol. 13, no. 1, 2022. https://doi.org/10.1002/wcs.1560.

Pinker, Steven. The Better Angels of Our Nature: The Decline of Violence in History

and Its Causes. New York, NY: Penguin, 2012.

Plumwood, Val. 'Nature, Self, and Gender: Feminism, Environmental Philosophy, and the Critique of Rationalism.' *Hypatia* vol. 6, no. 1, 1991, pp. 3–27. https://doi.org/10.1111/j.1527-2001.1991.tb00206.x.

Rathmann, Joachim, Kalevi M Korpela, and Philipp Stojakowits. 'Pleistocene Hypothesis – Moving Savanna Perceptual Preference Hypothesis Beyond Savanna.' *Frontiers in Psychology* vol. 13, 2022. https://doi.org/10.3389/fpsyg.2022.901799.

Reindl, Vanessa, Sam Wass, Victoria Leong, Wolfgang Scharke, Sandra Wistuba, Christina Lisa Wirth, Kerstin Konrad, and Christian Gerloff. 'Multimodal Hyperscanning Reveals That Synchrony of Body and Mind Are Distinct in Mother-Child Dyads.' *NeuroImage (Orlando, Fla.)* vol. 251, 2022. https://doi.org/10.1016/j.neuroimage.2022.118982.

Reinhard, David A, Sara H Konrath, William D Lopez, and Heather G Cameron. 'Expensive Egos: Narcissistic Males Have Higher Cortisol.' *PloS One* vol. 7, no. 1, 2012. https://doi.org/10.1371/journal.pone.0030858.

Richerson, Peter J., and Robert Boyd. 'The Darwinian Theory of Human Cultural Evolution and Gene-Culture Coevolution.' In *Evolution Since Darwin: The First 150 Years*, edited by M. A. Bell, D. J. Futuyma, W. F. Eanes, and J. S. Levinton. Gruter Institute Squaw Valley Conference 2010: Law, Institutions & Human Behavior, 2010. https://ssrn.com/abstract=1616311

Robinson, Jake M, and Martin F Breed. 'The Lovebug Effect: Is the Human Biophilic Drive Influenced by Interactions between the Host, the Environment, and the Microbiome?' *The Science of the Total Environment* vol. 720, 2020. https://doi.org/10.1016/j.scitotenv.2020.137626.

Rousseau, Jean-Jacques. *Julie, or the New Heloise: Letters of Two Lovers Who Live in a Small Town at the Foot of the Alps*. Edited by Jean Vaché. Dartmouth College Press. ProQuest Ebook Central, 1997 [1761].

Rousseau, Jean-Jacques. *Emile: or On Education*. Translated by Allan Bloom. Basic Books, 1979 [1762].

Rousseau, Jean-Jacques. *Essay on the Origin of Languages and Writings Related to Music*. Translated and edited by John T. Scott. University Press of New England, 1998 [1781].

Rousseau, Jean-Jacques. *The Confessions*. Wordsworth Editions, 1996 [1782a].

Rousseau, Jean-Jacques. *The Confessions of Jean-Jacques Rousseau: Complete*. The Floating Press. ProQuest Ebook Central, 2012 [1782b].

Rousseau, Jean-Jacques. *The Reveries of a Solitary Walker*. Lenox Hill, 1927 [1782c].

Rousseau, Jean-Jacques and Kelly, Richard (Ed.). *Jean-Jacques Rousseau: Autobiographical, Scientific, Religious, Moral, and Literary Writings*. Dartmouth college press, University press of New England, 2007.

Rousseau, Jean-Jacques. *A Discourse on Inequality*. Open Road Integrated Media, Inc. ProQuest Ebook Central, 2010 [1755].

Rozenberg, G. S, T. D Zinchenko, and A. G Rozenberg. 'Hierarchy of Ecological Homeostasis as a Principle of Systemology.' *Biology Bulletin of the Russian Academy of Sciences* vol. 50, no. Suppl 1, 2023, pp.109–17. https://doi.org/10.1134/S1062359023601271.

Salmi, Irina. "Nature-connective educational architecting–an approach to education based on the life-sustenance hypothesis." *Humanities and Social Sciences Communications* vol. 12, no. 1, 2025, pp. 1-9. https://doi.org/10.1057/s41599-025-05483-7

Sapolsky, Robert M. 'How Do Glucocorticoids Influence Stress Responses? Integrating Permissive, Suppressive, Stimulatory, and Preparative Actions.' *Endocrine Reviews* vol. 21, no. 1, 2000, pp. 55–89. https://doi.org/10.1210/er.21.1.55.

Sapolsky, Robert M. Why Zebras Don't Get Ulcers: The Acclaimed Guide to Stress, Stress-Related Diseases, and Coping. 3rd ed. New York: Henry Holt, 2004.

Schulkin, Jay. Adaptation and Well-Being: Social Allostasis. Cambridge: Cambridge University Press. ProQuest Ebook Central, 2011. http://ebookcentral.proquest.com/lib/kutu/detail.action?docID=691833.

Schutte, Nicola S, and John M Malouff. 'Mindfulness and Connectedness to Nature: A Meta-Analytic Investigation.' *Personality and Individual Differences* vol. 127, 2018, pp. 10–14. https://doi.org/10.1016/j.paid.2018.01.034.

Shuda, Quincy, Michael E Bougoulias, and Rebecca Kass. 'Effect of Nature Exposure on Perceived and Physiologic Stress: A Systematic Review.' *Complementary Therapies in Medicine* vol. 53, 2020. https://doi.org/10.1016/j.ctim.2020.102514.

Singer, Nina, Julia Binapfl, Monika Sommer, Stefan Wüst and Brigitte M. Kudielka. 'Everyday moral decision-making after acute stress exposure: do social closeness and timing matter?'. *Stress*, vol. 24, no. 4, 2021a, pp. 468–473. https://doi.org/10.1080/10253890.2020.1846029

Singer, Nina, Monika Sommer, Stefan Wüst, and Brigitte M Kudielka. 'Effects of Gender and Personality on Everyday Moral Decision-Making after Acute Stress Exposure.' *Psychoneuroendocrinology* vol. 124, 2021b. https://doi.org/10.1016/j.psyneuen.2020.105084.

Smith, Ashley M, Timothy J Loving, Erin E Crockett, and Lorne Campbell. 'What's Closeness Got to Do with It? Men's and Women's Cortisol Responses When

Providing and Receiving Support.' *Psychosomatic Medicine* vol. 71, no. 8, 2009, pp. 843–51. https://doi.org/10.1097/PSY.0b013e3181b492e6.

Sterling, Peter, and Joseph Eyer. 'Allostasis: A New Paradigm to Explain Arousal Pathology.' In Handbook of Life Stress, Cognition and Health, edited by S. Fisher and J. T. Reason, 629–649. New York: John Wiley & Sons, 1988.

Strahler, Jana, Nadine Skoluda, Mattes B Kappert, and Urs M Nater. 'Simultaneous Measurement of Salivary Cortisol and Alpha-Amylase: Application and Recommendations.' *Neuroscience and Biobehavioral Reviews* vol. 83, 2017, pp. 657–77. https://doi.org/10.1016/j.neubiorev.2017.08.015.

Sun, Ying, Peijun Ju, Ting Xue, Usman Ali, Donghong Cui, and Jinghong Chen. 'Alteration of Faecal Microbiota Balance Related to Long-Term Deep Meditation.' *General Psychiatry* vol. 36, no. 1, 2023. https://doi.org/10.1136/gpsych-2022-100893.

Sundman, Ann-Sofie, Enya Van Poucke, Ann-Charlotte Svensson Holm, Åshild Faresjö, Elvar Theodorsson, Per Jensen, and Lina S. V Roth. 'Long-Term Stress Levels Are Synchronized in Dogs and Their Owners.' *Scientific Reports* vol 9, no. 1, 2019. https://doi.org/10.1038/s41598-019-43851-x.

Taggart, P, H Critchley, and P. D Lambiase. 'Heartbrain Interactions in Cardiac Arrhythmia.' *Heart (British Cardiac Society)* vol 97, no. 9, 2011, pp. 698–708. https://doi.org/10.1136/hrt.2010.209304.

Tam, Kim-Pong. 'Concepts and Measures Related to Connection to Nature: Similarities and Differences.' *Journal of Environmental Psychology* vol. 34, 2013, pp. 64–78. https://doi.org/10.1016/j.jenvp.2013.01.004.

Taylor, Shelley E. 'Tend and Befriend: Biobehavioral Bases of Affiliation under Stress.' *Current Directions in Psychological Science : A Journal of the American Psychological Society* vol. 15, no. 6, 2006, pp. 273–77. https://doi.org/10.1111/j.1467-8721.2006.00451.x.

Ulrich, Roger S, Robert F Simons, Barbara D Losito, Evelyn Fiorito, Mark A Miles, and Michael Zelson. 'Stress Recovery during Exposure to Natural and Urban Environments.' *Journal of Environmental Psychology* vol. 11, no. 3, 1991, pp. 201–30. https://doi.org/10.1016/S0272-4944(05)80184-7.

Ulrich, Roger S. 'Biophilia, Biophobia, and Natural Landscapes.' In *The Biophilia Hypothesis*, edited by Stephen R. Kellert and Edward O. Wilson, 1993, pp. 73–137. Washington, DC: Island Press.

Veer, Ilya M, Nicole Y.L Oei, Philip Spinhoven, Mark A van Buchem, Bernet M Elzinga, and Serge A.R.B Rombouts. 'Beyond Acute Social Stress: Increased Functional Connectivity between Amygdala and Cortical Midline Structures.' *NeuroImage (Orlando, Fla.)* vol. 57, no. 4, 2011, pp. 1534–41.

https://doi.org/10.1016/j.neuroimage.2011.05.074.

Wardecker, Britney M, William J Chopik, Onawa P LaBelle, and Robin S Edelstein. 'Is Narcissism Associated with Baseline Cortisol in Men and Women?' *Journal of Research in Personality* vol. 72 ,2018, pp. 44–49. https://doi.org/10.1016/j.jrp.2016.07.006.

Wethington, E. 'Contagion of Stress.' *Advances in Group Processes*, vol. 17, 2000, pp. 229–253. Bingley: Emerald Group Publishing Limited. https://doi.org/10.1016/S0882-6145(00)17010-9.

Wilson, Edward O. *Biophilia*. Cambridge, MA: Harvard University Press, 1984.

Wilson, David Sloan, and Edward O. Wilson. 2007. 'Rethinking the Theoretical Foundation of Sociobiology.' *The Quarterly Review of Biology* vol. 82, no. 4, pp. 327–348. https://doi.org/10.1086/522809.

Wilson, David Sloan. This View of Life: Completing the Darwinian Revolution. 1st ed. New York: Vintage Books, 2019.

Whitburn, Julie, Wayne Linklater, and Wokje Abrahamse. 'Meta-analysis of Human Connection to Nature and Proenvironmental Behavior.' *Conservation Biology* vol. 34, no. 1, 2020, pp. 180–93. https://doi.org/10.1111/cobi.13381.

Wu, Jianhui, Shen Zhang, Wanqing Li, Shaozheng Qin, Yong He, Zhi Yang, Tony W Buchanan, Chao Liu, and Kan Zhang. 'Cortisol Awakening Response Predicts Intrinsic Functional Connectivity of the Medial Prefrontal Cortex in the Afternoon of the Same Day.' *NeuroImage (Orlando, Fla.)* vol. 122, 2015, pp. 158–65. https://doi.org/10.1016/j.neuroimage.2015.08.016.

Yaden, David Bryce, Jonathan Haidt, Ralph W Hood, David R Vago, and Andrew B Newberg. 'The Varieties of Self-Transcendent Experience.' *Review of General Psychology* vol. 21, no. 2, 2017, 143–60. https://doi.org/10.1037/gpr0000102.