

Review of:

**The Compass of Pleasure: How
Our Brains Make Fatty Foods,
Orgasm, Exercise, Marijuana,
Generosity, Vodka, Learning,
and Gambling Feel So Good**

DAVID J. LINDEN

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Invited Review

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Key Points

- Pleasure is a reward for salient activities that originally enhanced fitness, but it can turn to dangerous addiction
- Addiction is a form of associative learning, and pleasure can be associated with almost everything
- Virtuous behaviours, such as generosity and meditation, use the same medial forebrain pleasure circuit activated by heroin or orgasm
- In light of the findings exposed by Linden, philosophical questions about individual responsibility and biological constraints take on a renewed meaning

The Compass of Pleasure is a New York Times bestseller by David J. Linden (2011) and has a quite explicit subtitle, *How Our Brains Make Fatty Foods, Orgasm, Exercise, Marijuana, Generosity, Vodka, Learning, and Gambling Feel So Good*. David J. Linden is a professor of neuroscience at Johns Hopkins University in Baltimore and his laboratory has worked for many years on the cellular substrates of memory storage in the brain. Moreover, he is an accustomed science communicator and author in, 2007 of *The Accidental Mind*, a book debunking the common misconception according to which evolution designed our brain as an optimized problem-solving machine.

The *Compass* explains, in a pleasant and accessible manner, the neurobiology of pleasure, vice and virtue. The medial forebrain pleasure circuit involves an entire group of interconnected cortical and subcortical brain regions. Each chapter is dedicated to explaining how drug, food, sex, gambling and generosity similarly activate this circuit, from the dopamine-containing neurons of the ventral tegmental area (VTA) to their projections to the nucleus accumbens; the prefrontal cortex; the dorsal striatum, also involved in motor learning and decision-making; the amygdala and the anterior cingulate cortex, known to be emotion centres; and the hippocampus, which plays an important role in memory.

Human errors and happy accidents play a crucial role in scientific discoveries. Olds and Milner (1954) fortuitously implanted an electrode deeper than desired along the midline of a rat's brain, in the septum, a key part of the reward circuit. In a modified Skinner box, the rats self-stimulated as often as two thousand times per hour for twenty-four hours, neglecting any other activity, like seducing a female in heat or nursing new-born puppies. They had to be separated from the device to prevent death by starvation.

The identification of the pleasure circuit in humans is originally due to one of the most unethical studies on homosexuality and psychiatric patients. A young homosexual male, who suffered from chronic suicidal depression, was surgically implanted with electrodes in deep regions of his brain. By doing this, Dr Robert Galbraith Heath found out that the electrode in the septum produced pleasurable sensations. Following self-stimulation, the subject experienced «an almost overwhelming euphoria and elation [presumably like Olds and Milner's rats did] and had to be disconnected despite his vigorous protests» (Moan and Heath, 1972). He then had successful sexual intercourse with women, but his homosexual activity, although reduced, did not stop completely.

Throughout the most part of, 20th century, such *Clockwork Orange*-like studies were carried out on psychiatric patients, without producing any empirical evidence for classifying homosexuality as a mental disorder. In 1973, the American Psychological Association removed homosexuality from the list of mental disorders, and

the World Health Organization finally did the same in 1990.

Linden uses these and other anecdotes to show us how we charge pleasure with moral meanings and social conventions in order to channel its terrific motivating force. This control is possible because the neural substrates of pleasure are multi-purpose. In primates and cetaceans, at least, the medial forebrain pleasure circuit has been associated not only to food or mating, but even to abstract ideas, e.g. doing the right thing.

Given that pleasure can motivate us to entirely arbitrary goals, these goals may or may not have an evolutionary adaptive value. Compulsive shopping and food addiction are not the fittest behaviours ever. Nevertheless, they might not compromise the reproduction of the carriers. As long as some substance or behaviour is not immediately lethal, the pleasure circuit lets us run the risk. Our brain is definitely not a perfectly functioning device for adaptation.

After all, the co-optation of an existing biochemical system for an additional function is a common evolutionary theme. The oxytocin release has a role in the mother-infant relationship during breastfeeding, in the emotional understanding of others and in the pair bonding during afterglow, i.e. that blissful period following orgasm (Linden, 2011, p. 119). But oxytocin motivates also ethnocentrism in humans (De Dreu *et al.*, 2011). For a critical overview of the functional co-optation – and of other kinds of exaptation – in studies on human evolution, see Pievani and Serrelli (2011).

In this sense, the *Compass* is a good chance to understand evolution without common misconceptions. In contrast to some popular literature on evolutionary psychology, the *Compass* does not confuse historical origin and current utility, and focuses on the role played by one's biography rather than his neurobiological constraints.

Although our bodies are a sort of museum of natural history, our individual causal history can be pretty creative and flexible. Even the deepest parts of our brain – someone would say our reptilian brain – can be modified by experience. The concept of neural reuse, recycling or rewiring, is currently widespread in neuroscience (Anderson, 2010). The long-term synaptic potentiation (LTP) and the long-term synaptic depression (LTD) in the pleasure circuit are considered as particular cases of neural plasticity. Reinforced synaptic connections store memory of events in the brain, and this is why Linden claims addiction is a form of learning.

Does that mean we are not responsible for what we learn over our lifetime? Of course not. Neither social learning nor genetic predisposition erase the personal responsibility for the recovery from addiction. The striking power of pleasure, and of habit too, is demonstrated by several experimental studies cited by Linden. As an example, in monkeys the dopamine neuron firing gradually increased during the waiting interval between an unexpected stimulus and a potential reward (Fiorillo

et al., 2003). Similarly, it is not that gamblers necessarily need an early reward to like gambling.

Brain scanning techniques and experimental psychology suggest that vice and virtue, charity, physical exercise and compulsive gambling are intertwined. All of them are pleasurable and their distinction depends on personality. Even a little bit of pain can be associated with pleasure, revealing the indifference of evolution for the moral meaning we attribute to individual preferences. Liking sadomasochistic sex, very hot baths or chili pepper is not unnatural. Thanks to the use-dependent plasticity of neurons, the inborn aversion for irritation and pain can be reversed, especially if a substance or behaviour is harmless or socially promoted.

As far as sex is concerned, we humans are very different from the rest of mammals, and not because of our fetishism, kinky or forbidden practices, as one might expect. Animal sexuality is far from being monotonous in this regard, as rape, necrophilia and the only known case of nasal sex (Connor *et al.*, 2000) are being reported by ethologists. It is undeniable that most of human sexuality, even most human penis-vagina intercourse, is recreational and disjoint from reproduction. But this isn't in any case what makes human sexuality peculiar.

The truly aberrant part of our mating system turns out to be its conventional and socially sanctioned nature. Curiously, it is a common opinion that sex should be confined to reproduction, at least from a biological point of view. Nevertheless, non-reproductive sexual behaviour can contribute to the social context in which offspring emerge. The take-home message of the chapter titled "Your sexy brain" is that personal preferences are the sole biological compass for sexual pleasures. Apparently, this is the best application of the principle that individual variability is crucial to evolution, in spite of cultural taboos.

There is a sort of trade-off between sociocultural and biological factors. Public consensus and accessibility promote the use of drugs, although they activate the dopamine pleasure circuit weakly or not at all, as do alcohol or SSRIs. Drug policies usually mix up competing commercial, social and medical interests. This is why in many cases penalties do not correspond exactly to the harm caused by psychoactive drugs.

The last chapter speculates about a future in which pleasure can be artificially induced without harmful consequences. Imagine we could be able to precisely control our pleasure circuits with a mechanical device, pretty much like the mood regulator in the Philip Dick's masterpiece *Do Androids Dream of Electric Sheep?* Could pure pleasure, without desire, replace tolerance, craving and addiction? What about the curiosity driving science and culture? The influence of social habits on individual motivations makes the social prediction the hardest to make, whatever the future of pleasure.

More likely, according to Linden, in the not too distant future genetic screen-

ing will be available to predict the risk of developing addictions. The variability of those genes involved in dopamine signalling might be predictive of a general addictive predisposition. Also, as a pure speculation, particular variations in both endogenous opioids and endocannabinoids might correlate with specific drug addictions, such as alcohol or cocaine. Should individual variability and determination be preserved per se? The truth is, scientifically informed philosophy and public opinion will be needed in order to figure out an answer to these questions.

In conclusion, Linden does not naively reduce vice and virtue to dopamine surges, simply because he knows that:

- the medial forebrain pleasure circuit and other cognitively relevant neural circuits are partially overlapping, which means that we broadly dress pleasurable behaviours with memories, emotions and social meanings, mainly conveyed by language;
- repeated experiences cause long-term changes in neural functions and structures.

The Compass of Pleasure is a worthy reading both for the casual reader and for the academic philosopher. It is an example of how deeply philosophy needs scientific data, much more than masturbatory literature and internal debate.

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