



Letter



The Dopaminergic Coup d'État: Neurobiology of Addiction and the Architecture of Desire

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To whom it may concern,

Addiction represents a profound neurobiological disruption through which a subverted reward system overrides the prefrontal inhibitory control, translating impulses in survival imperatives. Perhaps, it is the most exquisite tragedy to have both free will and a conscience. It's a conflict that reeks of fratricidal violence. One yearns, whispers seductively, the other warns, screams incessantly. More often than not, it ends with free will smashing a rock on conscience's head, much like the biblical tale of Cain and Abel recites.

And, of course, a whole lot of regrets.

It seems common sense to characterize evolution as a beneficial process, the one through which we acquired the traits of our species and we gained insights previously unknown to other creatures, into both ourselves and the world.

But evolution was, has been and still is cruel. The survival of the fittest, the strongest, the ones who bravely fight what hides outside of the cave and are able to come back victorious on one side and on the other the inevitable death of those who are too weak and fragile. It kisses the courageous and spits on the frightened, for one likes blood and vengeance and murder and the other is condemned to witness it.

Man knew desire before it knew reason. It was intrinsically woven into his nature, wrapped around his brain structure.

Phylogenetically speaking, the brain evolved layer after layer, much like a city is built on the ruins of the previous. The oldest part of it knows nothing of thinking and operates on feeling. This is the limbic system. Buried deep within the brain, the structures making up the limbic system are interconnected, forming a pathway which relies upon stimuli, whatever their nature.

Thalamus, hypothalamus, basal ganglia, hippocampus and the amygdala [1].

The relay system and hormone factory, the dopamine producer and movement regulator, memory and emotional processor, they all form a circuit which shaped and still shapes us.

The evolutionary operational basis can be synthesized using the phrase "if it feels good, it keeps you alive", a brutal law nonetheless, but one that defined our basic needs.

Fighting, fleeing, feeding and fornication.

Hunger came with a side of violence, sex rendered naked from whatever emotional dressing the modern human may attach to it. Eating satisfied the stomach, hunting was a thrilling necessity. Sex satisfied the gonads, conserving the species was an interesting implication.

The action preceded a pre-packaged reward to better fit those shackles of desire to the flimsy wrists of the human race. A stone-cold algorithm, minimizing subcortical free energy in favor of balancing intrinsic biological forces to achieve homeostasis [2]. A perfect biological blackmail that, as a side effect, ensures survival.

At the basis of this "rewarding circuit" lies the ventral tegmental area and the nucleus accumbens. The VTA functions as the dopaminergic engine, responsible for anchoring neural networks dictating reward prediction, orchestrating salience attribution and reinforcement learning, while the nucleus accumbens is the primary target area, a motivation mediator. The VTA-NAc pathway communicates with the limbic system structures as well, via



neuroplasticity. Essentially every reward earned lights up mnemonic paths to set in stone the modalities of those actions and the lingering feeling of dopamine coursing through the cortex [3].

That's the mechanism through which a fortuitous action becomes a pattern, a behavior. Therefore, it is easily understandable that dopamine does not merely act as a "hedonistic vector", but it processes stimuli as "incentive wanting", transforming environmental cues into a prepotent motivational response [4].

However, what sets us apart from the other species just as much as from our animalistic ancestors, stems from a different portion of our brain, anchored in higher cognitive functions, home of logic and reason. "Man is a rational being". We house an internal conflict, replaying each day the somewhat detrimental effects of growing a conscience, reaping the seeds of being able to analyze our own essence in time and space. The impulse the horse, reason the saddle and man the jockey, sometimes skillfully riding through unfavorable conditions, other times being thrown to the ground amidst the dust of what could have gone differently.

It's a delicate balance that the jockey has to respect, whether mounting the horse becomes a prelude to disaster or a smooth ride over obstacles lies mostly in his strength.

But when the saddle feels too tight and, in the great scheme of this metaphor for life, the jockey feels as oppressed as the horse, riding away to chase that horizon of pre-instilled desire can quickly disrupt the race.

Reason transforms into a limping shadow of itself and Wanting takes the form of a blind giant, much like Schopenhauer's "Blind Will". Wanting wants and runs after Desire. Reason serves Wanting, mute and deaf to the actual needs. It's a goose chase, carving a circle into the ground, getting so close that distance becomes almost nullified one second and the next it withers away, leaving a much bigger gap than the last time.

That's how every kind of addiction feels. No matter the object of desire.

It quenches a secular thirst, trapped in the molds of what man is expected to be and to act and it makes him thirstier. It's that first gulp of fresh water on a scorching hot day that leaves you wanting for more until the stomach walls expand and the abdomen cannot hold it anymore but you keep drinking because it's taking care of a primordial need that leaves you basking in the glow of a thousand neurons firing satisfaction at the same time.

Neurobiologically speaking, addiction, whether to a substance or behavior, modifies the reward system, hijacks it, unlocking immense power and a symmetrically intense destruction. The naturally set resting state, the origin of the curve of fulfillment drawn by the rising of dopamine and consequent drop, is reprogrammed. It doesn't lie at (0,0) like it should, but it gets transposed along the numerical grid, so that the highest peaks touch unnatural values, far from the baseline, and consequently the decreases are equally far from that baseline in the opposite direction. It describes a picture of euphoric highs and dramatic and anxiety-inducing lows. The persistent hyperstimulation of the dopaminergic neurons, in turns, leads to a downregulation in dopamine production. This translates into the impossibility of producing the same results in terms of satisfaction, due to a much higher threshold and a much lower quantity of produced dopamine available. In practical terms, the craving gets stronger, the high much weaker and the addict unsatisfied, to the point where escalation in quantity seems the only logical answer [5].

At this point, as dopaminergic neurons begin to silence themselves in what becomes a neurological wasteland, the prefrontal cortex feels the effect as well, losing its functional connectivity to the deep reward centers. It's a coup d'état: lines have been breached from the inside and there's no communication left. It's hypofrontality. One can only watch, impotently, the destruction passing by. Concurrently, the lesser dopamine produced, the lesser the pleasure derived from ordinary things. Conversations weigh tons on the brain, colors lose their appeal and anhedonia spreads continuously like a rotting disease, demolishing everything in its pathway. It all turns black, uninteresting, cold. Time gets erased, subjugated to impulse. Contours evaporate and the Ego merges with the Id, cancelling the individual. The subject exists only in the addiction timeframe, essentially erasing itself from all other timelines. This phenomenological collapse of temporal continuity can be traced to a severe disruption in those cortical networks responsible for anchoring the "Self" in time and space [6].

As said in the beginning, it is exquisitely excruciating going through life with free will and a conscience strapped to one's hip but as a fellow member of the human race I can attest to how incredibly lucky it is to possess both. As much as it is a conflictual relationship, it is possible to use them both, in tandem, to build what was once destroyed. Those same tools used to strip down the architectural layout of the brain's layers, can be used to put them back together again. Granted the baseline won't be the same anymore, the first step towards rebuilding is acceptance of the scars left behind, to make use of those scars, to engrave them in our memory. Neural pathways are a dynamic reality and those same dopaminergic neurons can undergo functional realignment, through targeted synaptic remodeling, to appreciate the steadiness of life. This process is far from ideal since it has been proven, as functional neuroimaging shows, that targeted interventions do drive significant structural changes in aberrant reward circuits [7].

It is, therefore, within reach to live according to the statistical principle of regression to the mean, instead of chasing those highs and rebuking those lows.

For all one knows, the tension is a direct consequence of the belief that one must die for the other to survive, when, in all truth, the jockey does not need to kill the horse in order to win the game, but learn how to walk with it, both during good and bad weather.

For we are humans, brilliantly simple creatures with a humongous sense of existence encoded deep within us, capable of destroying one another and ourselves and at the same time sketching blueprints for our rebirth.

And maybe, just maybe, it is possible to stop chasing the void and feel finally exquisitely full.

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