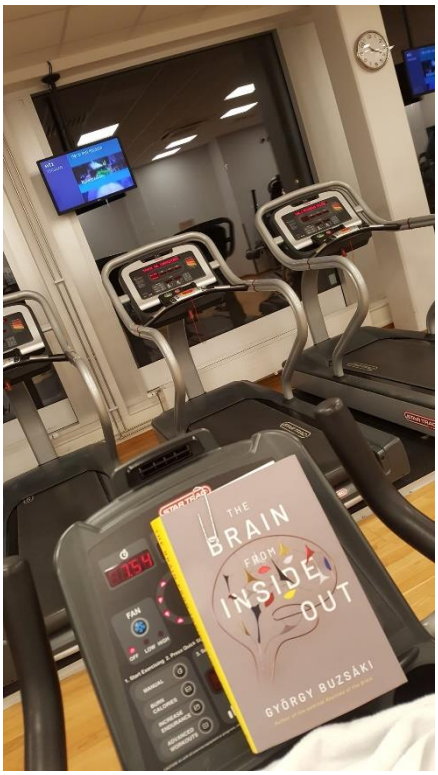
Book review: Inside or outside? That's the question. A look at the book "The Brain from Inside Out" by György Buzsáki



Move it. Change requires movement. Living memories require fluid learning with flexible automation. Life is movement. Consciousness is an interacting function: *a free energy principle*. Energy, matter, time and space... The neuroanatomical correlates are becoming increasingly minimalistic. "Matter" in the quantum physical world is a microcosm of quarks and leptons - energies in a void, inane, in constant motion. But for the theory of science and the discussion of atomic motion, molecular motion, and microbiological motion not to run wildly into "quantum psychology" and neo-vitalism, one probably needs to have a bit of diligence built into the speculations.

Consciousness is considered to be in relation to something or someone. We know that children learn language more by socializing than by just listening to the exact same vocal sounds via a video. We know that children in general learn about living creatures much faster than they do about inanimate stationary stiff things - we also know that children remember this much longer and better. Stagnant things could be boring. And if the stagnant things don't have any interactions, they are even more boring. Knowledge can be low-key. And slow. But is never stagnant. I move, therefore I am. I dance my life. At least to the extent that my stiff joints can move me around….

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 movements. 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 creatures have a body with a physiological and electrobiological evolutionary development. Buzsáki, as the scientist he is, takes theoretically very cautious steps about the intricate electrophysiology of the brain, which he discusses in detail. For me, this is brilliant, and raises lots of new possible inputs how the biochemical action potential could eventually interact with parallel electromagnetic systems between individual neurons – a neural 69.

Buzsáki sets the neuroscientific framework in a neurophilosophical and historical context starting 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, and up to modern times with Hume and Kant as antecedents and influencers to the emerging German empiricism and to modern neurophysiology with Donald Hebb & Co at the forefront. Anyone who wants to read further can read Matthew Cobb's fine book "The Idea of the Brain" (2020). Buzsáki's text is also particularly interesting as he pragmatically is not afraid to walk in the grey areas between continental and analytic philosophy - which is really liberating: for me, watertight boundaries between theories often seem paralyzing to free thinking. But it's not an accessible book; sometimes it's like reading scientific research articles, but here freed from references, making the reading a little more digestible.

An aside. Or maybe, two digressions... Do you know when you're avoiding something? Possibly experiences of fear, disgust and anger are within conscious reach, ... but are you aware of subtle freeze-reactions? Like sudden stoppings? Or when, silently in an everyday situation, you suddenly freeze for a brief moment ... what is that? Or reflexively avoiding something down town? The HOT-model, developed by Joseph LeDoux and colleagues, is a neuropsychological model of higher cognitive functions. He argues that humans have two main facets for processing perceptions. Both are effective survival mechanisms: a) a fast, sometimes called "amygdala-hijack", 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, type: body-mind. The fast ones are between 20-200 milliseconds, sometimes shorter, and the "slow" ones are over 200 ms (i.e.: just over one-fifth of a second; 1/5 s). We have a reasonably conscious control over the slow where-and-what systems, and we then construct, according to Lisa Feldman Barrett & Co (LFB) for example, what she calls "emotional constructs", i.e. subjective experiences: we think, plan and "feel" - and we worry, hate, get angry and yearn. And speaking 19th-century-philosophy with Immanuel Kant, and neurophysiology with Herman von Helmholtz, these subjective cognitive interpretations of our perceptions actually have quite little, or nothing at all, to do with reality. The only way to understand if a stick trough the surface of water is not broken (because of the optical illusion) is to move it. And cognitions, according to Buzsáki, are nothing more than internalized action, 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 influencer, his compatriot Nobel Prize laureate Albert Szent-Györgyi.

No, cognitions are actually entirely in our own predictive metapsychological imagination - thoughts about thoughts - and in combo with retentions of old episodic memories (where and what) and semantic cultural beliefs. But to become meaningful, these must be activated and sorted by a central executive, which simultaneously inhibits a lot of preconceived garbage. This is somewhat reminiscent of Kahneman's cognitive model: 'Thinking Fast and Slow'. And if we're talking interoception, there are some other interesting parallels 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 more into this).

According to Buzsáki, the brain is a self-organizing system, and its main task is to predict meaningful activities for survival. Although he does not completely dismiss the old reactive learning paradigm (US-CS; etc), he wants to open Pandura's black box, and he happily notes that the brain not primarily is a reactive device, but on predictive one. In self-adjusting algorithmic mechanisms (involving predictive errors) it is a kind of search engine that in a psychologizing context might be called "curiosity" – which is a fundamental survival mechanism. As a psychotherapist, you look 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 control our decisions ahead. The hypothesis is that our brain is born with a myriad of nonsense patterns, and by synchronizing these nonsense patterns into cognitive or motor activities, they shape for meaningful learnings. This is challenging to the traditional neuroscientific way of explaining cognitive processes, and here he gets proper traction from Nobel laureates John O'Keefe for his 1971 discovery of place cells and Moser and Moser for their hexagon grid cells documented in the early 2000s. This, as we know, has a direct bearing on spatial orientation and short-term memory organization and transcriptions into LTM. The previous distinction between different research traditions such as between spatial research and experiential research can no longer be kept apart: time and space are basically the very 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.

Is time perception just an illusion that is relative to our perceived inner and outer movement? Perhaps it is enough to ponder some boring memory to realize this? Or that time perception varies between different ages and different experiences…. Buzsáki presents preliminary findings indicating that hippocampal place and grid cells may have multiple sets of modalities that simultaneously can be understood even as “time cells” and thus encode memories as "memory cells" based on three aspects: distance, duration and the "what system". He discuss 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 that encodes, sequence, and thus structures the available limited amount of ordinal-scale information that heuristically covers the spaces between the various events that need to be ordered to provide a comprehensible context - albeit sometimes entirely contrived: compare how we try to make sense of various optical illusions. The hippocampus in this context is a repetitive apparatus that blindly performs 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, anyway as I understand his text, likely predictions of what is about to happen. In this model, the brain works with calculations resembling the so-called Bayesian inference, which in short means that simulated outcome values from a previous distribution provide support to calculate a new unobserved future distribution. Our neurobiology tries to understand and predict even when the unexpected occurs. And this with

increasing practical relevance and precision. A common example, also used for heuristic principles by Gerd Gigerenzer, is that when we try to catch a ball, we need to apply 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 "predictive error", which is either generalized, whitewashed, cleared away, or quickly adjusted with new learning to thereby improve understanding in the future, and again: prepare and automate; like daring to cross the road. Or even daring to chew on an apple. Or as with higher cognitive functions such as semiotic language comprehension, we interpret the sound picture (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 were to think about every single sound, every syllable, we wouldn't understand much. Or imagine that we comprehend.

The brain is a myriad of parallel and interacting neural networks, making an incomprehensible number of predictions every second, which are also at different biological levels such as atomic, molecular and neural correlates. Neuroanatomically, it has been estimated that there are about 150,000 rice-grain-sized separate bundles distributed across the cortex - all with roughly the same global structural makeup, but with apparently quite different tasks.

If our cognitive, sensory and motor systems reach their capacity limits, i.e. if they approach overload with excessive demands and acute stress reactions, then there are three classic familiar patterns of action: avoidance, freezing and attacking. Just as classically, there is then a catalogue of primitive problem solving.

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

Perhaps methods based primarily on classical and operant conditioning are required for the automated processes? But what about the subjective experiences which are conscious processes and over which we have control - are we victims of our emotions? - They are something that should perhaps be changed by other methods than just exposure. Or is it all the same-same - but as always from the same old classic different perspectives? Plato versus Kant? Body-mind and dualism haunting the wings as always... What role does our consciousness play? What does it mean for a memory to be updated and refreshed by new impressions? That memories come as it were from within, as springing from some genuine essential transcendent response to our "true self", is perhaps nothing more than an illusion?

But the inner core of what is meant by life must then be defined, which has proved be more than difficult. What is life? And an "inner" life? And even worse: what is an authentic life...? A genuine

self? How are you true? Can you be true to your feelings? If so, are emotions something separate from higher cognitive functions?

The fast aspect, is at a non-conscious level: neurobiological, molecular and electromagnetic; we "reflexively" jump away from the honking car, or freeze at something unpleasant, or strike out with our hand in self-defense. Thus, it is easy to see that this shunning and freezing, is a completely different cognitive process than refusing to go to the woods because there might be snakes there; or refusing to go to school because there are bullies, or stalking, or persecuting an ethnic group of humans. The distinction has been around since William James and Carl Lange hypothesized at the turn of the last century, but it's only now into the 00s that we're starting to get reasonably good neuroscientific explanations. But we're probably not even halfway there yet. 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 allostatic strives to create optimal conditions for survival, with social cooperation at its highest. Has neuroscience approached a paradigm shift? Are the labs revolting, shifting from reactive explanatory models to predictive models of consciousness. This turns the previous black-box model of the brain responding to the environment inside out. Instead, it seems that the brain works with prepared systems and is an active participant in probability calculations and best guesses of what is to come. Compare this with Seligman's concept of "learned helplessness" and his critique of the traditional learning paradigm. And compare with Aaron Beck's concept of "negative automatic thoughts". The lines of demarcation lie on several levels first and foremost empirically with more and more 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 via a neuropsychoanalytic perspective he still discusses both 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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Bibliography

- Adolphs & Andersson (2018). The Neuroscience of Emotion.
- Buzsáki, György (2019). The Brain From Inside Out. OUP.
- Butz, M.V., & Kutter, E.F. (2016) How the Mind Comes into Being - Introducing Cognitive Science from a Functional and Computational Perspective, OUP.
- Cobb, Mathew, The Idea Of The Brain
- Craig, B. (2015) How do you feel. Princeton.
- Feldman Barrett, Lisa (2015). How Emotions Are Made.
- Friston, K. (2010) The free-energy principle: a unified brain theory, Nature Reviews Neuroscience vol 11, p 127–138.
- Gigerenzer, Gerd red (2016). Heuristics.
- Hawkins, J. (2021). A Thousand Brains – A New Theory of Intelligence. Basic Books.
- Holms, M. (2021). The Hidden Spring – a journey to the source of consciousness. W.W. Norton Ltd.
- Kahneman, Daniel (2011). Thinking, Fast And Slow. Farrar.
- LeDoux, Joseph (2015). Anxious.
- Mountcastle, V.B. (1997). The columnar organization of the neocortex. Brain, 120, p 701–722.
- Seligman, M., & Johnston, J. (1973) A cognitive theory of avoidance learning. In F. J. McGuigan, & D. B. Lumsden (Eds.). Contemporary approaches to conditioning and learning (p 69–110). Winston & Sons.
- Seth, A. (2021) Being You - A New Science of Consciousness. Faber & Faber.
- Solomon, Robert (2007). True To Our Feelings.
- Wegner & Gray (2016). The Mind Club. Penguin.
- Zimmer, Carl (2021). Life's Edge – The search for what it means to be alive.