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Rachel Carson Center for Environment and Society
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Kirsten Brukamp

Neurohistory: Being in Time

What is neurohistory?—The ambitious endeavors suggested by the novel term possess the potential to result in unexpected perspectives on both history and neuroscience. Neurohistory projects fall into one of three categories.

Focus on history: Neurohistory may first be history informed by neuroscience. Accordingly, neuroscience is here understood as a support for achieving historical understanding: historical events and processes are assessed in light of insights from neuroscience.

Examples for projects in this field comprise all those that would benefit from a deeper understanding of individual actions, collective intentions, and social behaviors—that is, goals that may be reached with psychology as well as social and cultural neuroscience (Adolphs 2009; Rizzolatti and Sinigaglia 2010; Martinez Mateo et al. 2011). In particular, research can unearth new perspectives on gender differences, personal factors in history, conflicts, conflict resolution, hierarchy, and power structures. In select cases, the behavior of influential individuals may be explained by disorders of the nervous system (Toole 1995). For prehistory, comparative biology and neuroscience could identify distinct stages of behavior and culture in the evolution of human ancestors (Stout et al. 2011). Moreover, insights from cognitive science could reveal more specifics about how spirituality and religious convictions have influenced history.

This first approach to neurohistory includes the history of neuroscience as a topic, containing the history of the study of the central and peripheral nervous system in neuroanatomy and neurophysiology, as well as the history of neuromedicine with its disciplines neurology, neurosurgery, and psychiatry.

Focus on neuroscience: Second, neurohistory comprises neuroscience informed by history, where history is understood as an aid to neuroscience. It deals with the history of the nervous system, either as a *collective* history through the millennia or as a *personal* history during the development of an individual. Both routes may focus on a *narrow* subject, or they may be regarded as a *broad*, interactive field.

Approaching the topic with a narrow focus, collective histories of the nervous system are concerned with the evolution (i.e. the phylogenetic history) of the nervous system up to the human brain. While this may be called classic phylogeny, a wider perspective takes into consideration the mutual influences between organism and environment: brain functions have always been shaped by the already existent human cultures. Coevolution therefore looks at the impact of the human, cultural environment on genetic material in evolutionary history.

Investigating individual histories of the central and peripheral system includes classic ontogeny, which studies the development *in utero* and as a child, as well as the changes towards the end of our lives during senescence. Transcending this narrow understanding, neurohistory also considers the correlation between brain functions and individual experiences, such as the representation of individual memories from one's personal life in the brain, for example through neuroplasticity. This is the traditional realm of developmental, biological, and clinical psychology, depending on when and in which contexts the shaping of memories takes place.

Fundamentals of neurohistory: Third, the term neurohistory points to the fundamental realities that lie at the basis of both history and neuroscience: anthropology and the philosophy of time and world history. The reflection about humanity is an element that is inherent to both disciplines.

Humans are beings existing in time and in the world, and they experience themselves as distinct and special in both regards. As creatures constituted not least by their nervous system, they construct both world history and their own personal history through narration. They find facts and artifacts in the world, put them into causal contexts, and shape their interpretations by telling stories. The prefix "neuro" in neurohistory means, at first sight, everything related to the nervous system in all animals. Nevertheless, in accordance with the philosophical perspectives of neurohistory, humans frequently are primarily interested in those compartments of the brain that likely form the material basis for higher cognitive functions. Thinking about the philosophy of time and reflecting on the state of humanity in the world provides a basis for history, neuroscience, and neurohistory alike.

In the following, a sketch of three examples illustrates the potential of neurohistorical approaches for the advancement of knowledge in different fields. In all cases, the results are intriguing for both neuroscience and history.

Contemporary functional brain imaging has been employed to demonstrate evidence for the *relevance of the motor resonance system in prehistoric learning*. In one study, three subject groups—namely technologically naïve, trained, and expert individuals—were exposed to video clips of two types of prehistoric toolmaking techniques, which differed in complexity according to their earlier or later appearance in the archaeological record (Stout et al. 2011). On the basis of modern insights into the functioning of mirror systems for motor behavior (Rizzolatti and Sinigaglia 2010), the authors concluded that the relatively younger method of toolmaking involved more extensive resonance systems in the study. In particular, the later toolmaking method activated brain areas that nowadays aid in achieving immediate action goals.

Consequently, resonance systems may be regarded as valuable elements for the foundation of human culture. Study results (Stout et al. 2011) are inconclusive as to whether humans developed new brain regions that allowed novel toolmaking or utilized the plasticity of already existent brain morphology to acquire additional skills. The conclusions of this investigation certainly rely heavily on presuppositions about the overall stability of both brain morphology and function. Nevertheless, with this approach, the researchers were able to catch a glimpse at a plausible reconstruction of the workings of *homo* species brains from deep history millions of years ago, even though the remains of these early humans have long vanished almost entirely from this earth.

Human cognitive aptitudes are adaptive and versatile, and this flexibility is rooted in a plethora of separate and partially overlapping systems and functions in the nervous system. Subsequently, a theoretical *analysis of cognitive deficits* in humans, and humans of the past in particular, can provide insights into higher brain capacities. Otherwise, these deficits, be it in behavior, perception, emotion, and thought, cannot be investigated because the results of animal studies are not to be applied unconditionally to humans, while experiments with human subjects are unacceptable because of moral concerns. Since instances of partial brain disorders are rare, scholars have scrutinized historical evidence on the basis of contemporary knowledge to reveal how prominent individuals may have been affected, an exploration that then allows novel interpretations of their historical actions and effects (Toole 1995).

The brain is usually regarded as merely a single organ among others that constitute a full human subject. In an alternative perspective, the brain itself may be regarded as

an agent, an organ with needs of its own. Here, the basic neurobiological properties of the brain come into play: biological evolution and cultural coevolution have molded the brain, and in turn, emergent features of the brain have shaped the environment and influenced history in very specific ways (Smail 2008). For example, the craving for sugary foods, likely due to the role of handy carbohydrates as an energy source for the brain, has resulted in special markets and economies with characteristic food products over the millennia. This was not only associated with weighty effects on economics, agriculture, and food production, but also on health and well-being, due to aftereffects such as the emergence of dental caries (i.e. tooth decay), obesity, and diabetes. Likewise, the modern entertainment industry relies partly on the inherent interest of humans in moving images, arousing sensations, and engaging stories. Again, this phenomenon has economic and health effects as well as social and political sequelae, because the involvement with media entertainment leads to a tendency to disengage from interaction on the personal level.

These examples provide just a sketch of the vast possibilities that research questions in neurohistory have to offer, as the history of neurohistory has not yet been written.

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