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# Neurosexism, Neurofeminism, and Neurocentrism: From Gendered Brains to Embodied Minds

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## ABSTRACT

Over the course of the last decade, a strand of feminist science scholarship has come together under the rubric of “neurofeminism”. One of the driving concerns for scholars in this area is to expose and criticize what is sometimes called “neurosexism”. This is a tendency among some neuroscientists, science writers and journalists to exaggerate cognitive, emotional, and behavioural sex differences and to pin gender stereotypes on allegedly innate sex differences of brain structure and function. The standard neurofeminist response has operated largely within the framework of the nature vs. nurture problematic, emphasizing the lack of attention to the role played by experience-dependent neuroplasticity in the development of a gendered brain. I propose to reframe this debate using resources from the philosophy of mind. I argue that several issues driving this debate hinge on the more fundamental question of how the role of the brain in behaviour should be conceptualized. In this regard, I show how neurosexism assumes neurocentrism—which I explicate as the transposition of the Cartesian immaterial soul onto the material brain—as its philosophical foundation, and I develop the case against this assumption, drawing in part on the enactive approach to the philosophy and science of the mind.

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## Introduction

In feminist science studies, there is a strand of scholarship that goes by the name *neurofeminism*. The term was chosen as the main title of an edited collection of papers (Bluhm et al., 2012a) coming out of the inaugural workshop of the Neurogenderings Network at the Center for Gender Research at Uppsala University in 2010. The event almost coincided, ironically, with the airing of the controversial Hjernevask (“Brainwash”) series on Norwegian national TV. Neurofeminism remains an ongoing and collective scholarly effort to expose and overcome gender-essentializing tendencies within and around basic research on sex differences in brain function and structure, for which Fine (2008) has famously coined the term *neurosexism*. According to neurofeminists, such tendencies compromise neuroscientific research on sex differences in multiple ways: From insufficient handling of the risk of generating (and reporting) false positives and exaggerating effect sizes of “sex” as a variable, via the “a brain difference is a hardwired difference” belief as default assumption (thus neglecting possible effects of experience-dependent plasticity), to unmoored flights of evolutionary fancy citing any small sex difference as a hint of a possible adaptation to ancestral environments (Fine et al., 2019).

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So far, however, there has been relatively little engagement with the more *philosophical* questions to which the neurofeminist endeavour gives rise, particularly the kind of questions addressed within the philosophy of mind. This paucity of philosophical thematization is striking, given the extent to which any pronouncement on the implication of a “fact” about the brain—such as a sex difference in the structure or activation pattern of a certain brain region of interest—for our understanding of human cognition, emotion and behaviour cannot but proceed on assumptions of a philosophical nature. Along these lines, there is every reason to undertake, as part of the neurofeminist effort, an analysis bent on unearthing the philosophical assumptions that go into neurosexism as a way of understanding sex differences in brain and behaviour. Should those assumptions turn out not to hold up in some fundamental respects, while the neurofeminist commitments on the corresponding philosophical front have more going for them, the neurofeminist critique of neurosexism will have at least one more leg to stand on.

In this article, therefore, I offer a reading of neurosexism that locates it in a landscape of philosophical thought concerning the mind and the brain and explore some strategies for addressing neurosexism with regard to its philosophical underpinnings. Specifically, I shall be claiming that neurosexism—as a sexist (i.e., gender essentialist) way of thinking about differences of brain structure and function between men and women on the group level—is an instance of the more general phenomenon that it is now common to refer to as *neurocentrism*. On one level, the term is used to denote a style of reasoning that problematically centres the brain in accounting for human experiences, ailments, and behaviours in various domains, such as education (cf. Katchergin, 2017), mental health (Lilienfield et al., 2015), or the law (Wiseman, 2020). At a more fundamental level, the term is also used in reference to a philosophical outlook that narrowly focuses on the brain as the basis for understanding core features of the human mind—such as the nature of our cognitive and affective states and processes, along with their associated behaviours—and that reserves for the body only a marginal place (if at all) in such understanding (cf. Gallagher, 2018a). Here my goal is to relate neurosexism to neurocentrism in this latter, more philosophical sense and, in so doing, to motivate a stronger appreciation for the philosophically fundamental issues about the human mind that must therefore be seen to lie at the core also of neurofeminism. In this regard, I propose to see the neurofeminist struggle against neurosexism in the context of the challenge to neurocentric proclivities currently mounted by emerging embodied-enactive paradigms within (the philosophy of) cognitive and affective neuroscience (cf. Colombetti, 2014; Gallagher, 2005, 2018b; Varela et al., 1991)

My strategy for making this argument will be as follows. In the first section, I offer an account of what I take neurosexism to consist in as a general way of thinking about sex differences in brain structure and function. In this account, three tenets of neurosexism are delineated—essentialism, innatism, and neurocentrism respectively—along with the standard ways in which these have been critically addressed by neurofeminists. I note the relative paucity of explicit neurofeminist thematization of the neurocentrist undergirdings of neurosexism as compared with the concerted effort to undermine essentialism and innatism, pointing to some instances where neurofeminist thinking itself hovers close to invoking aspects of neurocentrism. In the second section, I present the case against neurocentrism as a philosophical basis on which to understand human psychology and behaviour, drawing on—among other resources—the enactivist version of the emerging embodied philosophy and science of the mind. Finally, in the concluding section, I address some doubts one may entertain regarding the value of the enactive conception of embodied subjectivity and agency for future (neuro)feminist work in other domains.

## Neurosexism, neurofeminism, and neurocentrism

In the paper in which the term “neurosexim” was first entered into circulation within neurofeminist discourse (incidentally, prior to the coining of the term “neurofeminism”), Fine (2008, p. 70) used it in the sense of “gender stereotypes dressed up as neuroscience”. Although the target of her criticism

in this paper was the emerging genre of popular books such as Louann Brizendine's *The Female Brain* (marketed as some sort of guide to getting the most out of life with a "female brain"), Fine later extended the usage of this term to address how such gender stereotyping also infiltrates the echelons of institutionalized cognitive neuroscience (cf. Fine, 2010, 2013a, 2013b). The subtle (and not so subtle) methodological and theoretical ways in which basic research on sex differences in brain and behaviour have been seen to either draw upon, or ended up lending its garbs to, old gender stereotypes (or both) are legion (cf. Fine et al., 2019). It seems to me, however, that there are three overarching themes or tenets that jointly define neurosexism as a general way of reasoning about differences of brain structure and function between men and women at the group level. I shall refer to them as *essentialism*, *innatism*, and *neurocentrism* respectively, of which the third tenet (as already indicated) serves to ground the former two, which—being more conspicuous—are more frequently thematized in neurofeminist criticisms. I have chosen to order my exposition of neurosexism so that it moves from the surface to the deeper levels, using as my chief illustrative example the (in)famous study by Rachel and Ruben Gur's team at the Perelman School of Medicine, University of Pennsylvania, of sex differences in the human connectome (Ingallhalikar et al., 2014). Published in the prestigious journal *PNAS*, and widely covered and commented on in popular media upon its online publication in December 2013 (including in Norway), it has gone down in history as a "perfect case study in neurosexism" (Fine, 2013b; cf. O'Connor & Joffe, 2014).

An account of sex differences in brain and behaviour is *essentialist* to the extent that it assumes (whether explicitly or implicitly) that differences of brain structure and function between men and women on the group level warrant pronouncements on what "male brains" and "female brains" respectively are like, considered as *kinds of brains*. When the terms "male brain" and "female brain" are thus used to denote kinds of brains, it is implied that each such kind has an *essence*, in the sense of possessing a set of traits or properties that are individually necessary and jointly sufficient to mark it off from its counterpart. The Penn Medicine study of the sex-differentiated human connectome exemplifies this sort of reasoning. Based on the finding that, on average, stronger connectivity within each hemisphere and stronger modularity and transitivity predominated among males whereas more females showed stronger interhemispheric connectivity and less modularized and transitive networks, and correlating these findings with results on a battery of cognitive tasks in a companion study of the same group of subjects, the authors conclude that "male brains are structured to facilitate connectivity between perception and coordinated action, whereas female brains are designed to facilitate communication between analytical and intuitive processing tasks" (Ingallhalikar et al., 2014, p. 823). It is as if the brain of a woman does not equip her to adjust her movements to the sensory feedback she receives from the environment, making her dependent on her male companion to perform the tasks that require such coordinated action—as if natural selection would not have discarded such a clunky type of brain long ago. However, as neurofeminist Daphna Joel and colleagues have shown, it doesn't make sense to think of brains in this essentialist way: Although there are differences of brain features and behaviour between men and women on the group level, at the individual level—in the overwhelming majority of cases—brains are *mosaics* of both male- and female-typical traits. For instance, someone with a female-typical connectivity strength in one brain region may well have male-typical connectivity strength in some other brain region (cf. Joel et al., 2015).

The second tenet of neurosexism is *innatism*, consisting in the tendency to assume as a default hypothesis that observed sex differences of brain structure and function among adolescents and adults are due primarily to sex-typed developmental factors that either operate pre- and perinatally or independently of social environment in other ways (genomic profile, organizing/activating hormones etc.) This idea is typically expressed through the idiom of "hardwiring" (and often in combination with the essentialist tenet), such as in Simon Baron-Cohen's now classical formulation "*The female brain is predominantly hardwired for empathy. The male brain is predominantly hardwired for understanding and building systems*" (Baron-Cohen, 2004, p. 1). But it is also invoked in the 2014 connectome study, in and through the same passage that was cited above: "[M]ale brains

are structured to facilitate connectivity between perception and coordinated action whereas female brains are designed to facilitate communication between analytical and intuitive processing modes” (Ingallhalikar et al., 2014). Here, the assumed interchangeability of the terms “structured” and “designed” reveals the innatist assumption, since one would only use the term “designed” in this context if one is certain that experience-dependent input (which may vary with gendered life circumstances) has not contributed anything of significance to the developmental outcome one is looking at. The neurofeminist rejoinder to such arguments has been to point out that they are typically made without duly controlling for possible effects of gendered experience-dependent plasticity on whatever sex differences that show up in one’s data about brain and behaviour (as was the case in the study at issue), and to offer new insights into how such neuroplasticity comes into play (cf. Fine, 2013; Jordan-Young & Rumiati, 2012, p. 106; Rippon, 2019; Schmitz & Höppner, 2014, pp. 15–16).

The third tenet of neurosexism, *neurocentrism*, is the most fundamental while also the most inconspicuous of the three, and for this reason merits particular attention. It is most fundamental, in so far as it is that which motivates the other two: It is what makes it seem worthwhile to hunt for innate and essential sex differences in the brain in the first place, if the goal is to explain observed sex differences (at the group level) in cognition, emotion and behaviour. At the same time, it is also the most inconspicuous of the three tenets, because it is so widespread—although less so now than two or three decades ago—in the cognitive-affective research community at large (i.e., not limited to research on sex differences in brain and behaviour), thus amounting to a paradigmatic assumption that anchors and orients what is arguably still the bulk of research on human cognition, emotion and behaviour. In a nutshell, neurocentrism amounts to the assumption that accounts of structures, states, and processes in/of the brain are not only necessary, but *sufficient* to adequately explain mental states and processes and their associated behaviours. This supposes that the shape and direction of the explanandum (mental life and behaviour) is *fully determined* – at least proximally, i.e., on the behavioural timescale—by the explanans (brain activity). This idea was vigorously defended by Jean-Pierre Changeux in his classic *Neuronal Man: The Biology of Mind* (1983/1997), at a time when neurocentrism had yet to be established as “what goes without saying”. Observations of what happens in the brain during various kinds of mental processes, movements, and behaviours “lead not only to an explanation of the internal mechanisms of behaviour”, Changeux wrote, “but to the adoption of a deterministic point of view. In theory nothing prevents us from describing human behaviour in terms of neuronal activity” (125).

These days, for the most part, neurocentrism operates more subtly and tacitly than in Changeux’ stark formulations. Looking again at our “textbook example” of neurosexism, we get a glimpse of it in a statement made by Ragini Verma, one of the co-authors of the connectome study, as she talks to her university’s Department of Communications about it (Penn Medicine News, 2013). The “stark difference—and complementarity—in the architecture of the human brain”, she argues, “helps provide a potential neural basis as to why men excel at certain tasks [e.g., cycling and navigating directions], and women at others [e.g., creating solutions that work for a group]”. As instances of tasks in which men excel, Verma cites cycling and navigating directions, whereas multitasking and “creating solutions that work for a group” supposedly encapsulate the kinds of tasks in which women have an edge (neither set of tasks were being tested for in the study). What goes without saying here is the idea that, although the kinds of behaviours concerned all require more than just brain activity for their realization, no other “bases” than the neural ones are of interest when it is a matter of explaining (differences in) such behaviours. That is, bodily states, movements, and engagements with resources in the person’s environment are trivial add-ons to the real action that goes on inside the skull. In different contexts, the neurocentric underpinning of neurosexism may be more bluntly stated, such as when Joe Herbert, in his book *Testosterone: Sex, Power, and the Will to Win* (2015), speaks of the brain as “the crucible of humanity” and of humans as “largely what brains are” (viii). Applied to the question of what it is to be a man or a woman respectively, this line

of reasoning yields the unsurprising conclusion that “[i]t is his brain that makes a man, not his testosterone” (168).

As far as I can gather, the neurofeminist response to the neurocentric tenet of neurosexism has been less consistent than is the case with the two other tenets, discussed earlier. It seems to vary on a spectrum, ranging from bold attacks on neurocentrism as such (although not advanced as a critique of neurosexism), to functionalist-style rebuttals of neurosexism, some of which themselves hover in the vicinity of neurocentrism. In her contribution to the 2012 *Neurofeminism* collection, Gillian Einstein takes to task what she calls the “classic biomedical model” of the human body for its Cartesian supposition of a “disconnect between the rest of the corporeal body and the brain”:

On this view, even if mind equals brain and thus, is meat, the brain still sits privileged atop our polarized body with other body systems arrayed like arms, legs, and trunk on a marionette’s strings—to be pulled and moved by the brain. Information comes in. The brain processes it. An action is generated and then carried out by the peripheral nervous system. The rest of the body responds. On this view, the brain is the CEO of the body (Einstein, 2012, p. 159).

Incidentally, writers such as philosopher and cognitive scientist Daniel Dennett and the Norwegian neuroscientist Kaja Nordengen have recently described the role of the brain in human behaviour in terms highly reminiscent of how it is depicted in this passage.<sup>1</sup> Einstein clearly intends it, however, as a damning critique of a reasoning style that is grossly inadequate as a framework for the kind of research she is engaged in, such as the study of how female genital cutting affects nervous system functioning. But it is insofar as it constitutes a paradigmatic assumption of the “classical biomedical model” more generally that neurocentrism draws her critical remarks, and not insofar as it also forms the bedrock of neurosexism.

In Ginger Hoffman’s contribution to the *Neurofeminism* anthology, by contrast, the focus is precisely on arguments that involve the “neural sex-differences explain cognitive and behavioural sex differences” type of reasoning as their unstated premise. However, the sort of challenge that Hoffman levels against neurosexism hits it farther from its neurocentric core, in so far as it relies heavily on functionalist-style arguments from multiple realizability. Such arguments, Hoffman writes, “appeal to the idea that our brains are like computers: we can envision our brains as the hardware and our minds as the software”, which, when applied to sex differences in brain, cognition and behaviour, suggest that “mental states may be identical to brain states, but may, say, be identical to one *type* of brain state in women, and to a different *type* of brain state in men” (Hoffman, 2012, p. 37), just as the same kind of software may run on different kinds of hardware. It should be noted that Hoffman does not commit herself to the truth of this picture in general; it is sufficient for her that it represents a plausible way to account for sex differences at the neural level that does not naively assume that such differences must translate into differences rather than similarities at mental and—by extension—behavioural levels.

Fine et al. (2019) proceed in a fashion akin to Hoffman’s, when they try to rebut the “sex-differentiated brains explain sex-differentiated minds and behaviours” assumption by pointing out that “it is quite possible that the same behaviour is generated by somewhat different neural networks in the brain of different people,” as exemplified in the case of the prairie vole, “in which brain and hormonal differences between males and females give rise to similar parenting behaviour” (Fine et al., 2019). The moral of the story, they suggest, is that “there are many neural roads to the same behavioural end”, that there is currently a “cavernous gap in knowledge” concerning how to map which roads may lead to which ends in this regard, and that one should resist the temptation to have gender stereotypes fill this gap (Fine et al., 2019). What is not considered here, however, is the possibility that there may be other roads than just neural ones that, for non-trivial reasons, must be travelled in order to get to behavioural ends (although neural roads surely form inescapable parts of the route). Nor is it acknowledged that our bafflement with regard to which neural networks generate which behaviours in what kinds of individuals may result

from more than—or even something else than—just a cavernous gap in our knowledge; in other words, that it may also stem from an ideological attachment to neurocentrism.

If neurosexism is indeed rooted in neurocentrism in the way and to the extent that I have suggested, a fully adequate neurofeminist response to it must address more than the sexist part of the picture: It would also have to involve a resolute struggle against those very neurocentrist underpinnings. In the next section, therefore, I present a strategy through which one might put pressure on neurocentrism (and *eo ipso* on neurosexism), one that reaches down to its roots in modern Western philosophy, and I offer this analysis as a contribution to the neurofeminist struggle against neurosexism.

## From the Cartesian brain to the Embodied Mind

There is no denying that, at least since the publication of Varela, Thompson, and Rosch's *The Embodied Mind* some thirty years ago (1991), theoretical and experimental approaches to the mind have been moving increasingly in an embodied direction, away from neurocentrism (cf. Barrett et al., 2016; Barsalou, 2008; Chemero, 2009; Colombetti, 2014; Damasio, 1999; Friston, 2012; Gallagher, 2005; Lakoff & Johnson, 1999). Specifically, workers in the field have begun exploring ways in which bodily movement and posture, allostasis (i.e., metabolism and energy regulation), and interoceptive signalling from the enteric nervous system connected to the viscera and the gut (including the latter's bacterial microbiome) modulate and shape perceptual, conceptual, social-cognitive, and affective processes and states. Nevertheless, as commentators from both within and outside the field of (cognitive, affective and behavioural) neuroscience proper have been pointing out in the course of the last decade or so, neurocentrism continues to hold sway—both in mainstream neuroscience and in our culture at large—as a powerful force shaping our conception of ourselves as subjects of experience, action, ailment, betterment and optimization (Brennkmeijer, 2016; Choudhury & Slaby, 2012; Jasanoff, 2018; Rose & Abid-Rached, 2013). Although the idea that we *are* our brains, or that—in Francis Crick's (1994, p. 3) memorable phrase—“you're nothing but a pack of neurons”, might have seemed astonishing to the originally intended audience of Crick's book *The Astonishing Hypothesis*, today it seems to have lost all air of sensation or scandal and to have installed itself among those truths that go without saying.<sup>2</sup> I submit that even many of those who are now advocating various “embodied” approaches within (the philosophy of) the sciences of the mind (e.g., “embodied inference”, “embodied simulation”, “somatic marker hypothesis” etc.) would find something to agree with in Patricia Churchland's claim that “The weight of evidence now implies that it is the brain, not some non-physical stuff, that thinks, feels and decides” (cited in Rose & Abid-Rached, 2013, p. 200).<sup>3</sup>

The claim that it is the brain, not some non-physical stuff, that thinks, feels, and decides may look superficially like a reductionist claim (and the scholar advancing this particular claim has even been an avid defender of *eliminativism* about such mental states as thinking, feeling, desiring, and deciding). In some crucial respects it certainly is reductionist, and problematically so, as we will consider in due course. What I would like to focus on first, however, is the sense in which the notion of a thinking, feeling, and deciding brain is the opposite of reductionism and becomes all the more problematic for it. As suggested by Churchland's phrasing, it presents itself as an advancement beyond and a resolution of the difficulties involved in holding, with Descartes, that the thing that thinks, feels, and decides is an utterly immaterial, non-physical soul, difficulties that famously were pointed out to Descartes by such clear-sighted philosophers as Princess Elisabeth of Bohemia, with whom Descartes corresponded. In a nutshell, the difficulty with Cartesian dualism is to explain how an immaterial thing (e.g., the soul) can causally interact with a material thing (e.g., the body), such as happens in sensory perception (through which the body effectuates changes in the soul) and voluntary action (through which the soul effectuates changes in the body). Hence, since causal relations are ubiquitous in nature, and since such commonplace mental phenomena as perceptions and voluntary decisions seem to be embedded in such causal relations either on the receiving or

delivering end of things, it is plainly incomprehensible how—on the Cartesian model—our mental life could get the foothold in nature that it at least apparently has. As it is difficult not to sympathize with Princess Elisabeth’s verdict that “it would be easier . . . to concede matter and extension to the soul than to concede the capacity to move a body and to be moved by it to an immaterial thing” (Elisabeth, 2007, p. 68), it would seem, then, that progress can be had on this front only by allowing that that which thinks, feels, and decides is also something consisting of matter and extended in space. Granted this much, what else—one might reasonably ask—than the brain could fit the bill, given that we’re not familiar with any instances of genuinely thinking, feeling, and deciding in which a brain (or something sufficiently similar to a brain) was not involved?

The problem with this form of reasoning, however, is its circularity. What we want to understand is the physical basis of *our* mental powers, i.e., our capacities for thought, feeling, and volition; we want to know how such powers can operate in a world that is, fundamentally, a physical world. Now, why would it explain anything about our ability to think, feel, and make decisions to ascribe these same powers to a *part* of us, namely, that 1,3 kg mass of goo housed between our ears? Why should it be any easier to explain how a *brain* is able to think, feel, and decide than to explain *our* possession of such abilities? Supposing that what makes it possible for us—adult human beings and other kinds of animals—to see, feel, judge, and decide things is that our brains are doing all of this for us is simply, as Alva Noë puts it, to “work in a big, plain circle”, as it “just takes for granted the nature of mental powers without explaining them” (Noë, 2009, p. 161). In short, one has simply replaced one mystery—how *we* are able to think, feel and decide—with another mystery—how the brain is able to think, feel and decide—since, “at present, we have no better understanding of how ‘a vast assembly of nerve cells and their associated molecules’ might give rise to consciousness than we understand how supernatural stuff might do the trick” (Noë, 2009, p. 6).

There is, moreover, a sense in which the mystery of how the brain thinks, feels, and decides is even more impenetrable than the original mystery (i.e., how *we* do those things). This is because, as Bennett and Hacker (2003) point out, no one really has any clear idea of what it would be for a brain to think, feel and decide things, that is, “what *counts* as a brain’s doing these things and what sort of evidence would support the ascription of such attributes to the brain” (Bennett & Hacker, 2003, p. 71). For example, we are familiar with what it would mean for a *human being* to be (momentarily) depressed, reconsider things, and decide to go outside for a walk because such states, processes, and events are typically evidenced in characteristic bodily attitudes, expressions, and movements; they are also often communicable in a linguistic form that may be either concise and direct or sketchy and indirect. But it is not clear what it would mean for a brain to feel either dejected or elated, as it does not have the means with which to reveal such states outwardly (it doesn’t have a bodily frame, facial features or a tone of voice that can express either dejection or elation); nor is either going out for a walk or remaining inside part of the repertoire of what a brain is able to do, hence not something it can decide to do, as it does not have legs to walk on, nor is it able to make its way in a wheelchair should its legs be disabled. Here, we are in a very different situation than in other areas of research where mental powers previously thought to be exclusive to human beings were discovered to lie dormant in other primate species, such as the bonobo Susan Savage-Rumbaugh successfully trained to ask and answer questions, reason in rudimentary fashion, give and obey orders, and so on (cf. Bennett & Hacker, 2003, p. 72). In this case, the evidence of Kanzi’s reasoning abilities lies in his behaviour, i.e., the pattern of his interactions with the primatologist. If neuroscientists are nowhere near this kind of situation regarding the kind of evidence that may show the brain to think, feel and decide, then what *would* count as an empirical discovery that the brain, *rather than an immaterial soul*, indeed has these properties?<sup>4</sup>

So, the neurocentric claim that it is the brain, rather than some non-physical thing, that thinks, feels, and decides is anything but reductionist in so far as it inflates the brain with properties and powers it cannot conceivably have. However, there is an important sense in which it is also reductionist. Significantly, this is a reductionism it shares with the Cartesian account it claims to be supplanting, and consists in reducing the perceiving, thinking, feeling, and comporting agent as



a whole (i.e., the person or the animal) to some discreet, interior part of it, whether this interior part be an immaterial soul or a material brain. In other words: claiming that it is the material brain, rather than some immaterial soul, that thinks, feels, and decides changes very little in the overall picture of what it is to be a minded and minding creature, since it still proceeds on the assumption that thinking, feeling, and deciding are activities, states, and processes taking place in some space hollowed out and tucked away in the interior of that creature.<sup>5</sup> This is the decisive point at which modern Western thought took a fatefully wrong turn, leading the neurocentrist inheritors of this tradition into the sort of dead-ends discussed above, including those of neurosexism. Hence, it is the point to which one needs to back up to be off to a better start.

As indicated at the outset of this section, this effort is currently underway in several strands of theoretical and empirical work that suggest a more “embodied” conception of the subject of perception, thought, emotion, and action than the received (i.e., Cartesian) view assumed in mainstream cognitive, affective, and behavioural neuroscience. The approach that, in my view, most resolutely points the way out of Descartes’ shadow in this regard at the moment is the version of the so-called *life-mind continuity thesis* developed by defenders of the *enactive* approach to theoretical biology and neuroscience, going back to the seminal work on autopoietic organization by Humberto Maturana and Francisco Varela (Maturana & Varela, 1980) and the organismic philosophy of Hans Jonas (1966).<sup>6</sup> This approach centres on the notion of *sense-making*, suggesting that living beings *qua* living, in their manner of approach and adjustment to their environment, literally make sense of or *enact* this environment in terms of the conditions on their continuation as viable and flourishing beings within it. Whether in the case of a single-celled motile bacterium swimming up a sugar gradient or that of a multicellular animal tracing a path through a landscape or through its conspecific’s verbal or non-verbal gesticulation, we are dealing with variations on the same fundamental theme of enactive sense-making.

Most significantly for my present purposes, this way of looking at things suggests that sense-making cannot be reduced to neural activity in the brain. “In fact”, as Giovanna Colombetti points out, “it does not even *require* a brain or a nervous system” (Colombetti, 2014, p. 101). It is the living being as a *whole* that counts as a sense-making agent, not some supposedly dedicated part of it charged with the responsibility to monitor the (internal and external) environment and then pass motor instructions to other parts of it. Thus, Colombetti observes,

[t]he presence of a nervous system inside the organism does not make sense making suddenly “shrink” to it (and, correlatively, it does not relegate the rest of the organism to a mere interactant that provides inputs to the nervous system and receives outputs from it). Rather, from an enactive perspective, it augments and diversifies the sense-making capacity of the organism, enabling new modalities of interacting with the world, as well as new modalities of self-maintenance and self-regulation (Colombetti, 2014, p. 102).

Instead of seeing the body as a “mere interactant” providing extero- and interoceptive sensory information to the brain and taking motor orders from it, then, the enactive approach sees the extra-neural body as “itself a vehicle of significance or salience” (Colombetti, 2014, p. 106), constitutively participating in the organism’s sense-making activities within its environment. Crucially, this notion of the perceiving and comporting agent also seems to dovetail nicely with a long-standing commitment within feminist theory to see the body “not [as] a thing”, but rather as “our grasp on the world and the outline of our projects” (de Beauvoir, 1949/2010, p. 46) and “the very ‘stuff’ of subjectivity” (Grosz, 1994, p. ix).

## Concluding reflections

Neurofeminism is both a destructive and a constructive endeavour: It seeks both to destroy the basis for neurosexist accounts of brain and behaviour, and to construct an alternative account of what (if anything) sex and gender have to do with the brain and how they mesh

with one another. In the preceding, I have sought primarily to contribute to the destructive part of the neurofeminist endeavour, by articulating a strategy through which to dismantle the philosophical foundations on which neurosexism is ultimately built, namely, neurocentrism. Towards the end, however, I also sketched, in the broadest outline, enactivism as a possible alternative to the neurocentric view of the subject of perception, thought, feeling, and behaviour—a general picture of ourselves as minding and comporting creatures that both unifies much of the new discoveries currently underway within the so-called embodied turn in the cognitive, affective, and behavioural neurosciences and also resonates with deep-seated intuitions within the canons of (post)modern feminist theory.

One may nevertheless want to question the suitability of enactivism for the more constructive (neuro)feminist purposes in some respects, however. It has been argued, for example, that enactivism shares with the other E-approaches (embodied, extended, embedded etc.) within (the philosophy of) the cognitive sciences the feature of operating with a “relatively asocial” conception of the body, seeing it as “a somehow purely natural product, fundamentally unaltered by the distinguishing characteristics of the society in which it is placed” (Bluhm et al., 2012b, p. 8; cf. also Pitts-Taylor, 2014). Certainly much of the work undertaken in the name of “enactivism” – not least including its early, pioneering developments by the likes of Varela, Thompson, and Di Paolo—is vulnerable to such criticisms. Still, such shortcomings have not dissuaded feminist scholars working both within and around the cognitive neurosciences from drawing on enactivist ideas (such as of “operational closure”, “sense-making”, “agency” and “enaction”) in their attempts to reconceive the embodied development of gender identity and sexual orientation (cf. Fausto-Sterling, 2019), “the making, unmaking, and remaking of sense as it pertains to gender” (Merritt, 2014), how gender as a socio-cultural, narrative structure influences our sense of agency (cf. Brancazio, 2019), even to get an explanatory handle on Butlerian gender performativity and how it is reproduced through time (cf. Butnor & MacKenzie, 2022). To my mind, such extensions of enactivist ideas to feminist and queer-theoretical concerns—to the extent that they are fruitful ones—at least indicate that these ideas may harbour socio-political implications that were perhaps unsuspected by their originators.

Another issue that may bear on how one judges the value of enactivism for (neuro)feminist purposes is whether the reticence regarding the notion of *representation* that has become a staple of enactivist thinking makes it unfit for those feminist tasks that one may reasonably call “representation-hungry”, to borrow Andy Clark and Josefa Toribio’s memorable phrase (Clark & Toribio, 1994, p. 403). Specifically, one might argue that to understand how gender ideology insinuates itself into the psychic life of power, one must consider how gender norms, embedded as representations within a culturally shared space of social meanings, work to shape our minds as gendered social knowers and actors, something that seems to require that one look beyond the purview afforded by enactivism.

Haslanger (2018) has recently proposed an update on the social analysis of power that, drawing on insights from such disparate sources as evolutionary psychology and Bourdieuan sociology, highlights ways in which such social meanings have already literally shaped our own minds before we ever get to “read” the minds of others “by providing symbolic resources that structure our behaviour” (Haslanger, 2018, p. 14). This reference to “symbolic resources” would seem to point in the direction of a representational economy of the mind. However, Haslanger is adamant that one must avoid collapsing all social meanings into the category of *beliefs*, i.e., internal mental states bearing propositional content that may be either true or false. Instead, she argues, we should recognize that ideology operates in the form of what she calls a “cultural *techne*”, i.e., “the set of social meanings that agents draw on in a particular milieu in order to participate in the local practices”, meanings that “can be made articulate and challenged, and explicitly upheld as orthodoxy”, yet which prior to such explicit espousal or contestation are “enacted in practice” (Haslanger, 2018, pp. 18–19). The oblique reference

to “enaction” here seems to indicate that enactivism might supply at least *some* of the tools needed to flesh out the *modus operandi* of the Haslangerian “cultural techne”, perhaps also to check the neurocentric leanings that inflect the evolutionary-psychological sources Haslanger draws on for her concept of “mindshaping”.<sup>7 8</sup>

## Notes

1. According to Nordengen (2017, p. 95), “[w]hat the cortex *dictates*, the hormones and the autonomic nerve system *carry out*”, “the autonomic nerve system is the brain’s *subordinate*”, and this system is in its turn what “switches you on” (through the sympathetic nerve system) and also, via the parasympathetic nerve system, “switches you off” (my translation and emphases). Daniel Dennett (2017, p. 150) has similarly described the brain as the “headquarter” or “control centre” of sensorimotor functioning in sentient and mobile organisms.
2. As Alva Noë pointed out in his 2009 book *Out of Our Heads* (and his diagnosis there is still largely valid): “What is striking about Crick’s hypothesis is how astonishing it isn’t. (...) It *would* be astonishing to be told that you are *not* your brain” (2009, pp. 6–7).
3. Shaun Gallagher has consistently remarked on how some accounts that are sold as “embodied” accounts of perception, cognition, emotion and empathy are, at best, only weakly embodied, in so far as the body they are concerned with is not the materially present, living, moving, agitated and suffering body but rather *the body in the brain*, i.e., the body as “represented” in and by the brain. This analysis applies no less to Damasio’s “somatic marker hypothesis” (cf. Gallagher, 2005, p. 135) or Lakoff and Johnson’s “embodied metaphors” than to Barsalou’s notion of “grounded cognition” and Goldman and Vignemont’s “sanitized” and “B[body]-formatted” neural representations (Gallagher, 2018b, pp. 28–35). As Gallagher puts it, “In cases of hypoglycaemia, perception is not modulated because the brain *represents* hunger and fatigue, but because the perceptual system (brain and body) is chemically (materially) affected by the actual hunger and fatigue. (...) My hunger may not affect my perception so much if a sexually attractive person walks into the room; although this has something to do with processes in the hypothalamus (as well as in the social world), it is not the result of a confused hypothalamic B-representation” (Gallagher, 2018b, p. 39). Similarly, with regard to the “inferences”, “predictions” and “testing” referred to by workers within the more recently emerging predictive coding/Bayesian brain paradigm, a more thoroughly embodied account would have to question whether “inference” – even when qualified as “active inference” – can really take the place of *doing*, i.e., of the organism’s active engagement with the world (cf. Gallagher, 2018b, p. 19). For some reason, Gallagher seems to exempt Barrett and Bar (2009) from the same kind of criticism when commenting briefly on their “affective prediction hypothesis” (as does Colombetti, 2014, pp. 105–106). But shouldn’t the exact same kind of question be put to the notion of a brain “routinely making affective predictions”, predictions that include “representations” of the “affective impact” that have accompanied visual sensations similar to the ones currently processed by the system (cf. Barrett & Bar 2009, p. 1326)?
4. The attempt to get past such hurdles by working with more fine-grained “neural representations” – supposed to be content-bearing physical states, structures, or processes somewhere and somehow in and of the brain—does not resolve the issue. We tend to conflate states and processes in the brain that represent information *for the brain researcher* with states and processes that represent information *for the brain* (i.e., information consumed and made use of by the brain), as we lack a clear sense of how the brain itself can be said to decode whatever is encoded in a given representation, or of the nature of the physical channel used to transmit encoded content from one part or process of the brain to another (cf. de-Wit et al., 2016).
5. “It would then turn out that contemporary neuroscience has been in the thrall of a false dichotomy, as if the only alternative to the idea that the thing inside you that thinks and feels is immaterial and supernatural is the idea that the thing inside that thinks and feels is a bit of your body” (Noë, 2009, p. 7).
6. An alternative version of the life-mind continuity thesis is found in Friston’s (2009) work on the free-energy principle. For a comparison between the autopoietic-enactive and free-energy versions of this thesis, see Kirchhoff (2018), who ultimately votes for the latter. With regard to what is at issue at present—how to break with the Cartesian picture of what it is to be a minded and minding agent—my enthusiasm for this approach is tempered by the following set of statements by Friston himself: “The brain is an inference machine, generating hypotheses and fantasies that are tested against sensory data. Put simply, the brain is—literally – a fantastic organ (fantastic: from Greek, *phantastikos*, the ability to create mental images)” (cited in Rippon, 2019, p. 103). If this brain is, as Rippon (2019, chapter 5) suggests, “the Twenty-First Century Brain”, it looks deceptively similar to the Seventeenth Century Subject in some respects that could be questioned. Isn’t this once more to repeat what Bennett and Hacker (2003) have termed *the mereological fallacy*, namely, the mistaken ascription to a part (of a living being) of attributes that can only meaningfully be ascribed to the whole (person or animal)?

7. This possibility has recently been explored in detail, with specific reference to Haslanger's paper on mind-shaping, by Maiese (2022). Maiese uses enactivist notions of agency, embodiment, and habit to foreground how a Haslangerian "cultural techne" comes to be set up in individual subjects and to throw light on what space for resistance there might be from this point of view whenever such a cultural techne is socially oppressive.
8. Parts of the argument developed in this article were test-driven in talks given at SLSA 2018 – Out of Mind: The 32nd meeting of the Society for Science, Literature, and the Arts, held at the Hilton Hotel, Toronto, 15–18 November, 2018, at BIAS in AI and Neuroscience, a transdisciplinary conference held at Radboud University, The Netherlands, 17–19 June, 2019, and in an open seminar at the Centre for Women's and Gender Research, University of Bergen, 16 January, 2019. I want to thank participants on those occasions for their feedback. I also want to thank two anonymous reviewers for *NORA* for insightful criticisms and valuable suggestions to earlier versions of this article.

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