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## Cultural Niche Construction as a Framework for Reorienting Human–Environment Relations

Michiru Nagatsu,<sup>a</sup> Roope O. Kaaronen,<sup>b</sup> Mikko Salmela,<sup>a,c</sup> Miles MacLeod<sup>d</sup>

<sup>a</sup>*Practical Philosophy and Helsinki Institute of Sustainability Science (HELSUS), University of Helsinki*

<sup>b</sup>*Past Present Sustainability Unit, Faculty of Biological and Environmental Sciences, University of Helsinki*

<sup>c</sup>*Department of Communication, Center for Subjectivity Research, University of Copenhagen*

<sup>d</sup>*Philosophy Section, University of Twente*

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### Abstract

In this paper, we argue that the theory of cultural niche construction provides a cogent and fruitful framework for studying and managing human–environment relationships, including our conceptualizations of them. We first review the development of the ideas of niche construction from evolutionary to social contexts. We then discuss how various human cognitive and affective goals are achieved through our engagement and interaction with the environment, as cognitive and affective niche construction. We extend this analysis to the built environment, as urban niche construction, and provide two examples of urban design for which niche construction provides useful theoretical and practical insights. We also discuss how different urban policy initiatives are related through the lens of cultural niche construction.

**Keywords:** Niche construction; Cognitive and affective niche; Urban design; Scaffolded cognition; Human–nature relations; Sustainability; Conceptual engineering

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Correspondence should be sent to Michiru Nagatsu, Practical Philosophy, Faculty of Social Sciences, University of Helsinki, P.O. Box 24, Unioninkatu 40A FI-00014, Helsinki, Finland. E-mail: michiru.nagatsu@helsinki.fi

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## 1. Introduction

The relation between nature and humans has been one of the central ontological and ethical questions not only in the Western tradition but in all world systems of thought, including traditional and indigenous ones. How people(s) conceptualize this relationship and understand their place in the world—both (meta)physically and ethically—has been variously influenced by these intellectual traditions. The recent rise of academic interest in this topic across disciplines (Pizza and Kelemem 2023; Kashima et al. 2023 in this special issue) is motivated, at least partly, by the gradual realization that the ongoing sustainability crises, not only climate change and biodiversity loss but also collateral problems of environmental injustice on multiple levels, might have a root cause in failing human–nature relationships (Richardson et al., 2020). Environmental psychologists address this failure as declining “connectedness to nature,” a psychological construct that aims to capture degrees of closeness individuals feel with nature on cognitive, affective, and experiential dimensions. Research suggests that nature connectedness is positively associated with proenvironmental (resource-saving and nature-conserving) behavior (Richardson et al., 2020), although its causal efficacy and effectiveness to reduce individuals’ net ecological footprint have not been established. Sustainability scientists, therefore, consider reconnecting humans to nature (or to the biosphere) as one of the main leverage points in achieving sustainability transformation (Folke et al., 2011). Although useful in some contexts, there are several theoretical limitations to this approach.

First, this approach presupposes a categorical separation between humans as the subjects of cognition, affection, experience, and action, and all else as their objects (anthropocentrism, see Kim et al., 2023, in this issue). Although the fact that humans are ontologically part of nature is sometimes acknowledged when one calls nature “the rest of nature,” anthropocentrism in this sense remains unquestioned. However, this way of conceptualizing human–nature relations is characteristic of modern industrialized society, whereas many indigenous and traditional societies adopt different conceptualizations (e.g., Shepard Jr. et al., 2023, in this issue). For example, some indigenous communities do not have a similar category of objectified nature, and they attribute agency or right-holding personhood (or deity) to (what we conceptualize as) the rest of nature including plants, rivers, mountains, and so on (Ojalehto Mays, Seligman, & Medin, 2020). Nature connectedness is, therefore, a parochial scientific construct at best, a naive adoption of which might miss an opportunity to more fundamentally rethink our relationship with nature (e.g., Eisenstein 2018; Kimmerer 2013; Kaaronen, 2018; Lent, 2017).

A second problem of relying too much on the construct of nature connectedness is that it does not allow us to tap into more powerful mechanisms that regulate human–nature relationships. As a construct of the subjective degree of individual mental dispositions or attitudes, it is not apt for analyzing historical processes and social practices that affect individual minds. Different conceptualizations afford and constrain how individuals can relate to and interact with nature in the first place (Can we communicate and sympathize with it? Can we establish a reciprocal relationship with it?), and such abilities are correlated but not reducible to individual dispositions. Similarly, acknowledging legal personhood, ownership or various kinds of rights of animals or ecosystems is a collective, institutional practice that systemically

regulates behavior, which historically contributed to the effective control of unsustainable resource extraction and environmental destruction of the commons (Herrmann-Pillath, 2023). Scientific theorizing could have particularly powerful impacts on practice through influencing both vernacular conceptualizations and institutional practices, for better or for worse. For example, scientific concepts such as “ecosystem services” and their monetary valuation (as a flow from the stock of “natural capital”) have been widely criticized as reflecting and encouraging anthropocentrism, commodification of nature, economic imperialism, and so on (see Schröter et al., 2014 for a review). This tendency has historical roots in the “denaturalization” of the notion of the economy in neoclassical economics (Schabas, 2005).

We thus need a scientific theory of human–nature relationship that liberates us from parochial anthropocentric conceptualizations, and at the same time allows us to fully exercise our human agency to improve this relationship. In this paper, we will argue that cultural or human-centered forms of niche construction, originally derived from Niche Construction Theory (NCT) in evolutionary biology, can provide a useful framework for understanding the dynamic processes of human–environment interactions, including their conceptualization. Moreover, these forms (cognitive and affective, and urban) can help us connect existing ideas for sustainability in a new light, thereby enhancing their potential. We will explain these forms of niche construction in more detail in Section 2.

Here, we briefly motivate our approach by contextualizing it. First, this proposal is not our invention. Lewontin and Levins (1997, p. 98), the first of which is zone of the founders of NCT in evolutionary biology, already pointed out that for “a rational political ecology” or “a sensible environmental politics,” we need to recognize that there is no such thing as *the* environment to protect or save because organisms (including humans) and their environments codetermine and coevolve. This perspective, however, has been largely lost in the subsequent sustainability science literature as the prospect of catastrophic civilizational collapses/declines, or worse total extinction, has loomed large (Steel, DesRoches, & Mintz-Woo, 2022). However, we think that the full implications of cultural forms of niche construction are worth developing given that its founders explicitly recognized the relevance of original concepts of niche construction not only to biology but also to contemporary environmental problems (without further elaboration).

Another motivation to promote niche construction as a useful framework concerns an unnecessary and undesirable epistemological divide in sustainability research, in which two ideal-type camps can be identified. One camp criticizes implicit value-laden assumptions underlying scientific theories, such as anthropocentrism, and advocates changing ontological and ethical categories in order to change reality. Just to name a few, promoted alternative ideas include more-than-human nature (Larsen & Johnson, 2017; Tsing, 2015), processual (Kaaronen, 2018), and relational (Gergen, 2011) ontology. Philosophers characterize this approach, broadly construed, as *conceptual engineering*, highlighting the facts that language, concepts, and scientific theories are tools that humans use to interact with reality, and that such symbolic artifacts are themselves amenable to purposeful modification in order to achieve some desired state in the world (cf. Cappelen, 2018). The other camp, in contrast, assumes that the job of science is first to establish true (enough) theories, models, measurements, and explanations of target phenomena, and then apply them to manipulate their workings. Economics is

a paradigmatic discipline that champions this epistemology. Both camps tend to be skeptical about the prospect of the other helping solve current sustainability crises.<sup>1</sup> Niche construction provides a reconciliatory framework to accommodate the aspirations of both camps: it is a naturalistic causal theory of biological and cultural evolutionary processes, and as such, it guides disciplined model building and operationalization of dynamic human–environment interactions. At the same time, cultural niche construction can articulate different functions cultural artifacts play in human–environment coevolution, without being distracted by empirically unconstrained debates about what kind of ontology of human–nature relationship is metaphysically correct and ethically right. One proviso: our claim is not that niche construction is an omnipresent and omnipotent theory that gave birth to and subsumes all the relevant ideas of human–environment interactions; rather, it is that niche construction allows us to see those ideas in a coherent and new light, with potential synergies between them.

The paper is organized as follows: The next section explains how NCT, originally proposed in evolutionary biology, is extended to study interactions between humans and environments more generally as cultural niche construction. Section 3 discusses cognitive and affective niche construction, in which both symbolic and material “scaffolding” interact with human practices. Section 4 discusses urban niche construction, further elaborating on the functions of the built environment as material scaffolding. Section 5 discusses niche construction-inspired modeling (cycling cities) and a project (urban cohousing) toward sustainability in urban contexts. Section 6 concludes the paper by summarizing our main argument and briefly discussing the policy implications of niche construction.

## **2. Niche construction: From biology to culture and society**

NCT is a general theoretical framework in evolutionary biology to study the dynamic coconstructive and coevolutionary relationship between the environment and organisms that inhabit it. Niche construction is “[t]he process whereby organisms, through their metabolism, their activities, and their choices, modify their own and/or each other’s niches.” (Odling-Smee, Laland, & Feldman, 2003, 419) The term “niche” is in turn defined as “[t]he sum of all the natural selection pressures to which the population is exposed” (ibid.). In other words, NCT states that organisms participate in creating and modifying natural selection pressures on themselves, thus creating dynamic feedback between organisms and their environment. The theory challenges or complements the default neo-Darwinian heuristic framework for evolutionary modeling that focuses mainly on “the individual and its fitness-based relationship to a given (social/ecological) environment” (Fuentes, 2016, S14). Examples of niche construction range from microorganisms such as bacteria and protists to animals such as beavers and “farmer” leaf-cutter ants (Odling-Smee et al., 2003, ch. 2). Importantly, humans are considered to be the ultimate or “champion niche constructors” because of their capacity for culture (Laland, 2017, 190).

Since NCT was originally developed in evolutionary biology, the important first project was to establish NC as a distinct evolutionary process that systematically affects gene frequency in a population, which Downey (2016) calls the neo-Darwinian litmus test. However,

another important project has emerged, which is to explore the full implications of the general idea of environment–human interactions in nongenetic time scales: a “nongenetic channel of inherited developmental bias” (Downey, 2016, S53) can mediate niche construction. Downey (2016) recommends human and social scientists to advance the latter project because “most of the niche-organism dynamics that characterize human cultural activity” (S54) take place through nongenetic channels (few but important exceptions being “our longest-established niche modification techniques” (S54) such as Neolithic innovations including dairy and rice farming) (for a more recent perspective, see Evershed et al. 2022). As a result of these lines of thinking among Downey and others, several notions of niche construction have emerged which attempt to account for aspects of human cultural evolution. Downey himself has developed his own theory of urban niche construction (see below). We also consider in this paper cognitive and affective niche construction.

We think that this nongenetic (cultural) interpretation remains true to the original NCT first because the theory does not limit the inheritance mechanism to only the changes in gene frequency through natural selection. Cultural artifacts (built environments or concepts) can influence the frequency of individuals acquiring or adopting particular physical, psychological, or behavioral traits, such as obesity, generosity, or physical activeness over multiple generations (inheritance of behavioral bias). Second, the dynamic interaction between the environment and organisms, which is the core idea of niche construction, is *more* pronounced in such cases than in the case of genetic inheritance. Nongenetic positive feedback mechanisms can be observed in a couple of generations, as in the case of obesity and automobilized built environments, or even within generations (think: the social norms and behaviors selected through the presence of social media). Third, NCT highlights the role of *active agency* of organisms, which *better* depicts human cases where individuals can consciously and reflectively intervene on the environment–organisms interactions. We can normatively evaluate certain positive feedback as good or bad (e.g., promoting or demoting health or well-being), and intervene accordingly. We thus follow Downey’s suggestion and explore the implications of considering cities and social media, for example, as a type of human niche (we use the term niche construction in this broader sense below unless otherwise mentioned).

This is in line with the broader movement in cultural evolutionary sciences, which focus not only on genetic inheritance, but also on the selection and transmission of cultural traits and behaviors (e.g., Henrich, 2015; Mesoudi 2011). Ever since niche construction was proposed as a key evolutionary mechanism, interest has grown in the notion that our capacity to alter our everyday environments is a key driver of human cultural evolution (Henrich, 2015; Laland, 2017). Accordingly, the concept of “cultural niche construction” was devised especially to highlight that, similarly to genes, cultural traits are also passed on between—and unlike genes, *within*—generations, and that niche construction can radically alter the rates by which certain cultural traits (such as cultural norms) are transmitted (Laland, Odling-Smee, & Feldman, 2001). Recently, this idea has also been extended to the study of sustainable behavioral traits, analyzing how sustainable cultural traits are transmitted through environmental affordances and constraints (see Kaaronen, Mulder, & Waring, in print for a review).

Another important point Downey (2016, S54) highlights is that a niche “is not simply a material reality but *a form of living in relation to an environment*” (our emphasis).

Lewontin and Levins (1997) state the same point differently: “There is no organism without an environment, but there is no environment without an organism” (p. 96). The same material reality affords different things to different species and individual organisms, due to their form of living, including their sizes, ways of obtaining energy, and so on (see also Rietveld & Kiverstein, 2014). Although Downey (2016) emphasizes that this understanding of niche or environment<sup>2</sup> is better suited for the understanding of human agency in the social sciences, the idea of a niche that is coconstitutive with organisms is already fundamental to the original NCT, which does not separate human agency from other biological agents.

But what makes humans the “champion niche constructors” then? Beyond the above-mentioned narrow understanding of culture as agricultural or material techniques, the most distinct aspect of human culture, many argue, is the invention of its linguistic and conceptual apparatuses that transformed humans’ relation to their environment and with each other. Those conceptual apparatuses, themselves transmitted over generations, enable intergenerational social learning, large-scale human cooperation, and coordination across vast spatial and temporal horizons (Laland, 2017). They also contribute to the selection of cultural ideas, values, norms, and innovations. These apparatuses constitute a niche in the sense that they systematically affect the inter- and intra-generational transmission of cultural traits and behaviors. In other words, human culture, both symbolic and physical, is typically a constructed niche. In order to substantiate this point and to highlight how niche construction sheds light on concrete cases, in the next section, we review how human cognitive and affective achievements have recently been studied using this framework.

### **3. Human cognitive and affective niche construction and its implications to the conceptualization of human–nature relation**

What distinguishes human niche construction from that of other species is the fact that the former’s niche is constructed not only by physical alterations but by conceptual ones. For example, the concept of “15-minute city” (the city whose services are accessible for residents within 15 min of a walk, cycling, or ride on public transport) can spread and physically shape the structure of an urban built environment, as has recently occurred in cities such as Paris (Khavarian-Garmsir, Sharifi, & Sadeghi, 2023). Another similar case is the “Doughnut city” concept, which has been adopted by Amsterdam.<sup>3</sup> In turn, these new conceptual and physical environments help select for the transmission of cultural norms and preferences in favor of sustainable environments by creating a context in which these are perceived as beneficial and valuable. In other words, our distinct form of living is to live our niche as mediated through various concepts. Other aspects of culture, such as the use of tools and domestication of other species for the source of nutrition, are not unique to humans, although such activities are arguably most extensive and cumulative among humans (Mesoudi & Thornton, 2018). In contrast, the use of language-based conceptualization of the world is qualitatively separating humans from all the other species. We will not go into the evolutionary origins and consequences of language in this paper (see, e.g., Laland, 2017, chs. 8 and 9). Instead, we start from this observation and elaborate on some of the important ways in which the human niche

is constructed through conceptual means. In this section, we draw on Sterelny's (2010) work on cognitive or epistemic niche construction and its extension as affective niche construction (Colombetti & Krueger, 2015; Nagatsu and Salmela 2022).

### 3.1. Cognitive niche construction

Although the ultimate function of niche construction is survival and reproductive success, cultural niche construction serves more immediate and variable functions. For example, Sterelny (2010, p. 470) notes that "epistemic action is a form of niche construction too. Agents alter the informational character of their environment in ways that make crucial features more salient." Such examples include ants' scent trails between nest and food source and hawks' roosts that maximize their view of hunting territories. But central cases of human epistemic actions are distinct from these simple cases of physical alterations because they are scaffolded by representational systems. Sterelny (2010) proposes a scaffolded mind hypothesis, which states that "human cognitive capacities both depend on and have been transformed by environmental resources" (p. 472). The hypothesis also states that epistemic niche construction has mostly served to enhance human cognitive capacity. Focusing on cognitive enhancement, Sterelny (2010) proposes three relevant dimensions along which such niche-mediated cognitive enhancement could be analyzed, namely, (1) trust, (2) interchangeability-individuation-entrenchment, and (3) individual-collective. Although Sterelny (2010) does not explicitly state this, we interpret these dimensions as an elaboration of reinforcement mechanisms of constructed niches.

First, since the reliability of a source of information (relative to the agent's goal) can vary, we can analyze how information encoded in the niche increases its reliability or trustworthiness. Sterelny (2010) points out that, although externally stored information is more susceptible than the internally stored memory in the brain to manipulation by hostile agents, "information resources in a shared space are sometimes reliable *because* they are shared" (p. 474). Language is a central example of this in the sense that its public nature is a precondition for reliable communication (which also functions as a software of internal memory). However, particular concepts or conceptualizations in a given language can be more or less reliable, depending on the relevant scale. For example, the shared conceptualization of human–nature relationship as user-resource in our languages might have facilitated efficient (well-coordinated and cooperative) exploitation of nature and other peoples, but in the long run, such "efficiency" might turn out to be maladaptive.

Second, the dimension of interchangeability-individuation-entrenchment concerns the extent of cognitive niche-agent coupling. Since the agent and her environment modify each other in NCT, customization of one's informational environment tends to result in some change in the agent's epistemic capacity as well. The general idea is that the more one invests in a particular cognitive niche, the more likely it is that one's epistemic agency is more profoundly driven to adapt to that niche.

Concerning the conceptualization of human–nature relation, *anthropocentrism* (overemphasis on the centrality of humans in the world) and *human exceptionalism* (the assumption that humans are superior or separate from the rest of the natural world), two patterns

of thinking that Kim et al. (2023) discuss, may have been a consequence of cognitive niche construction, in which humans have adapted their conceptual resources to better navigate the built environments in which accurate attention to other species and their complex relations is no longer critical for survival; instead, interpersonal, intergroup, and institutionally and symbolically mediated human relations became more salient. There has probably been positive feedback: once such patterns of thinking have been adopted, other cognitive and conceptual resources are also biased to better manage the aspects of the world that are made salient by these patterns of thinking. This is an example of entrenchment. An example could be that entrenched anthropocentrism and human exceptionalism have contributed to the development of cognitive schema such as “fish stocks” or “environmental externalities.” The former reduces other sentient beings into mere renewable resources for human consumption. The latter tends systematically to under-value biophysical ecosystems because their critical functions are not accounted for in market transactions (cf. Livernois, 2019). Again, although entrenchment enhances the cognitive capacity of human individuals by specialization, there could be a trade-off: overspecialization in a human-built niche might result in critical failures to coordinate and cooperate with other species and life-support systems, which are less salient but no less significant.

Third, the dimension of individual-collective sheds light on an important mechanism of human cognitive niche construction. The case of the professor’s books highlights that his library is his individual niche, but it is also collective in the sense that it is (used by or) shared with his students. This understanding of collectivity implies that a more individualized niche (e.g., the subset of books that have been heavily modified by the professor) is less collective (i.e., less usable by or sharable with others). However, there is another sense of collectivity which does not imply such individual-collective rivalry. On the contrary, collectivity can facilitate individual cognitive enhancement. We have already noted that language is a type of such collective niche because of its *inherited* and *public* nature. Language also evolves through *reciprocal* interactions of its users: all users benefit from a given language, but also they contribute to its change, intentionally or not, by making certain uses of terms and concepts obsolete or inventing new ones. The project of ameliorative conceptual engineering of human–nature relations that we discussed in the introduction is, therefore, also collective in this sense: it critically engages with our linguistic and conceptual heritage, with a clear intention to benefit all participants in a reciprocal manner. The challenge of such a project, however, is clearly stateable along the dimensions of trust and entrenchment. How can a collective of people, who have adapted to more dualistic human–nature relation, and whose institutional and normative frameworks and even material environments are built upon such concepts, begin to trust alternative conceptualizations as a reliable handrail for managing the relationship? How can we undo an undesirable but entrenched cognitive niche when the agents’ epistemic capacity has adapted to that particular niche? Can a new and better niche be built, or should the old one somehow be retrofitted? We will return to these questions in Sections 4 and 5 where we discuss niche construction in the urban context.



### 3.2. Affective niche construction

Given the centrality of niche construction for humans, it is natural that human niches serve purposes other than cognitive achievement. Colombetti and Krueger's (2015) account of *affective* niche construction extends Sterelny's (2010) analysis to highlight the different ways in which niche construction gives the agent the possibility of achieving certain *affective goals*. They describe affective niches as "instances of organism-environment couplings that enable the realization of specific affective states" (p. 1160).

Affective niche construction can be analyzed along similar dimensions, as these authors do. Colombetti and Krueger (2015) distinguish two types of alterations of the affective resources, namely, material and interpersonal manipulation, discussing agents' trust in and individualization-entrenchment of each type of niche construction. For example, certain artifacts, such as portable music players and fashion items, are used to regulate one's mood and other affective states, including bodily processes, action readiness, cognitive appraisals, and feelings of phenomenal experiences. Other agents are used in the same way as material resources. "We spend time with partners, family, and friends because we enjoy their company and the pleasant feelings they bring about, and we engage in joint activities that are qualitatively enriched by the presence of others" (Colombetti & Krueger, 2015, p. 1166). Each individual benefits from the presence and feelings of other members of the group, while at the same time contributing to their positive affective states. There is a functional interdependence similar to what characterizes Sterelny's collective cognitive niche. Nagatsu and Salmela (2022), on the other hand, focus on the distinctly *collective* (as opposed to merely interpersonal) nature of affective niche construction, elaborating on the relevant psychological mechanisms. Similarly to our analysis of the collective cognitive niche above, we identify reciprocity and cooperation as its central features: agents depend on each other's collaborative contribution for the achievement of a shared affective goal.

Although we distinguish cognitive and affective functions of niche construction for analysis, these functions are not causally independent of each other in achieving particular goals. The fact that affective states influence cognitive appraisals and action readiness is an obvious case in point. Another example is intensive scientific collaboration, which synergistically serves both cognitive and affective functions (Parker & Hackett, 2012; Hampton & Parker, 2011). Similarly, human exceptionalism is a type of conceptual scaffold that serves both cognitive and affective functions. As Kim et al. (2023) note, human exceptionalism could impede "pro-environmental attitudes and actions related to sustainability." Such consequences might be mediated by emotional disengagement with nonhuman worlds, exacerbating cognitive failures to understand and respond appropriately to complex interdependence between social and ecological systems.<sup>4</sup>

In this section, we have outlined how NCT can illuminate various types of organism-environment couplings, with a special focus on their cognitive and affective functions as well as their relations and action-guiding function. In sum, NCT could be usefully applied to account for human individual, interpersonal, and collective activities that take place in nonevolutionary timescales, but nonetheless involve deeper, sustained processes of behavioral adaptation and reinforcing environmental modification. We have also briefly commented

on language in general, and human–nature conceptualization in particular, as an important class of scaffolding, with large downstream consequences because of the positive feedback mechanism: not only has language transformed the human mind in an evolutionary scale, but the culturally transmitted use of particular grammar and concepts, once adopted for whatever reason, may make specific aspects of the world cognitively and affectively salient to agents, thereby facilitating its transformation in such a way as to reinforce the kind of utility construed through such cultural and linguistic apparatuses (e.g., marginal utility from consumption).

#### 4. Urban niche construction

The most distinct and environmentally impactful niches humans have constructed are our urban environments, or cities. Around two-thirds of the global population are projected to live in cities by 2050 (United Nations, 2019), in a global rural-to-urban movement that is predicted to be the largest human migration event ever (West 2017). Under current trajectories, more urban environments will be constructed during the 21st century’s first three decades than in the totality of preceding human existence (Seto, Güneralp, & Hutya, 2012). Urban environments are also, as a consequent, hotspots for ecological harms: as of today, urban areas have been claimed to generate around 90% of global economic activity and up to 70% of global Greenhouse Gas emissions (Solecki et al., 2018)—in short, cities act as key drivers of the exponential consumption of natural resources. Therefore, we pinpoint urban areas as the key locus where human–nature relations and their conceptualization should change, and suggest below some ways in which NCT can help us understand and change human–nature interactions in ways that promote sustainable lifeways.

##### 4.1. *Urban niche as a distributed and scaffolded cognitive system*

Cities are cognitive, technological, and cultural niches that have enabled unforeseen amounts of innovation, economic development, and technological evolution. In many respects, cities could be perceived as a pinnacle of niche construction, and cities (and the economies they foster) can be fruitfully understood as “ecosystems of ideas” (see, e.g., Wolfram, 2018). It is not unusual to see proponents of technological innovation discussing the “innovation ecosystem”—although such appropriation of ecological terminology has been, perhaps rightfully, criticized, we do agree that there is merit in understanding cognitive niches in such terms. As Jane Jacobs (1961) already noted, cities enable the spontaneous and relatively free interaction of ideas and information between city dwellers, effectively creating a cognitive niche which affords the transmission and evolution of cultural concepts and technologies. More recently, researchers have noted that the urban ecological niche can lead to “superlinear scaling” in economic and technological development (West 2017; cf. Arthur, 2009). Even if today the internet may bypass the need for in-person encounters, the role of the city as a key hub for innovation exchange has not diminished, and many cities are actively designing technology clusters and “innovation complexes” to promote innovation, information exchange, and economic growth (Zukin, 2020).

The downside to this growth in economic activity and innovation, as West (2017) and many others have noted, is that it has also resulted in an increase of urban metabolism: more and more resources are needed to satisfy urban and technological development and material and economic growth. Even if urbanization can have some environmental benefits when compared to rural lifeways or urban sprawl, as long as absolute decoupling between economic growth and ecological harms does not exist (Vadén et al. 2021), a fundamental unsustainability can be seen to underlie the cognitive niche construction of cities. If cities drive growth, and growth is not decoupled from environmental harms, cities may not be sustainable. Simply, if we do not have control over how urban niches (and their technological components) are constructed, human societies risk climatic and ecological overshoot at an accelerating rate.

Considering that cities are key drivers of many feedback-loops that affect people and ecosystems worldwide, we, therefore, need to be especially mindful about how urban niches are constructed in the Anthropocene, and which kinds of conceptual frameworks shape the development of our urban niches. On a more positive note, urban niche construction can also be leveraged for the common good, as we show below with cases of sustainable transport and conviviality. Before discussing such NCT-based policy interventions, we review another set of sustainability problems arising from urban niche construction, namely, its impact on people's well-being.

#### 4.2. Urban niche as developmental challenges to human health and well-being

Some urban studies scholars try to frame the affective relation between urbanites and their environment in terms of niche construction. For example, Burns (2000) notes that people “create their own social and territorial niches in the city, and in this way, are able to develop a sense of identity and comfort in the modern metropolis” (p. 70). Importantly, the city is not “merely a physical mechanism and an artificial construction. It is involved in the vital processes of the people who compose it.” (p. 73) However, systematic relations between these “vital processes” and the urban environment, and what the former consist of, have not been addressed until recently.

Downey (2016) is one of the systematic attempts to demonstrate the value of NCT for the study of urban well-being. Unlike other precedents in urban studies that use the term niche in a loose, metaphorical way, Downey (2016) applies the evolutionary framework of NCT in a way that integrates cultural and biological perspectives. Specifically, Downey (2016) addresses one of the core sustainability problems of contemporary urbanization, namely, inequality and poverty, with a case study of street children in Brazil. His analysis of this *stratified* niche reveals first that the street children's “foraging” (food collecting) strategies are *developmentally adapted* to the street life without familial support and cooperation. Unlike the complex hunting and foraging skills in wilder environments that take 5–15 years to master with learning from adults, street children manage to secure food independently at an earlier age, because the skills required in urban “secondary foraging” are general-purpose one of social negotiation (e.g., asking a diner who is about to leave a restaurant to give the leftover), which does not need to be customized to specific food sources. Such foraging behavior is an adaptation to a particular condition with weaker intergenerational knowledge transfer. Second, Downey

(2016) shows that strong peer socialization in the absence of familial support facilitates *intra-group and generational transmission* of not only general-purpose foraging skills but associated social norms against begging, stealing, or scavenging even when food is available, which have some benefits to the street children: norms against scavenging might protect them from food poisoning, and norms against begging might be a rational response to safety and return-on-effort considerations. Another interesting finding Downey (2016, S59) highlights is that street children do not have the same propensity for obesity and malnutrition as other children in the middle-class and rural poor counterparts, respectively, probably due to both higher physical activity level and lower but varied energy intake.

Although the focus on secondary foraging suggests some health advantages of street life, they face more severe health challenges than the middle-class or rural poor counterparts, including infectious disease, parasites, substance abuse, violence, and morbidity from accidents. In particular, they face increased risks to mental health. Urbanization is generally associated with various mental problems due to social isolation, greater work and life stress, social hostility, and so on. These factors negatively affect humans who have evolved to be sensitive to social cues, which was adaptive in the environment with less intensive and smaller-scale social interactions. Although most city dwellers develop adaptive strategies to limit interactions (sensory, behavioral and spatial strategies, such as using headphones, cycling instead of using crowded public transport, or creating comfortable social and territorial niches, as Burns (2000) noted), these strategies are often unavailable for those who live on the street.

Flight from a violent home into the urban streets exposes children to much more frequent social interaction, potentially with hostile strangers. Because of the anonymous and superficial nature of those interactions—a kind of “hyposociality”—they may produce stress without the rewards of greater social engagement and support (Downey, 2016, S60).

Consequently, individuals must adapt their affective systems to this hyposocial urban space, with differentiated mental health consequences. Individuals who face other kinds of adversity, for example, psychiatric conditions, develop behavioral strategies to create “a precarious comfort zone in urban space” (Bieler and Klausner 2019, cited in Rose, Birk, & Manning, 2022, p. 13). Immigrant workers in megalopolises from rural areas also actively develop practices of “small-scale sociality and self-techniques to manage their stresses and sustain their aspirations” (Rose et al., 2022, p. 13). A more anecdotal case is homeless people in urban parks who routinely feed a flock of pigeons or ducks, “socializing” with other species, as rewarding social interactions with other humans are limited.

These are examples of the urban affective niche construction to cope and live with urban mental and affective challenges. They build niches through individuation and entrenchment, both on individual and collective scales, thereby adapting their identities, styles of interpersonal or interspecies engagement, and even the brain neural networks and their developmental pathways (Rose & Fitzgerald, 2022). Although these studies have not encompassed the question of generational change of cultural traits directly and systematically, we can observe that particular traits (such as social norms about urban food foraging and self-techniques of urban survival) are inherited to the next generations (not necessarily biologically related) through urban niches and their impact on individuals.

An interesting question from the perspective of nature-human conceptualization is whether and how such conceptualization can be adapted in urban niches to increase well-being. On a coarse scale, developments of notions of unbridled and pristine “nature” excluding humans and built environment may well be an adaptation to (and a driver of) broader and longer-term patterns of declining saliency and frequency of interactions with other species (“connectedness to nature” partly captures such patterns). In this romantic framework, nature is regarded as pristine, which functions as a site of emotional recovery from stimulating but exhausting urban life. More recently, integrative theoretical frameworks to explicitly couple natural and social processes (e.g., the theoretical framework of social-ecological systems) have been utilized to conceptualize urban space differently, suggesting practical design principles such as nature-based solutions to gain cobenefits of better ecological and societal management of cities (Tzoulas et al., 2021). These examples indicate that conceptualization and practice coconstruct and coevolve. In this sense, niche construction allows us to reflectively and purposefully develop theories that encourage new practices of sustainable urban planning. In the next section, we will review two cases of such cultural niche construction analyses, first cycling cities and second a project to reconnect stratified urban niches.

## 5. Examples of sustainable urban niches and niche construction

### 5.1. Cycling cities

Recently, the potential of cultural evolutionary research in understanding sustainability concerns has been emphasized (Kaaronen et al., in print). A part of this multifaceted work has utilized NCT in the modeling of urban environments and urban cultural evolution. Kaaronen and Strelkovskii (2020) modeled the emergence of bicycling cultures in “cycling cities” such as Copenhagen and Amsterdam. This research has argued that niche construction can be understood as a key leverage point for triggering collective behavior change as well as change in attitudes and social norms. Inspired by NCT, Kaaronen and Strelkovskii (2020) model four key assumptions, embedding a sequence of feedback-loops that may be triggered through niche construction:

1. Humans inhabit cultural-ecological niches which provide behavioral opportunities (*affordances*).
2. The affordances in ecological niches enable (and constrain) behaviors, which can spread in social networks through the key cultural evolutionary mechanism of *social learning* (e.g., the copying of others or conformism).
3. Behavioral patterns enabled by these affordances can reinforce learned behaviors through *individual learning* (development of know-how, habituation, attitude change, affective change, etc.).
4. These affordances in an ecological niche can be altered and refined via intentional *cultural niche construction* (such as the design of everyday environments and infrastructure).

Under such assumptions, it has been shown that even moderate efforts at intentional niche construction (such as the design and construction of bicycling infrastructure) can trigger a self-reinforcing feedback-loop, where:

1. Improved infrastructure creates affordances for more of the wished-for behavior (bicycling)—and can make the not-wished-for behavior more difficult—resulting in the increased uptake of bicycling behaviors.
2. These behaviors are copied and spread socially through social networks.
3. Behavior change also results in patterns of individual learning (e.g., developing better bicycling skills, assuming more bicycle-friendly attitudes)—which also increase the probability of behaving this way in the future.
4. Increased bicycling behaviors can result in further niche construction as public demand for infrastructure increases. Moreover, increased user bases construct new “niches” themselves: for instance, a large number of bicyclists may create “safety in numbers” which makes it easier for novices to adopt the new behavior.

Validating the model on real-world data, Kaaronen and Strelkovskii (2020) argue that it is self-reinforcing niche-constructive patterns like these that have underlied the evolution of bicycle cultures in cities such as Copenhagen and Amsterdam (Kaaronen & Strelkovskii, 2020; Kaaronen and Rietveld 2021). An upshot of the conceptual feedback-loop model above is that even linear change in the built environment (e.g., the linear increase of constructed kilometers of bicycle paths) can result in the nonlinear (S-shape) increase of traveled kilometers on a bicycle. This is indeed what we witness in cities such as Copenhagen (Kaaronen & Strelkovskii, 2020), where bicycle lanes have increased at a linear rate, but the social adoption of bicycling behaviors has been nonlinear and accelerating (see figs. 5 and 6 in Kaaronen & Strelkovskii, 2020).

Importantly, such reinforcement between behavioral and environmental changes, through individual learning (changes in people’s skills, expectations [both factual and normative], and preferences), creates a long-lasting pro-cycling culture that may bias physical and psychological development of future generations such that they are fit for this culture (e.g., lower body mass index, values, and norms of pro-cycling). Unlike genetic inheritance, this can take place over decades (and occur within biological generations), and could affect nonbiologically related immigrants similarly. Although Kaaronen and Strelkovskii (2020) do not explicitly model such intergenerational effects, the model does include random mutations of personal states, which could be interpreted to simulate the random effects of intergenerational knowledge transfer (vertical cultural transmission).

As a consequence, cultural niche construction can be viewed as an important driver in the cultural selection of collective behavioral patterns. As increasing amounts of humans live in shared everyday urban environments, the power of cultural niche construction in shaping collective behaviors should not be underestimated—intentional niche construction may trigger sequences of sociocultural phenomena that affect cultural evolution more broadly, such as the emergence of robust bicycling cultures. Although the topic was discussed above in the context of bicycling (in a stylized agent-based model), in principle, the same mechanisms may shape

cultural evolution in many other environmentally relevant domains with cobenefits in terms of ecological and human mental-physical health.

## 5.2. *Urban cohousing*

Cohousing, which is defined as more or less shared use of amenities, has been argued to be a socioecologically sustainable form of living. When it comes to *ecological sustainability*, cohousing facilitates resource-saving forms of living through sharing spaces, such as kitchen, laundry room, gym, sauna, and other recreational facilities that have a potential of reducing the ecological footprint compared to conventional housing where each resident has some or most of these facilities (kitchen, washing and drying machines, sauna) in their own apartments (Hagbert, 2020). Marckmann, Gram-Hanssen, and Christensen (2012) critically explore four sustainability claims in cohousing that they critically explore: (1) the potential of adopting more sustainable technologies; (2) small compact dwellings; (3) whether cohousing mutually supports proenvironmental behavior; and (4) cohousing as providing environmental advantages for small households. In sum, while cohousing has taken many forms in its history, the resource efficiency of urban cohousing as a denser form of dwelling, with a higher degree of sharing space and things, contributes to urban sustainable development.

Besides being resource efficient, urban cohousing facilitates a combination of privacy and sociality, whose balance each resident can regulate, thereby promoting *social sustainability*, which is another key dimension of sustainability. Socially sustainable urban development relates to social cohesion (or mixing) and self-governance, linking to notions of community and integration (Hagbert, 2020, p. 184). Social cohesion, sense of community, and integration of individuals from mixed backgrounds are facilitated by the same shared spaces and especially shared activities that also serve ecological sustainability in cohousing. Cohousing projects and research emphasize how cohousing combines collectivity with space for individual autonomy. This is spatially expressed in the fact that cohousing involves both shared and private spaces (ibid.). As a form of living that involves an opportunity to both privacy and company of others, urban cohousing constitutes materially scaffolded interpersonal and collaborative affective niches that serve the mental health and well-being of the residents (Rose et al., 2022).

One of us (Salmela) led a research project (funded by Kone Foundation in 2018–2022) that studied the contribution of interpersonal and collective affective niches to the emergence of a sense of community and togetherness among the residents of the Generations' Block (“Sukupolvien kortteli” in Finnish) in Helsinki, a recent initiative of urban cohousing that seeks to implement both ecological and social sustainability. Extant theoretical and empirical research suggests that empathy and shared emotions can be generated by face-to-face social interaction, generating and reinforcing feelings of togetherness, belonging, and group identification (Collins, 2004; Salmela, 2014; see a review in Salmela & Nagatsu, 2017). Specifically, collective dance improvisation activities (Himberg, Laroche, Bigé, Buchkowski, & Bachrach, 2018; Kimmel, 2021) and book clubs for collective reading (Tijms, Stoop, & Polleck, 2018; Polleck 2010) have been shown to have positive impact on these, the latter of which have been studied among disadvantaged minority groups. Motivated by these findings, the project

offered two hobby groups (one for book reading and another for dance improvisation) to the residents, and qualitatively analyzed participants' experiences. Unlike Tijms et al. (2018), it was not a randomized controlled trial, but an observational case study of how voluntary participants experience these collective activities.

The analysis of the findings (video recorded material from both the reading group and dance improvisation group, analyzed with the tools from linguistic discourse analysis as well as literary analysis for the reading group) suggests that both activities allowed participants to experience shared emotions and feelings of togetherness, despite the fact that the groups consisted of individuals with heterogeneous socioeconomic and demographic backgrounds. In the book club, the shared emotions and feelings of togetherness were mediated through the novels the participants read and discussed, whereas the feelings of togetherness in the dance improvisation group were based on kinaesthetic empathy in bodily synchronization (Rossi, 2021; Voutilainen, 2022). Importantly, the designated shared spaces in the Block facilitated both groups to meet regularly with ease, and thus concretely supported the building of a sense of community among the participating residents. Although the project did not directly address such a possibility, in light of cultural niche construction, future research on urban residential design could explore (1) how spatial design affords procommunal joint activities, which could have positive spill-over effects on other activities and spatial use and development; and (2) how such urban communal niche could generate lasting welfare-promoting shared emotions and activities over generations.

While cohousing is one form of establishing and reinforcing conviviality in urban contexts, there is evidence that city life facilitates similar processes of collective and interpersonal affective NC on a larger scale as well. The interfusion of social groups in the city occurs partly because of the multifunctionality of social space (Young, 1990, 239; Jacobs 1961). The NC-supportive integration of multiple functions in urban environments is largely a matter of conscious design, and there is some evidence that even old neighborhoods built for single-use can be appropriated by the residents into public spaces that allow for conviviality-building diversity of functions and social activities.

## 6. Conclusion

We have argued that cultural NCT provides strong scientific and philosophical motivations and tools to rethink and reorient human relation to the environment, including our conceptualizations of this relationship. First, it allows us to better understand and account for various organism–environment interactions in human niche construction, moving us beyond the assumption that there is *the* environment that needs to be protected or preserved for the sake of the predetermined well-being of humans and other species. In this sense, the theory itself is a conceptualization of the human–nature relations suitable for the Anthropocene. Second, it allows us to understand and interact with our immediate environments in a more dynamic and situated manner than the frameworks that focus on the spatial scale of the planet (e.g., the planetary boundaries framework) or the temporal scale of the geological epoch (e.g., the Anthropocene). Niches can be constructed more locally and rapidly. Third, as the



two examples suggest, once we relax the static notion of environment, cultural NCT gives a framework in which to understand how environments might be constructed in ways which can generate, through nongenetic selection of cultural traits, robust norms, and practices of sustainability.

## Notes

- 1 For example, one of the reviewers of this article notes that “I am extremely sceptical about the idea that non-sustainable practices have anything to do with the conceptualisation of human/nature interactions,” and instead claims that sustainability problems are different versions of the tragedy of the commons (i.e., social dilemmas formalized by game theory). The social dilemma framework is in fact a popular folk theory of sustainability crises (Capstick, 2013). For the purpose of this paper, it suffices to point out that game-theoretic analysis requires that players share conceptualizations and individuations of the states of the world, possible actions and outcomes.
- 2 A terminological clarification is needed here. While Downey (2016) and other NCT advocates understand “niche” as organism-relative aspects of a given physical reality or environment, Lewontin and Levin (1997) criticize the fixed concept of “ecological niche” and use the term “environment” as an alternative. See Justus (2021, ch. 1) for a systematic evaluation of the concept of ecological niche in ecology.
- 3 <https://assets.amsterdam.nl/publish/pages/867635/amsterdam-city-doughnut.pdf>
- 4 Kim et al. (2023) highlight that this relation is more ambiguous, noting that seeing human agency as special in nature (a type of human exceptionalism) could encourage environmental stewardship.

## References

- Arthur, W. B. (2009). *The nature of technology: What it is and how it evolves*. Simon and Schuster.
- Bieler, P., & Klausner, M. (2019). Nicheing in cities under pressure. Tracing the reconfiguration of community psychiatric care and the housing market in Berlin. *Geoforum*, *101*, 202–211.
- Burns, A. (2000). Emotion and urban experience: Implications for design. *Design Issues*, *16*(3), 67–79.
- Cappelen, H. (2018). *Fixing language: An essay on conceptual engineering*. Oxford: Oxford University Press.
- Capstick, S. B. (2013). Public understanding of climate change as a social dilemma. *Sustainability*, *5*(8), 3484–3501. <https://doi.org/10.3390/su5083484>.
- Collins, R. (2004). *Interaction ritual chains*. Princeton, NJ: Princeton University Press.
- Colombetti, C., & Krueger, J. (2015). Scaffoldings of the affective mind. *Philosophical Psychology*, *28*(8), 1157–1176. <https://doi.org/10.1080/09515089.2014.976334>.
- Downey, G. (2016). Being human in cities: Phenotypic bias from urban niche construction. *Current Anthropology*, *57*(S13), S52–S64. <https://doi.org/10.1086/685710>.
- Eisenstein, C. (2018). *Climate: A new story*. Berkeley, California: North Atlantic Books.
- Evershed, R. P., Davey Smith, G., Roffet-Salque, M., Timpson, A., Diekmann, Y., Lyon, M. S., Cramp, L. J., Casanova, E., Smyth, J., Whelton, H. L., & Dunne, J. (2022). Dairying, diseases and the evolution of lactase persistence in Europe. *Nature*. Aug 11;608(7922), 336–345.
- Folke, C., Jansson, Å., Rockström, J., Olsson, P., Carpenter, S. R., Chapin, F. S., Crépin, A.-S., Daily, G., Danell, K., Ebbesson, J., Elmqvist, T., Galaz, V., Moberg, F., Nilsson, M., Österblom, H., Ostrom, E., Persson, Å.,

- Peterson, G., Polasky, S., Steffen, W., Walker, B., & Westley, F. (2011). Reconnecting to the biosphere. *Ambio*, 40(7), 719–738. <https://doi.org/10.1007/s13280-011-0184-y>.
- Fuentes, A. (2016). The extended evolutionary synthesis, ethnography, and the human niche: Toward an integrated anthropology. *Current Anthropology*, 57(S13), S13–S26. <https://doi.org/10.1086/685684>.
- Gergen, K. J. (2011). *Relational being: Beyond self and community*. Oxford: Oxford University Press.
- Hagbert, P. (2020). Co-housing as a socio-ecologically sustainable alternative? In P. Hagbert, H. Gutzon Larsen, H. Thörn, & C. Wasshede (Eds.), *Contemporary co-housing in Europe. Towards sustainable cities* (pp. 183–201). London & New York: Routledge.
- Hampton, S. E., & Parker, J. N. (2011). Collaboration and productivity in scientific synthesis. *Bioscience*, 61(11), 900–910. <https://doi.org/10.1525/bio.2011.61.11.9>.
- Henrich, J. (2015). *The secret of our success*. Princeton University Press.
- Herrmann-Pillath, C. (2023). The universal commons: An economic theory of ecosystem ownership. *Ecological Economics*, 208, 107822. <https://doi.org/10.1016/j.ecolecon.2023.107822>.
- Himberg, T., Laroche, J., Bigé, R., Buchkowski, M., & Bachrach, A. (2018). Coordinated interpersonal behavior in collective dance improvisation: The aesthetics of kinaesthetic togetherness. *Behavioral Sciences*, 8(2), 23. <https://doi.org/10.3390/bs8020023>.
- Jacobs, J. (1961). *The Death and Life of Great American Cities*. NY: Random House.
- Justus, J. (2021). *The philosophy of ecology: An introduction*. Cambridge: Cambridge University Press.
- Kaaronen, R. O. (2018). Reframing tacit human–nature relations: An inquiry into process philosophy and the philosophy of Michael Polanyi. *Environmental Values*, 27(2), 179–201. <https://doi.org/10.3197/096327118x15162907484466>.
- Kaaronen, R. O., Mulder, M. B., & Waring, T. (in print). Applying cultural evolution to address climate and environmental challenges. *Oxford Handbook of Cultural Evolution*. <https://doi.org/10.31219/osf.io/u7hvj>
- Kaaronen, R. O., & Rietveld, E. (2021). Practical lessons for creating affordance-based interventions for sustainable behavior change. *One earth*, 4(10), 1412–1424.
- Kaaronen, R. O., & Strelkovskii, N. (2020). Cultural evolution of sustainable behaviors: Pro-environmental tipping points in an agent-based model. *One Earth*, 2(1), 85–97.
- Kashima, Y., Sewell, D. K., & Li, Y. (2023). Sustainability, Collective Self-Regulation, and Human-Nature Interdependence. *Topics in Cognitive Science* [this special issue]. <https://doi.org/10.1111/tops.12668>
- Khavarian-Garmsir, A. R., Sharifi, A., & Sadeghi, A. (2023). The 15-minute city: Urban planning and design efforts toward creating sustainable neighborhoods. *Cities*, 132, 104101. <https://doi.org/10.1016/j.cities.2022.104101>.
- Kim, J. J. H., Betz, N., Helmuth, B., & Coley, J. D. (2023). Conceptualizing Human-Nature Relationships: Implications of Human Exceptionalist Thinking for Sustainability and Conservation. *Topics in Cognitive Science*, 15, 357–387.
- Kimmel, M. (2021). The micro-genesis of interpersonal synergy. Insights from improvised dance duets. *Ecological Psychology*, 33(2), 106–145. <https://doi.org/10.1080/10407413.2021.1908142>.
- Kimmerer, R. W. (2013) *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*. Minneapolis, MN: Milkweed Editions.
- Laland, K. N. (2017). *Drawing's unfinished symphony: How culture made the human mind*. Princeton, NJ: Princeton University Press.
- Laland, K. N., Odling-Smee, J., & Feldman, M. W. (2001). Cultural niche construction and human evolution. *Journal of Evolutionary Biology*, 14(1), 22–33. <https://doi.org/10.1046/j.1420-9101.2001.00262.x>.
- Larsen, S. C., & Johnson, J. T. (2017). *Being together in place: Indigenous coexistence in a more than human world*.
- Lent, J. (2017). *The patterning instinct: A cultural history of humanity's search for meaning*. Prometheus Books.
- Lewontin, R., & Levins, R. (1997). Organism and environment. *Capitalism. Nature Socialism*, 8(2), 95–98. <https://doi.org/10.1080/10455759709358737>.
- Livernois, R. (2019). *A philosophical analysis of the concept of an externality in economic theory and policy*. University of British Columbia. <https://doi.org/10.14288/1.0380447>.

- Marckmann, B., Gram-Hanssen, K., & Christensen, T. H. (2012). Sustainable living and co-housing: Evidence from a case study of eco-villages. *Built Environment*, 38(3), 413–429.
- Mesoudi, A. (2011). *Cultural Evolution: How Darwinian Theory Can Explain Human Culture and Synthesize the Social Sciences*. Chicago: University of Chicago Press. <https://doi.org/10.7208/9780226520452>
- Mesoudi, A., & Thornton, A. (2018). What is cumulative cultural evolution? *Proceedings of the Royal Society B: Biological Sciences*, 285(2018072), 1–8. <https://doi.org/10.1098/rspb.2018.0712>.
- Nagatsu, M., & Salmela, M. (2022). Interpersonal and collective affective niche construction: Empirical and normative perspectives on social media. *Review of Philosophy and Psychology*, 1–28. <https://doi.org/10.1007/s13164-022-00625-1>.
- Odling-Smee, F. J., Laland, K. N., & Feldman, M. W. (2003). *Niche construction: The neglected process in evolution*. Princeton, NJ: Princeton University Press.
- Ojalehto Mays, B., Seligman, R., & Medin, D. L. (2020). Cognition beyond the human: Cognitive psychology and the new animism. *Ethos*, 48(1), 50–73. <https://doi.org/10.1111/etho.12264>.
- Parker, J. N., & Hackett, E. J. (2012). Hot spots and hot moments in scientific collaborations and social movements. *American Sociological Review*, 77(1), 21–44. <https://doi.org/10.1177/0003122411433763>.
- Pizza, L., & Kelemen, D. (2023). Are humans part of the natural world? U.S. children's and adults' concept of nature and its relationship to environmental concern. *Topics in Cognitive Science* [this special issue]. <https://doi.org/10.1111/tops.12675>
- Pollock, J. N. (2010). Using book clubs to enhance social-emotional and academic learning with urban adolescent females of color. *Reading & Writing Quarterly*, 27(1-2), 101–128.
- Richardson, M., Dobson, J., Abson, D. J., Lumber, R., Hunt, A., Young, R., & Moorhouse, B. (2020). Applying the pathways to nature connectedness at a societal scale: A leverage points perspective. *Ecosystems and People*, 16(1), 387–401. <https://doi.org/10.1080/26395916.2020.1844296>.
- Rietveld, E., & Kiverstein, J. (2014). A rich landscape of affordances. *Ecological Psychology*, 26(4), 325–352.
- Rose, N., Birk, R., & Manning, N. (2022). Towards neuroecosociality: Mental health in adversity. *Theory, Culture & Society*, 39(3), 121–144. <https://doi.org/10.1177/0263276420981614>.
- Rose, N., & Fitzgerald, D. (2022). *The urban brain: Mental health in the vital city*. Princeton, NJ: Princeton University Press.
- Rossi, R. (2021). Empaattinen ahdistus romaanin tunnevaikutuksena: Tapaustutkimuksena Marjo Niemen Kaikkien menetysten äiti. *Avain*, 18(1), 38–55.
- Salmela, M. (2014). Collective emotions as the 'glue' of group solidarity. In A. Laitinen, & A. B. Pessi (Eds.), *Solidarity: Theory and practice* (pp. 48–70). Lanham: Lexington Books.
- Salmela, M., & Nagatsu, M. (2017). How does it really feel to act together?: Shared emotions and the phenomenology of we-agency. *Phenomenology and the Cognitive Sciences*, 16, 449–470.
- Schabas, M. (2005). *The natural origins of economics*. Chicago, IL: University of Chicago Press.
- Schröter, M., van der Zanden, E. H., van Oudenhoven, A. P. E., Remme, R. P., Serna-Chavez, H. M., de Groot, R. S., & Opdam, P. (2014). Ecosystem services as a contested concept: A synthesis of critique and counter-arguments. *Conservation Letters*, 7(6), 514–523. <https://doi.org/10.1111/conl.12091>.
- Seto, K. C., Güneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, 109(40), 16083–16088. <https://doi.org/10.1073/pnas.1211658109>.
- Shepard Jr., G. H., & Daly, L. (2023). Sensory ecology, bioeconomy and the age of COVID: A parallax view of indigenous and scientific knowledge. *Topics in Cognitive Science*, 15, 584–607.
- Solecki, W., Rosenzweig, C., Dhakal, S., Roberts, D., Barau, A. S., Schultz, S., & Ürge-Vorsatz, D. (2018). City transformations in a 1.5°C warmer world. *Nature Climate Change*, 8(3), 177–181. <https://doi.org/10.1038/s41558-018-0101-5>.
- Steel, D., DesRoches, C. T., & Mintz-Woo, K. (2022). Climate change and the threat to civilization. *Proceedings of the National Academy of Sciences*, 119(42), e2210525119. <https://doi.org/10.1073/pnas.2210525119>.
- Sterelny, K. (2010). Minds: Extended or scaffolded? *Phenomenology and the Cognitive Sciences*, 9(4), 465–481. <https://doi.org/10.1007/s11097-010-9174-y>.

- Tijms, J., Stoop, M. A., & Polleck, J. N. (2018). Bibliotherapeutic book club intervention to promote reading skills and social–emotional competencies in low SES community-based high schools: A randomised controlled trial. *Journal of Research in Reading*, 41(3), 525–545.
- Tsing, A. L. (2015). *The mushroom at the end of the world: On the possibility of life in capitalist ruins*. Princeton, NJ: Princeton University Press.
- Tzoulas, K., Galan, J., Venn, S., Dennis, M., Pedroli, B., Mishra, H., Haase, D., Pauleit, S., Niemelä, J., & James, P. (2021). A conceptual model of the social–ecological system of nature-based solutions in urban environments. *Ambio*, 50(2), 335–345. <https://doi.org/10.1007/s13280-020-01380-2>.
- United Nations, Department of Economic and Social Affairs, Population Division. (2019). *World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420)*. New York: United Nations.
- Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T., & Eronen, J. T. (2021) Raising the bar: on the type, size and timeline of a ‘successful’ decoupling, *Environmental Politics*, 30(3), 462–476, <https://doi.org/10.1080/09644016.2020.1783951>
- Voutilainen, L. (2022). Jaetut empaattiset tunteet kirjallisuuspöytäkirjassa. *Puhe ja Kieli*, 42(1), 69–90. <https://doi.org/10.23997/pk.119694>.
- West, G. (2017). *Scale: The Universal Laws of Growth, Innovation, Sustainability, and the Pace of Life in Organisms, Cities, Economies, and Companies*. First Edition. NY: Penguin Press.
- Wolfram, M. (2018). Cities shaping grassroots niches for sustainability transitions: Conceptual reflections and an exploratory case study. *Journal of Cleaner Production*, 173, 11–23.
- Young, I. M. (1990). *Justice and the politics of difference*. Princeton, NJ: Princeton University Press.
- Zukin, S. (2020). Seeing like a city: How tech became urban. *Theory and Society*, 49(5), 941–964. <https://doi.org/10.1007/s11186-020-09410-4>.