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Getting angry with endocrine-disrupting chemicals

Enfadarse con las sustancias químicas alteradoras endocrinas

Enfadar-se amb les substàncies químiques alteradores endocrines

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Abstract

Endocrine-disrupting chemicals are industrially manufactured compounds that have the capacity to mimic or interfere with biosynthesis, metabolism, and the functions of bodily produced hormones. The ubiquity and persistence of endocrine-disrupting chemicals in the environment have raised concerns about their impacts on human as well as nonhuman life. How do these chemicals affect us? How do we interact with them? And how do we respond to the risks that they pose? My inquiry into how chemical endocrine disruptors affect us focuses upon the ways in which they can influence our emotions. I bring attention to how being exposed to them can disrupt our brain chemistry, and therefore our emotions, too. With the help of the Endocrine Disruption Tracker Tool—a speculative instrument for a collective investigative practice that I have created—I look into what we can learn about endocrine disruption if we consider how are emotions are affected. I have developed this tool to help me, my research participants, and a broader community of interested people to address the exigencies of our lives, as affected by involuntary chemical exposure, and to construct responsive care relations—paving the way for new approaches to research, ethics, and politics that are embodied, experientially and materially grounded, in their concerns about endocrine-disrupting chemicals.

Keywords

Endocrine-Disrupting Chemicals; Chemical Exposures; Anthropocene; Feminist Technoscience.

Resumen

Las sustancias químicas alteradoras endocrinas son compuestos fabricados industrialmente que tienen la capacidad de imitar o interferir en la biosíntesis, el metabolismo y las funciones de las hormonas producidas por el organismo. La ubicuidad y persistencia de las sustancias químicas alteradoras endocrinas en el medio ambiente han suscitado preocupación por su impacto en la vida humana y no humana. ¿Cómo nos afectan estas sustancias químicas? ¿Cómo interactuamos con ellas? ¿Y cómo respondemos a los riesgos que plantean? Mi investigación sobre cómo nos afectan los alteradores endocrinos químicos se centra en cómo pueden influir en nuestras emociones. Atiendo a cómo la exposición a ellos puede alterar nuestra química cerebral y, por tanto, también nuestras emociones. Con la ayuda de la herramienta Endocrine Disruption Tracker -un instrumento especulativo para una práctica de investigación colectiva que he creado- examino lo que podemos aprender sobre la alteración endocrina si consideramos cómo se ven afectadas nuestras emociones. He desarrollado esta herramienta para ayudarme a mí, a los participantes en mi investigación y a una comunidad más amplia de personas interesadas a abordar las exigencias de nuestras vidas, afectadas por la exposición involuntaria a sustancias químicas, y a construir relaciones de cuidado receptivas, allanando el camino para nuevos enfoques de la investigación, la ética y la política que estén encarnados, basados en la experiencia y el material, en sus preocupaciones sobre las sustancias químicas que alteran el sistema endocrino.

Palabras clave

Sustancias químicas alteradoras endocrinas; Exposiciones químicas; Emociones; Antropoceno; Tecnociencia feminista.

Resum

Les substàncies químiques alteradores endocrines són composts fabricats industrialment que tenen la capacitat d'imitar o interferir en la biosíntesi, el metabolisme i les funcions de les hormones produïdes per l'organisme. La ubiqüitat i persistència de les substàncies químiques alteradores endocrines en el medi ambient han suscitat preocupació pel seu impacte en la vida humana i no humana. Com ens

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afecten aquestes substàncies químiques? Com interactuem amb elles? I com responem als riscos que plantegen? La meva recerca sobre com ens afecten els alteradors endocrins químics se centra en com poden influir en les nostres emocions. Atenc a com l'exposició a ells pot alterar la nostra química cerebral i, per tant, també les nostres emocions. Amb l'ajuda de l'eina Endocrine Disruption Tracker - un instrument especulatiu per a una pràctica de recerca col·lectiva que he creat- examino el que podem aprendre sobre l'alteració endocrina si considerem com es veuen afectades les nostres emocions. He desenvolupat aquesta eina per a ajudar-me a mi, als participants en la meva recerca i a una comunitat més àmplia de persones interessades a abordar les exigències de les nostres vides, afectades per l'exposició involuntària a substàncies químiques, i a construir relacions de cura receptives, aplanant el camí per a nous enfocaments de la recerca, l'ètica i la política que estiguin encarnats, basats en l'experiència i el material, en les seves preocupacions sobre les substàncies químiques que alteren el sistema endocrí.

Paraules clau

Substàncies químiques alteradores endocrines; Exposicions químiques; Emocions; Antropocè; Tecnociència feminista.

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Introduction

Endocrine-disrupting chemicals are industrially manufactured chemicals that are capable of mimicking or interfering with the ways in which the body's hormones typically work. The hormones whose production and performance they disrupt are "chemical messengers" (Starling, 1905) that circulate through the bloodstream, informing the various functions of the body's organs and tissues. Hormones can be biosynthesized in and released from the endocrine glands of animals (including humans), or they can be produced within the bodies of plants and fungi. Naturally occurring phytohormones and mycohormones also have the capacity to interfere with the hormonal systems of human and nonhuman organisms, but they do so in ways that are believed to be beneficial to those organisms, or that are considered to belong among the manifold material processes taking place in the "natural" world. Indeed, we mostly have industrially manufactured endocrine disruptors in mind when we talk about the endocrine disruption that is associated with adverse health outcomes and linked to environmental pollution. The circulation and persistence of anthropogenic endocrine disruptors, which have the capacity to "hack" the chemical information network of the body and thereby connect our endocrine systems to global chemical supply chains, entangle us in uneven relations of power, capital, and harm, while raising questions about who we are becoming, since these chemicals are increasingly part of the very substance of our bodies.

Of the hundreds of thousands of synthetic chemicals that are currently in existence, approximately 800 are either suspected or known to possess endocrine-disrupting properties. Ubiquitous chemical endocrine disruptors include Bisphenol A (commonly known as BPA), which is found in plastic bottles, food containers, the liners of metal cans, and other packaging materials; phthalates and parabens, which are found in cosmetics; ultraviolet (UV) filters, which are added to sunscreen products to absorb UV radiation from the sun; detergents that are used in household cleaners; and flame retardants that safeguard furniture and electronics. Besides their presence in such everyday consumer products, endocrine-disrupting chemicals are also deployed in various industrial processes, such as polychlorinated biphenyls, which are used as industrial lubricants and coolants; the chemicals that are discharged during oil and gas extraction, as a result of hydraulic fracturing technologies; and the pesticides that are used to protect crops from weeds, insects, rodents, and fungi. In addition, industrial wastewater and livestock waste are two other major sources of endocrine-disrupting chemicals.

Some pharmaceutical drugs also have the potential for endocrine disruption (Tijani et al., 2013). These include hormonal medicines, such as hormonal contraception, hormone replacement therapy, and thyroid hormone substitutes, as well as nonhormonal drugs. Paracetamol—one of the most purchased over-the-counter drugs, which is used to treat fever and mild to moderate pain—is a familiar example of a nonhormonal endocrine disruptor, while a broad range of antipsychotic, antiepileptic, antihypertensive, antiviral, antidiabetic, and anticancer drugs also have the capacity to disrupt the endocrine system through a wide array of different mechanisms. Pharmaceutical drugs (both human and veterinary) that impact hormonal systems as a side effect and through the uptake of their residues that are subsequently released into the environment trouble the clear-cut categories of "good" and "beneficial" medicines versus "bad," "toxic," and "disrupting" environmental chemicals. Endocrine-related toxicity of pharmaceutical drugs, as well as many other staples of life in the era of late industrial modernity, from plastics to agrichemicals, foregrounds the necessity of investigating the presence of these chemicals with an open and curious mind—by remaining attentive to the intricacies and complexities of our chemical becoming, which is finally irreducible to the simplifying categories of "good" and "bad" and "beneficial" and "toxic." Ultimately, what makes these chemicals problematic may not have to do with their effects, but rather with their unscrupulous production, use, and disposal, as well as the involuntary and uneven nature of our exposure to them. Studying such chemicals therefore

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requires us to pay critical attention to our non-innocent chemical relations, including our various engagements with the issues of consent, complicity, and violence that are bound up with the extractivism and consumerism that is implicit in their manufacturing and circulation.

Hormones—and the hormonally active chemicals that are synthesized in laboratories and manufactured at industrial sites—have wide-ranging impacts on our bodies, including effects on growth and development, bone density, the cardiovascular system, fat distribution, lipid metabolism, blood sugar, sleep, mood, cognition, and stress levels. Nonetheless, it is their impact on sexual development and reproduction that has mostly captured the attention of scientists, as well as the popular imagination, especially when it comes to endocrine-disrupting compounds. Gender Studies scholar Celia Roberts (2007) has coined the term "messengers of sex" as a means of critically analyzing how hormones act to produce sexed bodies and behaviors. Her analysis of how the biological and the social come together in the concept of the hormone has inspired and informed a growing body of research, which has extended her insights in order to address the biosocial character of endocrine-related toxicity (Ah-King & Hayward, 2014; Bailey, 2010; Birke, 2000; Chen, 2012; Davis, 2015; 2022; Di Chiro, 2010; Haraway, 2012; Hayward, 2014; Langston, 2010; Lee, 2020; O'Laughlin, 2016; 2020; Oppermann, 2016; Pollock, 2016; Robyn & Mykitiuk, 2018; Scott, 2009; Shotwell, 2016). Building upon the theoretical findings and queer ecological sensibilities of these researchers, this essay attends to the signals (chemical and cultural) that are transmitted and communicated within the material-discursive networks of endocrine disruptors. In what sense do these chemical messengers have the potential to disrupt not only endocrine systems, but also normative gender orders? And what kinds of disruption can emerge if we shift our gaze to the "other" effects of endocrine disrupting chemicals, such as their effects on our emotions?

Exposure to endocrine-disrupting chemicals in the environment, at early stages of development as well as later stages of life, has been associated with the high incidence rates of—and increasing trends in—the early offset of puberty, lower sperm counts, genital malformations, infertility, and adverse pregnancy outcomes in humans, while genital malformations and changes to sexual and reproductive physiologies and behaviors have been observed in wildlife populations that have been exposed to endocrine-disrupting chemicals and identified by laboratory studies (Bergman et al., 2013). But besides these frequently cited, discussed, and examined effects on sexual development and related functions, chemical endocrine disruptors also act as carcinogens, increasing the risks of hormone-sensitive cancers in humans and animals (Bergman et al., 2013a; Soto & Sonnenschein, 2010). Additionally, animal model data and human evidence have linked endocrine disruptors to endometriosis and autoimmune diseases, as well as increased susceptibility to infections, diabetes, obesity, and cardiovascular problems (Bergman et al., 2013a). Furthermore, exposure to chemical endocrine disruptors has also been associated with effects on neurodevelopment and brain function, which can result in neurological and learning disabilities (Bergman et al., 2013a). While disrupted brain chemistry and signaling can lead to severe mental illnesses and neurological disorders, this essay focuses on the less serious ways in which endocrine disruptors impact our lives, by affecting our emotions.

Being exposed to endocrine-disrupting chemicals can be traumatic and harmful—and even deadly. So why does this essay focus on how these chemicals can affect our emotions? And what can we learn about endocrine disruption by considering how our emotions can be impacted? Whereas endocrine disruption is too often displaced as a looming cause of sexual and reproductive anomalies, as well as—to a lesser extent—cancers, the act of calling attention to less serious forms of endocrine disruption that most of us experience can help us to address endocrine disruption as a shared (albeit unevenly) condition of living in the Anthropocene. Locating the effects of endocrine-disrupting chemicals in our irritability, anxiety, sadness, and fear

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foregrounds our shared vulnerability in relation to the ongoing chemical transformation of the planet, raising awareness of how closely interconnected we are becoming with global networks of man-made chemicals. In what follows, I examine the critical (and political) potentials of thinking endocrine-disrupting chemicals not only with the anger, fear, and anxiety that can be caused or modulated by disrupted brain chemistry, but also with the anger and other emotions that can be provoked by involuntary and unjust exposures to profitable chemicals, which put us at risk of harm. To this end, I first reflect on the narratives and discourses that populate the public sphere and shape the public`s perceptions, attitudes, and practices when it comes to endocrine-disrupting chemicals and their effects. Then I introduce the Endocrine Disruption Tracker Tool, my intervention into these narratives foregrounding the impact of chemical endocrine disruptors on emotions. I elaborate on the ideas and motivations behind its design and share observations from a workshop, which made use of it. I conclude with an argument in favor of the speculative practice centering the likely influence of endocrine-disrupting chemicals on our emotions. What are the potential consequences of feeling angry, frustrated, and sad with these chemicals as they continue to affect us? What possibilities could the collective and public expression of these feelings open up? In what ways could our feelings of anger, frustration, and sadness motivate and energize action opposing the oppressive conditions that are making us angry, frustrated, and sad in the first place?

Endocrine Disruption

The very nature of chemical exposure makes this issue difficult to track, but it is by no means "invisible." Rather, we should think about the different cultural practices that have rendered exposure to endocrine-disrupting chemicals—and the effects of such exposure—(in)visible or (im)perceptible. In this section of the essay, I take a closer look at the practices that have sensitized (or desensitized) us to the presence of endocrine-disrupting chemicals in our lives and their hidden, slow-moving, and gradually emerging effects on our bodies.

According to the report titled *State of the Science of Endocrine Disrupting Chemicals* (Bergman et al., 2013a), a landmark review of the science of endocrine-disrupting chemical agents, which was released by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP), the true extent of our exposure to chemical endocrine disruptors, and the consequences of such exposure, have yet to be fully understood.[1] The report summarizes research findings that provide evidence that endocrine-disrupting chemicals are causally implicated in adverse health outcomes in both humans and wildlife, while also raising concerns about the incompleteness of our knowledge about the endocrine activity that results from the presence of environmentally ubiquitous chemicals:

> Because only a small fraction of the hundreds of thousands of synthetic chemicals in existence have been assessed for endocrine-disrupting activity, and because many chemicals in consumer products are not identified by the manufacturer, we have only looked at the tip of the iceberg. (Bergman et al., 2013b, p. 18)

Despite the proliferation of research on endocrine-disrupting chemicals, significant uncertainties remain about the true extent of the risks that are posed to human health and wildlife:

> How many endocrine disrupting chemicals are there? Where do they come from? What are the human and wildlife exposures? What are their effects individually and in mixtures during development and adulthood and

[1] *State of the Science of Endocrine Disrupting Chemicals* released in 2013 by the WHO and UNEP remains the largest and most comprehensive systematic review to this date. Recent updates include Kabir et al. (2015), La Merill et al. (2020), and Lauretta et al. (2019).

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> even across generations? What are their mechanisms of action? (Bergman et al., 2013b, p. 18)

These are some of the questions outlined in the WHO–UNEP report that demand urgent answers. Unfortunately, however, given the invisibility, mobility, penetrability, and complex interactivity of endocrine-disrupting chemicals, these problems remain largely intractable. The study of chemical endocrine disruptors requires the examination of a plurality of interactive factors, including the net effects of complex chemical mixtures; tissue-specific responses; critical windows of exposure across lifespans; the intricate problematics of epigenetic effects, which alter susceptibility to diseases both intra- and inter-generationally; and anomalous dose–response relationships, which mean that even low-concentration exposures can be harmful. In sum, endocrine disruption is a complex and multilayered phenomenon, which poses momentous challenges, not least in terms of the gathering of scientific evidence.

Endocrine-related diseases and disorders are on the rise, but is it plausible and scientifically demonstrable that chemical endocrine disruptors are among the causes that are to blame? Endocrine-related effects have been observed to occur in wildlife populations inhabiting contaminated environments, but what do such identified changes in wildlife development and physiological function tell us about the potential consequences for the human populations that are suffering from chronic exposure to endocrine-disrupting chemicals? Numerous laboratory studies have identified the adverse outcomes that result from chemicals with endocrine-disrupting properties (Bergman et al., 2013a),[2] but how do findings that are focused upon the selected effects of single chemicals under laboratory conditions bear upon the real-life conditions of humans and nonhuman organisms that are exposed to complex chemical mixtures throughout their lives on a daily basis?[3]

The absence of irrefutable evidence means that chemical regulation is contestable. National and international legislative frameworks for regulating chemicals aim to ensure high levels of protection for human health and the environment. Such frameworks are developed and managed by means of national laws, national and international regulatory agencies, and international initiatives, agreements, and conventions.[4] By defining policy elements, such as exposure and emission limits, and by overseeing their enforcement, chemical regulators can be just as influential as scientists, if not more so, in determining public perceptions of chemical pollution and its various effects upon human health and the environment. Under the currently existing neoliberal governance systems, though, many regulatory decisions tend to be lax and industry-friendly, facilitating investment and economic growth, instead of protecting public health and the environment. More often than not, regulatory decisions result from a utilitarian calculation of the potential benefits and harms, which exaggerates the social and economic benefits of toxic chemicals, while downplaying the suspected or known costs in terms of the health of humans, nonhuman organisms, and the environment.[5]

[2] See the review of these studies in chapter "Evidence for endocrine disruption in humans and wildlife," Bergman et al. (2013a), p. 23–188.

[3] For a discussion about the methodological limitations of studying endocrine-disrupting chemicals in human populations, see Lee & Jacobs (2018).

[4] In the EU, the European Commission and European Chemicals Agency (ECHA) overseeing Registration, Evaluation, Authorisation and Restriction of *Chemicals* (REACH), the new *European chemicals legislation*, are the most important bodies informing the regulation of endocrine-disrupting chemicals. In the US, it is the US Environmental Protection Agency (US EPA). The following international collaborations have been set up to achieve regulatory goals for endocrine-disrupting chemicals: EU/WHO/International Programme on Chemical Safety (IPCS) coordinating international research and development through the formation of the Global Endocrine Disruption Research Inventory; WHO/IPCS overseeing the global assessment of the state of the science of endocrine disruptors through an assessment prepared by an expert group on behalf of the WHO and UNEP; EU-US Science and Technology Agreement under which a joint meeting was held in Italy in 1999. https://ec.europa.eu/environment/chemicals/endocrine/index_en.htm

[5] Environmental justice researchers Reena Shadaan and Michelle Murphy (2020) refer to governance systems that justify the continued production of known toxins and "acceptable" risks to health as "permission-to-pollute regulatory systems," while pointing out the links between such systems and the structures of settler colonialism and racial capitalism. For a discussion about the conceptualization of pollution as a form of colonial violence,

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Industry-friendly regulatory policies are predicated upon systemic asymmetries that make it easy for the financial beneficiaries of chemical manufacturing processes to obscure or buy their way out of their wrongdoings. At the same time, they make it more difficult for those on the receiving end to demand more stringent regulations, as the burden of proof is often placed on the victims of pollution, rather than on the perpetrators. Moreover, it is difficult to hold chemical companies accountable when only the high probability—rather than the reasonable possibility—of adverse health outcomes warrants regulatory action, and when the bar for evidence is raised impossibly high in relation to the applicable scientific methodologies. Furthermore, as the immensely profitable chemical industry increasingly encroaches upon the domain of scientific research, chemical industry executives not only exploit but actively manufacture doubt, by hiring reputable experts to controvert the findings of independent researchers (Oreskes & Conway, 2011). Exemplifying this strategy is an article by a collective of industry-sponsored scientists (Lamb et al., 2012), published in the acclaimed scientific journal *Regulatory Toxicology and Pharmacology*. It undermined the influential WHO–UNEP report by contesting its conclusions, suggesting that they were drawn without sufficient evidence, that they were lacking in scientific rigor, and that they provided an unbalanced and misleading view of endocrine disruption. The authors of the WHO–UNEP report responded to the article, to defend the credibility of their claims, and accused their opponents of deliberately manufacturing doubt about the harmful effects of endocrine-disrupting chemicals, with the aim of confusing the public and decision makers, who do not possess specialist knowledge in the field of endocrine disruption, rather than attempting to convince the scientific community (Bergman et al., 2015).[6] Since current legislation requires substantial evidence in order to ban or restrict chemicals that are suspected of causing harm, such a strategy of manufactured skepticism can pay off: the chemical companies succeed in their querying of the evidential basis of health hazards, which ultimately enables them to keep their products on the market.[7]

Given the uncertainty about the true extent of chemical damage, and the reinforcement of this message by industry-sponsored campaigns of denial and doubt, members of the public have been encouraged to take preventive and protective actions. The sociologist Norah MacKendrick (2010; 2018) has introduced the term “precautionary consumption” to describe a practice of reducing personal exposure to the chemicals that are found in everyday consumer products, by making responsible and informed consumer choices. As MacKendrick (2010; 2014; 2018) has shown, “precautionary consumption” shifts the responsibility for reducing toxic burdens away from the manufacturers and distributors of toxic products and instead places it upon individuals, especially child-bearers and those caring for young children. However, such individualized tactics, which invoke the consumer caution, fail to the extent that the surrounding presence of chemicals is not limited to consumer products, but also encompasses various industrial processes. Even more crucially, these chemicals cannot be contained, since they infiltrate the environment. Once they have been released from their multiple outlets, endocrine-disrupting chemicals circulate through the ground, water, and air, eventually being diffused throughout the whole environment. While disadvantaged workers suffer the consequences of occupational exposure, and the communities that live in the environs of chemical production and dumping sites are disproportionately affected, a truly effective

see also Liboiron (2021) and Murphy (2016; 2018). Shadaan, Murphy, and Liboiron are members of EDAction, a coalition of researchers concerned with the widespread presence of endocrine disrupting chemicals in Canada. https://endocrinedisruptorsaction.org/

[6] For the continuation of this debate, see Beronius & Vandenberg (2015), Lee (2018), Vandenberg et al. (2016), and Zoeller et al. (2014).

[7] For instance, Syngenta, the producer of the common herbicide atrazine, managed to keep it on the US market by successfully challenging the evidence demonstrating the health hazards that it poses, even though it had already been banned in other parts of the world. In 2016, the US Environmental Protection Agency found that atrazine posed reproductive risks to wildlife, and in 2018 the Agency concluded that combined exposure to atrazine from different sources posed developmental risks to children—yet it still reapproved atrazine for use in lowered amounts in 2020 (Erickson, 2020).

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means of preventing wider exposure to chemicals would be infeasible, and not something that even the expensive and onerous practices of shielding, filtering, and distancing that MacKendrick elaborates would be able to achieve. Individualized tactics for managing environmental toxicities have been subjected to feminist critiques (Robyn & Mykitiuk, 2018; Scott et al., 2017; Shadaan & Murphy, 2020; Szasz, 2007), not only because they spread the misguided belief that effective protection from environmentally ubiquitous chemicals is possible, but also because, in doing so, they shift our focus from protecting the environment to protecting ourselves individually, with the result that we will be less likely to engage in public debates about how to address the problem of chemical pollution via systemic precautionary arrangements.

In contrast to the neoliberal prescription that individuals should attempt to maintain control under conditions of uncertainty by avoiding chemicals individually, through their consumer choices, environmental activists demand structural changes in order to hold those who are truly responsible to account. International environmental organizations—such as Greenpeace, the World Wildlife Fund, the Sierra Club, and Friends of the Earth—as well as NGOs and community groups are campaigning for a toxin-free future, in which hazardous chemicals are no longer produced, used, and dumped into the environment. Environmental activists insist that the manufacturers and regulators of the chemical industry must be held accountable for the multifarious impacts of the toxic chemicals that they produce, especially on the communities that are immediately affected, and that decisive steps must be taken in order to achieve a toxic-free global environment. However, the agenda of a zero-pollution and toxicity-free future for all, which is utilized to promote the banning of toxic chemicals and subsequent transitions to alternatives that are considered to be safe and sustainable, is underpinned by problematic assumptions. Fantasies about bodies and environments that are clean and chemical-free promote anxieties about impurity, contamination, and pollution, and are prone to what Giovanna Di Chiro (2010) has termed "eco-normativity"—that is, they are often ableist and normative ideas that have been harnessed by environmental discourse in order to conceptualize chemical exposure and its effects.

This uncritical rhetoric—labeling bodies and environments as "unhealthy," "unnatural," "impure," or "toxic"—becomes increasingly problematic when considering the effects of endocrine-disrupting chemicals on sexual and reproductive development and functions. Eco-normativity becomes eco-heterosexism once queer bodies and behaviors are put forth as the main evidentiary focus of documented harms. When studies that examine the effects of endocrine-disrupting chemicals on animal sexual development and reproduction are published in acclaimed scientific journals and use normative expressions and catchphrases, such as "chemical castration" or "gender-bending chemicals," or when they describe animal physiologies and behaviors as "feminized," "homosexual," or "transgender," they make endocrine disruption visible in ways that promote heterosexist and transphobic views. Indeed, some images—such as a photograph of copulating frogs, one of them being a genetic male that has been turned into a female by the endocrine disruptor atrazine—have already taken hold in collectively shared imaginaries of endocrine disruption. The photograph in question, which was taken in 2010 by scientist Dr. Tyrone Hayes (Sanders, 2010), was even mobilized to uphold far-right sentiments, after it caught the attention of alt-right conspiracy theorist Alex Jones, who made use of it in several of his widely shared *InfoWars* videos. His rant about the government "putting chemicals in the water that turn the friggin' frogs gay" circulated on Twitter for months and gave rise to an impressive number of memes and threads on 4chan and Reddit. Scientific articles and media reports that are concerned with endocrine disruption often have a disturbing amount in common with Jones's alarmist and attention-seeking language, and they can be dangerously reminiscent of the rhetoric and logic of far-right ideology, as epitomized in its

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conspiracy theories about "white genocide" and "male extinction."[8]

How, then, do we orient ourselves in this labyrinth of unreliable facts, indirect evidence, inconclusive research results, manufactured doubt, and normative assumptions? How do we conceive of endocrine disruption without resorting to the normative imaginary of a toxin-free futurity in which ableism, heterosexism, and transphobia are embedded? How do we identify, study, and represent endocrine-disrupting chemicals in ways that facilitate caring relations and allow us to envision and enact hopeful futures with—and despite—them? How do we navigate the territories of the unknown and uncertain, which indicate harms, but also remain open to the potentials of becoming, while admitting the presence of hormone-disrupting chemicals?

The representation of chemical violence is key to effective resistance against it, but the manner of its representation is also significant, as the ways in which chemical harms are made visible can become sources of violence in their own right. Under the umbrellas of feminist technoscience and queer ecologies, a growing body of research has developed an alternative vocabulary for conceptualizing chemical exposure—doing so with care, and in a hopeful manner, but also remaining critical and refusing to gloss over the ongoing violence resulting from the profitable chemicals that are being produced, used, and dumped into the environment. The artists, activists, and scholars who are adopting a queer ecological approach not only point out the biosocial nature of endocrine-related toxicity, by critiquing heterosexist articulations of sexuality and nature that are predicated upon socially constructed binaries of the "natural" and "cultural," the "pure" and "polluted," and the "healthy" and "damaged," but also offer feasible alternatives to discourses and practices that are grounded in static, essentialist, and normative understandings of bodies, sexualities, and environments.[9] Rather than addressing environmental chemicals with "concerns" (about "purity" and "health"), a queer ecological approach views them through notions of indeterminacy, becoming, and care—looking for, experimenting with, and inventing forward directions that facilitate caring relations, allowing us to live well with these chemicals, despite their potential for harm. My inquiry into how endocrine-disrupting chemicals affect our emotions is inspired and informed by the affective, caring, and experimental engagements (both scholarly and artistic) that queer ecological thinking and sensibilities have given rise to.

Affective Disruptions

The circulation of knowledge about endocrine-disrupting chemicals, as well as our embodied experiences of their effects, not only inform our understanding of what these chemicals are and do, but also make us emotional about them. This prompts an array of angry and "unhappy" feelings: the misery of the workers who suffer the consequences of occupational exposure, the anger and fear of the communities who live nearby chemical production and dumping sites, the emotional distress of gestators who are burdened with the task of protecting their unborn children, the anxieties relating to the effects of "gender-bending" chemicals that are fostered by mainstream environmental advocacy, the anger and hurt felt by queer and trans folks who are habitually excluded from considerations of how endocrine-disrupting chemicals differentially affect different groups of people, or the sadness, anger, and feelings of being let down that are felt by those who suffer symptoms of diagnosed and undiagnosed conditions and diseases that may have been caused, triggered, or modulated by endocrine-disrupting agents—such as the hormone-related migraines that I suffer from. In addition to the emotions that are provoked by known, suspected, or perceived exposure to chemical

[8] For further discussion about the links between scientific and popular media rhetoric on endocrine disruption, normative masculinity, and far-right ideology, see Perret (2020).

[9] See, for example, Ah-King & Hayward (2014), Birke (2000), Chen (2012), Davis (2015; 2022), Di Chiro (2010), Hayward (2014), Kier (2010), Lee (2020), O'Laughlin (2016; 2020), Oppermann (2016), Pollock (2016), Robyn & Mykitiuk (2018), Scott, (2009), and Shotwell (2016).

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endocrine disruptors, we can further observe emotions that are caused and modulated by brain chemistry being affected by endocrine-disrupting actions, as well as the interactions between the two.

The adverse outcomes that have been linked to exposure to chemical endocrine disruptors include effects on neurodevelopment and brain functions. Such disruptive influences on thoughts, feelings, and motivations are not commonly discussed in relation to endocrine disruption. But even though these impacts on emotions have generally been overlooked in previous research on endocrine disruption, examinations of emotional symptoms have taken center stage when the effects of physiologically produced hormones have been considered. Fluctuations in endogenous (physiological) hormones during puberty, pregnancy, and menopause, as well as over the course of the menstrual cycle, have long been associated with sensory, cognitive, and emotional changes. These result in symptoms such as anxiety, irritability, mood swings, difficulty in concentrating, fatigue, lethargy, insomnia, social withdrawal, depression, paranoia, and feelings of being overwhelmed and out of control, which have been attributed to underlying hormonal changes in female (and, to a much lesser extent, male) bodies. Furthermore, adverse influences on sensory and cognitive capacities, as well as emotions, have been associated with the use of hormonal medicines and listed as common side effects of hormonal contraception, hormone replacement therapy, and fertility-stimulating treatments and assisted reproductive technologies that make use of synthetic hormones. Both scientific studies (Brooks-Gunn et al.,1994; de Vied & van Keep, 1980; Freeman et al., 2004; Golightly & Young, 1999; Hoagland, 1957; Marceau et al., 2015; Rio, 2014; and Toffol et al., 2013) and the testimonies of those who have experienced emotional symptoms resulting from fluctuations in endogenous hormones (notably, many period-tracking apps contain a mood-tracking function) or as a consequence of medical interventions confirm the vital influence that hormones have on our emotions, with even the slightest change in their levels being reflected in our emotional makeup.

As a teenager I suffered from anxiety and depressive symptoms. When I was eighteen, I received my first prescription for hormonal contraception from my gynecologist. I started to use it in a continuous manner and my mental health improved. My mood became more stable and less prone to the episodes of feeling down. A positive effect of the continuous use of contraceptive hormones on my emotional well-being has been confirmed whenever, for various reasons, I discontinued their use. Following withdrawal of synthetic hormones, I experienced adverse symptoms, both physical and psychological, with the psychological distress being more serious and lasting than physical changes, which went away after some time. In addition, since my thirties, I have been suffering from migraines. Contraceptive hormones used in extended cycles have helped me manage my condition and live well with migraines.

In my inquiry into chemical endocrine disruptors, I have drawn on this experience. Insofar as endocrine-disrupting chemicals are increasingly entering and acting upon our bodies, then, I argue, they also play a part in the fundamental processes that shape our hormonal makeup, and thus also our emotional well-being and subjective experience. The Endocrine Disruption Tracker Tool (EDTT) is a speculative instrument that I have created (Veselá, 2022) which foregrounds disrupted emotions as an index of endocrine disruption. I have developed the EDTT as a tool for a collective investigative practice in which I can examine, together with other research participants, what we can learn about endocrine disruption if we consider how our emotions are affected.

The EDTT is modeled on a tool for diagnosing premenstrual syndrome and premenstrual dysphoric disorder, two medical conditions that are caused by changes in hormonal levels in the second half of the menstrual cycle and the first few days of menstruation, leading to a range of physical and emotional symptoms, with the emotional symptoms resulting in greater impairment than the physical symptoms. The EDTT has been adapted from the 2021 variant of the Premenstrual Symptom

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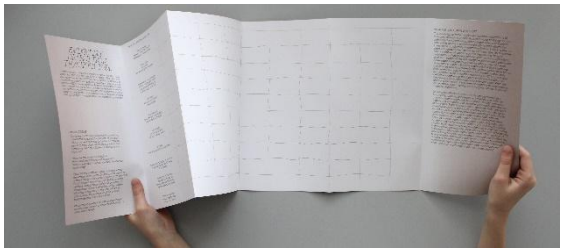
Tracker that has been developed by the International Association for Premenstrual Disorders (2021), using the same set of ten emotional symptoms, while leaving out the eleventh symptom—the only physical symptom on the list.[10] The physical symptom was left out to keep the focus on the psychological disruptions and to make the tool gender inclusive. Significantly, the EDTT adapts the original design by expanding the functional range to cover emotional symptoms that are caused by the production and interplay of hormones and hormone-disrupting chemicals.

The EDTT invites participants to examine their emotional symptoms over a period of 10 days. Each day during the investigation period, participants take a moment to make observations about the emotional symptoms listed in the EDTT and note their observations in the chart. They consider emotions both as they are personally experienced and as they are shared with or observed in others. Participants describe the emotion and the situation in which they experienced it. They then reflect on how it impacted their daily life and well-being. In addition, they think about the possible influence of exposure to disrupting chemicals on the onset of the emotion and the degree to which it was felt.

The EDTT opposes an individualized understanding of the exposure to chemical substances and an individualized responsibility for the endurance of their impacts. Contrary to medical handbooks and self-tracking apps for the self-management of a medical condition that the EDTT refers to by its aesthetics, it does not provide an individual diagnosis or prognosis, nor does it offer a solution in the form of an individualized preventive or therapeutical intervention. Instead, it is a tool for a workshop practice drawing attention to the necessity of a political response to the problem of environmental chemical disruptors and involuntary exposure to them. The EDTT is intended as a means for the discussion about the exigencies of our lives, as affected by chemical exposures, and the possibility of a politics for anti-toxic actions that foster and exercise solidarities in opposition to nonconsensual chronic exposure to environmentally ubiquitous endocrine-disrupting chemicals—collectively and affectively.

The EDTT invites participants to examine their emotional symptoms over a period of 10 days.



[10] Printable version of the Premenstrual Symptom Tracker developed by International Association for Premenstrual Disorders (IAPMD), as well as a tracking app based on it, can be downloaded from the IAMPD website: https://iapmd.org/symptom-tracker.

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Endocrine Disruption Tracker Tool, Veselá (2022).

Uncertain Effects

Prior to conducting the first workshop with participants, I presented my proposal at several conferences and symposia, receiving important feedback.[11] Some of the female attendees of these events who had observed changes in their emotions resulting from hormone fluctuation during the menstrual cycle or because of synthetic hormone intervention

were particularly intrigued by the idea of using this experience to relate to environmental chemicals. At the same time, they expressed reservations whether the changes in their mood can be attributed to environmental endocrine disruptors in the same way they were able to link them to endogenous or synthetic hormones. As one attendee pointed out:

> When I started to use [hormonal] contraception, I could tell something changed, I didn`t feel like myself. I felt
>
> tense, on edge, and irritable. It was so bad that I decided to switch to a different [contraceptive] method. After that, things went back to normal. This way I knew, my contraception was to blame. But how can I tell when I am exposed to [environmental] chemicals? How do I know when they exert their influence on me and my emotions?

Indeed, it is not possible to identify when chemical endocrine disruptors are involved, specifically, with a high degree of confidence. The influence of chemical endocrine disruptors cannot be distinguished from the actions of endogenous hormones and exogenous hormonally active agents, such as self-administered synthetic hormones and medications or naturally occurring phytohormones that are absorbed from our diets, as well as the many other nonhormonal influences (biochemical and social) that also affect us. Environmentally ubiquitous endocrine-disrupting chemicals penetrate our bodies and interfere with the normal functioning

[11] Invited lecture "Mé chemické já: o životě s toxickými chemickými látkami (a navzdory jim)" [My chemical self: On life with and despite toxic chemicals] for the course Antropologie, tělo a biotechnologie [Anthropology, body, and biotechnologies], Faculty of Social Studies, Masaryk University, Brno, 29 November 2022; invited talk "Endocrine disruption tracker tool" for symposium *Toxic futures and the creative process,* Planet B—Module for sustainability and civilization issues, UMPRUM, 27 October 2022, https://www.umprum.cz/cs/web/o-umprum/udrzitelnost/planeta-b/toxicke-budoucnosti-a-kreativni-proces; paper "Getting angry with environmental chemicals," *Earth sensations: Affects, sensibilities and attachments in an era of climate change,* Aarhus Institute of Advanced Studies, Aarhus University, Denmark, 13—14 October 2022, https://aias.au.dk/events/earth-sensations; paper "Endocrine disruption tracker tool", *Vienna ethnography lab: Relating risks,* Department of Social and Cultural Anthropology, University of Vienna, 28—30 September 2022, https://ksa.univie.ac.at/en/department/events/vienna-ethnography-laboratories/;
"Keeping track of the Anthropocene: Endocrine disruption tracker tool" in panel "Posthumanism/new materialism," *11th European feminist research conference: Social change in a feminist perspective: Situating gender research in times of political contention,* University of Milano-Bicocca, 15—18 June 2022, https://11efrc.unimib.it/.

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of our endocrine systems to a degree that remains unknown. Accordingly, it is not possible to determine the precise extent to which chemical endocrine disruptors are able to affect our emotions. Given their ubiquity, it is likely—even certain—that they are influencing our emotions. But how extensive this influence is, and whether it is always detrimental, resulting in emotions that are considered to be "negative," "unpleasant," or "unhappy," cannot be determined.

This indeterminacy goes beyond the mere uncertainty about the causal ties linking endocrine disruptors with disrupted emotions. Indeed, the very possibility of these causal relations being established in the first place comes into question. Indeterminacy relates to complexity that is characterized by the actions of multiple entangled components interacting in situated ways, yielding nonlinearity, randomness, collective dynamics, and emergence. In this respect, indeterminacy also relates to the notion of "becoming," especially as it is discussed by the feminist theorist Karen Barad (2007), who understands it to be a counter-causal process. According to Barad, "becoming" signifies the mutual constitution of entangled material and social phenomena coming into being out of the different possibilities that occur at each moment. It therefore follows that cause and effect—as well as other binary distinctions, such as "natural" and "synthetic," "clean" and "polluted," or "beneficial" and "harmful"—do not exhibit clear-cut boundaries, but only become determinate and meaningful in the dynamic and open-ended processes of becoming.

The indeterminacy of the effects of endocrine-disrupting substances that results from their unfolding performatively and relationally by no means gives grounds to excuse the violence of involuntary chemical exposure or to relativize its effects. Rather, it foregrounds the necessity of uncovering and opposing the structural conditions and systemic arrangements that make this violence possible—urging us to shift our attention from the "damaged" bodies of victims of pollution to the damaging colonial practices of the perpetrators of chemical violence, who are responsible for the reckless actions of chemical manufacturing, application, and disposal.[12] The notion of "becoming" helps us to grasp the indeterminacy of how endocrine-disrupting substances unfold and emerge relationally and differentially, beyond the normative and essentializing dualisms outlined above, prompting us not only to investigate unjust chemical relations, but also to ditch purity politics and attend to the emancipatory possibilities that chemical becoming can give rise to. The notion of "becoming" encourages us to keep the lines of our inquiry open, to embrace impure and contaminated forms of life and affirm their capacity to recompose into something else, and to search for new, surprising, and unpredictable ways of living well with the presence of "bad" chemicals—the nascent forms of resilience, "chemical kinship" (Balayannis & Garnett, 2020), queer survival, and resurgent life that are asserting themselves and continuing nonetheless.

It follows that a consideration of our emotions as they are affected and modulated by endocrine-disrupting chemicals cannot provide conclusive answers about the current state of endocrine disruption. Nonetheless, locating the effects of endocrine disruption in our irritability, anxiety, sadness, sleeplessness, or inability to concentrate underscores our shared (albeit unevenly) fragility and vulnerability when it comes to the chemical transformation of the planet. Furthermore, it raises awareness of how closely interconnected we are becoming with the planetwide networks of man-made chemicals. By attending to these subtle—and not necessarily always harmful—effects of exposure to the endocrine disruptors that have become an inescapable part of our lived

[12] Indigenous Studies scholar Eve Tuck (2009) uses the term "damage-centered research" to refer to research that documents people's pain, brokenness, and suffering in order to hold those in power accountable for the oppression that they have perpetrated. According to Tuck, the possible gains of research that describes people, communities, or environments as "damaged," "polluted," or "toxic" do not warrant the costs of thinking about ourselves or others in reference to such terms. Tuck urges communities, researchers, and educators to reconsider how research is framed and conducted, and to rethink how research findings could be used by, for, and within communities.

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experience (rather than displacing them as impending threats to infertility and causes of cancers), we can bring about a politically generative understanding of our collective becoming within the confines of industrially transformed circumstances. And by reflecting upon the mobility and interactivity of chemical endocrine disruptors, as well as the porosity of the body, in terms of its absorption and excretion of chemicals, we can unsettle the atomistic conception of humans as bounded individuals who are separated from the broader collectivity of nonhuman life in the shared environment of Earth. Our contemplation and experience of the far-reaching effects of endocrine-disrupting chemicals on our emotions not only constitute valuable sources of situated—and felt—knowledge of the effects of these chemicals, but also an important basis for initiating cross-species solidarity and actions that are rooted in interconnectedness, interdependency, and mutual becoming, in an ever-changing and ever-diminishing world. To the extent that endocrine disruption can be felt at the levels of individual cognition and emotion, considering these impacts invites us to think about and feel the effects of endocrine disruption, even though our thinking and feeling has already been disrupted by these effects—encouraging highly subjective and deeply personal accounts of endocrine disruption. In doing so, such consideration can open up a space for addressing the effects of endocrine disruption from situated, personally engaged, and emotionally charged points of view, which are vital for fostering and exercising solidarities in opposition to nonconsensual chronic exposure to endocrine-disrupting chemicals.

Exposures and Emotions

The first workshop with a small group of three participants comprised two four-hour sessions on 21 October and 4 November 2022. The participants, selected through an open call, included: Eliška, a female university student of environmental chemistry, Ondra, a male university student of international relations and European politics, and Pavel, a recent graduate of physical education and sport, currently working as a sports instructor for children.[13] The first part of the workshop focused on the participants` awareness of chemical exposures. The questions and prompts that I shared with them encouraged them to discuss exposure to environmental chemicals, voluntary exposure to synthetic drugs and medicines, and the possible influence of both on their health and well-being. Coincidentally, both Eliška and Ondra are from Ostrava, a former coal-mining and metallurgical center and one of the most heavily polluted areas in the country. During their childhood years, the air pollution in Ostrava was so bad at times that the schools closed, and people were advised not to go out. Eliška detailed how during those years she was frequently ill and suffered from asthma and allergies. Eliška mentioned that she also started to suffer from anxiety and depression while in Ostrava, introducing the topic of mental health into discussion. All the three participants were interested in environmental issues, including water, air, and soil pollution. As Ondra stated, speaking for all of them: “We are aware of it, and we are on the side of those who think something should be done about this.” At the same time, they saw the problem of pollution as a future rather than immediate threat. All of them had trust in the system of chemical regulation protecting public health in the European Union and the Czech Republic. That said, they also believed that it is reasonable to try to prevent chemical exposures individually even though preventive and protective measures can be time-consuming and costly. They provided accounts of the ways in which they protect their health by, for example, avoiding food with too many chemical additives or buying fruit, vegetables, and meat from smaller farmers rather than conventional production.

At the end of the first part of the workshop, I gave participants copies of the EDTT, explaining the ideas behind it and how it should be used. During the two weeks before the next part of the workshop, the participants

[13] Participant information and views are shared here with their permission.

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completed the EDTT review by examining the list of emotional symptoms, making observations individually, and noting the emotions in the EDTT chart.

The focus of the second part of the workshop was on the possible influence of chemical exposures on the participants` emotional health. The session started with the participants taking turns to share what they learned about their emotions and the emotions of others while completing the review. The workshop continued with participant-driven discussion of the role of emotions in both their private lives and the public realm, the prevalence and treatment of the feelings of anger, irritation, frustration, and sadness in both of these spheres, and the possibility of their emotions being impacted by endocrine disrupting chemicals, including the prospect of tracking and affirming these emotions, as they are affected by chemical exposure. I offered the participants prompts and questions to guide their discussion, while also encouraging them to steer the agenda according to their unfolding interests and needs. The issue of talking publicly about privately experienced “unhappy” or “negative” feelings, such as loneliness, anxiety, sadness, annoyance, or anger, emerged as the key concern that participants kept returning to throughout their debate. Interestingly, while they claimed to mostly keep these emotions to themselves to avoid bothering others with them, they said that they did not feel bothered when others expressed and shared these emotions with them. In Ondra`s words:

> If I considered some "negative" emotions, sadness or anger, for example, then I would say, I am affected. But I try not to transfer them to others. I don`t want to burden others with them. At the same time, however, I don`t mind taking on emotions of others, unless there are too many of them.

Eliška mentioned that she formed a self-help support group with her friends whose life is also marked by mental health struggles. Within their group, they can talk about their emotions freely and honestly:

> We found each other because we share this and can talk about it together. It really helps me. I have “normal” friends too but they can never understand this. It is much easier to talk about it with someone who knows what I am talking about.

Eliška also talked about how her struggle with anxiety and depression was dismissed by her family as something that she had made too much fuss about, with her parents insisting that it was just part of her puberty, and she would grow out of it. Eventually, Eliška sought help on her own. With the help of therapy, medication, and support from her friends, she was finally able to get her condition under control. Eliška also explained that while in high school she was unable to hide her condition and everyone knew, she decided to keep her anxiety and depression secret from people at the university and her part-time job. She did not mind people in high school being aware of her condition, as it made her life easier—nobody acted surprised or made a big deal out of it when she broke down in the class and started to cry uncontrollably. At the same time, she deliberated, people knowing can be a double-edged sword, and while it could make her life less complicated in some ways, it could also backfire and harm her career and relationships. Which is why, after giving it a lot of thought, she decided not to tell her current colleagues at school and work.

The workshop succeeded in raising awareness about the possible influence of endocrine disrupting chemicals on emotions. The participants were well acquainted with the problematics of environmental exposures and precautionary measures to prevent them but their influence on thoughts, feelings, and motivations, they admitted, was not something they had considered. Following the workshop debate, they were all convinced that environmental chemicals do affect emotions and mental health, albeit in much lesser extent than other influences, such as study- or work-related stress, relationships with friends and family, or some pharmaceutical and recreational drugs. The workshop concluded with a speculative part in which participants

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elaborated on what would change, if we knew that chemical exposures are indeed disrupting our emotions significantly. Responding to the speculative scenario, they said that it could spark significant changes and transform both their private lives and society at large. The ability to talk about privately experienced "unhappy" or "negative" feelings openly in public emerged, once again, as the key point of the debate. Eliška, for example, said:

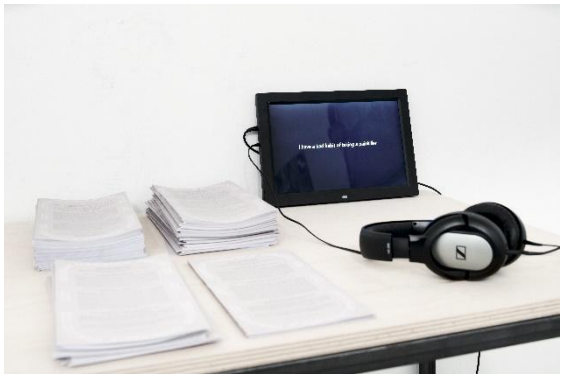
> It wouldn`t be as problematic for me to talk about them [emotions] because I would know that they were not my fault. And they are not my fault anyway. Like if I had a skin rash from bad water, I would talk about it differently, knowing that it was not my fault. I wouldn`t have problem saying that, because of the bad water, I suffered from that. It would be better, I think.

Ondra agreed and added:

> I agree that it would make it easier to talk about it. It would also likely be part of a big social debate. It would become something that we could talk about because it would be happening without us being to blame. It would be like, "Everyone experiences it, so we can talk about it. Because everyone knows what it is about." I think there would also be a social movement to address it and acknowledge it. I don`t know what to compare it to. It isn`t comparable. But generally speaking, it would gain traction in the society, if it were clear that it was an external influence rather than a problem of each of us individually.

And Eliška responded:

> I think that the individualized approach is prescribed by the society. Because my problems are not talked about, it is hard for me to... I don`t talk about it when I meet someone new because I don`t want to bother them. But if it were normal to talk about it… […] If it were completely normal, I would also experience my emotions differently.[14]



Exhibition presentation of the EDTT project, *Synthetic Becoming*, FaVU Gallery, Brno, 6 December 2022–10 February 2023[15].

Getting Angry with Endocrine-Disrupting Chemicals

[14] Workshop recording *Exposures and Emotions* can be accessed at https://youtu.be/rP9_o9D3j7E. With the focus on the story of one of the participants, the recording captures the workshop discussion concerned with involuntary exposure to environmental chemicals, voluntary exposure to synthetic drugs and medicines, and the possible influence of both on emotions.

[15] Malin Ah-King & Eva Hayward, Aliens in Green, Konstantin Biehl, Anjali Rao-Herel & Jacquelyne Luce, Maddalena Fragnito & Zoe Romano, Annabel Guérédrat, Rian Ciela Hammond, Franziska Klaas & Susanne Bauer, Marne Lucas, Mary Maggic & Perrrformat, Byron Rich & Liz Flyntz, Rosæ Canine Collective & Mariana Rios Sandoval, Lenka Veselá, Ker Wallwork & Juliet Jacques, Synthetic Becoming, curated by author, Galerie FaVU, Brno, 6 December 2022–10 February 2023. https://artalk.cz/2022/12/27/synthetic-becoming-v-galerii-favu/

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Chemical pollution has now reached a dangerous global level. Under the various regimes of Western industrial modernity, all corners of the planet and all parts of our bodies have been exposed to, and affected by, industrially manufactured chemicals. We live in an era of absolute and permanent exposure, where nothing is safe or pure, so the only way forward is to continue with—and despite—the presence of toxic anthropogenic chemicals. Chemical exposure has become a condition of living in/with industrial modernity, and this understanding calls for effective forms of resistance, not only in terms of demanding the accountable production, use, and disposal of chemicals, but also in terms of cultivating forms of resilience that are attuned to the experience and requirements of lives that have already been altered by exposure to man-made chemical agents. What do industrial chemicals bring to our lives? And how do we "make-with" (Haraway, 2016) and continue to live with them, despite their potential for harm?

In the essay, I reflected on a practice tackling these questions with the assistance of a speculative design tool called the Endocrine Disruption Tracker Tool. The EDTT foregrounds that endocrine-disrupting chemicals affect, among other things, our brain chemistry and, as a consequence, our thoughts and feelings. Through the material effects of exposure to them, the physiology of our perception, cognition, and emotions—the very ways in which we encounter and interpret the world around us—is now being reconstituted. The EDTT invites us to attend to and act upon these changes to our sensory and cognitive capacities, as well as our emotional well-being. In this way, it helps us not only to come to terms with modern life—as it is continually reshaped by industrial chemicals—but also to form the basis of an embodied, experientially and materially grounded politics opposing involuntary chronic exposure to environmentally ubiquitous endocrine-disrupting chemicals.

The speculative approach can be a fitting way to address the issue of environmental endocrine disrupting chemicals, whose harmful effects are uncertain but real. To the extent that we have only looked at the tip of the iceberg, as the WHO–UNEP report claims, the speculative approach can help us confront the uncertainties and ambiguities of our chemicalized existence and underscore the urgent need for systemic precautionary measures. Together with other participants, we examined the likely influence of chemical endocrine disruptors on our emotions and the possible role of these emotions in addressing the hidden, slow-moving, and emerging realities of chemicalized life. We explored the potential consequences of feeling angry, frustrated, and sad with endocrine-disrupting chemicals as they continue to exert their influence on us and the possibilities that the collective and public expression of these feelings could open up. Our collective practice has thus provided the initial bearings for a vision of the future that is liberated from oppressive chemical relations—and for a political project that, by opposing the chemical violence that systematically impairs life in all its forms, has the potential to get us there.

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