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Neuroscience and the dialectics of history

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Neuroscience and the dialectics of history. Historians, like all social scientists, must make assumptions about how the brain works. This essay suggests how some of the recent findings of the brain sciences might enhance our ability to understand or describe patterns or processes in the past. A key feature of the brain and nervous system is that they are open to developmental and epigenetic influences, meaning that cultural patterns can shape or influence brain structures, at least in the aggregate population. This essay sets out the theoretical basis for a neuroscientific approach to the past, and develops a case study based on the neurobiology of stress.
Keywords: neuroscience; history; coevolution; stress.

A neurociência e a dialética da história. Os historiadores, tal como todos os cientistas sociais, precisam de fazer assunções acerca do funcionamento do cérebro. Este artigo aborda o modo como algumas das mais recentes descobertas das neurociências podem melhorar a nossa capacidade para compreender ou descrever padrões ou processos do passado. Uma característica fulcral do cérebro e do sistema nervoso é a de que se encontram abertos a influências epigenéticas e de desenvolvimento, o que quer dizer que as estruturas cerebrais podem ser moldadas ou influenciadas por padrões culturais, pelo menos na generalidade da população. Este artigo estabelece a base teórica para uma abordagem neurocientífica do passado, e explora um estudo de caso baseado na neurobiologia do stress.
Palavras-chave: neurociência; história; coevolução; stress.

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Neuroscience and the dialectics of history

History and neuroscience make strange bedfellows. The past cannot easily offer neuroscientists a set of hypotheses or research questions to be tested via brain imaging experiments. Historians, in turn, have been disinclined to deal with behavioral or psychological patterns that have the appearance of being universal or hard-wired, since the realm of the universal offers little traction for arguments about historical change. In addition, there are problems of relevance, for on what grounds can we legitimately borrow the findings of a science based largely on the study of sea slugs and mice and the like and project those findings willy-nilly onto the human past? Finally, neuroscience may have something to offer fields that focus on the present day: what goes on in the nervous systems of people who are shopping or dancing or engaging in devotional exercises, for example, or whether music contributes to healing (Patel, 2008). But how can any study of the brain and the nervous system be drawn into explanations about how and why things have *changed*, the question at the heart of the historical enterprise?

In this paper, I hope to offer an architecture of historical understanding that may allow us to bring aspects of neuroscience into conversations we have about change in the human past. Much of this architecture comes from environmental history, a field that explores human history in relationship to the environment we inhabit. The key feature of this field is that environmental history does not treat either humans or the environment as the sovereign partner in the relationship; the model does not assume a simple Aristotelian pattern of cause-and-effect, where influence flows from a prime mover toward an object that is moved.[1] Instead, the patterns of influence are cross-cutting, mutual, and

1 The argument of environmental determinism has a long pedigree, extending back at least to the nineteenth century in the work of Henry Thomas Buckle (1857-61). The most recent →

contingent. In his study of the German landscape from the age of Frederic the Great to the twentieth century, for example, the historian David Blackbourn (2006) explored how rivers, marshes, and coastal zones were diked, drained, dammed, and channeled, and how, in the process, a new landscape was created, with unpredictable consequences for the people who lived in it. The channeling of rivers, for instance, lowered the water table, and agrarian patterns were transformed by the resulting need to rely on irrigation. The channeling of rivers also influenced seasonal fish runs. In this changed environment, certain cultural patterns and institutions faded away and others emerged in their place. Studies like this promote an understanding of the past in which humans and their environment are engaged in an ongoing relationship defined by a mutual and reciprocal set of influences.

Environmental history, in short, develops a dialectical model for understanding change in the human past. Rather than offering a solipsistic history, as if humanity is the only agent in creating change, the field assumes that change emerges from a complex relationship between humans and something else, in this case the environment. But what, exactly, is "the environment"? We can, in a narrow sense, think of the environment as nature, in the form of water, climate, sources of energy, and disease. Yet it does not violate the architecture of a dialectical approach to treat something other than nature as the partner in the relationship. By way of example, it has become possible to argue that human society and sociability have constituted an important niche in which humanity itself has evolved. This argument has been developed most fully in the literature on the social intelligence hypothesis, which suggests that the human brain developed its qualities not simply in response to nature (e. g. the dangers of predation; the difficulty of the hunt; the challenge of living in the highly changeable climate of the Pleistocene) but also in response to other humans (Byrne and Whiten, 1988; Goleman, 2006). To navigate the complex world of human sociability, early hominins had to learn how to read and infer the intentions of others so as to build support groups or coalitions (Dunbar, 1996; Hrdy, 2004, 2009). The argument also pertains to the modern world of the last five or ten thousand years, where we continue to respond to a constantly changing social niche through adaptations that are cultural in nature or take the

→ version of environmental determinism can be found in the work of scholars such as Jared Diamond (1997; see also 2005) and climate historians who have argued for the sovereignty of climate in determining the fates of human societies (e. g. Fagan, 1999). More common is the approach that assumes human sovereignty over the environment; this is associated with a trope whereby history describes a "conquest of nature." Again, this idea has a deep pedigree in nineteenth-century historiography.

form of changes in physical and psychological phenotypes, e. g. through epigenetic or developmental down-regulation of testosterone (Wrangham, 1996; Larsen,1999; Cochran and Harpending, 2009).

Given the fact that the "environment" in environmental history does not have to consist of nature, it takes just a small leap of the imagination to treat our own nervous system as an ecological niche in which the patterns of human culture have emerged and evolved. At first blush, this sounds like a very peculiar thing to say. In the self-and-other relationship that is essential to any dialectical process, isn't the human nervous system on the "us" side? But it is not hard to come by simple examples illustrating how a quality of the nervous system helps explain some feature of human culture. Most historical societies, for example, have found ways to incorporate psychoactive substances—alcohol, qat, opium, marijuana, coca, peyote, and so on—into their rituals or their marketplaces. By virtue of their ability to stimulate or alter the production of neurotransmitters such as dopamine or serotonin, these substances help create distinctive cultural forms, such as the religious trance, which would not otherwise exist in quite the same way (Whitehouse and Martin, 2004). Neural pathways also help explain why pets are cute and why music has a beat, among many other things. The point that must be borne in mind here is that the science of the nervous system cannot explain the hows and whys of historical patterns. It cannot explain why, for example, the United States has criminalized marijuana, cocaine, and other drugs, but has not criminalized nicotine, alcohol, or for that matter other addictive practices like Facebook and shopping (Herlinghaus, 2010). That is a matter for history to determine, not neuroscience. The nervous system is an ecological niche in which patterns or practices *can* evolve, but the niche does not insist that those patterns *must* evolve, nor does it guarantee that patterns will endure once they *have* evolved.

This is the architecture of a neurohistorical approach to the past. It is an architecture of explanation that abandons the idea of a "transfer of sovereignty" from nature to culture that is so dominant in history, the humanities, and some of the social sciences like cultural anthropology. It offers instead a model where the nervous system itself is involved in a complex, never-ending dialectic with the cultural formations of the human past.

In the first section of this paper, I seek to elaborate on this model by exploring some of the evolutionary principles that help explain how it works, including the principle of coevolution and the idea of a niche. A key feature of the model is that it does not treat the nervous system of any individual as hardwired or genetically determined. Virtually no one in the neurosciences these days understands the brain-body system in the simple manner once proposed by pop sociobiology and evolutionary psychology. Part of the reason for this

lies in the failure of the human genome project to find a one-to-one relationship between genes and phenotypic traits, at least where behavioral patterns are concerned. This, it turns out, was an immensely productive failure. Gene expression is far more complicated and far more interesting than once imagined, in part because it is subject to developmental and epigenetic influences (Francis, 2011; Carey, 2012; Kenneally, 2011). The point here is that a neurohistorical model assumes that the nervous system, consisting of synapses and receptors, is like any ecosystem: it can be shaped by the organisms that inhabit it. In practical terms, this means that individual or cultural circumstances help determine features of the practical architecture of the nervous system itself.[2] Translated into history, this means that in the same way that there is a continuous dialectic of influence between humans and their natural environment, so too is there a dialectic of influence between humans and their own nervous systems.

Abstract reasoning, all too often, is an obstacle to understanding. For this reason, I seek to develop in the second part of this essay a case study based on the neurobiology of stress, which draws on some of my own work on the patterns of violence in later medieval Europe. Like most neurobiological states, stress is not something we can explore directly via the historical record: we cannot test the saliva or urine of historical actors for the presence of stress hormones, nor can we measure the activity of stress receptors in the hippocampus. This is not even remotely a problem for the practice of history. No historian ever assumes that facts emerge in a simple and uncomplicated way from the record of the past. Historical epistemology is necessarily inferential and inductive; it proceeds by way of strategic comparison and plausible supposition. At their best, historical arguments are based on a consilience of observations drawn from independent bodies of evidence. Historical claims are never assumed to be true; instead, corroborating research allows claims to grow ever more robust and plausible. Thus, although we cannot "see" stress hormones in the historical record, we can plausibly infer the presence of stress in situations involving violence, humiliation, and poverty. Stress is interesting as a historical subject because it allows us to write a human history framed in the context of an ongoing dialectic between the stress-response system on the one hand and human institutions, practices, and patterns of behavior on the other.

2 Neural Darwinism has proposed an elegant explanation for how synapses and receptors are formed by focusing not on synaptic growth but instead on synaptic death. The infant brain has many trillions of neurons and potential synapses, but these will decay if not exercised. See Edelman (1987).

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The dialectical pattern characteristic of environmental history is not unique to that field, for the philosophy of dialectical systems has a deep pedigree within the philosophy of history as theorized by Hegel and Marx. The work of Hegel, who did so much both to clarify and to obfuscate the practice of history, is of special relevance here, in part because of the paradoxes it generates. On the one hand, the Hegelian philosophy of history was instrumental in dividing the realm of biology from the realm of history (Trautmann et al., 2011, p. 160). Biology, to Hegel, could not describe a historical process of change; it described instead the never-ending cycle of daily existence, revolving around birth, death, and the search for food. History, in the Hegelian view, described a non-cyclical or directional pattern of time, in which the presence of a political order, the State, offered humanity a release from the sterile cycling of the biological condition. The State allowed humans to transcend nature by softening and taming it. The memory of the past, that is to say historiography, created the possibility of a moral system, since the desire to be remembered well by the historians of the future encouraged rulers to be beneficent.

The idea that history was founded on a break with nature cast a very long shadow over the practice of history. In the wake of the Darwinian revolution, this break took on special significance. If humans were once animals, after all, they must have once lived in a biological and therefore historyless condition. "The beast lives ahistorically," wrote Nietzsche, thereby putting his finger on the very nub of the paradox of deep human time—for if humans were beasts and lived without history, where did history come from? (Nietzsche, 1957 [1874], p. 1). And when did it start? By the 1930s, the answer to this conundrum had become clear: history sprang into being during the Neolithic revolution, when some humans, by virtue of the invention of agriculture, civilization, and writing, escaped the grip of nature and embarked upon a new path, the path that Hegel, a century earlier, had described as the path of the State. If this story has a familiar ring to it, it is because it is simply the secular transposition of a story long told by Judeo-Christian sacred history, where history began with the expulsion from Eden.

Hegel, like Leopold von Ranke, Henry Sumner Maine, and Oswald Spengler after him, was partly responsible for the belief that human history can be divided into a historyless period and a period of history. This school of historical philosophy did not simply project historylessness onto the deep past of human existence. To the European observers of the nineteenth century, historylessness seemed to be all around them, not just in the so-called primitive tribes but also in great civilizations like China that, to Europeans, never

seemed to be going anywhere. Only Europe, in European historiography of the nineteenth century, was pregnant with historicity.

The paradoxical feature of Hegel is this: not only did he help create the original break in the fabric of history, he also conceived of a philosophy of historical change that now makes it possible to transcend that break. Historical change, to Hegel, is a dialectical process. Absent in nature (or so he thought), the dialectical pattern becomes activated by the presence of the State, and its presence explains the directionality and ceaseless change that marks historical societies. In Hegel's day, of course, Charles Darwin and A. R. Wallace had not yet published their theory of natural selection. Writing when he did, Hegel could not know that natural history, like human history, is thick with dialectics. This is the pattern we now call Darwinian evolution.

As a biological concept, Hegelian dialectics maps well onto a process that some biologists call *coevolution*. The idea of coevolution is that organisms do not evolve in response to a hard and unyielding set of selection pressures. Instead, there is always some sort of dialogue between an organism and its environment. In Hegel's philosophical vocabulary, this was the dialogue between a thesis and its antithesis, but that is just an abstract way of describing the dialogue between an organism and another organism, an organism and its niche, and even between an organism and its own genes.

Coevolutionary patterns share some unusual or interesting features. Some herbivores, for example, can get locked into spiraling relationships with the plants on which they feed, for as plants gain toxins to avoid being eaten, the animal or insect develops the capacity to metabolize those toxins. The competitive one-upping of these coevolutionary relationships describes well how the dyad can go haring off in wild directions. Relative to each other, for example, the cheetah, like its ancestors, has always been just a tiny bit faster than the gazelle or the pronghorn and their ancestors. That ratio, arguably, has not changed over the long evolutionary relationship between the species involved. But even though cheetahs and gazelles stand still in their relationship to one another, both species have become spectacularly swift relative to *other* animals. In his path-breaking 1973 article, Leigh van Valen described this as the "Red Queen" hypothesis, where Alice and the Red Queen dance furiously but never go anywhere (Van Valen, 1973; Ridley, 1995). Following a different metaphor, Richard Dawkins and J. R. Krebs described these evolutionary processes as a kind of "arms race," where an arms build-up by one party entails a similar build-up by the opponent (Dawkins and Krebs, 1979). Where historical explanation is concerned, what is significant about the evolutionary arms-race is the way in which it describes a trend that seems to spiral off in wild new directions. This is an apt description for how historians have understood the

dramatic patterns of historical change in the wake of revolutions like the Neolithic Revolution, the Scientific Revolution, the French Revolution, and so on.

Coevolutionary relationships do not have to be antagonistic arms-races. Where human history is concerned, perhaps the most obvious example is offered by the agricultural transition starting some 10,000 years ago. It used to be thought that humans domesticated plants and animals, turning them to do their bidding and creating new breeds or strains in the process. Agriculture, however, is now understood as a process of mutual domestication, with all parties concerned acting as equal partners in a relationship that changed humans just as much as it changed plants and animals (e. g. Pollan, 2001).

Recently, the principle of coevolution has been extended to the niche itself, though in a sense this was always understood to be the case (Odling-Smee et al., 2003). Organisms are adapted to exploit not the entirety of an ecosystem but instead one particular corner, that is to say a niche. Thus, the genus *Homo* was adapted to exploit a foraging, scavenging, and hunting niche that came into being in the savannahs of East Africa with the onset of the drier conditions of the early Pleistocene around 2.6 million years ago. Niches have a number of interesting properties. Among them is the fact that there are only a limited number of solutions to the challenges inherent in exploiting a given niche. This constraint is what lies behind the principle of convergence, namely, the pattern whereby the phenotypes of plants and animals that inhabit similar niches can converge toward similar solutions (Conway Morris, 2003; Dawkins, 2004; Vermeij, 2006). Convergence explains why both the placental and marsupial lineages produced a saber-toothed cat with teeth designed to kill large prey through puncture wounds that cause them to bleed to death, and why the niche occupied by small mammalian insectivores, as found in both Madagascar and England, has produced two animals, the tenrec and the hedgehog, that are nearly identical in body plan and behavior despite being separated by tens of millions of years of evolutionary time.

Older models of Darwinian evolution imagined that organisms typically follow a step behind changes in their ecological niches. Thus, human evolution *followed* the pattern of climate change that made the East African savannahs. In a vivid recent example, elephants in certain parts of Africa are now increasingly likely to be born without tusks, a trait that probably developed in response to predation by human ivory hunters. The principle of niche construction, however, suggests that organisms do not simply lie passively within their niche. Instead, to greater or lesser degrees, they are continuously engaged in constructing their own niche. In her study of sheep-raising in colonial Mexico, the environmental historian Eleanor Melville described a process whereby the action of millions of tiny hoofs over a period of decades gradually

compacted the soil and removed texture, thus discouraging water retention and fundamentally changing an agrarian landscape to a landscape consisting of an eroded scrubland suitable only for pasture (Melville, 1994). In the same way that there is a coevolutionary dialogue between two organisms, so too is there a dialogue between an organism and its niche. This is, in fact, the best way to think about the Neolithic transition: as humans found ways to extract calories, power, fibers, and a range of secondary products from the plants and animals in their environment, they transformed the niche they occupied, but at the same time were transformed in response to the new niche.

In his seminal study, William Durham argued that genes and culture can get tangled up in a coevolutionary relationship (Durham, 1991). The habit of drinking fresh milk in a few early pastoral societies, to take the best known example, created a selection pressure that favored the retention into adulthood of the ability to digest milk sugar. As the necessary alleles spread in central Europe, Africa, and perhaps other milk-drinking areas, dietary patterns were changed. Selection pressures generated by cultural changes, in other words, can be felt in the genome, even over relatively short spans of time. Much the same pattern works for features of the brain and the nervous system, though in this case we are not necessarily dealing with genetic changes. The genotype builds neurons and neurons create synapses, and thus the basic architecture of the systems like the stress-response system and the reward system are sketched out by the genome. But epigenetic patterns and developmental experiences determine how these systems actually work in practice by creating, maintaining, and in some cases destroying receptors and synapses.

The epigenetic revolution allows us to abandon the idea that in the relationship between culture and the brain, one of the two must be sovereign. Pop sociobiology and certain fields of evolutionary psychology have insisted that cognitive modules, designed by natural selection, are sovereign in their ability to define behavioral traits. Anthropology and history, in contrast, have insisted that culture is sovereign. Yet despite the illusion of antagonism, these two stances are two sides of the same coin. They share the Hegelian supposition that biology and culture can be placed in an imaginary historical timeline where biology was in the past and culture in the present. Evolutionary psychologists and culturalists differ only on the issue of whether behavioral sovereignty has been handed off from biology to culture. The insights of epigenetics allow us to transcend this utterly sterile debate by treating the nervous system and culture as equal partners in an ongoing and never-ending coevolutionary relationship.

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To explore how this dialectical model might work in practice, let us consider the neurobiology of stress. As Robert Sapolsky, the leading figure in the study of stress, has pointed out, stress is good for you in limited doses (Sapolsky, 2004). It primes the system to respond quickly and efficiently to temporary or sudden challenges. Stress generates a number of adaptive responses in the body, ranging from dilated eyes and elevated heart rate to loss of appetite and sexual desire.

Chronic stress, by contrast, is clearly bad for you, and the effects of a chronic stress can begin to erode the ability of the nervous system to handle stress. For this reason, stress works well as a social or political tool. Among certain baboons, for example, dominant females systematically terrorize their subordinates to ensure unfettered access to resources, and one of the effects of stress is that the fertility of lower-ranking females is reduced or diverted toward the production of male offspring who will not compete with the offspring of dominant females. Stress, in other words, is a neurobiological correlate of social rank or position. The experience of stress also implicates the reward system. Consider, in this vein, an experiment involving mice, an animal that shares the stress-response system common to all mammals (Yap and Miczek, 2007; see Zimmer, 2010). If a mouse is handicapped in such a way as to be the loser in a series of fights with other mice, it enters a condition of stress marked by chronically high levels of stress hormones. The mouse loses initiative and becomes listless and compliant (Snyder et al., 2011). Mice who suffer repeated social defeat begin to self-medicate themselves with cocaine, a dopamine agonist, at a higher rate than other mice. Stress, finally, is heritable in an oddly Lamarckian way that has considerable implications for history. Experiments with rats conducted by Michael Meaney and his associates have shown that the maternal licking of pups leads to a greater density of stress receptors in the hippocampus, which in turn allows the young rats to handle stress more easily (Liu et al., 1997). If rat pups are not licked, their ability to handle stress is reduced; what is more, female rats who were not cared for as pups are less likely to lick their own offspring, leading to several generations in which a situation similar to chronic stress is transmitted epigenetically from mother to offspring.

As this rapid survey suggests, the stress-response system is one of many candidates for the dialectical model of neurohistory sketched out above. Because chronic stress can have social or political consequences, it is easy to imagine that human behavioral patterns have evolved, albeit unconsciously, in ways that allow powerful or dominant individuals or institutions to exploit the latent quality of chronic stress. The stress-response system, in other words, acts as a niche in which human patterns and institutions take shape. At the

same time, the stress-response system has a significant degree of plasticity—not in its structure, but in the way in which it works in given individuals. That plasticity can produce a pattern whereby stress can be an inherited feature of certain class or status groups, which may help explain a pattern that figures in the way that Marx and Gramsci sought to explain through ideas such as false consciousness and hegemony. Chronic stress cannot explain why peasants and workers (let alone the participants in the Arab Spring) have, on occasion, chosen to rebel against the systems that have oppressed them, but it might help explain why they have done so less often than the conditions of their abuse would have suggested. In the example of the mice that experience social defeat, note that the self-medication with a dopamine agonist, although seen as a symptom of defeat by the scientists who have conducted the studies, could just as well be seen as a symptom of resistance.

Let me now bring the neurobiology of stress to bear on patterns of violence in Europe during the later Middle Ages, the period that is the subject of much of my own research. Violence is interesting in part because violence can be stressful to the victims; arguably, this is one of the reasons that violence has proven to be so adaptive for humans, other primates, and other animals. Violence as a stress-delivery system works well if it inflicts non-lethal and humiliating violence on the bodies of others, or if it acts in a context of publicity that allows the message to be conveyed to a wider audience. Far from being irrational, in other words, violence is adaptive by virtue of the stress it induces. Surveying the primatological literature, for example, Randolph Roth has pointed out that the chronic stress to which lower-ranking male chimpanzees are often subjected lowers their testosterone level and discourages them from challenging the position of higher-ranking chimpanzees (Roth, 2011).

In the records from later medieval Europe, violence can take many different forms. One omnipresent form is the violence inflicted by one person on another. Some of this violence shows up in contests sparked by a sense of honor or justice; such fights often lead to bloodshed, insults, and threats. Other violent behaviors include spousal abuse, child-beating, or the abuse of servants and slaves. A second type is the violence that sovereign bodies, including lords, kings, and city-states, chose to inflict upon their subjects. This violence takes the form of public spectacles, such as humiliating punishments and public executions arising from crime, treason, witchcraft, and the like. Even more common if less spectacular are spectacles of private debt recovery supervised by the courts of law; these spectacles sometimes involved shaming rituals and also countless acts of highly publicized and potentially violent seizures of goods from the households of debtors (Smail, 2012).

Relatively uncommon before AD 1250 or 1300, state-on-subject violence begins to accelerate in the fourteenth and fifteenth centuries, and remains a significant feature of the European scene until the eighteenth century and beyond, when the flow of violence and stress in European states starts to take on new qualities. We can write this history in a conventional Weberian way. That is to say, we can argue that newly emerging states were seeking to develop a monopoly on the exercise of coercive force, and sought to criminalize illicit forms of person-on-person violence in the process. Violence, according to this argument, is permitted only in contexts like sports, where it is sanctioned by the state (Elias and Dunning, 1986). The history of violence has long been plotted as a history of declining rates of homicide and everyday acts of aggression, where the state and the civil or courtly institutions that it fosters play a major role in the "civilizing" of a violent instinct. This argument tends to assume that violence is a feature of humanity's evolved psychology. In the recent work of Steven Pinker, for example, violence, like a continental plate in a subduction zone, has largely disappeared underneath the weight of the Leviathan and the emergence of reason or self-control (Pinker, 2011). Like volcanoes or hot water springs, it might occasionally punch through the weight of the plate that lies atop it, but otherwise person-on-person violence has been largely repressed.

There is a lot to be said for this model, since it provides a relatively parsimonious explanation for what appears to have been a general per capita decline in death by violence in Western Europe and the United States. It certainly conforms to a folk reason according to which people in the largely ungoverned Middle Ages were violent and grew progressively less violent over the ensuing centuries. Once we look at violence using some of the perspectives of neuroscience, however, things begin to look a little different.

To begin with, let us consider the nature of testosterone. The history of violence has assumed a steady supply of testosterone. But supposing testosterone itself has been down-regulated in societies that have less violence? This is at least theoretically possible. Roth has already pointed out that stress might play a role in this, since stress can lead to the down-regulation of testosterone production in socially subordinate chimpanzees (Roth, 2011). Another study has shown that testosterone production is typically down-regulated in human males who engage in three or more hours of care-giving per day (Gettler et al., 2011). This process, which is described in the study as a life-cycle issue, is also a historical or cultural one, since the down-regulation of testosterone does not happen automatically with fatherhood. It depends, instead, on the prior existence of a family and work environment that allows or promotes regular contact with infants. The genotype certainly defines the parameters of testosterone production, and it may define a probability spectrum in the testosterone

phenotype of any given male, but the actual phenotype is determined in large part by developmental or epigenetic circumstances and by cultural patterns. To put this differently, it is uninteresting to say that males are predisposed to violence if the neurobiological hardware for violence is shaped to a large degree by cultural or historical circumstances.

What this emerging literature suggests is that we ought to look for the decline of violence not just in the rise of state-level policing and crime control but also in other institutional factors, including patterns of chronic stress or social defeat and, perhaps more positively, in transformations in family forms and work patterns that have encouraged greater paternal care-giving. Other potential factors may well come to light, and we can look to see whether they have any historical correlates.

How, then, might we reinterpret the history of violence in later medieval and early modern Europe through the perspectives of the neurobiology of stress? As noted above, we have a strong inclination to contrast person-on-person violence with state-on-person violence, and to assume that the latter emerged only for the purpose of restraining the former. But we can think of this process without the assumption that states are benevolent. In light of the neurobiology of stress, it is possible to think of states as organizations that have an interest in controlling the circulation of stress in society. States criminalized illicit violence, in this view, not for the stated purposes of preventing the sinful or uncivil shedding of blood, but instead to develop a monopoly on the production and distribution of stress in European society. Person-on-person violence, in this model, was interpreted by the new authority figures as an illicit "stress transaction" that needed to be repressed or taxed via criminal fines. These stress transactions, in other words, were not criminalized because states had an interest in eliminating violence and stress. Far from it: this is exactly the period during which states were perfecting their own systems for delivering stress, in the form of pillories, shaming rituals, public spectacles, and, as I have argued elsewhere, the institutional shaming and humiliation of debtors (Smail, 2012). Where debt is concerned, the stress transaction still involves two individuals, a creditor and a debtor, but state sovereignty arises from the fact that the transaction necessarily flowed through the civil courts, a medium controlled by the state. The state profited monetarily from the transaction, and also benefited from the monopoly it was developing on the flow of stress in human societies.

Writing about the dialectical process, Hegel supposed that every thesis generated its own antithesis. In this case, it is possible to imagine the antithesis to an emerging state desire to develop a monopoly on the circulation of stress in European society. In our analyses of violence, we tend to sympathize with

the victims, and lose sight of the fact that violence is a major element of the tournament of prestige where the humiliations inflicted on the losers are counter-balanced by the pleasures and satisfactions experienced by the winners. State-level restrictions on person-on-person violence motivated by concerns for honor and justice, thus, arguably reduced a significant source of pleasure and self-satisfaction. In this light, one of the most striking features of early modern and modern Europe has been the development of a significant array of new dopamine agonists, ranging from psychopharmacological substances to cultural practices such as theater, music, and consumption. Modern global capitalism, in a sense, can be seen as an enormous dopamine-delivery system. It may be plausible to suggest that when state-level restrictions reduced the prevalence of violence-based tournaments of prestige, citizen-subjects found new sources of reward, and shifted their tournaments of prestige into the realm of competitive consumption and taste.

This, of course, is a vague and insubstantial set of arguments. The value of this sketch, if any, lies in its potential to suggest new research questions. Rather than a vision based on the civilization of manners and the decline of violence, this neurohistorical perspective suggests a transformation in the ways in which prestige and stress were and are transacted in European societies. Historians generally like to advance grand narrative structures, such as "the birth of Western Civilization," "the rise of the state," "the creation of patriarchy," or "the decline of violence." These narratives are neither true nor false; they are useful only because they help to organize historical work. With any given narrative, you are either for it or against it, and that choice determines how you, as a historian, approach your teaching and your research. The complex history of stress, when viewed from a deep historical perspective, is at least as interesting as any of the usual narratives. Like any deep historical narrative (and unlike conventional historical narratives), the dialectical history of stress does not have a beginning or an end. Put differently, it is not a history defined by the *telos*—civilization; the state; the patriarchal condition; a peaceful utopia—toward which it is heading. In *1984*, George Orwell hinted at just such a *telos*, where history ends with a system of government that has perfected a pattern of governance based on the exploitation of the stress-response system (Orwell, 1949). Perhaps it is too optimistic to say that this cannot happen, but for now, we can proceed from the assumption that the future is probably not so grim.

BIBLIOGRAPHY

BLACKBOURN, D. (2006), *The Conquest of Nature: Water, Landscape and the Making of Modern Germany,* London, Jonathan Cape.

BUCKLE, H. T. (1857-61), *History of Civilization in England*, 2 vols., London, J. W. Parker and Son.

BYRNE, R. W., WHITEN, A. (eds.) (1988), *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans*, New York, Oxford University Press.

CAREY, N. (2012), *The Epigenetics Revolution: How Modern Biology Is Rewriting Our Understanding of Genetics, Disease, and Inheritance*, New York, Columbia University Press.

COCHRAN, G., HARPENDING, H. (2009), *The 10,000 Year Explosion: How Civilization Accelerated Human Evolution,* New York, Basic Books.

CONWAY MORRIS, S. (2003), *Life's Solution: Inevitable Humans in a Lonely Universe*, Cambridge, Cambridge University Press.

DAWKINS, R., KREBS, J. R. (1979), "Arms races between and within species". *Proceedings of the Royal Society of London, Series B, Biological Sciences*, 205, pp. 489-511.

DAWKINS, R. (2004), *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution*, Boston, Houghton Mifflin.

DIAMOND, J. M. (1997), *Guns, Germs, and Steel: The Fates of Human Societies*, New York, W. W. Norton.

DIAMOND, J. M. (2005), *Collapse: How Societies Choose to Fail or Succeed*, New York, Viking.

DUNBAR, R. I. M. (1996), *Grooming, Gossip and the Evolution of Language*, London, Faber and Faber.

DURHAM, W. H. (1991), *Coevolution: Genes, Culture, and Human Diversity*, Stanford, Stanford University Press.

EDELMAN, G. M. (1987), *Neural Darwinism: The Theory of Neuronal Group Selection*, New York, Basic Books.

ELIAS, N., DUNNING, Eric (1986), *Quest for Excitement: Sport and Leisure in the Civilizing Process,* Oxford, Blackwell.

FAGAN, B. M. (1999), *Floods, Famines, and Emperors: El Niño and the Fate of Civilizations*, New York, Basic Books.

FRANCIS, R. C. (2011), *Epigenetics: The Ultimate Mystery of Inheritance*, New York, Norton.

GETTLER, L. T., et al. (2011), "Longitudinal evidence that fatherhood decreases testosterone in human males". *Proceedings of the National Academy of Science*, 108 (39), pp. 16,194-16,199, doi: 10.1073/pnas.1105403108.

GOLEMAN, D. (2006), *Social Intelligence: The New Science of Human Relationships*, New York, Bantam Books.

HERLINGHAUS, H. (2010), "From transatlantic histories of 'intoxication' to a hemispheric 'war on affect': paradoxes unbound". *In* M. Bailar (ed.), *Emerging Disciplines: Shaping New Fields of Scholarly Inquiry in and beyond the Humanities*, http://cnx.org/content/m34250/1.4/

HRDY, S. B. (2004), "Evolutionary context of human development: the cooperative breeding model". *In* C. S. Carter and L. Ahnert (eds.) *Attachment and Bonding: A New Synthesis*, Dahlem Workshop No. 92, Cambridge, MIT Press, pp. 9-32.

HRDY, S. B. (2009), *Mothers and Others: The Evolutionary Origins of Mutual Understanding,* Cambridge, Mass., Harvard University Press.

KENNEALLY, C. (2011), "Goodbye, genetic blueprint. What the new field of epigenetics reveals about how dna really works," http://www.slate.com/articles/arts/books/2011/06/goodbye_genetic_blueprint.html

LARSEN, C. S. (1999), *Bioarchaeology: Interpreting Behavior from the Human Skeleton*, Cambridge, Cambridge University Press.

LIU, D., et al. (1997), "Maternal care, hippocampal glucocorticoid receptors, and hypothalamic-pituitary-adrenal responses to stress". *Science* 277, (5332), pp. 1659-1662.

MELVILLE, E. G. K. (1994), *A Plague of Sheep: Environmental Consequences of the Conquest of Mexico*, Cambridge, Cambridge University Press.

NIETZSCHE, F. W. (1957 [1874]), *The Use and Abuse of History*, trans. Adrian Collins, Indianapolis, Bobbs-Merrill.

ODLING-SMEE, F. J., LALAND, K., FELDMAN, M. W. (2003), *Niche Construction: The Neglected Process in Evolution,* Princeton, NJ, Princeton University Press.

ORWELL, G. (1983 [1949]), *Nineteen Eighty-Four*, New York, Harcourt Brace Jovanovich.

PATEL, A. D. (2008), *Music, Language, and the Brain*, Oxford, Oxford University Press.

PINKER, S. (2011), *The Better Angels of Our Nature: Why Violence Has Declined*, New York, Viking.

POLLAN, M. (2001), *The Botany of Desire: A Plant's Eye View of the World*, New York, Random House.

RIDLEY, M. (1995), *The Red Queen: Sex and the Evolution of Human Nature*, New York, Macmillan.

ROTH, R. (2011), "Biology and the deep history of homicide". *British Journal of Criminology*, 51, pp. 535-555, doi:10.1093/bjc/azr029.

SAPOLSKY, R. M. (2004), *Why Zebras Don't Get Ulcers*, 3rd ed. New York, Times Books.

SMAIL, D. L. (2012), "Violence and predation in late medieval Mediterranean Europe". *Comparative Studies in Society and History*, 54, pp. 1-28.

SNYDER, J. S., et al. (2011), "Adult hippocampal neurogenesis buffers stress responses and depressive behaviour". *Nature*, 476, pp. 458-461.

TRAUTMANN, T. , (2011), "Deep kinship". *In* A. Shryock and D. L. Smail (eds.), *Deep History: The Architecture of Past and Present*, Berkeley, University of California Press, pp. 160-188.

VAN VALEN, L. (1973), "A new evolutionary law". *Evolutionary Theory*, 1, pp. 1-30.

VERMEIJ, G. J. (2006), "Historical contingency and the purported uniqueness of evolutionary innovations". *Publications of the National Academy of Sciences*, 103, pp. 1804-1809.

WHITEHOUSE, H., MARTIN L. H. (eds.) (2004), *Theorizing Religions Past: Archaeology, History, and Cognition*, Walnut Creek, Cal., AltaMira Press.

WRANGHAM, R. W. (1996), *Demonic Males: Apes and the Origins of Human Violence*, Boston, Houghton Mifflin.

YAP, J. J., YAP, K., MICZEK, A. (2007), "Social defeat stress**,** sensitization, and intravenous cocaine self-administration in mice". *Psychopharmacology*, 192, pp. 261-273.

ZIMMER, C. (2010), "The brain: the switches that can turn mental illness on and off". *Discover*, 31, pp. 26-27.

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SMAIL, D. L. (2012), "Neuroscience and the dialectics of history".
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