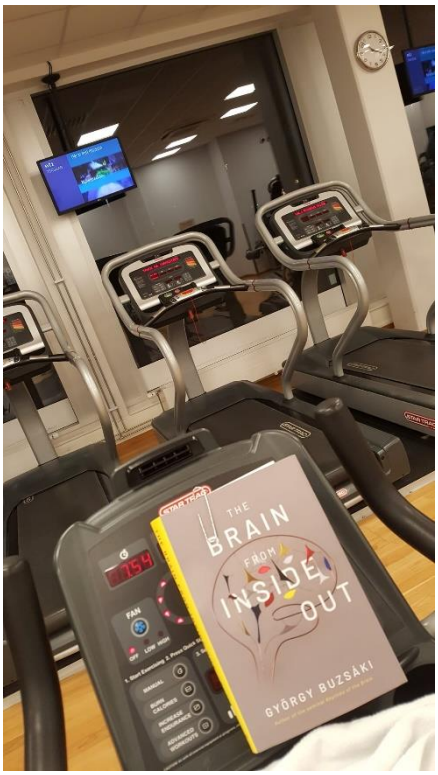
Book review: Inside or outside? That's the question. A look at the book "The Brain from Inside Out" by György Buzsáki



Move it. Change requires movement. Living memories require fluid learning with flexible automation. Life is movement - changes in space-time. Consciousness is an interacting function: a free energy principle. Energy, matter, time and space... Neuroanatomical correlates become increasingly minimalist. "Matter" in the quantum physical world is a microcosm of quarks and leptons - energies in a void, inane, in constant motion. But in order for the theory of science and the discussion of atomic motion, molecular motion and microbiological motion not to veer wildly into "quantum psychology" and neo-vitalism, it is probably necessary to build a little diligence into the speculations.

Consciousness is seen as a process - a sense of presence in time and in relation to something and someone. We know that children learn language by socialising more than by listening to the exact same vocal sounds on video. We know that children generally learn about living things much faster than they do about inanimate, stationary, stiff things - and we know that children remember these things much longer and better. Still things can be boring. And if the stagnant things don't interact, they're even more boring. Knowledge can be inconspicuous. And slow. But it is never stagnant. I move, therefore I am. I dance my life. At least to the extent that my stiff joints can move me... - but perhaps this is also how our neural networks shape our sense of time: there must be movement - differences in the basic neural settings of the brain.

In his book The Brain from Inside Out, György Buzsáki discusses how higher cognitive functions and consciousness do not arise in an isolated vacuum inside an isolated brain, but in interaction with neurophysiological activity - and thus an experience of time. He discusses alternatives to both inherited systems and tabula rasa - the blank slate models. These aspects in terms of movement and change, where all living beings have a body with a physiological and electrobiological evolutionary development. Buzsáki, being the scientist he is, takes very cautious theoretical steps about the complicated electrophysiology of the brain, which he discusses in detail. For me, this is

brilliant and opens up many new possibilities for how the biochemical action potential might eventually interact with parallel electromagnetic systems between individual neurons - a neural 69.

Buzsáki sets the neuroscientific framework in a neurophilosophical and historical context, from classical Greek natural philosophy with Plato, Aristotle, through the Middle Ages and Thomas Aquinas, Enlightenment rationalists like Rène Descartes and empiricists like John Locke, to modern times with Hume and Kant as precursors and influencers, to emerging German empiricism and modern neurophysiology with Donald Hebb & Co at the forefront. For those who want to read further, there is Matthew Cobb's fine book "The Idea of the Brain" (2020). Buzsáki's text is also particularly interesting because he is pragmatically unafraid to walk in the grey areas between continental and analytic philosophy - which is really liberating: for me, watertight boundaries between theories often seem paralysing to free thinking. But it's not an accessible book; sometimes it's like reading scientific research articles, but here freed from references, which makes the reading a little more digestible.

A digression. Or perhaps two digressions... Do you know when you're avoiding something? Perhaps experiences of fear, disgust and anger are within conscious reach, ... but are you aware of subtle freezing reactions? Like suddenly stopping? Or when, in an everyday situation, you suddenly freeze in silence for a brief moment ... what is that? Or reflexively avoiding something in the city? The HOT model, developed by Joseph LeDoux and colleagues, is a neuropsychological model of higher cognitive function. It argues that humans have two main facets for processing perceptions. Both are effective survival mechanisms: a) a fast one, sometimes called "amygdala hijacking", and b) a slow one, where perceptions take different "detours" (where and what) and via different parts of the prefrontal lobes, most studied are dlPFC, vmPFC and OFC and its network with the limbic system, amygdala and hippocampus.

Both aspects are cerebral, subcortical and interoceptive. Thus the type: body-mind. The fast ones are between 20-200 milliseconds, sometimes shorter, and the 'slow' ones are over 200 ms (i.e. a little over a fifth of a second; 1/5 s). We have reasonably conscious control over the slow where and what systems, and then, according to Lisa Feldman Barrett & Co (LFB), we construct what she calls "emotional constructs", i.e. subjective experiences: we think, plan and "feel" - and we worry, hate, get angry and long. And, to borrow from nineteenth-century philosophy with Immanuel Kant and neurophysiology with Herman von Helmholtz, these subjective cognitive interpretations of our perceptions actually have little or nothing to do with reality. The only way to understand whether a stick through the surface of water is not broken (because of the optical illusion) is to move it. And cognitions, Buzsáki argues, are nothing more than internalised actions, and the increasingly conscious, dialogue-driven brain gradually observes its own cognitions - an argument that is a clear flirtation with Lev Vygotsky and, perhaps an influence, his compatriot Nobel laureate Albert Szent-Györgyi.

No, cognitions are actually entirely in our own predictive meta-psychological imagination - thoughts about thoughts - and in combination with retentions of old episodic memories (where and what) and semantic cultural beliefs. But to become meaningful, these need to be activated and sorted by a central executive that simultaneously inhibits a lot of preconceived rubbish. This is somewhat reminiscent of Kahneman's cognitive model: Thinking Fast and Slow. And if

we're talking about interoception, there are some other interesting parallels with how the peripheral action potential also works by adapting and inhibiting the fast and slow peripheral sensory receptors (tonic and phasic). And how the brain works with proprioceptive biofeedback systems in the muscle coils, i.e. our muscle and body senses as a direct with relatively slow interoceptive non-myelinated neurons to consciousness processes in the insula and anterior cingulate (read Bud Craig if you want to delve deeper into this).

According to Buzsáki, the brain is a self-organising system whose main task is to predict meaningful activities for survival. Although he does not completely reject the old reactive learning paradigm (US-CS; etc), he notes that the brain is not primarily a reactive device, but a predictive one. In self-adapting algorithmic mechanisms (with predictive errors) it is a kind of search engine, which in a psychologising context might be called "curiosity" - which is a fundamental survival mechanism. As a psychotherapist, you look at when, where and how a patient's positive curiosity is triggered ("motivation").

Buzsáki, like LFB, describes the brain as a predictive device that interacts with the environment to guide our decisions in the future. The hypothesis is that our brains are born with a myriad of nonsense patterns, and by synchronising these nonsense patterns into cognitive or motor activities, they are shaped into meaningful learning. This is a challenge to the traditional neuroscientific way of explaining cognitive processes, and it is here that he gets his due from Nobel laureates John O'Keefe for his discovery of place cells in 1971, and Moser and Moser for their hexagonal grid cells documented in the early 2000s. This, as we know, has a direct bearing on spatial orientation and the organisation of short-term memory and its transcription into LTM. The previous distinction between different research traditions, such as between spatial and experiential research, can no longer be kept apart: time and space are basically the same energy and follow the same motion and the same basic principles. The old simplified Newtonian model of space as a box and motion as an arrow no longer holds.

Neural Networks

Is time perception just an illusion, relative to our perceived internal and external motion? Perhaps it is enough to think about a boring memory to realise this? Or that time perception varies with age and experience.... Buzsáki presents preliminary findings suggesting that hippocampal place and grid cells may have multiple sets of modalities that can also be understood simultaneously as "time cells" and thus encode memories as "memory cells" based on three aspects: distance, duration and the "what system". He discusses how the distinction between place cells and time cells is actually irrelevant to the thinking brain, instead it is "how downstream reader mechanisms classify hippocampal messages". He sees the hippocampus as a general-purpose generator, encoding, sequencing and thus structuring the limited amount of ordinal-scale information available, heuristically covering the spaces between the various events that need to be ordered to provide a comprehensible context - albeit sometimes completely contrived: compare how we try to make sense of various optical illusions. The hippocampus, in this context, is a repetitive apparatus, blindly doing the same thing over and over again to be encoded by frontal mechanisms. Both the fast and slow aspects of perception are, according to Buzsáki, at least as I understand his text, likely predictions of what is about to happen. In this model, the brain works with computations similar to Bayesian inference, which in a nutshell means that simulated outcome values from a past distribution provide support for calculating a new, unobserved future distribution. Our neurobiology

seeks to understand and predict even when the unexpected occurs. And it is doing so with increasing practical relevance and precision. A common example, also used by Gerd Gigerenzer for heuristic principles, is that when we try to catch a ball, we have to use simple heuristic predictions that do not get in the way - otherwise we would never catch the ball. When we don't understand something - when something is incomprehensible - there is a neural mismatch, a "prediction error", which is either generalised, whitewashed, cleared away, or quickly adjusted with new learning to improve understanding in the future, and again: prepare and automate; like daring to cross the road. Or even daring to chew an apple. Or, as with higher cognitive functions such as semiotic language comprehension, we interpret the sound image (syntax and prosody) in an automated context. The sound image then becomes comprehensible: we think we understand what people mean even before the sound image is complete. If we had to think about each sound, each syllable, we wouldn't understand much.

The brain is a myriad of parallel and interacting neural networks, making a staggering number of predictions every second, at different biological levels such as atomic, molecular and neural correlates. Neuroanatomically, it has been estimated that there are about 150,000 separate columns, distributed throughout the cortex - all with roughly the same global structural make-up, but with apparently very different tasks.

When our cognitive, sensory and motor systems reach the limits of their capacity, i.e. when they approach overload with excessive demands and acute stress reactions, there are three classic, familiar patterns of behaviour: avoidance, freezing and attack. Equally classic is the catalogue of primitive problem solving.

But things that are completely new and unfamiliar are also much harder to learn - there are no predispositions - there is nothing to match the experience. The brain still has to make a best guess. They are not neurobiologically automated. This is also a typical neuropsychiatric problem. The question is whether curiosity and approach or suspicion, fear, anxiety and avoidance dominate... and which parts of these components can be influenced by, for example, psychotherapy or drugs.

Perhaps the automated processes require methods based primarily on classical and operant conditioning? But what about the subjective experiences that are conscious processes and over which we have control - are we victims of our emotions? - Are they something that should perhaps be changed by methods other than mere exposure? Or is it all the same - but as always from the same old classical perspectives? Plato versus Kant? Body-mind and dualism haunt the wings as always... What is the role of our consciousness? What does it mean that a memory is updated and refreshed by new impressions? That memories come from within, as if from some genuine, essential, transcendent response to our "true self", is perhaps no more than an illusion?

But then the inner core of what is meant by life has to be defined, which has proved to be more than difficult. What is life? And an "inner" life? Even worse, what is an authentic life? An authentic self? How true are you? Can you be true to your feelings? If so, are emotions something separate from higher cognitive functions?

The fast aspect is at an unconscious level: neurobiological, molecular and electromagnetic; we 'reflexively' jump away from the honking car, or freeze at something unpleasant, or hit with our hand in self-defence. So it is easy to see that this avoiding and freezing is a very different cognitive process from refusing to go into the woods because there might be snakes; or refusing to go to school because there are bullies, or stalking, or persecuting an ethnic group of people. The distinction has been around since William James and Carl Lange hypothesised it at the turn of the last century, but it's only now, in the '00s, that we're starting to get reasonably good neuroscientific explanations. But we're probably not even halfway there. More research is needed.

But the brain does not sit in some isolated bird's nest behind the eyes, but is a socially and interoceptively interacting organ that allostatically strives to create optimal conditions for survival, with social cooperation at its highest. Is neuroscience on the verge of a paradigm shift? Are the labs revolting, moving from reactive explanatory models to predictive models of consciousness? The previous black-box model of the brain reacting to the environment is being turned on its head. Instead, it seems that the brain works with prepared systems and is an active participant in probability calculations and best guesses about what is to come. Compare this with Seligman's concept of "learned helplessness" and his critique of the traditional learning paradigm. And compare it with Aaron Beck's concept of 'negative automatic thoughts'. The lines of demarcation lie on several levels, first and foremost empirically, with an increasing number of scientific discoveries that are incompatible with either dualistic models or static random distributions. An important branch is the neuro-philosophical critique of all the anomalies in earlier emotion psychology with the old ideas that emotions are essential basic categories with the well-known models of "basic" emotions and bottom-up models and/or dualistic proponents such as Plato and Descartes, but also in modern times, where Darwin, Ekman and Tomkins just built on these conservative models. Continuing proponents today can be said to be Panksepp and Adolphs - and to some extent Solms, although he argues from a neuropsychoanalytic perspective, he still discusses both the Beayan inference and Karl Friston's free energy principle.

This is really exciting research. And György Buzsáki's lab in New York is one of the spearheads.

In short: a very, very, nice read!

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