

"There's No Constant": Oxytocin, Cortisol and Balanced Proportionality in Hormonal

Models of Autism

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ABSTRACT

Autism is a fluid category with sensory difference recently emerging as a key aspect of the lived experience of the condition. In concert with the “fight or flight response”, sensory sensitivities are used to articulate chronic stress caused by “sensory overload” from living in sensorially “toxic” environments. Based on long-term participant observation in the UK and USA with practitioners and participants of an autism-specific horse therapy method I offer an ethnographic window onto this ecological model of autism that entangles material flows, embodiments, and environments. I detail a novel hormonal understanding of autism, in which oxytocin and cortisol act as material-semiotic messengers of sociality. I ask what is at stake and show how notions of hormonal “balance” and proportionality provide a means of comprehending simultaneities of behavioral, diagnostic, and material fixity and flow in autism.

Keywords: *autism, balance, equine therapy, hormones, proportionality, therapeutic ecology.*

Media teaser: How do hormones mediate our understandings of autism, sociality and relatedness?

BIONOTE

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There is luckily a hormone which has been found to counteract the corrosive effect of cortisol in the brain and that is a hormone called oxytocin (Amy, method co-founder and practitioner).

On a cold, dry December morning I sat in the day room of a large house on a repurposed cattle ranch in southern USA. This was the birthplace of AM - an autism specific method of horse therapy – and home to its founders and their families. They shared the ranch with AM trainees, 16 horses and an expanding menagerie of animals. The creator of the method was Louis, the father of a young autistic boy. Louis had devised the method in the mid 2000s around an emerging model of idiosyncratic sensory-perceptual experience in autism. AM sessions were offered at the ranch and were purported to “enhance learning, communication and brain function” in autistic children and adults. I had travelled to the ranch after 15 months of fieldwork at AM centers in the UK.

A woman in her early 30s stood poised at a whiteboard at the front of the room, pen in hand. This was Amy, a British psychology graduate who had developed AM with Louis whilst working as an educator for his autistic son. As I sat in the room with three trainees, Amy described the “stress response” of neurotypical people, and explained that chronic stress resulted in enhanced cortisol release:

What we have with a stressed person is that part of the brain known as the amygdala is activated ... It triggers the release of different hormones ... including cortisol. Which is the stress hormone. What the cortisol does is narrow your focus so that when you are trying to respond to danger, you don't get distracted. In people that are experiencing chronic stress, this is what happens. That is the case in most people with autism.

Reflecting some autistic peoples' focus on idiosyncratic sensory experience in autism (Baggs 2007; Belek 2018; Chamak et al. 2008; Malcolm 2019; Williams 1998), Amy highlighted sensory issues as a core feature of autism, and promoted the theory that the "stress response" (otherwise known as "fight or flight") was more easily activated in autistic people:

The neurotypical sensory system processes information accurately – so if we go outside just now and it's windy our bodies will detect that, and we'll be fine with it ... But a person with autism could go out there and could detect that wind as a gale force hurricane. At which point the amygdala is activated. Danger, danger, danger. Cortisol, cortisol, cortisol.

As I will detail below, by making environments less sensorially toxic, it is claimed that AM can modulate hormonal flows, reducing cortisol and enhancing oxytocin, and in so doing, affect behavioral and brain changes. In this article, I reflect upon the use of hormonal models of therapeutic efficacy, and explore the question of how a kind of thinking afforded by hormones and their cascading flows mediates understandings of autism and relatedness.

The hormonal models of autism that unfolded in the field were framed in terms of "healthy" balances and "pathological" imbalances, reproducing assumptions regarding hormonal "normality." Equine therapy practices enact "a complex choreography of normalization" (Malcolm, Ecks and Pickersgill 2018: 10) and Amy's use of hormone knowledge pathologizes and biologizes autism. Her bricolage of scientific hormone knowledges reflects the

molecularization of life and the emergence of the “somatic” self (Novas and Rose 2000; Braun 2007). In the context of the disability rights movement, autism is defined as a form of neurodiversity, not pathology (Kapp 2020; Bagatell 2007, 2010; Solomon and Bagatell 2010). The well detailed tensions emerging between models of neurodiversity and medical deficit models of autism (Broderick and Ne’eman 2008) are arguably replayed in these sensorial and hormonal models of autism.

Yet biomedical knowledges (particularly those holding cultural capital) can destabilize derogatory constructions of autism and normalcy in the context of the neurodiversity movement (Brownlow and O’Dell 2013; Ortega 2013). My aim is to explore what comes into view when we resist assumptions that the uptake of biomedical knowledges in autism are wholly reductive. Gaudillière notes that with the discovery of sex hormones came an “endocrine style of thought” (2004, 542) which normalized female and male sexual bodies. In the context of autism and AM, hormones similarly enact an “endocrine style of thought”, which operates in a novel way to encapsulate bodies experiencing environmental stress. This hormone thinking does not singularly normalise or molecularise. It simultaneously reflects emerging “post genomic” understandings of ecologically situated biologies (Landecker 2011, Lappé and Landecker 2015).

To understand the import of this, a description of the biomedical definition of autism is required. Autism is biomedically defined as a neurodevelopmental “disorder” reported to affect around 0.6 percent of the global population (WHO 2018), and a search for genetic biomarkers is ongoing. The current Diagnostic and Statistical Manual of Mental Disorders (DSM-5) problematically defines autism as a condition of impaired sociality and relatedness via a triad of individual impairments in social interaction, communication, and fixed interests and behaviors (APA 2013). Heightened sensory-perceptual experience was included in the 2013

iteration of the DSM-5 (APA 2013). These impairments are assumed to exist in neurological structures of individual brains, reducing sociality from a form of relation to a capacity of the individual, and failing to acknowledge the impairment reported by autistic people to be produced by living in social worlds that fail to take autistic experience into account.

By shifting the focus from genes to hormones, and from innate neurological structures to toxic environments and chronic stress, AM incorporates “exogenous” environmental phenomena in “endogenous” processes of the body in new ways. Amy’s words describe a view, shared by the AM practitioners I got to know, and which is informed by the experiences of autistic people who advocate for AM, that autism is not isolated in neurological structures, but rather enacted in interrelated feedback loops across scales of material flows, embodiment, social relations, and environments. Autism was perceived to be emplaced, or distributed across body-mind-environment (Howes 2005).

The AM founders have defined a model of therapeutic efficacy which decreases in scale from “toxic” sensory environments (due to a lack of autism-friendly environments and general knowledge of autistic experience that would to aid others with communication strategies), through lived experience, to “fight or flight” systems, to the minute flows of hormones in the blood. This reflects the situatedness of autistic lived experience, and seeks to acknowledge what can be an intensely felt perceptual experience for autistic people with sensory idiosyncrasies. These intersecting loops form a topography of the autism-equine therapy nexus enacted through a range of scales, and imply a particular kind of ecologically situated condition existing beyond the brain that is enacted through autistic embodiments in environmentally social relations. I refer to this model as a “therapeutic ecology” to encompass these biosociolooping scales (Malcolm 2019).

The hormonal scale of this therapeutic ecology acknowledges the situated enactment of negative and stressful autistic experiences. Rather than assume that hormonal models infer a wholly reductive and pathologizing narrative of autism, I attend to the way this acknowledges environmental (affective and architectural) stress. A more nuanced exploration can reveal much about current framings of autism, and autistic experience. Hormone knowledges allow an exploration of foregrounding and backgrounding of fixity and flow in autism that score through the history of autism, while also, in line with a social model of disability, they acknowledge the disabling effects of inhabiting environments that do not take into account non-normative ways of being. In addition, hormone knowledges enable the rethinking of autism as a situated form of embodiment, reflecting increasingly intimate ecological entanglements of neural, sensory, and endocrinological processes of the human body promoted via systems biology.

The uptake of scientific hormone knowledge by proponents of brain-based parenting, and practitioners of aligned and unregulated therapies requires exploration with a “wondering ambivalence” (Mackenzie and Roberts 2017: 137). This ambivalence sits at the crosshairs of a particular tension between a slender optimism about ameliorating chronic stress by changing affective environments and living spaces, and an awareness that the molecularizing of these processes elides the structural causes of chronic stress for autistic people, and a newly emerging kind of autistic citizenship centered around sensory issues that I elsewhere define as a form of “limbic citizenship” (Malcolm, 2019). This ambivalence reflects my reticence to focus only on metaphorical aspects of my interlocutors’ references to the materiality of the body.

In their explorations of “situated biologies,” Niewöhner and Lock (2018) remind anthropologists to question taken-for-granted assumptions embedded in biomedical knowledges and practices. These are rational knowledges always situated in a “view from a

body, always a complex, contradictory, structuring and structured body” (Haraway 1988: 589). I build upon this approach, encouraging the reader to see oxytocin and cortisol as “embodied facts” (Roberts 2002), that is, as entities that are biological and yet situated in and produced by one’s experience of worldly inhabitation. The reported modulation of hormonal flows by AM should not be considered in terms of isolated biology. These effects were understood as a direct response to environmental forces considered sensorially therapeutic or toxic, and in relation to the agency and behaviors of the therapeutic horse.

Hormone knowledge in this context is used to comprehend the body-society nexus. Taken from the Greek, hormone means “that which sets in motion.” These compounds act as the body’s biological messengers, yet also hold much symbolic power (Roberts 2002), which in this context index relatedness and stress. Hormonal “imbalances” are now used to parse the “normal” from the “pathological.” Sex-hormone treatments are widely available across the life course for conditions of “imbalance” from a predefined norm such as early onset puberty, intersex, and to assist in reproductive processes including conception, contraception, and birth (Roberts 2002, 2007). Hormones “shape what it means to be human in fundamental ways” (Bärnreuther 2018: 1) and are increasingly bound up in our understandings of the body. Sex hormones trouble binaries of sex/gender, inside/outside, and nature/culture (Appleton 2018). Existing literature has very usefully focused on hormones in biomedically mediated reproductive processes of conception (Roberts 2007), contraception (Sanabria 2016; Appleton 2018), menopause and andropause, gender transition and elite sports performance (Roberts 2007; Hoberman 2005; Erikainen 2017) in considering the sex/gender binary. Others look to endocrine-disrupting chemicals in exploring environmental toxicities and the inside/outside boundary of the body proper (Langston 2011).

A range of non-sex hormones are increasingly implicated in the management of health. “Imbalances” of serotonin and dopamine are implicated in depression and dementia. Cortisol has received attention in popular media in recent years in relation to the effects of long-term chronic stress, where concerns around finding the right work/life balance become central. Oxytocin and cortisol are biomedically framed as “endogenous,” yet materially and semiotically correspond to the transmissions of affect between persons and were bound up in local notions of relatedness in my field sites. AM practitioners draw on endocrinology to conceptualize hormones as mediators of stress, and bodily and affective relatedness, and, like sex-hormones, to flow across binaries of material/symbolic, inside/outside. Yet they also flow across affect/emotion and self/other. I explore these novel models of autism and relatedness through cascades of hormone knowledge, asking what is at stake in these understandings.

For the practitioners I got to know, the hormones oxytocin and cortisol held a related material and symbolic tension between embodiments of stability and mutability, aspects variously utilized in popular and scientific models of autism. Below I examine how these tensions emerged and explore local uses of “balance” and proportionality for understanding these multiple flows and oscillations between fixity and flow. I indicate four points. Firstly, cortisol and oxytocin communicate material-semiotic messages regarding the bodily effects of our worldly inhabitation. Secondly, “balance” is key to how we understand the interactions of these messengers, “inside” the body and in how they mediate relations of “inside” and “outside.” Thirdly, “balance” forms a broad theme in contemporary Euro-American understandings of well-being (Corsin-Jimenez 2008) and the interrelations of biology and society. Fourth, I conclude that “balance” and hormonal proportionality provide a means of comprehending simultaneities of material, behavioral and diagnostic fixity and flow in autism without assuming their exclusivity.

METHODS AND CONTEXT

I draw in this article on research which builds on my early experience from 2007 to 2012 at an equine therapy center in Scotland offering a range of horse therapy methods. AM was developed in the USA in the mid-2000s after its founder Louis discovered that horseback riding had positive effects on his young son, recently diagnosed as autistic. The method was formalized in the early 2010s and after training courses were offered, it began to be practiced at an increasing number of centers worldwide.

During 16 months of ethnographic fieldwork in the UK and USA in 2015 and 2016, I took part in hundreds of AM sessions with autistic clients, their parents, carers and teachers, AM practitioners and horses, alongside getting to know autistic students working on the stable yards, and autistic advocates of AM. Embodied interactions via sound, touch or shared rhythms were used in go-along interviews during AM sessions (with or without verbal language) in these contexts. For those who used verbal language informal interviews, and latterly semi-structured interviews were employed. I used discourse analysis, and followed the lead of my interlocutors to explore the embodied experience of autism and equine therapy. Pseudonyms are used for all interlocutors and sites.

Sessions at my field sites were offered at means-tested subsidized rates. Depending on income, families in the UK would pay between £10 and £25 per weekly session. Services in the US were framed around a similar charitable model, with organizations offering services for free or at significantly subsidised rates. Clients attended with either parents, teaching assistants, or carers, and predominantly attended mainstream, rather than special educational needs schools, where support level was variable. Two brothers, aged four and seven, were full time students, and each had a full time, dedicated teaching assistant. Other families struggled to secure a place

at a mainstream school for their child, and even when they did, they were disappointed by part-time places with no teaching assistance.

Some families were financially comfortable and would discuss other therapies they were exploring and using: AM residential camps, surfing, swimming with dolphins, EEG biofeedback therapy, and gluten-free and casein-free diets. Others were less well-off and did not talk about using such interventions. In the UK, irrespective of wealth, families often financed the sessions with a government Disability Living Allowance. AM was not widely available or known to many families therefore access was not equitable for all.

AM is one among many unregulated therapies emerging in response to a perceived autism “epidemic,” ongoing biomedical uncertainty regarding the condition (Eyal et al. 2010; Fitzgerald 2014), and the continual morphing and broadening of the classification whereby an increasing diversity of autistic ways of being in the world have come into being (Hacking 2007). “Treatment” practices for autistic people are therefore diverse, ranging from attempts to “cure” to more sensitively assisting with day-to-day life.

The AM method defined itself as an autism-specific and sensory-based method of therapy and attracted a particular kind of autistic client: people who enjoyed being around horses and the “natural” environment, and who experienced sensory idiosyncrasies as a core feature of their condition. The method founders differentiated the therapy from organizations offering less specific therapies for people with a range of disabilities, such as PATH International in the USA, and Riding for the Disabled Association in the UK. Not all interlocutors understood autism, nor therapeutic efficacy to be shaped by the balance of hormones. The centrality of these to the AM model of therapeutic efficacy is used as a route to exploring broader concerns with hormonal models of autism.

One aim of AM was to enhance communication and social engagement between autistic children and those they shared their lives with, which makes it a normative approach. This involved working to address sensory issues, supporting autistic ways of being, and changing environments, rather than “curing” autism. This distinguished the method from Applied Behavioral Analysis, roundly criticized by the autistic community and the people I got to know as an unproven intervention based on normalization of the child by removing rather than working with behaviours used by autistic people to manage their sensory experience, at significant financial and emotional cost to families (Lilley 2011).

I highlight here my interlocutors’ emphasis on the bidirectional enactment of negative autistic experiences (and arguably extensive stress) by others’ lack of sensitive engagement with autistic ways of being and communication, countering reductive framings that isolate the condition as a fixed impairment of isolated biologies. Autistic sociality clearly exists, enacted via non-normative modes of engagement with others (Belek 2018; Fein 2015; Grinker 2010; Solomon 2012). By viewing relations as the smallest units of social life and personhood as distributed in moments of relation (Strathern 1988, 1991), we can explore non-normative communications as meaningful forms of sociality. Sociality and empathic engagement are of course multidirectional processes, and a “double empathy problem” (Milton 2012) often occurs between autistic and non-autistic people. As Solomon (2012) has shown, engaging in communicative strategies more open to autistic ways of being facilitates what she calls an “ontological choreography” of embodied communications that facilitate sociality and relatedness. Understanding of, and affordances for, autistic ways of being are key to enhancing these relations.

SIMULTANEITIES OF FIXITY AND FLOW IN AUTISM

In this section I describe how the bidirectionality of social interaction and its impairment across self/other has been variously promoted in the history of autism, alongside other modes of fixity and flow across the nature/nurture binary. By this I refer to the various notions of material (biological), behavioral and diagnostic forms of movement and stasis that have emerged as attempts to understand autism since its discovery. In defining autism as a form of neurodiversity and difference that cannot be removed from a person, autistic advocates situate the condition as both biological and deeply socially situated. This biosocial model of self/other is to some extent supported by “hormone thinking” and the ensuing endocrinological models of autism, particularly in the context of stress hormones which offer a mode of understanding social processes as biological flows.

As we sat in the training session that day, Amy drew on knowledges garnered from the bricolage of scientific research on autism, endocrinology and neuroscience used by the AM founders to explain the effects of continually inhabiting stress states:

At a certain point, if the amygdala is being continually activated ... this person will start to experience too high levels of cortisol ... parts of the brain start to get damaged, so they stop inhibiting cortisol ... the person gets locked into a negative cycle where it's basically impossible to learn.

Amy noted that chronic stress and resulting cortisol “locked” clients into states where learning and engagement with others became increasingly difficult, borrowing from older models that consider autism as an ontological closing off from the world (Hacking 2007), and reductive biomedical framings of “repetitive behaviors” and “fixed interests” (APA 2013). She suggested that the negative effects of chronic stress could be ameliorated by improving environments and “balancing” hormonal flows:

The brain is constantly evolving and if you can stop this from happening it will repair itself. The brain creates new pathways. We know that the brain remains plastic throughout a person's life ... There is luckily a hormone which has been found to counteract the corrosive effect of cortisol in the brain and that is a hormone called oxytocin. In a nutshell, cortisol is our enemy and oxytocin is our friend.

Continual stress states were not therefore perceived to cause permanent change. This implies significant levels of somatic plasticity via the modulation and balancing of hormonal flows in proportional relations.¹ The interplay of being biologically and ontologically “locked in”, yet flexible by way of external influences, recurs throughout the history of autism, and is expressed in new ways by hormone thinking.

The word “autism” is derived from the Latin *autos* meaning “self,” and traces of autistic “internalization” were enshrined in the concept coined by psychiatrist Eugen Bleuler in 1912 to denote “autistic withdrawal of the patient to his fantasies, against which any influence from outside becomes an intolerable disturbance” as a symptom of dementia praecox (Kuhn 2004: 363). The term was taken up by Leo Kanner and Hans Asperger in the 1940s (Hacking 2007) and entered the DSM as a discrete disorder in 1980 via the work of Bernard Rimland (Evans 2013). Notions of the “flexible” autistic person through therapeutic intervention recur throughout the history of autism. During the ascendancy of psychoanalytic psychiatry, Bettelheim (1967) developed a psychogenic model of autism emphasising bidirectional relations in the etiology of autism. He maintained that the child withdrew as a result of cold parenting from “refrigerator mothers.” Bernard Rimland (1964) on the other hand defined autism as a biological disorder; twin studies promoted hereditary and genetic bases of autism (Folstein and Rutter 1977).

These developments were welcomed by parents for discrediting mother-blaming narratives, and recasting autism as a medical condition with potential remediation (Bumiller 2009). Whilst this remediation remains a potential, rather than a reality, biomedical research aiming to “cure” autism receives the bulk of research funding (Pellicano, Dinsmore, and Charman 2014). It is now situated in unknown interactions of innate (genetic, neurological) and environmental factors. Following developments in epigenetics, risk at increasingly early points of pre- and perinatal development are now implicated (Lappé 2014), entangling genetic inheritance and maternal environments in new ways.

Perceptions of flexibility in autism are not only reflected in historical biological or behavioural models of etiology or potentials for remediation. The category of autism itself is highly mutable and categorizes manifold ways of being autistic (Hacking 2007; Davidson and Orsini, 2013). The DSM-IV (APA 1994) favored a biologized, individual deficit model of autism, the category Asperger’s Disorder, which includes people with extensive language skills, was added to the DSM-IV (APA 1994), and later removed from the DSM-5 (APA 2013). In 2013, the DSM-5 included sensory idiosyncrasies as a symptom of autism for the first time (APA 2013), situating the condition again to a degree in “external” environmental effects. Emerging as a symptom of dementia praecox and later defined as a discrete psychiatric condition, variously accounted for by genetic inheritance (nature) or/and social affects (nurture), autism has slowly been re-categorized as a “developmental,” latterly “neurodevelopmental,” and very recently, a “sensory-perceptual” condition.

Fixity is foregrounded in the current psychiatric definition that defines “fixed interests” as a deficit in autism, promoted by a stereotype that autistic people require strict routines and struggle with change. An ontological status of autistic difference is promoted by proponents of neurodiversity who problematize the term “person with autism” (known as person-first

language) for its action of divesting a person from “their autism,” for whom being autistic is a permanent way of being in the world, not a pathology to be cured. Conceptual spaces of behavioral and diagnostic fixity and mutability are variously engaged in these shifting models of autism. Below I show how these simultaneities of behavioral and diagnostic fixity and flow are incorporated into hormonal models of autism, in ways that acknowledge both autistic lived experience and the enactment of significant anxiety and stress resulting from aspects of the environment understood to be toxic. These knowledges fold in and extend assumptions of the biological mutability of autistic bodies prompted by the work of Rimland via incorporating interactions of “endogenous” bodily processes, and social and therapeutic experience into a therapeutic ecology.

The function of the “stress hormone” cortisol, and the “bonding hormone” oxytocin, were modelled as being directly related in the rationale used to validate the efficacy of AM. Holding their flows in proportion was key to re-enabling learning and enhancing relatedness for autistic people and their families. Although this molecularization is problematic, practitioners were not aiming to “remove autism” from a person nor enact neurotypicality. Neither was it their understanding that the condition prohibited learning or connection to others. As noted above, inhabiting worlds that make no affordances for autistic difference can create a “negative spiral of stress” (Milton 2013). AM was instead promoted as a way of ameliorating ongoing damage done by embodiments of chronic stress.

One such affordance is to work with rather than against autistic ways of being. In the DSM-5 (APA 2013), intense interests are referred to as “fixed,” and the practice of repetitive movement behaviors known by many autistic people as “stimming” are pathologized as “stereotypy,” implying that these behaviors are aimless. Yet for those I got to know, stimming was a kind of

“flow” state (see McDonnell and Milton 2014). Thomas was an autistic advocate and budding horse trainer in his early 20s. He told me that:

What people need to understand is that nothing changes about your autism from when you are little to when you grow up. The sensory problems and social problems and stimming are all there. You just develop better coping strategies. Stimming is one of these. It is something autistic people find incredibly soothing and pleasurable, it’s kind of like a feeling of calm, happiness and pleasure... if you see someone stimming, don’t worry or try to stop them. Just leave them alone.

Louis, Chrissie, and Amy understood stimming as methods of self-regulation and finding spaces of calm and aimed – appropriately or not – to amplify this process on horseback. They built on autistic advocates’ reframing of the biomedical understanding of “stimming” as an aimless fixed interest or “stereotypy”, to instead a dynamic mode of becoming unstuck. By using horseback movement within carefully designed environments to modulate these flows practitioners felt that endocrinological processes could be reshaped. Ultimately this was promoted as effecting a mutability in endocrinological systems of clients’ bodies and, as I will show, an enhancement of social relations with others. In Amy’s words:

Oxytocin is a hormone that goes by many names; the “feel good hormone,” the “love hormone,” the “trust hormone.’ It’s a really nice hormone... it also has the exact opposite effect on the brain as cortisol. So, what the oxytocin does is broaden your awareness. Which allows you to be open to and take in new information ... Oxytocin has also been found to counteract the corrosive effect of cortisol on the brain. The basic idea is that the cortisol is bad, and the oxytocin is good.

Amy explained how this remedying could occur:

If we have oxytocin instead of cortisol then the prefrontal cortex and hippocampus can start to recover which means they can start to inhibit the cortisol again, which means that the brain is being returned to that resting feeling, a safe space where the child can begin to learn.

The flows of oxytocin and cortisol were understood as directly related parts, able to be held in proportion and balance to affect relational wholes. In the context of AM, proportionality was used to understand how the moving parts of hormones as relations, persons, horses, and movement practices were balanced into the whole of relational efficacy.

BALANCED PROPORTION AND SIMULTANEITIES OF FIXITY AND FLOW

The therapeutic ecology promoted by AM practitioners entangled numerous biolooping scales of parts and wholes of bodies, persons and environments. This ecology was held together via simultaneities of fixity and malleability. For example, practitioners viewed repetitive “stimming” habits as dynamic modes of unsticking oneself from the “negative spiral of stress” (Milton 2013). This was in line with the experience of sensory difference and difficulties inhabiting worlds designed by neurotypical people, as explained to me by my autistic interlocutors. Through horseback movement in “the right environment,” flows of oxytocin and cortisol were perceived to be brought into balanced proportion. AM was understood to “do more than just reduce the bad cortisol and increase the good oxytocin” (Amy). Practitioners referred to helping avoid “fixed” spaces of “shutdown” and associated “brain damage” resulting from chronic cortisol release, and in so doing promoted a more pervasive mutability of autistic people (and people in general). Autism has been variously characterized as a condition of diagnostic and behavioral fixity and malleability. A novel “endocrine style of thought” (Gaudillière 2004: 542) is facilitated by the perceived flows of oxytocin and cortisol.

This communicates significant *biological* mutability of the autistic person via the interrelation of environmental and endogenous processes.

In my interlocutors' understandings, oxytocin and cortisol held a material and symbolic tension between both stability and mutability. This was so in a range of ways. Firstly, too much cortisol was understood to make autistic people become "stuck" or "fixed" in repetitive behaviors, closing off the "learning centers in the brain" and foreclosing lessening of brain changes resulting from stress. In contrast, oxytocin was a facilitator of "neuroplasticity," learning and relatedness. These hormones were conceptualized as directly related, however, and in sharing a fixed relation, unable to be viewed in isolation. Through inculcating embodiments of sensory calm, practitioners felt able to enact homeostatic balance in the limbic (fight or flight) and nervous (sensory and endocrinological) systems of the body. This perceived homeostatic balancing and stability provided states in which oxytocin and cortisol could be rebalanced and brought into proportion, ultimately changing neural patterns and endocrinological responses.

My interlocutors understood sociality and the symbolic as inseparable from material realities. In autism, they were inextricable from the stressful environments that caused "sensory overload" and "meltdown." Via the careful design of choreographed movements through sensorially non-toxic environments, AM could enhance these capacities by modulating bodily processes, even down to minute hormone flows in the blood. These hormones were understood to produce malleability.

The focus on hormones in the context of AM molecularized autistic ways of being and the aims of the therapy were normative. Yet, by simultaneously acknowledging and seeking to improve lived environments, AM practitioners pushed against the simple biologization of autism in neurological structures and emphasized environmental causes of chronic stress. As chemicals that flow between biology and society, linking self and environment, languages of hormone

flows were used to produce this situated model of autism, utilizing the authority afforded by biomedical knowledges.

As noted, hormone knowledges require apprehension with what Mackenzie and Roberts (2017: 137) have called a “wondering ambivalence.” As a route through this ambivalence I argue that in local understandings, oxytocin constitutes a powerful material-semiotic substance of relatedness. This approach encapsulates the therapeutic ecology detailed by my interlocutors that indexed autism as a sensorially-mediated condition of the soma and psyche, situated in affective and architectural environments. “Balance” offers a route to acknowledging my interlocutors’ views that autism could be defined as neither fixed nor malleable, but rather as enacted precisely in simultaneities of both. Proportion allows us to explore the biofeedback loops of parts and wholes of this therapeutic ecology.

Partonomy is a type of hierarchy detailing relationships between parts and wholes and is distinctive in its ability to focus on relations between a range of scalar phenomena. Proportionality affords new ways of approaching these scalar relations, including in the context of “well-being” where diverse interrelated factors, or in this case scales, are at play (Corsin Jimenez 2008). It transports us from binary thinking, and offers a mode of appreciating material flows (Copeman and Banerjee 2019). Here it acts as a useful mode of locating hormonal materialities considered to flow across binaries of self/other, biology/society, and fixity/flow, and the range of scales incorporated in these movements.

This proportional balancing of parts and wholes in AM was perceived as the means through which relational change could occur. This whole did not only include the autistic person, but also the people they shared their life with. In the following section, I consider how hormone knowledges were used to promote AM as a mode of enhancing engagement with family members. Via the horse, these hormones were understood to act as powerful material mediators

of malleability in autistic clients and caregivers, shifting towards more normative forms of sociality.

FLAWS OF RELATEDNESS

Whilst hormones are in sharpest focus in this article, they acted within a therapeutic ecology (Malcolm 2019) of various scales including lived environments, sensory sensitivity and “fight or flight” systems. For one of my closest interlocutors, AM practitioner Chrissie, balancing all of these factors and not only hormonal flows was therefore key to producing therapeutic effects. When I asked her how she qualified this dynamic, multifaceted therapy, she told me:

It’s really hard. I generally say, come along and have a look. Because it’s really difficult to describe. It’s about balancing between timing, and sensitivity and pressure and other people parents/volunteers and the horse and the environment. It’s like the old-fashioned weighing scales with the little tiny weights, you know the ones? Except instead of two trays, you’ve got at least three, probably more like four or five. And all the time you’re moving tiny weights from one to another, and just trying to keep it all level and balanced. And so that’s how it goes. There’s no constant.

Themes of proportion and balance not only referred to hormones on a molecular scale, but the whole therapeutic ecology of parts and wholes of equine therapy introduced here. This included balancing people (and horses) within environments that catered to their sensory and endocrinological needs, and in relations of people with autism and their parents and carers. Practitioners made it clear during our discussions after sessions that by creating calm spaces and encouraging engagement with the animals, they actively helped parents, carers and teachers to become more relaxed. This helped to counter any “negative spiral of stress,” and enhanced openness and sensitivity to the rhythms of their child’s experience.

Tracy, a Teaching Assistant, would often arrive from school bristling with contagious, negative energy, and regularly interacted with the child she assisted in tense and abrupt ways after having battled about wearing wellington boots or aggressive behaviors on the way to the center. She spent a lot of time during the therapy sessions letting off steam to Chrissie and me about what kind of week she and the child she cared for had been having. Chrissie felt conflicted over finding a balance between the needs of her client and his teacher in these sessions. Her priority was to use the short session to create the most relaxing experience for the child. Yet it became her priority to give the teacher a safe space to calm down, to improve the child's experience for the rest of the week. Finding balance between autistic children and those caring for them (if required) relied on bringing them back into the relaxed embodiments of calm needed to engage with the flow of autistic ways of being and communicating.

Somewhat countering the significant relational labor that went into reducing these tensions, Amy continually recentered the effects of AM within the horses' movements, and oxytocin flows, stating that the hormonal substance was "free and really easy to produce." The movements and bodily postures required by horseback movement were "the pinnacle" of oxytocin production.

One of the easiest ways to produce it is to ride a horse. Research shows that oxytocin is produced when you rock your hips... And that's why it feels so good to ride a horse. And this is the main reason why it seems like riding horses is so beneficial for children with autism, because of the oxytocin being produced.

Practitioners promoted the calming "natural" environment, presence of the horse, rocking, rhythmic movement and "deep pressure" of horseback riding as modes of boosting the flow of oxytocin, which would in turn further inhibit the flows of cortisol.

Specific practices of therapeutic horses were deemed key to oxytocin flows and therefore efficacy of AM. Louis and the team worked with a particular breed of dressage horses, animals selectively bred and trained for their gymnastic levels of bodily control. This included the horses' enhanced ability to "collect" – perform a very rounded, and bouncy as opposed to flat, canter movement. This choice of dressage horses over traditional riding school ponies was based on an oxytocin flow rationale:²

We noticed a connection between collection and oxytocin and learning in the kids. So, then we had to get serious about it... It was not me saying "I've got these clever ideas about oxytocin" and so forth. It was just that we noticed what worked and what did not. When we back ride [double riding with the child in front of the adult], we can ride at a walk, trot and very collected canter. And some of our horses are even trained in the *terre à terre* canter - basically a canter on the spot - where the horse is doing a really big movement at that point. So, the kids are really getting their hips rocked, producing the oxytocin, which we know is a really good thing.

The method was designed to actively engage with and shape the mind and nervous system of clients through bodily modulations within altered environments.

During another day of training, Amy announced, "pair up everybody. We're going to do the diaper shake." Once paired, she demonstrated another method of "boosting oxytocin flow," this time particularly for parents. "I'm going to place my hands at the sacrum at the base of Laurie's back and rock in rhythm." She rocked Laurie like this for a few minutes before getting us all to do the same. "This is a great thing to do with the mums and dads, on or off the horse. It's really relaxing for them and it's so important to involve them."

As part of our training that day, we would also try sensory work ourselves, so that, as Amy put it, we could "feel with our own body just how great it feels to be up there bareback on the

horse.” We gathered at the door, each getting our boots on before heading out to the stables. “Sensory work” was encouraged at every opportunity, not only for practitioners but also for volunteers and parents. “It’s good for all of us,” Louis told me. “We also do it with the parents because autism parents are stressed.” Reflecting Chrissie’s perspective, yet again situating these bidirectional changes in hormone talk, Amy stated that getting parents up on the horse and “getting the oxytocin flowing” was the basis of effecting a sustainable change for the child by changing affective environments at home. This constituted a tri-directional flow of the effects of oxytocin between parent and child, via the horse. As the horse was prepared for our demonstration of sensory work, Amy explained:

Parents are overwhelmed and we know that this is something simple and easy we can do to reduce those stress levels. We sort of trick them into doing it by telling them we want them to feel what their child is feeling. And by telling them that if their child is a bit reluctant to ride then seeing them (parents) up on the horse will maybe make the child view the horse as a safe place to be.

We took it in turns to get up onto the horses’ back to try sensory work as Amy continued to teach us:

The main reason is to try and do something to reduce the parents’ stress levels. Because if we can send the parents home less stressed, then that is going to have a much bigger effect than just spending an hour or two with us once a week.

We each lay forwards over the horse’s neck for a few minutes before sitting up, then reversed, facing the roof of the stables with our backs along the horse’s back. We then changed direction to face backwards and lie forwards, with the front of our bodies over the horse’s back and rear. Oxytocin flow via movement of the clients’ (and at times parents’) bodies on horseback was mobilized by practitioners as key to bonding and enhancing relatedness between kin. Oxytocin

was moralized as “the good hormone,” and understood as a subjunctive substance which not only rebalanced hormonal flows and facilitated learning, but which held the promise of rebalancing family relationships.

ENGENDERING THERAPEUTIC HORMONES

Various hormones have been investigated in relation to autism including estrogen, testosterone, vasopressin and, as here, oxytocin and cortisol. Whilst entering the autism nexus more recently, oxytocin is put to strategic use in the AM context, echoing the moralization of normative sociality as inherently “good.” Oxytocin is widely implicated in parent-child, and most often mother-child bonding, evidenced by a proliferation of popular science and news articles such as “Love hormone improves mother child bond” (Brit 2007). Amy characterized oxytocin as a “bonding hormone” reflecting biomedical and popular mobilization of the hormone in understandings of reproductive processes and parent-child bonding when she stated that “oxytocin is... actually what kick starts labor. It’s released when a mother or father holds their child, rocks their child. It’s released when you breastfeed, so it’s really important for bonding.”

Oxytocin has been linked to women’s bodily processes and particularly reproduction since its discovery when the hormone was named after the Greek for “rapid birth.” It is central to biomedical (and more recently popular) understandings of kin-making processes of reproduction; conception, birth, and breast feeding. It is conceptualized as central to milk production and let down and as being transported between mother and child through human milk. In this context hormones were situated in affective environments and places, and framed as substances of embodied sociality and relatedness. I have detailed how enhancing flows of oxytocin was perceived to set in motion processes of relatedness between autistic people and those they shared their lives with. I extend anthropological conceptualizations of bodily substances of relatedness that simultaneously index fixity and flow (Carsten 2011; Copeman

and Banerjee 2019), and suggest that as a material compound flowing through blood and milk, oxytocin and cortisol similarly index this simultaneity.

Oxytocin is a chemical compound released by the hypothalamus into the blood stream by the pituitary gland. The power of bodily substances such as blood, milk, and semen to simultaneously denote fixity (in terms of materiality and biological kinship) and flow (via material properties of these liquids) in processes of relatedness has been an ongoing topic of focus in anthropology (Carsten 2011; Copeman and Banerjee 2019). Oxytocin is carried through the blood and highly mingled in processes of reproduction; conception, birth, and the production and let down of breast milk. Oxytocin flows arguably also hold much material and symbolic power in indexing relatedness³. These simultaneities of fixity and malleability in hormone thinking also encapsulate the various prioritising and deprioritising of diagnostic, behavioral and biological stasis and mutability throughout the history of the autism classification.

Through its characterization of autism, the autistic practice of “stimming,” and the flows of oxytocin, the explanatory model crafted by the AM founders and reproduced by its practitioners echoes an historical simultaneity of fixity and malleability in autism, and conveys this through the novel discourse of biomedical hormone knowledges, reflecting emerging framings of the body as a complex, ecologically situated system of biofeedback loops. Speaking to the anthropological body of work on bodily substances (such as milk and blood) and the perceived fixity of materiality, yet also flow and malleability they come to index (Carsten 2011; Copeman and Banerjee 2019), I suggest that notions of balance and proportionality in discussions of hormones offer a way to encapsulate simultaneous interplays of fixity and flow, without assuming their exclusivity.

CONCLUSIONS

AM practitioners understood their therapy to open reciprocal flows of relatedness between autistic and non-autistic people, including family members by modulating the flows of oxytocin and cortisol, and enacting hormonal balance and proportionality. They considered oxytocin and cortisol to be molecular “parts” that act as material-semiotic substances and distribute relations. Oxytocin and cortisol were “endogenous” yet materially and semiotically corresponded to transmissions of affect between people, and central to local models of relatedness. In the context of AM, the minute flows of hormones were used by practitioners as modes of biologizing these relations. Yet they acknowledged the social and sensorial situatedness of autistic experience, and the negative effects of living in stressful environments. In this novel model of autism and relatedness, oxytocin and cortisol are perceived to flow across binaries of material/symbolic, inside/outside, yet they also flow across affect/emotion and self/other.

Within the minutest mode of hormonal efficacy in the therapeutic ecology modelled by my interlocutors, oxytocin and cortisol were understood to hold a related material and symbolic tension between stability and mutability. I have traced the folding of repeating tensions between biological, behavioral and diagnostic fixity and flow in autism. Whilst practitioners problematically molecularized the efficacy of AM via the biomedical language of hormones, the situatedness of autism was intrinsic to their approach and consistent with my autistic informants’ views of the condition. Knowledges of hormonal flows were woven into a model of therapeutic efficacy promoting the power of well-designed environments and respectful, sensitively informed communication for enhancing well-being for autistic people. These accounts promote autism as an increasingly sensorially-mediated condition of the whole person in worldly inhabitation.

I have explored the entanglement of sensorially toxic, stressful environments and sensory sensitivity in autistic lived experience. Also detailed are the hormonal “imbalances” used to understand this lived experience. In elaborating the significance of materiality in appeals to hormonal flows in my interlocutors’ models of therapeutic efficacy, I have asked what is at stake in these conceptualizations, questioning the pathologizing of autism via assumptions of hormonal “balance.” These accounts, and the therapeutic ecology through which they are produced, allow us to explore increasingly embodied models of autism, the effects of toxic environments on the permeable and stressed body, and somatic plasticity more generally. The notion of finding spaces of physiological, behavioral and environmental proportion and balance, emerging from my interlocutors’ considerations of situated hormonal flows, allows for an appreciation of the simultaneity of fixity and flow in the context of autism.

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REFERENCES

American Psychiatric Association (APA)

1994 Diagnostic and Statistical Manual of Mental Disorders: DSM-IV (4th ed.). Washington, DC: American Psychiatric Association.

2013 Diagnostic and Statistical Manual of Mental Disorders: DSM-5 (5th ed.). Washington, DC: American Psychiatric Association.

Appleton, N.S.

2018 Unintended Logics. Member Voices, Fieldsights, August 14. Available at:

<https://culanth.org/fieldsights/unintended-logics>

Bagatell, N.

2007 Orchestrating Voices: Autism, Identity and The Power Of Discourse. Disability & Society 22(4): 413–426.

2010 From Cure to Community: Transforming Notions of Autism. Ethos 38(1): 33-55.

Baggs, A.

2007 In My Language. YouTube. Accessed at

<https://www.youtube.com/watch?v=JnylM1hI2jc>.

Bärnreuther, S.

2018 Hormones. Member Voices, Fieldsights, August 3. Available at:

<https://culanth.org/fieldsights/series/hormones>.

Belek, B.

2018 Articulating Sensory Sensitivity: From Bodies with Autism to Autistic Bodies. *Medical Anthropology: Cross Cultural Studies in Health and Illness* 38(1): 30–43.

Bettelheim, B.

1967 *The Empty Fortress: Infantile Autism and the Birth of the Self*. New York: Free Press.

Brit, R.R.

2007 Love Hormone Improves Mother-Child Bond. *Live Science*, October 15th. (online). Available at <https://www.livescience.com/1955-love-hormone-improves-mother-child-bond.html>

Broderick, A.A. and Ne'eman, A.

2008 Autism as Metaphor: Narrative and Counter-Narrative. *International Journal of Inclusive Education* 12(5–6): 459–476.

Brownlow, C. and O'Dell, L.

2013 Autism as a Form of Biological Citizenship. In Davidson, J. and Orsini, M. (Ed.). *Worlds of Autism: Across the spectrum of neurological difference*. Minnesota, MN: University of Minnesota Press. Pp 97 – 116.

Braun, B.

2007 Biopolitics and the molecularisation of life. *Cultural Geographies* 14: 6-28.

Bumiller, K.

2009 The Geneticization of Autism: From New Reproductive Technologies to the
Conception of Genetic Normalcy. *Signs* 34(4): 875 – 899.

Carsten, J.

2011 Substance and Relationality: Blood in Contexts. *Annual Review of
Anthropology* 40(1): 19-35.

Chamak, B., Bonniau, B, Jaunay, E. and Cohen, D.

2008 What Can We Learn About Autism From Autistic Persons? *Psychotherapy and
Psychosomatics* 77(5): 271–279.

Copeman, J. and Banerjee, D.

2019 *Haematologies. The Political Life of Blood in India*. Ithaca and London: Cornell
University Press.

Corsin Jimenez, A.C.

2008 Well-being in Anthropological Balance: Remarks on Proportionality as
Political Imagination. *In. Culture and Well-Being : Anthropological*

Approaches to Freedom and Political Ethics. Pluto Press. Pp 180-198.

Davidson, J. and Orsini, M. (Ed.).

2013 *Worlds of autism: Across the spectrum of neurological difference*. Minnesota: University of Minnesota Press.

Erikainen, S.

2017 *Hybrids, Hermaphrodites, and Sex Metamorphoses: Gendered Anxieties and Sex Testing in Elite Sport, 1937–1968*. In *Gender Panic, Gender Policy*. Pp. 155 – 176.

Evans, B.

2013 *How Autism became autism: The radical transformation of a central concept of child development in Britain*. *History of the Human Sciences* 26(3): 3-31.

Eyal, G. Hart, B. Onculer, E. Oren, N. and Rossi, N.

2010 *The Autism Matrix: The Social Origins of the Autism Epidemic*. Polity Press.

Fein, E.

2015 *Making Meaningful Worlds: Role-Playing Subcultures and the Autism Spectrum*. *Culture, Medicine and Psychiatry* 39: 299-321.

Fitzgerald, D.

2014 *The Trouble With Brain Imaging: Hope, Uncertainty and Ambivalence in the*

Neuroscience Of Autism. *BioSocieties* 9(3): 241–261.

Folstein, S. and Rutter, M.

1977 Infantile Autism: A Genetic Study of 21 Twin Pairs. *Journal of Child Psychology and Psychiatry* 18(4): 297–321.

Gaudillière, J.P.

2004. Genesis and development of a biomedical object: styles of thought, styles of work and the history of the sex steroids. *Studies in History and Philosophy of Biological and Biomedical Sciences* 35: 525–543.

Grinker, R.

2010 Commentary: On Being Autistic and Social. *Ethos* 38(1): 172-178.

Hacking, I.

2007 Kinds of People: Moving Targets. *Proceedings of the British Academy*, 151: 258–318.

Haraway, D.J.

1988 Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies* 14(3): 575-599.

Hoberman, J.

2005 Testosterone Dreams: Rejuvenation, Aphrodisia, Doping, Berkeley and Los

Angeles: University of California Press.

Howes, D. (ed.)

2005 Empire of the Senses: The Sensual Culture Reader.

Oxford, UK: Berg

Kapp, S. (ed)

2020 Autistic Community and the Neurodiversity Movement: Stories from the Front

Line. Palgrave Macmillan.

Kuhn, R.

2004 Eugen Bleuler's Concepts of Psychopathology. *History of Psychiatry* 15(59

Pt3): 361–366.

Landecker, H.

2011 Food as Exposure: Nutritional Epigenetics and the New Metabolism.

BioSocieties 6(2): 167-194.

Langston, N.

2011 Toxic Bodies: Hormone Disruptors and the Legacy of DES. Connecticut: Yale

University Press.

Lappé, M.D.

2014 Taking Care: Anticipation, Extraction and the Politics of Temporality in Autism

Science. *BioSocieties* 9(3): 304–328.

Lappé, M.D. and Landecker, H.

2015 How the Genome Got a Lifespan. *New Genetics and Society* 34(2): 152-176.

Lilley, R.

2011 The ABCs of Autism: Aspects of Maternal Pedagogy in Australia. *Social Analysis* 55(1): 134-159.

Mackenzie, A. & Roberts, C.

2017 Adopting Neuroscience: Parenting and Affective Indeterminacy. *Body and Society* 23(3): 130–155.

McDonnell, A. and Milton, D.

2014 Going with the flow: reconsidering ‘repetitive behavior’ through the concept of ‘flow states’. In Jones, G. and E. Hurley, eds. *Good Autism Practice: autism, happiness and wellbeing*. Birmingham UK: BILD.

Malcolm, R.

(n.d) *Rhythms That Matter: A Therapeutic Ecology of Autism and Equine Therapy*. Book manuscript in preparation.

2019 *Rhythms That Matter: Kinetic Melodies and Mattering in Autism and Equine Therapy in the UK and USA*. PhD Thesis, The University of Edinburgh.

Malcolm, R., Ecks, S. and Pickersgill, M.

- 2018 'It Just Opens Up Their World': Autism, Empathy, and the Therapeutic Effects of Equine Interactions. *Anthropology and Medicine* 25(2): 220-234.

Milton, D.E.M.

- 2012 On the Ontological Status of Autism: The "Double Empathy Problem." *Disability & Society* 27(6): 883–887.

- 2013 Reversing the negative spiral of stress – a personal and philosophical reflection. *In* Stress and autism: combating stress, lightening the load, Research Autism Conference, 14th May 2013, London, UK. (Unpublished)

Novas, C. and Rose, N.

- 2000 Genetic risk and the birth of the somatic individual. *Economy and Society* 29: 485-513.

Niewöhner, J. & Lock, M.

- 2018 Situating Local Biologies: Anthropological Perspectives on Environment/human Entanglements. *BioSocieties* 13(4): 681–697.

Ortega, F.

- 2013 'Cerebralising Autism within the Neurodiversity Movement. *In* Davidson, J. and M. Orsini, eds. *Worlds of autism: Across the spectrum of neurological*

difference. Minnesota: University of Minnesota Press. Pp 73-96.

Pellicano, E. Dinsmore, A., and Charman, T.

2014 What Should Autism Research Focus Upon? Community Views and Priorities from the United Kingdom. *Autism* 18(7): 756-770.

Rimland, B.

1964 *Infantile Autism: The Syndrome and Its Implications for a Neural Theory of Behavior*. New York: Appleton-Century-Crofts.

Roberts, C.

2002 'A matter of embodied fact': Sex hormones and the history of bodies. *Feminist Theory* 3(1): 7-26.

2007 *Messengers of Sex: Hormones, Biomedicine and Feminism*. Cambridge Studies in Society and the Life Sciences, Cambridge, UK: Cambridge University Press.

Sanabria, E.

2016 *Plastic Bodies: Sex Hormones and Menstrual Suppression in Brazil*, Durham: Duke University Press.

Solomon, O.

2012 *Doing, Being and Becoming: The Sociality of Children with Autism in Activities with Therapy Dogs and Other People*. Cambridge Anthropology,

30(1) pp.109–126.

Solomon, O. & Bagatell, N.

2010 Introduction: Autism: Rethinking the Possibilities. *Ethos* 38(1): 1–7.

Strathern, M.

1991 *Partial Connections*. Savage, MD: Rowland and Littlewood.

1988 *The Gender of the Gift*. Berkeley: University of California Press.

Williams, D.

1998 *Autism and Sensing: The Unlost Instinct*. London: Jessica Kingsley.

World Health Organization

2018 *Autism Spectrum Disorders*. 2 April 2018. Sourced on 30.8.2019 from

<https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders>.

Notes

¹ Whilst neuroplasticity is of importance in some of my interlocutors' models of efficacy, it is beyond the scope of the article to explore the full import of this notion.

² Only the AM Ranch had access to such gymnastic horses, the other centers studied used traditional riding school horses.

³ The gendering of relatedness in the context of autism being enacted here via reference to oxytocin in particular is of importance and is taken up in a forthcoming article on gender and hormone models of autism.