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The Cognitive Neuroscience of Nature? Sociological and Historical Perspectives on Environmental Neuroscience

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1. A splash of smart sauce on an over-tired frontal lobe

In May 2012, the well-known hiking and wilderness magazine, *Backpacker*, published a story about new research showing how, beyond even the everyday pleasure and invigoration of outdoor exercise, "staying home is just plain dumb" (Kwak-Hefferan, 2012). Under the title, *Hiking Makes You Smarter,* the journalist, Elisabeth Kwak-Hefferan, described how she had recently taken part in a pilot study in a Utah canyon, to show how being exposed to nature can cause a measurable change to the brain. The research team, Kwak-Hefferan reported, hypothesized that being out in the wilderness would make a person think and focus more acutely; it would de-stress them, calm them down, make them measurably happier. The appeal for the magazine's readers was obvious. "Imagine a world," Kwak-Hefferan wrote, in which "backpacking becomes the science-recommended way to prepare for the SATs, chess tournaments, and all of life's biggest mental challenges."

Here then, in the hollow wilderness of the American west, was the frontier of a new discipline, "environmental neuroscience" – an emerging field, said the magazine, that "hones in on how one's surroundings specifically affect the way the brain works." Environmental neuroscience, the reporter went on, is grounded in the idea "that something about being in the wilderness causes physiological changes: the release of certain hormones, maybe, or the switch of activity from one brain region to another." In the experiment, participants were given a set of cognitive tests, before spending the next few days hiking in the wilderness, while continuing to take tests. The hypothesis was that participants' cognitive performance would improve as they became more and more

immersed in the environment. This all had to do, Kwak-Hefferan told the readers of *Backpacker*, with the prefrontal cortex, an area of the brain that was becoming chronically over-burdened by the "buzzers, sirens, and ringtones of life"— that was now increasingly over-worked, tired, stressed out. "Our modern environment is something that we've invented in the last 100 years or so," David Strayer, the lead researcher, told the journalist: "Frankly, we don't know what that's going to do to us." Following some positive results, the article ends with an account of how the scientists were planning a bigger study down the line, perhaps also taking a blood measure of participants. But the journalist herself needed no such reassurance: "I'm a believer," she declares, startlingly, at the end of the article: "While my weekend outings are just as much fun as they've always been, I think of these trips differently. They've become a vital investment in my own brainpower, a much-needed splash of smart sauce on an overtired frontal lobe." Sure, she concludes, she could use biological or cognitive tests to demonstrate this association – but the point is, she doesn't need to. "Hell yes, I'm smarter," this journalist reports at the end of her four-day wilderness immersions: "I can feel it. Can't you?"

I begin this short essay on sociological and philosophical issues in environmental neuroscience with this example for several reasons. As an early (and quite scientifically detailed) media story on the coalescence of environmental neuroscience, this article is a useful historical artefact for making sense of precisely how, and in what terms, the then emergent (and as I argue in this contribution: *still* emergent) field was being constituted by its publics. I also begin with this article because of where it appears – not the *New York Times*, not the *Guardian*, not *Die Zeit*, but in the rather less-storied pages of *Backpacker* magazine, i.e. a self-conscious media accomplice of the solidification of 'nature' and 'the outdoors' as sources of middle-class physical and moral improvement in the middle decades of the twentieth century (indeed, a subscription to the magazine is bundled with membership of the American Hiking Society to this day; see Berg, 2015). But I begin with it especially because of that last striking, definitive claim: that whatever the quality or strength of the scientific research, however exciting the emergence of a brain measure for environmental effects may be – in some sense, all of this doesn't matter. Because the mere idea itself, that nature contact is good for our minds, that it improves our mental health and our capacity to think clearly, all of this is, somehow, something we already know intuitively – we know it already because we can *feel* it. At stake, here, is a set of implicit philosophical and sociological commitments – about the gap between city and the countryside, about our ideas of nature, about what an environment is, about what kinds of spaces might be good for human beings, about what is good for our mental health – that come together, I argue, to make environmental neuroscience into a potent and rapidly growing field. In what follows, rather than follow a prescriptive list of 'social issues,' I want to make an argument that environmental neuroscience has emerged within a very specific social and historical context. Understanding the field as a social phenomenon, I suggest, means understanding how it is embedded in, and reproductive of, a set of historical trajectories and macro-social contexts – about urbanization, about the place of nature, and in particular about the perceived catastrophe of our modern built environment.

2. The cognitive neuroscience of nature

Of course, understanding the emergence of environmental neuroscience means, initially at least, understanding the technical and conceptual developments that have made the field thinkable in the first place. In terms of the former, large-scale funding and coordination activities over the last 10 to 15 years, such as the NIH's BRAIN initiative, have significantly advanced the technical capacity for what is sometimes called 'real world neuroscience'—i.e. the use of either virtual environments, or mobile brain-imaging methods, to take a brain measure while a person moves around a space (see NIH, 2023). While these technologies are still at a preliminary stage, we are at least now within sight, say Krugliak and Clarke, of a 'toolkit that allows for the study of neural function in uncontrolled complex visual environments, getting us closer to studying cognition in our natural habitat' (2022: 2291). In one sense, we could read environmental neuroscience as, in essence, technologically determined: the field emerged as it becomes possible (at least in a preliminary sense) to take a brain measure of a person moving around a changing three-dimensional environment. The 'environment' is simply now visible and measurable at the level of the brain.

However, this technological story has to be added to a conceptual one. Because we might *also* read environmental neuroscience as one part of a wider realization, common to a larger set of neuro-disciplines, that the environment has a much larger role in brain function than was previously thought. As Berman and his colleagues put it in an introductory text to the field, 'simply controlling for, or regressing out, environmental context is not sufficient to truly understand behavior' (2019a: 1040). More specifically perhaps, if genome-wide association studies explain only a small portion of brain phenotype variance – then environment, or environmental exposure, must explain the remainder, whether we understand this relationship as 'gXe,' the 'exposome' or some other neologism (se Liu et al, 2023; Vineis and Barouki, 2022). In this sense, environmental neuroscience might be read as another development within what sociologists of science have called the 'post-genomic' turn in the life science, i.e. a general turn, in the wake of the relative disappointments of both the decade and the brain and the human genome project, towards an account of human biology as no longer an isolated kingdom unto itself – but understood, now, as a system in constant transaction with, indeed highly dependent on, the social and cultural world in which biological individuals are embedded (see Reardon, 2017).

But what, precisely, is meant by 'environment' here? The word itself, of course, is a recent invention, and has been used to mean a wide array of non-overlapping things (see Warde et al, 2018). Moreover, neuroscientists have been interested in different kinds of environments for some time. Indeed, one way of reading the emergence of environmental neuroscience would be as a kind of outgrowth, or expansion, of the more established field of *social* neuroscience. If the latter rested on a claim that it was now possible to integrate biological and social levels of analysis in making sense of mental behavior (see e.g. Cacioppo et al, 2000), the promise of *environmental* neuroscience, in turn, is to transform this narrowly cultural definition of the 'social' into, as Marc Berman and his colleagues put it, the 'sociophysical'. Environmental neuroscience is in this sense, straightforwardly 'the scientific study of brain-mediated, bidirectional relationships between organisms and their *social* a*nd physical* environment (Berman et al, 2019a: 1041; my emphasis). However, in another paper the same year, Berman again, now with different co-authors, draws a sharper distinction, leaving the 'social' or

even the 'sociophysical' some distance behind: although 'social psychology and social neuroscience are interested in similar questions' to environmental neuroscience, these scholars write, what distinguishes the latter is attention to 'aspects of the physical environment that include but are not limited to noise, greenspace, degree or intensity of urban development, crime, low-level perceptual features (for example, colors, contours, etc.), pollutants, lighting, temperature, etc.' (Berman et al, 2019b: 414). On its current [at time of writing] homepage at the University of Chicago, Marc Berman's lab describes itself as having an interest only in 'how the physical environment affects the brain and behavior.' From a more generous and open account of different environments, here the role of the physical environment is established as the field's conceptual grounding.

Indeed, in practice, the term is generally used even more narrowly than this. While, in principle, the physical environment in environmental neuroscience means any space a person might be in, whether a modern office, a busy city center street, or an open field, in experimental and theoretical work, 'environment' tends to mean something closer to what a person means when they refer to the 'environmental movement' or an incoming 'environmental catastrophe.' In other words, the 'environment' tends to signal a burgeoning interest in how the strictly physical qualities of the *natural* environment, or what Kühn and her colleagues (2023) call "living environments," affect brain function – whether these living environments are measured by the preponderance of vegetation and greenery, by physical distance from urban centers, or by the relative absence of humans. It should be noted that this focus on nature is in sharp contrast to the much earlier physical-environment psychology of figures such as Edward Tolman or Kurt Lewin, for whom the spatial layout of interior rooms, the arrangement of corridors etc., were key variables of interest. Certainly, contemporary researchers are still interested in built interiors (I will say more on this below) though very often these too are analyzed in terms of the role of plants or natural materials within them (see e.g., Qin et al, 2013). In one important recent intervention by a range of leading authors, environmental neuroscience is posited not only as a science of nature, but even as even a science for and on behalf of nature – a science that offers a route for neuroscientists to help 'tackle the existential environmental threats Earth is currently facing' (Doell et al, 2023: 1288). Such is the strength and consistency of this bias, indeed, that one might even read 'environmental neuroscience as – in the words of Madan and his colleagues (2019) – simply 'the cognitive neuroscience of nature.'

3. From nature to architecture

It is worth recalling that, while we live in a moment of widespread scientific and popular interest in how physical environments affect minds and brains, it is not the first such moment. Environmental neuroscience, of course, has conceptual and methodological links to environmental *psychology,* which itself crystallized at the turn of the nineteenth and twentieth centuries. Enric Pol traces the origins of this field to the work of Willy Hellpach – once a student of Wundt at Leipzig – whose *Geopsyche* (1911) was concerned with, inter alia, 'the effect of the sun and the moon on people's activities; the effect of colour and form; the effect of extreme environments –such as the Tropics or the Artic; the effect of urban microclimates' (Pol, 2006: 96). As Pol points out, Hellpach was himself the product of a fruitful local ecology among a particular generation of German-language psychological researchers: interest in questions of *lebensraum* (first coined by

the geographer, Friedrich Ratzel [1901], to describe how society is shaped by its physical parameters) and *umwelt* (a term invented by the aristocratic biologist, Jacob von Uexküll [1934], for whom it describes the relationship between an organism and the perceptual qualities of its physical environment) were in the air. It is not incidental to this story of how human psychology came to be seen as dependent on a particular kind of physical and social territory that both concepts would go on to be associated with National Socialism. Uexküll particularly, in the early 1930s, was an enthusiastic Nazi, and a signatory to the infamous professorial 'Vow of Allegiance' to Hitler (see Schnödl and Sprenger, 2022).

However, another strand of this history – one with a very different political inflection – passes through the early behavioral work of Edward C. Tolman (1948), whose pioneering experimental experiments on spatial navigation (Tolman was initially interested in how rats would learn to complete a maze to find food) showed that rats were not simply following stimuli, but were constructing 'cognitive maps' to make sense of their spatial environment. For Tolman, writing not long after the defeat of National Socialism, this capacity for learning, and for developing a contextually sensitive perception of space, was also a model for cold-war optimism about the human psychological capacity for social understanding. Humans, he wrote, much like the happiest and best treated of his own rats, could be taught to develop rich, nuanced accounts of the world around them, thus abandoning the narrow, stimulus-driven simplicities of previous eras. Just as for Hellpach, Tolman was working in an environment with a range of conceptual affordances. In the contemporaneous work of figures such as John B. Calhoun, Stanley Milgram, and especially Kurt Lewin (who carried the German gestalt concern with spatial environments to the United States after the Nazi rise to power) the capacity of *space*, and of spatial complexity, to dramatically effect an organism's behaviour, became a major site of interest, culminating in O'Keefe and Dostrovsky's famous recording of 'place cells' in the brains of rats in the 1970s (for a much fuller account of these histories, see Rose and Fitzgerald, 2022; Fitzgerald, 2024).

But a third historical strand – and the one I really wish to emphasize here – is the relationship of environmental neuroscience to the now largely-forgotten field of architectural psychology in the 1960s and 1970s. As Emina Petrović and her colleagues (2015) point out, massive postwar urban re-development, and in particular the rapid development of new housing, often constructed along daringly modernist lines, produced a widespread concern with how the designers of such spaces may 'lack of a deeper understanding of the culture and mental processing of the inhabitants' (Petrović et al, 2015: 482). As Canter and Craik (1981) argued in an early history of environmental psychology, postwar architecture found itself confronted with a whole set of new design problems, but also a whole new terrain of investigation in the new, modern 'totally controlled' environment. Lighting, for example, now 'had to be reappraised in terms of its capacity to meet human requirements for visual performance' (Canter and Craik, 1981: 3). Moreover, the rapid spread of heating and air-conditioning technology meant that, suddenly, a merely 'physiological model of human thermal comfort could no longer be considered satisfactory' (ibid). In other words, with the problems of the worker's *body* now apparently resolved (at least as far as the bodies of middle- and upper-class office workers were concerned) the problems of the *mind* now moved to centre stage. In his landmark 1975 monograph, *Psychology for*

Architects, David Canter, unquestionably the leading figure in the field in Britain in this period, contrasts an admiring quote from the modernist architects, the Smithsons, about a new Mies van der Rohe design, with a less admiring quote 'attributed to' a psychiatrist: 'half the mental hospitals would be empty and psychiatrists out of a job if every home had two bathrooms and soundproof bedrooms' (1975: 1). In other words, what mental health professionals knew about how spaces affected people's mental states, and what kinds of spaces leading architects thought looked good or worked well, were often in stark contrast to one another. Into this gap, a whole new field of empirical inquiry inserted itself.

It is noteworthy that this concern with working spaces remains a core feature of environmental neuroscience and its linked design practices. In one recent study, Mostajeran and her colleagues showed that participants in a virtual office showed improved performance on memory and creativity tasks when virtual plants were added to the workspace (Mostajeran et al, 2023). Similarly, in an experiment testing the effect of a short-term nature exposure on people's cognitive performance (participants were shown a video of an urban forest), Zhang and colleagues lamented that 'limited understanding of natural environments' restorative effects from a neuro-cognitive perspective lames [sic.] the practitioners to build healthy living and working environments scientifically' (2023: 116830). In a recent special issue of *Architectural Design* on 'neuroarchitecture, the architect, Ian Ritche (2020), described his work on the Sainsbury Wellcome Centre at University College London — where John O'Keefe was the first director. This design, says Ritchie, was steeped in 'the results of neuroscientific research to inform the spatial structure of the interior architecture: about how people interact with the space around them, the importance of adaptability, the nature of light and its wavelengths in the working environment, and how the spaces in which we live and work affect our mood and behavior. The nature and organization of the resulting interior spaces with long, short and vertical views and varying volumes was described by one of the scientists as akin to the scale-free nature of the brain itself' (2020: 9). None of this is inherently objectionable. And yet as the historian of science Michelle Murphy (2006) reminds us, corporate managers have long been interested in how working environments can ensure the maximum efficiency and range of the human bodies operating within them. Murphy shows, for example, that a critical forerunner of women entering the white-collar workforce *en masse* in the mid twentieth century was the widespread use of air conditioning systems, which made it possible for middle-class women simply to *be* in an office environment, without the socio-biological disturbance of their visible sweat.

With such histories in mind, we might also see environmental neuroscience in these kinds of spaces today as a way of using science to mediate the relationship between the needs of capital and the body of the worker. In the work of companies like Space Syntax, for example, we should not assume that bringing psychological, behavioral and increasingly neurobiological insights to bear on the design and functioning of a large-scale enterprise is a politically neutral activity; nor, indeed, is it necessarily benign from the perspective of an employee or resident within such an enterprise. After all, making working environments that are healthier, more restful, calmer, and so on, also means making spaces that are more economically efficient, and that extract value from the employee with less visible friction. The employee's improved mental state is thus

directly leveraged and indeed monetized by the organization for whom that same working environment is, often, little more than a tool for the generation of capital. This may seem excessive or unfair. But the question of the relationship between design and intention is quite central for the field, though it is little discussed. And with intention comes politics. It's worth recalling that a good deal of the energy within environmental neuroscience derives from the fact that the external environment is not, as it is for most nonhuman animals, a source of stimulus for the passive organism. Rather the human environment is something we make and create with intention. Scholars (e.g. Berman, 2019: 1041) are fond of a quote from Winston Churchill: "we shape our buildings and afterwards our buildings shape us." And yet, the fact that the same Winston Churchill, in 1920, had the physical environment in which I am currently writing this paper (i.e. the city of Cork, Ireland) burnt down in a characteristically vicious act of colonial reprisal, should remind us that such architectural shaping is not necessarily or obviously affirmative. We need to think much more seriously about what, precisely, is being shaped by our science, and what economic and political purpose lies behind that shaping.

4. Urbanization and climate change

In addition to these intellectual inheritances, I want to argue that the emergence of environmental neuroscience should *also* be understood in terms of a distinctive macro-social context, and via a growing global attention to two phenomena in particular: (1) urbanization and (2) climate breakdown. The much-cited United Nations statistic is that the earth has recently (in fact, sometime around 2007) passed the milestone of being more than 50% urban. In other words, today more than half of the population of the planet lives in an urban area, and this proportion is expected to increase to about 70% by 2050. This constitutes, according to UN Habitat (the UN programme focused on sustainable urban development) a 'global megatrend' - one that 'is intertwined with the existential challenges that the world has faced in the last 50 years, including climate change, rising inequality and the rise in zoonotic viruses' (UN Habitat, 2022: xvi). Though urbanization is often thought to have positive potential for sustainable development (through, for example, the concentration of population and more efficient use of resources) the growth of cities is nonetheless usually understood, politically as well as scientifically, as a problem in need of a solution: 'We have now entered the Century of the City,' point out the geographer Karen C. Seto and her colleagues in a recent *Annual Review*. In this new era, even if the city has some positive potentials and affordances, urbanization nonetheless 'creates the most human dominated landscapes and drives local and regional environmental changes by transforming land cover, hydrological systems, and biogeochemistry. Worldwide, urban expansion is one of the primary drivers of habitat loss and alteration and of plant and animal species extinction' (2010: 168). In the public health literature, similarly, scholars have moved from the analysis of urbanization as an historical, sociological, or ecological phenomenon, to the idea of 'urbanicity' as a form of atmospheric exposure. Urbanicity, say Vlahov and Galea, means 'the impact of living in urban areas at a given point in time… [it] refers to the presence of conditions that are particular to urban areas or present to a much greater extent than in nonurban areas' (2002: S5).

This idea of the contemporary city as a negative psychological exposure has been critical to the development of environmental neuroscience, and it remains a central experimental topic. In a 2020 paper, for example, Mazumder and his colleagues placed a group of participants outside two kinds of buildings in central London – one a medieval church, and the other a glass and steel skyscraper – while taking a range of physiological and cognitive measures (Mazumder et al, 2020). Or in a now famous paper from 2011, Lederbogen and his colleagues showed not only that an urban population processes stress differently from a more rural population, but they were even able to isolate the neural mechanisms implicated in this processing (Lederbogen et al, 2011). What is at stake here – and this I argue is a central philosophical commitment of the field – is a hard, diagnostic line between urban and rural life, or between natural and human-made materials. More specifically, there is a growing consensus, within environmental neuroscience, that there is something about the physical parameters of *nature*, some perhaps still not fully understood visual, olfactory or atmospheric quality of natural materials or scenes, that soothes and calms the mind – a quality that protects the modern person, and in particular, the modern *urban* person, from the stresses and strains of life in the city (see Rose and Fitzgerald, 2022, for a history). It is worth pointing out that this largely implicit philosophical distinction – between nature and non-nature – is fraught with difficulty, and those difficulties remain a large lacuna for the field (see e.g. Vogel [2015] on weak ontological justifications for distinguishing the natural from the unnatural, or Levinovitz [2020] for a more normative critique of the inherent goodness of nature).

But it is urbanization that remains the central focus. As Kühn and colleagues again put it: urbanization is 'one of the most important global health issues of the 21st century, in particular since mental health problems seem to be more frequent in cities… [thus] to safeguard mental and physical well-being in cities, research is needed that is targeted at identifying salutogenic factors of *living* environments (2023: 312; my emphasis). Or as Bratman and has colleagues put it one of the field's most well-known empirical papers: 'Never before has such a large percentage of humanity been so far removed from nature …more than 50% of people now live in urban areas, and by 2050, this proportion will be 70%…What are the potential mental health implications of this demographic shift?' (2015: 8567). Though they note that the picture is complex and far from unidirectional, Kühn and Gallinat (2024) similarly argue that 'mental health problems typically accumulate in urban areas. This seems to be especially true for schizophrenia, affective and anxiety disorders and autism.' Thus 'environmental Neuroscience may inform landscape and urban planning, as well as architecture, to make living environments more salutogenic' (ibid.). This desire to produce a salutogenic city is, I suggest, primary to environmental neuroscience — indeed to the extent that it is difficult to see the field existing at all absent a widespread cultural and political concern with the growing city and its psychological effects. This concern is hardly new. Frederick Law Olmsted, the great designer of urban parks, founded his career on a similar wave of concern in the mid nineteenth century, and indeed with much the same solution as that usually proposed today (see again Fitzgerald 2024 for a full account), Still, it is critical to stress that environmental neuroscience, today, exists as a field whose self-given goal is in large part to heal the sickly city – to help cure the planet of at least the *psychological* consequences of its frightening march towards more and larger urbanization.

The second aspect of the macro-social context that has produced the new field, environmental neuroscience' is climate breakdown, and in particular a widespread sense of climate anxiety. As Susan Clayton has pointed out, climate breakdown has quite direct psychological effects: heat increases the likelihood of anger and aggression; being caught in a major environmental disaster is likely to produced PTSD and depression; people displaced by climate events will experience stress and burnout (Clayton, 2020: 102262). But also, Clayton suggests, scientists are increasingly aware of another, less direct, and more nebulous phenomena, called climate anxiety, climate grief, ecological trauma, or sometimes, using Glenn Albrecht's and his collaborators' terminology, 'solastalgia' and 'psychoterratic illnesses' (e.g. Albrecht et al, 2007; Clayton, 2020). The last of these, describes an 'earth-related mental illness where people's mental wellbeing (psyche) is threatened by the severing of healthy links between them-selves and their home/territory.' These terms are of course quite new, generally describe sub-clinical phenomena, and have perhaps been prominent in more public-facing than in scholarly literatures. But the wider relation is nonetheless finding its way into scientific literature. Here I am on rather speculative ground, but I want to suggest, that the generalized projection of an anxious or hopeless relationship to the natural environment, cannot be easily disentangled from a science that claims to now be able to fully understand – and perhaps also recuperate – humans' psychic relationship to nature. Indeed, though experimental work in environmental neuroscience rarely operationalizes climate change or climate anxiety as a variable, the phenomenon is nonetheless very frequently in the background as the field accounts for itself. As Berman and colleagues argue, 'Humans and other species are in trouble… if we do not make attempts to protect and conserve nature that currently exists. Understanding how and when humans act in more environmentally friendly ways is an important area of research for an environmental neuroscience approach' (Berman et al, 2021: 80). For Leeuwis and colleagues (2022), similarly, environmental neuroscience can help to understand the neural basis of 'pro-environmental behavior' in consumers. While in a review paper, Susie Wang and Barry van der Berg (2021) propose using EEG measures to answers questions such as whether preparatory attention is linked to environmental motivation. My point is not that the field (falsely) promotes itself by promising to resolve climate change; rather I suggest that the presence of climate change as a psychological problem gives a neuroscience of the environment critical purchase in both institutional and public contexts, and forms a major part of its wider appeal.

5. The politics of the environment

In the mid-2000s, when social scientists and philosophers began to pay sustained attention to neuroscience's expansive epistemic vision following the 'Decade of the Brain,' and especially as they attended to novel claims made on behalf of the emerging field of social neuroscience, three consistent arguments took hold: first, that fields like social neuroscience, affective neuroscience, and their cognates, represented an unwarranted 'biologisation' of phenomena that scholars elsewhere took to be determined by historical and cultural forces (for example, a person's likelihood of committing a crime; an individual's voting preferences; the emotions we feel and express about a romantic partner); second, partly but not entirely with regard to this biologisation, that the expansive neuro-disciplines were attached to a new philosophy of personhood, in which a person's desires and actions were to be represented by their

brain only; and third, largely not wholly due to this notion of personhood, that neuroscience was attached to an implicit political ideology, wherein political interventions that would previously have focused on social or structural solutions now took the neurobiology of the individual body as the key site of attention and intervention. Perhaps most infamous, in this last regard, was work promoted by the one-time British Conservative Party leader, Iain Duncan Smith, on the neurobiological effects of poverty, which seemed to proceed as if being poor was an unfortunate brain disease, and not the direct effect of Duncan Smith's own party's welfare policies (see Woolf, 2010; on the wider critiques, see especially Choudhury, Nagel and Slaby, 2009; Vidal and Ortega, 2017; Rose and Abi-Rached, 2013). As the historian Joelle Abi-Rached put it at the very outset of these discussions in the early 2000s: 'we can already see the rise of new markets and economies based on the new findings and technologies coming from brain research. We can foresee applications in politics and in the courtroom; we have seen the continuous expansion of psychiatric disorders and diseases, and we are witnessing an intensifying debate about the ethical, moral and philosophical aspects of neuroscience and its applications. What is lacking, however, is a broad and inclusive debate about how society values and should deal with the knowledge and technology and their applications' (Abi-Rached 2008: 1162).

These debates largely fizzled out in subsequent years, partly because the irresistible force of the 'neuro age' eventually ran into the immovable object of biological complexity; and partly because philosophical and sociological energy moved away from these sometimes entrenched disciplinary disagreements, and towards attempts to find a conceptual and methodological third space (where, for example, innovative neurobiological experiments might not have to be at odds with decades of patient, qualitative work in social and political sciences). I do not wish to revive those rather stale debates here, but it is nonetheless striking how willing scholars within environmental neuroscience are to talk about policy, but *still* without any serious reflection on how policy recommendations may be guided by their own political and ideological priors, and still further without *any* demonstrated awareness of the complexity and mess of policy implementation. Berman and his colleagues, for example, argue that that it should be an explicit goal of environmental neuroscience 'to take a generative theoretical approach using results from (epi) genetics and neuroscience to design the physical environment to improve human psychological functioning' (2019b: 415). But once we start talking about the design of the physical environment, we are instantly in the realm of local politics, of municipal democracy, of finance, of competing interests, of ideology, and so on. It is not at all clear how well-equipped the environmental neuroscience community is to intervene with skill or care in such spaces, or indeed whether skill and care are even understood as important qualities within these proposed interventions. There is sometimes a sense in the concluding sections of environmental neuroscience papers that biological data will simply overcome political interest – that if the right people simply pay attention to the science, then the right course of action will follow, and competing interests will fall away. As Kühn and her colleague put it at the end of a paper showing positive associations between the extent of tree cover around one's home, volume of grey matter in the right orbitofrontal cortex, and improved cognitive performance in verbal and spatial domains: 'we anticipate that the research field of environmental neuroscience may in the long run provide a knowledge base for evidence-based urban landscape planning' (2023: 6-7). This is of course laudable, but it represents, too, a perhaps unfounded optimism about the

capacity of biological data to over-ride, or even to weigh significantly in, political decision making, as well as an implicit normative commitment to the idea that biological data *should* have political priority (that, for example, measures of cognitive performance or volume of grey matter should over-ride what car-drivers say about the journey times they find tolerable, or what we know about homeowners' desire to pave their front gardens, and so on).

In the conclusion of their paper cited above, which contrasted a tall modern building with a much smaller and more traditional one, Mazumder and his colleagues directly considered the position of Mayor of London, Sadiq Khan. Khan, they said, 'has directed individual boroughs in London, which is seeing an upswell of high-rise buildings across the city, to decide whether how tall buildings should be and to consider if the spatial context and character is suitable to them.' They quote approvingly from London planning documents that impose visual and other neighborhood-relational constraints on the building of high rises, and they note that 'it is encouraging to see this focus on the atmospheric stressors that can be caused by exposure to high-rise buildings' (2022: 1090). They thus conclude their paper with the claim that, 'as cities continue to densify, it is important that a psychological lens is applied to the process of urbanization' (ibid, 1091). In another paper, Berman and his colleagues draw on the work of the idiosyncratic architect, Christopher Alexander (once described by the *New York Times* as a 'fierce anti-modernist'). They contrast an image of a very modern-looking kitchen with a picture of a dining room in something like a medieval brick refectory: 'the red-outlined [modern] indoor environment,' they argue, 'has less scaling and contrast than the blue-outlined indoor environment… these elements may affect social interactions [and] brain network behavior' (2019b: 415). They conclude: 'in the future, dynamically altering the environment will also require that environmental neuroscientists work with architects, builders and planners to determine what designs are feasible (ibid.: 416). In their work using eye-tracking methods, similarly, Justin Hollander, Ann Sussman and their colleagues draw a sharp contrast between neighborhoods that do and do not favor 'Traditional Neighborhood Design' (TND)— in other words, street design that features more stereotypically old-fashioned qualities like 'narrow streets, complex facades, and bilateral symmetry' (2020: 485). Non-TND, by contrast, tends to feature more modern-looking square or rectangular buildings, often with blank facades, and little detailing. Hollander and colleagues find much greater eye fixation in street-scene images that feature higher levels of TND – 'suggesting features,' they argue, 'that draw the eye and may help people feel more connected in their built environments' (ibid.: 502).

This consistent focus on the old or the traditional as less psychologically taxing is worth paying attention to. While it is uncontroversial to note that urban nature alleviates the mental stress associated with city exposure, increasingly scholars in environmental neuroscience make a related but different claim, which is that the features associated with urban nature may also be associated with more *traditional* building styles in cities, and/or that *modern* architecture and planning worsen the cognitive load of urban space. Thus, scholars in this field often find themselves either explicitly or implicitly arguing for a kind of traditionalism in urban design. There are two things to stress here. First, that this is an unavoidably political position; and second, that a preference for traditional design is an ideological position often associated with very reactionary political forces. The conservative philosopher, Roger Scruton, for example, long railed

against modern buildings in post-war Britian, which he took as a sign of both aesthetic and moral decay. The related idea that modernist or tall buildings were inherently associated with crime or social breakdown — as in the much critiqued notion of 'defensible space' — was part of the intellectual armature that allowed conservative governments throughout Europe to disinvest from large scale public housing, which had long been associated with often daring modern design (see Scruton, 1974; Coleman, 1985). More recently, figures like Donald Trump, drawing on the broadly fascist aesthetic and social 'movement' sometimes called RETVRN, have used modern architecture as an important symbolic front for making their wider far-right political commitments clear (indeed, Trump signed an executive order before leaving office, mandating that all federal buildings must follow traditional or classical styles). Throughout Europe and North America, T*he Art Newspaper* points out, 'reactionary ideas hostile to the cosmopolitan, to Modernism, to modernity itself, are in the ascendant' and thus 'traditional architecture has become a vehicle of choice for the Right and Far Right' (Bevan, 2022).

None of this, of course, is to argue that the scientists cited above are pursuing a conservative political agenda. But we might nonetheless reasonably ask scholars in this space to reflect upon, and indeed take responsibility for, the fact that their science has the capacity to provide encouragement and support to a deeply reactionary urban politics – indeed that it may serve to biologize or naturalize a conservative, even fascistic agenda for the city and its buildings. This politics is of course not at all concerned with mental health, or with wellbeing, but rather with pushing back on a whole range socio-legal rights won in the second half of the twentieth century, and thus restoring the physical and symbolic order of the world before the welfare state, with the high rise housing block perhaps its most potent visual symbol.

6. Environments in the making

I have argued in this short contribution that environmental neuroscience is an emergent field, and that making sense of its emergence means taking account of this social, historical and philosophical contexts in which it is taking shape. One part of this context, I argued, is a very particular concern with *nature* as both a psychological and moral force. I suggested that *this* concern, in turn, should be understood in terms of a wider cultural anxiety about climate breakdown and about what urban sociologists call 'planetary urbanization' (Brenner and Schmid, 2015). This is how, ultimately, we should make cultural and social sense of the coming-into-prominence of a 'cognitive neuroscience of nature,' or the transformation of the psychology of architecture into the psychology of nature. I also suggested that this at least partly accounts for the field's guiding and central problematic, which is the question of urban mental health – i.e. the question of how modern spaces and habitats, often bereft of natural materials and vistas, can negatively affect our mental states. I went on to say that there is a coincidence, here, between spaces that are thought to be *psychologically* unhealthy by researchers in environmental neuroscience, and spaces that are thought to be *morally* unhealthy by a whole range of political reactionaries. This is not to say the former bear

responsibility for the latter or that they have anything to do with them. But it *is* to suggest that scholars may need to think through this problem as, at the very least, a significant ethical conundrum for the field.

The philosopher and anthropologist, Bruno Latour (1987), once argued that science always looks in two directions at the same time: in one direction, there is the world of established scientific facts, undisputed truths, agreed-upon methods and so on; in the other direction is what Latour called 'science in the making,' i.e. that much messier and uncertain, perhaps earlier process, in which things are not yet fully settled, in which what will become the 'established facts' of the field are, still, yet to be determined. Environmental neuroscience, I suggest, is very much 'in the making' in this sense, which is not at all a negative description but is rather both an invitation and an opportunity to think reflexively, and indeed politically, about which facts are currently 'in the making' and which are not, and what their responsibilities are to those facts either way. In a world that really *is* rapidly urbanizing, in which nature reality *is* under terrible threat, in which people really *do* lament the loss of ecological contact, environmental neuroscience has a major role to play in making sense of the coming decades. Precisely what the role will consist of, however, is not yet clear.

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