

# Neuropsychiatric and Neurobiological Consideration for Pornographic Addiction and Compulsive Sexual Disorder

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## Abstract

Many scientists postulate that several behavioral patterns may potentially affect the reward circuits in human brain leading to a loss of control and other symptoms of addiction in some individuals at least, yet despite the growing acceptance of the existence of these behavioral addictions based on the increased understanding of the function of the mesolimbic dopaminergic reward systems, there has been a reluctance to label Pornography as potentially addictive. Pornography consumption is becoming one of the most prevalent activities among the young adults and the adult groups, and its prevalence continues to increase as a direct consequence to the increased use of the internet. There is no clear answer to whether it is beneficial or harmful, or how does it affect our brain, thus in this manuscript, I tried to find the answer to this question, in order to keep up with the technological advances in our modern age. Studying internet pornography consumption is relatively a novel topic to delve into, contrasting between it and the other behavioral addictions or applying the three stage model of addiction wasn't done before, and there have been a clear reluctance to consider pornography as a potentially addictive behavior in spite of considering other behavioral addictions such as gambling and gaming addictions. Regarding Pornography, the current neuroscientific research supports the assumption that the responsible neural processes are similar to drug addictions and other non-drug addiction receiving greater attention such as pathological gambling and gaming, the current evidence are increasingly supporting the description of pornography as an addiction. In this review, I tried to give a summary of the most recent advances in the research into this matter trying to give an overview about neuroscientific, neuropsychiatric and neurobiological studies on Internet pornography addiction and compulsive sexual disorder, trying to find answers to the questions about internet pornography and other behavioral addictions. In addition to reviewing most of the available literature on Internet pornography addiction and comparing the results to the three stage addiction model and the neurobiological basis of the other non-behavioral addictions. Finally, while much remains unknown about the effects of Internet pornography on mental health, society, marriages and families were it positive or negative, the available data will hopefully provide an informed starting point for policy makers, educators, clinicians, and researchers.

## 1. Introduction

The manuscript is divided into four main paragraphs:

The first paragraph is mainly about the three stage model of addiction explaining how can a seemingly natural behavior becomes an addiction, the paragraph is divided into three subparagraphs, each subparagraph explains a stage in the three stage model of addiction.

The second paragraph is mainly about the neurobiological basis of how can non-drug (behavioral) addiction develops.

The third paragraph is mainly an application of the first two paragraphs in the case of internet pornography, explaining how can we apply the three stage model of addiction to internet pornography, and how can we apply the neurobiological basis of addictions to the internet pornography.

The fourth and the last paragraph is a glimpse on what can the future research provides to the scientific community and the policy makers regarding the case of internet pornography.

## 2. Three-Stage Model of Addiction

All the potentially addictive drugs are supposed to act through the mesolimbic dopamine pathway, which originates from the ventral tegmental area of the brain and projects into the nucleus accumbens commonly referred to as (the reward center) that seems to be very connected with pleasure, reward, learning and impulsivity.

The reward system is formed of: The amygdala responsible for positive and negative emotions, emotional memory, the hippocampus responsible for processing and retrieval of long term memories, and The frontal cortex responsible for coordinates and determines behavior [1].

Natural behaviors such as eating and mating, evolved over time so that they activate the reward system so as to keep the necessary behaviors for survival, yet on the other hand it can turn into a totally addictive behaviour [2,3].

Nora Volkow defines Addiction as "a neurobiochemically based shift from impulsive action learned through positive reinforcement into compulsive action learned through negative reinforcement which is seen in turn as leading to an addictive cycle that progressively worsens over time " [1].

The scientists Volkow, Wang, Fowler, Tomasi and Telang [1] take the debate further describing three stages of the addictive cycle;

- a. binge/intoxication;
- b. withdrawal/negative affect;
- c. preoccupation/anticipation.

## **2.1 Stage one "Binge/Intoxication"**

All the potentially addictive drugs affect the brain in many different ways, yet the universal end result is, a flood of dopamine in the NAcc (reward center), which results in acute positive reinforcement of the behavior that initiated the flood [1], and thus in response to this positive reinforcement, results an addictive related learning associations (routine) [4].

Neuroplastic brain changes start to happen, however, as the release of dopamine continues in the NAcc, Dynorphin levels start to increase and thus in turn, decreases the Dopaminergic of the reward system which results in a decrease of the reward threshold and an increase in tolerance [1,4].

## **2.2 Stage two "Withdrawal/Negative Affect"**

Dopamine flood has run its course, and the extended amygdala is activated which is mainly associated with pain processing and fear conditioning. This in turn leads to activation of the stress systems of the brain and dysregulation of anti-stress systems leading to a decreased sensitivity to rewards and increased threshold of reward, which is called (tolerance).

The individual continues to engage in the addictive behaviors to avoid the negative affect associated with withdrawal which progresses into negative reinforcement, which encourages repeat and/or reinforcement of the addictive behaviors. Now on this stage the impulsive behavior shifts into a compulsive behavior, which is referred to in the model as (chronic taking/seeking) [1,4].

An important point to mention is that withdrawal is not about the physiological effects from a specific substance, rather, this model measures withdrawal via the resulting negative effects, anxiety, depression, dysphoria, and irritability are all an indicators of withdrawal in this model of addiction [1,4].

Researchers who oppose the idea of behaviors being addictive (non-drug addictions) often overlook or misunderstand this critical distinction, confusing withdrawal with detoxification [5,6].

## **2.3 Stage three "Preoccupation/Anticipation"**

The neuroplastic affection is now beyond the mesocortical dopamine pathway into other regions of the prefrontal cortex that are responsible for motivation, self-regulation/self-control, delayed reward discounting, and other cognitive and executive functions [1,4].

The scientists Goldstein and Volkow [7] developed the Impaired Response Inhibition and Saliency Attribution (I-RISA) model to explain this process, it integrates the increased saliency of learned drug-related cues (resulting from the positive and negative reinforcement of the addictive behavior mentioned before) with newly developed deficiencies in the inhibitory control. Which leaves the individual susceptible to repeating the behavior [1,4]. A lot of neuroimaging studies substantiate this model [8,9], and these affections are the cornerstone behind the "chronic relapsing disorder" an important element of the medical definition of addiction [10,11].

### **3. Neurobiology of Non-Drug Addictions**

Non drug addictions are any form of addiction that occurs without the interference of any external drugs.

The scientists Grant, Brewer and Potenza [12] mentions pathological gambling, kleptomania, pyromania, compulsive buying, and compulsive sexual behavior as an examples of addictive behaviors, concluding that there is a strong neurobiological link between behavioral addictions and substance use disorders [12].

The scientist Olsen cited fMRI studies that shows gambling, shopping, sex, video games, and the sight of appetizing food, to activate the mesocorticolimbic system and extended amygdala in the same way as do drugs of abuse, which concludes that these benign in nature non drug behavior can actually turn into compulsive behaviors despite devastating consequences” [13].

The scientist Lobo and Kennedy [14] reported that pathological gamblers to be three times more likely to have a parent who is a pathological gambler, and twelve times more likely to have grandparents.

### **4. Internet Pornography**

Norman Doidge summarizes the research on the addiction and the reward system concluding that compulsively watching internet pornography and chronically releases dopamine that stimulates neuroplastic changes on the long term, building brain maps for sexual excitement, where the previously established brain maps for natural sexuality cannot stand to the newly formed and continuously reinforced maps generated by compulsively watching of Internet pornography, and thus tolerance is achieved so the individual progresses into more explicit and hardcore internet pornography to maintain the same level of excitement [15].

The neurosurgeons Hilton and Watts [16] published a commentary in the Journal Surgical Neurology in which they state that all symptoms of addiction operate through the same mechanisms, including many of the previously mentioned studies on the role of DeltaFosB in natural addictions and changes in dopamine receptor density.

Hilton published a second and similar literature review [17], again prioritizing the role of DeltaFosB research specifically on from scope of internet pornography consumption.

The first fMRI study dedicated to the internet pornography published in 2014 concluded that the same brain activity seen in drug addicts and alcoholics is the one produced when watching internet pornography [18]. The experiment was conducted to measure the subjective experience of cue-reactivity, as well as the neurobiological markers, if any, found in individuals with compulsive sexual behavior, this study used two main lines for investigation.

The first line, the study investigated the “liking vs. wanting” distinction for compulsive sexual behaviour and non-compulsive sexual behaviour subjects, where the subjects were shown the videos both inside and outside of the fMRI scanner. Each time, they were asked to rate their own subjective experiences via two specific measures: “How much did this increase your sexual desire?” and “How much did you like this video?” [18]. And it yielded two distinct results: (1) Compared to the healthy

control subjects, the compulsive sexual behaviour subjects reported higher desire ratings to the sexually explicit videos, but not to the erotic clips; (2) Compared to the healthy controls, the CSB subjects reported higher liking rating to the erotic clips, but not to the explicit cues. Which surprisingly indicated a dissociation between liking and wanting by compulsive sexual behaviour-subjects when watching sexually explicit videos. These results are similar to the results of another well-established studies on the incentive-salience theory of addiction, where the addicts report higher levels of wanting but not liking their salient rewards.

The second line, focuses on neuroimaging results of compulsive sexual behaviors and internet pornography specifically. Older studies have mentioned specific brain regions that gets activated through craving states, the amygdala, dACC, and ventral striatum [19]. Surprisingly the researchers in this study found these same regions to become activated within both compulsive sexual behavior and non-compulsive sexual behavior subjects when shown sexually explicit materials, but the researchers found elevated activation in compulsive sexual behavior subjects. And based on these results, Voon et al. [18] concluded that the current findings suggest that a common network exists for sexual-cue reactivity and drug-cue reactivity in groups with compulsive sexual behavior and drug addictions, respectively. These findings suggest overlaps in networks underlying disorders of pathological consumption of drugs and natural rewards. [18].

Incidentally, they also reported that 60% of subjects (average age: 25 years) had difficulty achieving erections/arousal with real partners, yet could achieve erections with internet pornography [2,6,4].

Kühn and Gallinat [19] conducted an MRI study with sixty-four healthy male subjects and correlated the total hours of online viewing of explicit material per week and years of use with dorsal striatal structure and connectivity. And it yielded three main results. First, longer duration and more hours per week of use were related to lower grey matter volume in the right caudate. Second, more years and more hours per week of use correlated with lower left putaminal activity in response to brief, still sexual images [20,21].

They suggested that this lower volume may indicate tolerance complicated by desensitization which supports the hypothesis that intense exposure to pornography videos results in a downregulation of the natural neural response to sexual stimuli” [22].

Concluding that the subjects who consumed more pornographic material were found to have less connectivity between the right caudate and left dorsolateral prefrontal cortex (DLPFC). While the DLPFC is responsible for executive functions, it is also related to cue reactivity to drugs and internet gaming, abnormalities in this circuit are implicated in drug and behavioral addictions, particularly poor functional connectivity between the DLPFC and caudate is present in heroin addiction [23].

The development of addictive sexual behaviors on the Internet was postulated to be related to anticipating and receiving gratification [24], since sexual arousal is highly reinforcing [25,26], as it was proved that sexual arousal to Internet pornographic cues were considered a symptom severity of internet pornography addiction in heterosexual males and females as well as in homosexual males [27-30] and that compulsive internet pornography users reacted with increased subjective craving when compared to healthy cybersex users when being confronted with Internet pornography videos [31].

## 5. Future of the Research

The future studies would need more research using more advanced methodologies far beyond simple correlational analysis and cross-sectional research. For example, conducting more gender focused research, putting into consideration the cultural factors, minority status, and understudied populations such as lesbian, gay, bisexual, and transgendered adolescents. As technology moves forward, researchers should move forward as well putting into consideration the various electronic media such as the smart phones, virtual reality, augmented reality that can be used to consume pornography.

### REFERENCES

1. Volkow ND, Wang GJ, Fowler JS, et al. Addiction: Beyond dopamine reward circuitry. *Proc Natl Acad Sci.* 2011; 108(37):15037-42.
2. Potenza MN. Non-substance addictive behaviors in the context of DSM-5. *Addict Behav.* 2014;39(1):1-2.
3. Volkow ND, Baler RD. Addiction science: Uncovering neurobiological complexity. *Neuropharmacology.* 2014;76(Pt B):235-49.
4. Koob GF, Volkow ND. Neurocircuitry of Addiction. *Neuropsychopharmacology.* 2010;35(1):217-38.
5. Ley D, Prause N, Finn P. The Emperor Has No Clothes: A Review of the “Pornography Addiction” Model. *Curr. Sex. Health Rep.* 2014;6(2):94-105.
6. Van Rooij AJ, Prause N. A critical review of “Internet addiction” criteria with suggestions for the future. *J Behav Addict.* 2014;3(4): 203-213.
7. Goldstein RZ, Volkow ND. Dysfunction of the prefrontal cortex in addiction: Neuroimaging findings and clinical implications. *Nat Rev Neurosci.* 2011;12(11):652-69.
8. Ko CH, Yen JY, Yen CF, et al. The association between Internet addiction and psychiatric disorder: A review of the literature. *Eur Psychiatry.* 2012;27(1):1-8.
9. Limbrick-Oldfield EH, van Holst RJ, Clark L. Fronto-striatal dysregulation in drug addiction and pathological gambling: Consistent inconsistencies? *NeuroImage Clin.* 2013;2:385-93.
10. American Society of Addiction Medicine (ASAM). Public Policy Statement: Definition of Addiction.
11. Koob GF. Negative reinforcement in drug addiction: The darkness within. *Curr Opin Neurobiol.* 2013;23(4):559-63.
12. Koob GF, Le Moal M. Neurobiological mechanisms for opponent motivational processes in addiction. *Philos Trans R Soc B Biol Sci.* 2008;363(1507):3113-23.
13. Olsen CM. Natural rewards, neuroplasticity, and non-drug addictions. *Neuropharmacology.* 2011;61(7):1109-22.
14. Lobo DSS, Kennedy JL. The genetics of gambling and behavioral addictions. *CNS Spectr.* 2006;11(12):931-9.
15. Doidge N. *The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science.* New York: Penguin Books, USA; 2007.
16. Hilton DL, Watts C. Pornography addiction: A neuroscience perspective. *Surg Neurol Int.* 2011;2:19.
17. Hilton DL. Pornography addiction- A supranormal stimulus considered in the context of neuroplasticity. *Socioaffect Neurosci Psychol.* 2013;3:20767.
18. Voon V, Mole TB, Banca P, et al. Neural Correlates of Sexual Cue Reactivity in Individuals with and without Compulsive Sexual Behaviours. *PLoS ONE.* 2014;9(7):e102419.
19. Kühn S, Gallinat J. Brain structure and functional connectivity associated with pornography consumption: The brain on porn. *JAMA Psychiatry.* 2014;71(7):827-34.

20. Arnow BA, Desmond JE, Banner LL, et al. Brain activation and sexual arousal in healthy, heterosexual males. *Brain*. 2002;125(Pt 5):1014-23.
21. Ferris CF, Snowdon CT, King JA, et al. Activation of Neural Pathways Associated with Sexual Arousal in Non-Human Primates. *J Magn Reson Imaging*. 2004;19(2):168-75.
22. Kittinger R, Correia CJ, Irons JG. Relationship between Facebook use and problematic Internet use among college students. *Cyberpsychology Behav Soc Netw*. 2012;15(6):324-7.
23. Wang Y, Zhu J, Li Q, et al. Altered fronto-striatal and fronto-cerebellar circuits in heroin-dependent individuals: A resting-state fMRI study. *PLoS One*. 2013;8(3):e58098.
24. Young KS. Internet sex addiction: Risk factors, stages of development, and treatment. *Am Behav Sci*. 2008;52(1):21-37.
25. Weiss R, Samenow CP. Smart Phones, Social Networking, Sexting and Problematic Sexual Behaviors- A Call for Research. *Sex Addict Compulsivity*. 2010;17(4):241-6.
26. Verdejo-García A, López-Torrecillas F, Giménez CO, et al. Clinical implications and methodological challenges in the study of the neuropsychological correlates of cannabis, stimulant, and opioid abuse. *Neuropsychol Rev*. 2004;14(1):1-41.
27. Holstege G, Georgiadis JR, Paans AMJ, et al. Brain activation during human male ejaculation. *J Neurosci*. 2003;23(27):9185-93.
28. Brand M, Laier C, Pawlikowski M, et al. Watching pornographic pictures on the Internet: Role of sexual arousal ratings and psychological-psychiatric symptoms for using Internet sex sites excessively. *CyberPsychology Behav Soc Netw*. 2011;14(16):371-7.
29. Laier C, Pekal J, Brand M. Cybersex addiction in heterosexual female users of Internet pornography can be explained by gratification hypothesis. *CyberPsychology Behav Soc Netw*. 2014;17(8):505-11.
30. Laier C, Pekal J, Brand M. Sexual excitability and dysfunctional coping determine cybersex addiction in homosexual males. *Cyberpsych Behav Soc Netw*. 2015;18(10):575-80.
31. Laier C, Pawlikowski M, Pekal, J, et al. Cybersex addiction: Experienced sexual arousal when watching pornography and not real-life sexual contacts makes the difference. *J Behav Addict*. 2013;2(2):100-7.