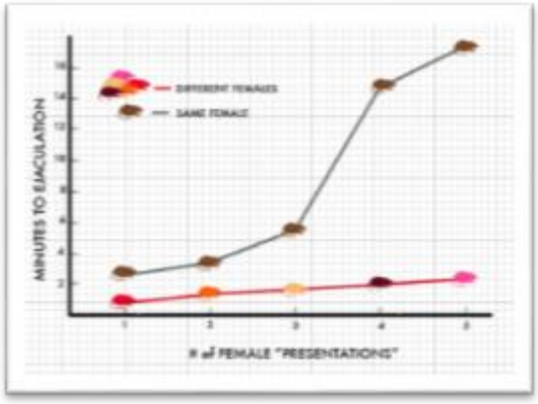
Straight Science on Internet Porn Addiction:
How It Works and Why It's Bad

Comprising excerpts from the website www.yourbrainonporn.com, this paper is a synopsis of some key concepts. For the science behind it, please follow the links and read more deeply. YBOP focuses on porn's effects on the brain—male or female. However, since this has been predominantly a male challenge, the site, as well as this paper, has a definite male slant. YBOP is secular, although everyone's views are welcome on the site. It is primarily science-based, is not a commercial site, accepts no ads, and advertises the sale of a single book, entitled (you may have already guessed) Your Brain On Porn, for $4.99. Proceeds from the book go to a UK registered charity that promotes education and research on the effect of pornography on individuals and in society. The creators of YBOP state their motivation thus: *". . . we don't like people suffering needlessly simply because they lack critical information for improving their circumstances themselves."* We recommend reading this paper online because of the many hypertext links to various studies and supporting scientific information. However, a printed copy of the paper also may serve its purpose.

CAVEAT: The Banyan Group does not necessarily endorse all the scientific conclusions of, nor are we connected in any way with YBOP. We recognize that, particularly for many evangelicals, conclusions based on animal experimentation are suspect, and reasoning and explanations based in evolution are questionable. Still, we do see a correlation between what occurs in the brains of animals, such as rats, and what we can clearly see using FMRI occurring in human brains (referenced later in the paper). We have not attempted to answer the many evolutionary comments included in the research. The scientists who performed these studies see many connections to man's "evolutionary development" which may also be explained in non-evolutionary ways. This fact, though, doesn't negate their conclusions. Our genetic makeup, for instance, does include an almost overwhelming drive to reproduce. Humans, created by God in His image, are profoundly fallen, and it follows that much of our original purpose has been twisted and coopted by the system that perpetuates our fallen-ness. This, though, also does not negate the conclusions these studies point out and clearly illustrate.

"*Every good gift and every perfect gift is from above, coming down from the Father of lights, with whom there is no variation or shadow due to change.*" (James 1:17, ESV) What is true and right, wherever it may be contained temporally, comes from God. We encourage believers to use discernment, and to gain whatever insight they can from this research. Speaking frankly and perhaps more colloquially, we would say: "Eat the fish. Spit out the bones."

Your Brain on Porn



What happens when you drop a male rat into a cage with a receptive female rat? First, you see a frenzy of copulation. Then, progressively, the male tires of that particular female. Even if she wants more, he has had enough. However, replace the original female with a fresh one, and the male immediately revives and gallantly struggles to fertilize *her*. You can repeat this process with fresh females until he is completely wiped out.

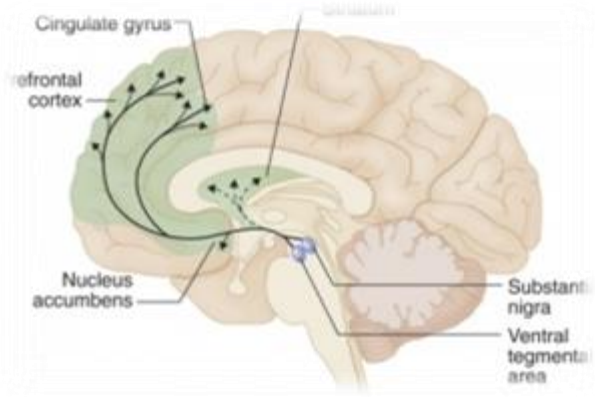
This is called the Coolidge effect—the automatic response to novel mates. Interestingly, men ejaculate more motile sperm and they do it more quickly when they view a novel porn star. This powerful automatic response to erotic novelty is what started you down the road to getting hooked on internet porn.

Like that lab rat, you have a primitive mechanism in your brain urging you to fertilize the two-dimensional females, males (or whatever) on your screen. (Note: The Coolidge effect also occurs in females. Studies show that, when given the opportunity, hunter-gatherer females are no less promiscuous than males.)

Primitive circuits in your brain govern emotions, drives, impulses, and subconscious decision-making. They do their jobs so efficiently that evolution hasn't seen the need to change them much since before humans were humans.

More dopamine, please

For you, rats, and all mammals, the desire and motivation to pursue sex arises largely from a neurochemical called dopamine. Dopamine amps up the centerpiece of the primitive part of the brain—the reward circuitry. It's where we experience cravings and pleasure, and where we get addicted.



The ancient reward circuitry compels you to do things that further your survival and pass on your genes. At the top of our human reward list are food, sex, love, friendship, and novelty. These are called 'natural reinforcers,' as contrasted with addictive chemicals.

The evolutionary purpose of dopamine is to motivate you to do what serves your genes. The bigger the squirt, the more you want something. No dopamine and you just ignore it. Chocolate cake and ice cream—a big blast. Celery—not so much. Sexual stimulation offers the biggest natural blast of dopamine available to your reward circuitry. One of dopamine's nicknames is the "molecule of addiction" because it plays a central role in all addictions.

Although dopamine is often referred to as a "pleasure molecule," this is not technically accurate. Dopamine is all about seeking and searching for rewards, the anticipation, the wanting. Dopamine provides the motivation and drive to pursue *potential* rewards or long term goals. Although controversial, it appears that the final reward or good feelings arise from opioids. Put simply - dopamine is wanting, opioids are liking.

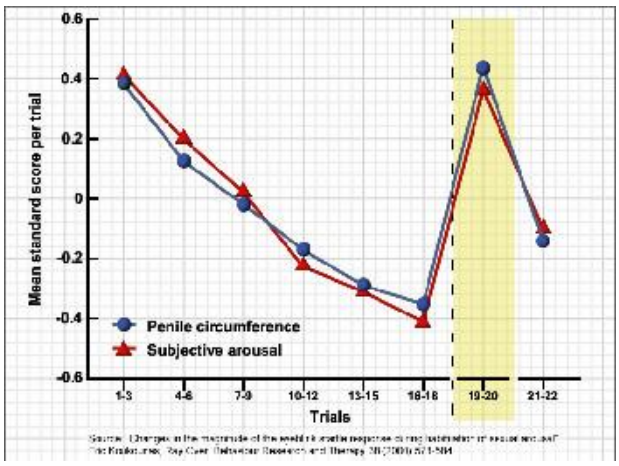
As psychologist Susan Weinschenk explained, the neurotransmitter dopamine does not cause people to experience pleasure, but rather causes a seeking behavior. "Dopamine causes us to want, desire, seek out, and search," she wrote. It is the opioid system that causes one to feel pleasure. Yet, "the dopamine system is stronger than the opioid system," she explained. "We seek more than we are satisfied." Addiction may be thought of as *wanting* run amok.

Novelty, novelty, more novelty

Dopamine surges for novelty. A new car, just-released movie, the latest gadget…we are all hooked on dopamine. As with everything new the thrill fades away as dopamine plummets.

Here's how the Coolidge effect works: The rat's reward circuitry is squirting less and less dopamine with respect to the current female, but produces a big dopamine surge for a new female. Does that sound familiar?

Not surprisingly, rats and humans aren't that different when it comes to response to novel sexual stimuli. For example, when Australian researchers (graph) displayed the same erotic film repeatedly, test subjects' penises and subjective reports both revealed a progressive decrease in sexual arousal. The "same old same old" just gets boring. Habituation indicates declining dopamine.



After 18 viewings—just as the test subjects were nodding off—researchers introduced novel erotica for the 19th and 20th viewings. Bingo! The subjects and their penises sprang to attention. (Yes, women showed similar effects.)

Internet porn is especially enticing to the reward circuitry because novelty is always just a click away. It could be a novel "mate," unusual scene, strange sexual act, or—you fill in the blank. With multiple tabs open and clicking for hours, you can experience more novel sex partners every ten minutes than our hunter-gatherer ancestors experienced in a lifetime. Research confirms that anticipation of reward and novelty amplify one another to increase excitement and rewire the limbic brain. Internet porn is what scientists call a supernormal stimulus. These are stimuli that are exaggerated (perhaps synthetic) versions of normal stimuli, which we falsely perceive as extraordinarily valuable.

Supernormal Stimulus

It was Nobel laureate Nikolaas Tinbergen who years ago coined the term supernormal stimulus. He discovered that birds, butterflies, and other animals could be duped into preferring fake eggs and mates. Female birds, for example, struggled to sit on Tinbergen's larger-than life, vividly spotted plaster eggs while their own pale, dappled eggs perished untended.

Humans, like the birds, appraise the value of a stimulus via reward circuit activation. This is why sexual excitement releases the highest levels of dopamine and opioids - reproduction is Job One for your genes. With internet porn, it's not just the unending sexual novelty that buzzes our reward system. Dopamine fires up for other emotions and stimuli too, all of which often feature prominently when using internet porn:

Strong emotions - such as guilt, disgust, embarrassment, anxiety & fear

Seeking and searching - the reward circuit is often called the seeking circuit

Anything that violates expectations - shock, surprise, or more than we could have imagined

J Abnorm Psychol. 1983 Feb;92(1):49-54.

Anxiety increases sexual arousal.

Barlow DH, Sakheim DK, Beck JG.

PMID: 6833633 [PubMed - indexed for MEDLINE]

Erotic words and pictures have been around a long time. So has the neurochemical rush from novel mates. Yet the novelty of a once-a-month *Playboy* evaporates as soon as you turn the pages. Would anyone call *Playboy* or softcore videos "shocking" or "anxiety-producing?" Would either violate the expectations of a computer-literate boy over the age of 12? Neither compares with the "searching and seeking" of a multiple-tab Google porn prowl. What makes internet porn unique is that you can keep your dopamine jacked up with the click of a mouse or tap on a screen.

Many of these same emotional states (anxiety, shame, shock, surprise) not only elevate dopamine, but each can also boost stress hormones & neurotransmitters (norepinephrine, epinephrine, cortisol). These stress neurochemicals increase excitement while amplifying dopamine's already powerful effects. Over time a porn user's brain can mistake feelings of anxiety or fear for feelings of sexual arousal. This helps explain why some porn users escalate into ever more shocking or anxiety invoking porn – as they need that extra neurochemical jolt just to become sexually aroused, or to orgasm.

What makes internet porn a unique stimulus?

It's evident that today's porn is easy to access, available 24/7, free and private. It affords unlimited novelty. The way it's used commonly keeps dopamine elevated for abnormally long periods, making internet porn uniquely compelling, and potentially addictive. Those who agree that porn addiction exists often compare internet porn to addictive drugs or video-games. While behavioral and substance addictions share certain brain changes, such analogies fail to address the elephant in the room: we posses brain circuits for sex, and these circuits are particularly vulnerable during adolescence (and somewhat vulnerable for as long as we live).

To say it another way, there are no innate circuits for alcohol, cocaine, or first-person shooter. While all can elevate reward center dopamine (requisite for addiction-related brain changes), none has the power to shape our sexual arousal template. Internet porn can alter or sculpt our extensive brain circuitry for sexuality and reproduction.

Since orgasm is our most powerful natural reinforcer, and reproduction our genes' top job, our brain tries to remember everything associated with this powerful experience. It does this by linking associations to The Big Event (climax), which in the case of porn use would include: voyeurism, searching/seeking, endless novelty, fetishes, multiple porn stars, multiple tabs, strange acts, shock, surprise, anxiety, etc.

(Note: We don't address the psychological impact on young people of escalating to hardcore porn of every type imaginable and unimaginable, *while highly aroused* - something our ancestors couldn't do.)

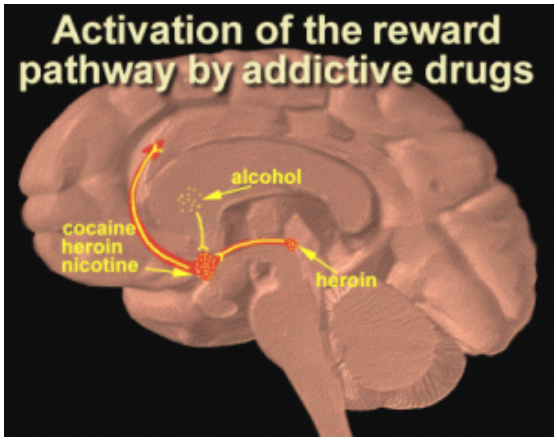
Other qualities that set internet porn apart from other potentially addictive substances and behaviors:

"Internet pornography has absolutely changed my generation's expectations. How could you be constantly synthesizing an orgasm based on dozens of shots?"

- John Mayer, Musician

1. Studies reveal that video porn is far more arousing than static porn.
2. To increase sexual arousal (and raise declining dopamine) one can instantly switch genres during a masturbation session. Couldn't do that before 2006 and the arrival of streaming tube sites.
3. Unlike photos of naked people, videos replace your imagination, and may shape your sexual tastes or trajectory (especially so for adolescents).
4. Porn is stored in your brain, which allows you to recall it anytime you need a "hit."
5. Unlike food and drugs, for which there is a limit to consumption, there are no physical limitations to internet porn consumption. The brain's natural satiation mechanisms are not activated, unless one climaxes. Even then, the user can click to something more exciting to become aroused again.
6. With food and drugs one can only escalate (a marker of an addiction process) by consuming more. With internet porn one can escalate both with more novel "partners" *and* by viewing new and unusual genres. It's quite common for a user to move to evermore extreme porn.
7. The age users start watching porn. A teen's brain is at its peak of dopamine production and neuroplasticity, making it highly vulnerable to addiction and sexual conditioning. Adolescent animals produce higher levels of DeltaFosB in response to drugs and natural rewards.
8.

Sexual stimulation and addictive drugs share similar mechanisms



Sexual stimulation and addictive drugs activate the *exact same reward circuit nerve cells*. In contrast, there's only a small percentage of nerve-cell activation overlap between addictive drugs and other natural rewards such as food or water. Turning on the same nerve cells that make sexual stimulation so compelling helps explain why meth, cocaine, and heroin can be so addictive. Interestingly, heroin addicts often claim that shooting up "feels like an orgasm". Supporting their experience, ejaculation mimics the effects of heroin addiction on the same reward circuit nerve cells. Specifically, ejaculation shrinks the same dopamine producing nerve cells that shrink with chronic heroin use. This doesn't mean sex is bad. It simply informs us that addictive drugs hijack the exact same mechanisms that urge us back into the bedroom for a romp.

In addition, both sex and drug use lead to the accumulation of DeltaFosB, a protein that activates genes involved with addiction. The molecular changes it generates are nearly identical for both sexual conditioning *and* chronic use of drugs. Whether it's sex or drugs of abuse, high levels of DeltaFosB rewire the brain to crave "IT", whatever "IT" is. In other words, addictive drugs hijack the same nerve cells and mechanisms that evolved to make sex so appealing.

Taken together, addictive drugs like meth and heroin are compelling because they hijack the precise nerve cells and mechanisms that evolved to make sex compelling. Most other pleasures do not. Thus, familiar talking points such as this actual comment fall apart - "*Well, lots of activities raise dopamine, so internet porn is no more addictive than watching sunsets or playing golf.*" That's an actual quote from an academic sexologist, demonstrating his ignorance.

The important take-away concept is that drugs can activate the "sex" neurons and trigger a buzz *without* actual sex. So can internet porn. Golf and sunsets cannot. For that matter, nor can good old rock & roll.

Addiction is not required for either porn-induced brain changes or negative effects

OK you get it: Internet porn is a unique supernormal stimulus and a "dopamine-producing machine." The usual question is:
"*What are the possible consequences of all this dopamine*?"
However, the more accurate question is:
"*What are the possible consequences all this dopamine in response to one type of stimulus*? (in this case internet porn and a computer screen)."

Internet porn: Consequences?

1) **Sexual Conditioning:**
   a) **"This is how it's done"**
   b) **"This is what turns me on"**
2) **Addiction-Related Brain Changes:**
   - **Can be on a spectrum**

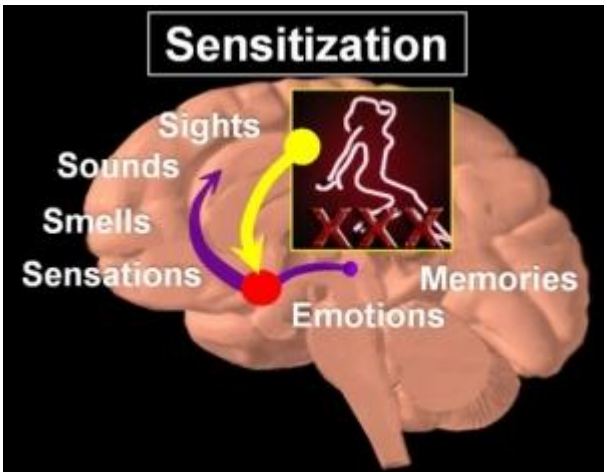
While the consequences are many, the following brain changes play a central role in the myriad symptoms and conditions seen:

1) Sexual conditioning - which manifests in two general ways:

- One type of sexual conditioning can be summed up as - "***This how people have sex, and this is how I should do it***." Most research & popular articles focus on this type of sexual conditioning, especially in adolescents. Although extraordinarily important, YBOP focuses on the second type of sexual conditioning.
- It can be summed as - "***This is what turns me on***." This deeper, more ingrained form of learning might include: watching porn being more exciting than real sex, or needing to click from video to video to stay sexual aroused, or the never-ending list of porn-induced fetishes users report.

2) Addiction-related brain changes - of which there are many. These complex brain changes are on spectrum and can occur without developing a full-blown addiction (as in this study on porn users).

Here's an important concept: Both sexual conditioning and addiction share the same key brain change, occurring in the same structure, which is initiated by the same biological signal.



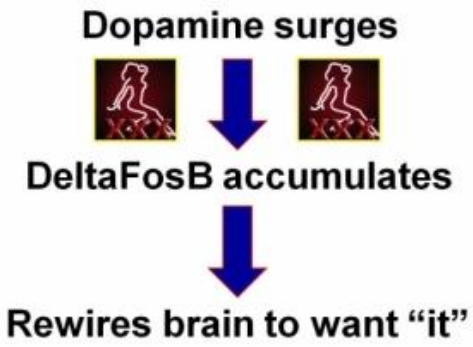
- The brain change is called 'sensitization' (but full blown addiction involves additional brain changes as well)
- The structure is the reward center (nucleus accumbens).
- The primary signal, is of course, dopamine.

Sensitization occurs when the brain wires together the sights, sounds, smells, sensations, emotions, and memories associated with a big reward, such as masturbating to porn - creating a pathway that can blast our reward center in the future. When activated by cues or triggers, this pathway creates powerful, hard to ignore, cravings.

Bingeing on drugs or natural rewards (porn, junk food) induces high levels of dopamine, which your primitive brain interprets as: "*This activity is really, really valuable - and you should do it again and again*." Of course, nothing's more important to your primitive brain than spreading your genes - even if your higher brain realizes it's just a screen. Dopamine helps us remember and repeat what (it assumes) furthers our genes' survival. It accomplishes this through rewiring the brain.

Your hijacked binge mechanism: Dopamine induces DeltaFosB

A "binge mechanism" is an evolutionary advantage in situations where survival is furthered by overriding normal satiety. Think of wolves, which need to stow away up to twenty pounds of a single kill at one go. Or our ancestors, who needed to store high-quality calories as a few extra pounds for easy transport to survive hard times. Or mating season, when there's a harem to impregnate. In the past, such opportunities were rare and passed quickly. (Update: compulsive eating circuit found.)



Our environments have drastically changed. The Internet offers endless mating opportunities, which your primitive brain perceives as real because you find them so arousing. As any good mammal would, you automatically attempt to spread your genes far and wide, but there's no end to *your* mating season.

Click, click, click, masturbate, click, click, click, masturbate, click, click, click. Day in and day out, never giving your brain a well-deserved rest. This can kick your binge mechanism into overdrive. Evolution never prepared your primitive brain for this kind of nonstop stimulation.

Excess consumption (food or sex) is the signal to your primitive brain that you have hit the evolutionary jackpot. With continued daily over-consumption, high levels of dopamine trigger the production of the protein DeltaFosB. Continued over-consumption of natural rewards (sex, sugar, high-fat, aerobic exercise) or chronic administration of virtually any drug of abuse causes DeltaFosB to slowly accumulate in the reward circuitry. DeltaFosB activates certain genes which initiate several brain changes, including sensitization.

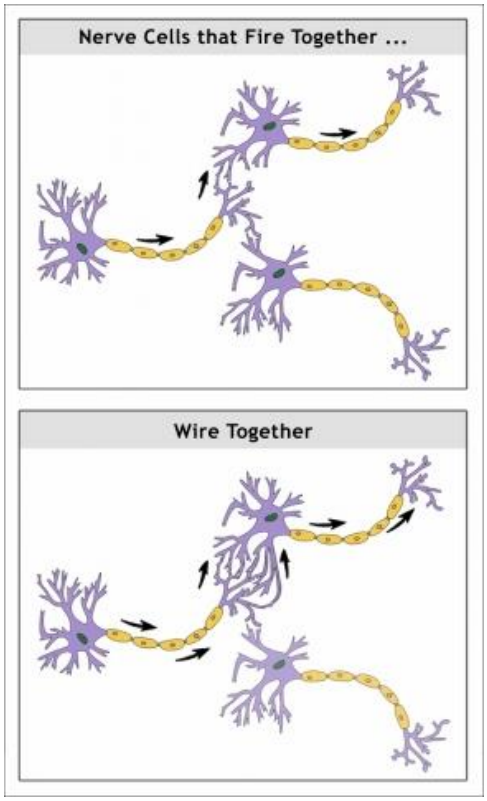
Overconsumption → Dopamine → DeltaFosB → Sensitization

It's important to understand that addictive drugs only cause addiction because they magnify or inhibit mechanisms *already in place for natural rewards*. One of DeltaFosB's evolutionary purposes is to motivate us to "get it while the getting is good!" It's a binge mechanism for food and reproduction, which worked well in other times and environments. With the advent of supernormal versions of natural rewards, however, it makes addictions to junk food and internet porn as easy as 1-2-3.

Sensitization: A Pavlovian super-memory is formed

Learning, memory, and habits can be summed up in the old, but true, saying - "Nerve cells that fire together, wire together."

The rewiring behind addiction arises partly from DeltaFosB, which strengthens the connections between nerve cells, making it easier for them to communicate. While DeltaFosB acts on the reward circuit, stronger nerve connections are behind all learning. This process is called neuroplasticity. The more intense the experience, the stronger the connections. The stronger the connections, the easier it is for electrical impulses to travel along this new pathway.



If habitual porn viewing has caused addiction-related brain changes, you have forged a rut in your brain. Just as water flows through the path of least resistance, so do impulses, and thus thoughts. As with any skill, the more you practice the easier it is do. Soon it becomes automatic, without any conscious thought. You've formed a deep pornography rut in your brain called a *sensitized neural pathway*.

Sensitized pathways can be thought of as Pavlovian conditioning on turbos. When activated by thoughts or triggers, sensitized pathways blast the reward circuit, firing up hard-to-ignore cravings. Several recent brain studies on porn users assessed sensitization, and all reported the same brain response as seen in alcoholics and drug addicts (studies reporting sensitization in porn users: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14)

DeltaFosB slowly degrades, and is back to normal levels about 2 months after an addict last uses. Even though DeltaFosB is no longer present, the sensitized pathways remain, perhaps for a lifetime. Remember, the purpose of DeltaFosB is to promote the rewiring of the brain, so that you will experience a bigger blast from whatever you have been overconsuming. This memory, or deeply ingrained learning, lingers long after the event. Addiction isn't damage - it's pathological learning.

When does one cross the line?

Many ask the obvious question: "*How much is too much*?" This question presumes that porn's effects are binary. That is, you either have no problem, or you are a porn addict. However, porn-induced brain changes occur on a spectrum and cannot be classified as black and white, either/or. Asking where one crosses the line ignores the principle of neuroplasticity: the brain is always learning, changing and adapting in response to the environment.

Studies reveal that even a small amount of supernormal stimulation can rapidly alter the brain and change behavior.

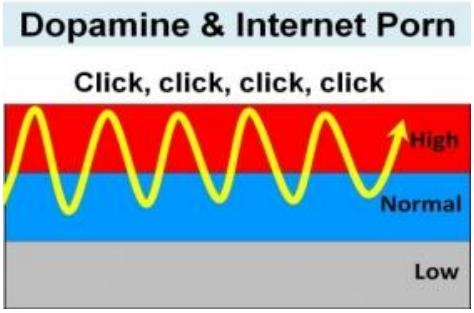
For example, it took only 5 days to induce marked sensitization to video games in healthy young adults. The gamers weren't addicted, but elevated brain activity aligned with subjective cravings to

play. In another experiment, nearly all the rats given unrestricted access to "cafeteria food" binged to obesity. It took only few days of junk food gorging for the rats' dopamine receptors to decline (reducing their satisfaction). Less satisfaction drove the rats to binge even more.

As for Internet porn, this German study onmen *not* addicted to pornfound addiction-related brain changes and less brain activation to porn correlating with more porn consumed. An Italian study found that 16% of high school seniors who consumed porn more than once a week experienced abnormally low sexual desire. Compare that to 0% of non-porn users reporting low sexual desire. The take away is that addiction is not required for either significant brain changes or negative effects.

Put simply, sexual conditioning, sensitization, or other addiction-related brain changes, occur on a spectrum. Also realize that our brain is constantly learning and adapting to the environment. Internet porn, being a supernormal stimulus targeting innate sexual circuits, shapes the brain and alters perception.

This is why posing such questions as "*"What is the definition of porn"*?" or *"How much porn use constitutes an addiction*?" are misleading and irrelevant. The former is like asking whether it's slot machines or blackjack that leads to a gambling addiction. The latter is like asking a food addict how many minutes she spends eating.



The reward center (nucleus accumbens) doesn't know what "porn" is. It only registers levels of stimulation through dopamine spikes. This is physiology, not morality or sexual politics.

Drug addictions aren't the only addictions

It's common knowledge that dopamine-raising substances, such as alcohol or cocaine, can create addictions. Yet only about 10-20% of humans or animals that use addictive drugs (except nicotine) ever become addicts. Does this mean the rest of us are safe from drug addiction? Perhaps. When it comes to substance abuse, both genetics and childhood stress play significant roles.

Yet when it comes to unrestricted access to super-stimulating versions of natural rewards, such as junk food, or even video games, the answer is *no*, although certainly not every user gets hooked.

Several animal studies have shown that junk food is more addictive than cocaine, (rats prefer sugar to cocaine) and that overeating to obesity can bring about addiction-related brain changes. In fact, when rats are given unlimited access to "cafeteria food," nearly 100% binge to obesity. The obese rats' brains and behaviors mirror those of drug addicts. These same rats don't overeat on regular rat chow, just as hunter-gatherers don't get fat on their native diets.
This helps explain why 35% of adult Americans are obese and 70% are overweight, even though none of them want to be. With our brain's reward circuit

lighting up, we can easily slam down 1500 calories in burgers, fries and milkshakes. Try slamming down 1500 calories of dried chewy venison and boiled roots in one sitting (or in one day).

Today's high fat/sugar foods and internet porn (you're reading this) have the potential to hook even more people than do drugs. These supernormal versions of natural rewards can override our brain's satiation mechanisms—the "I'm done" feeling—because concentrated calories and fertilization opportunities are your genes' top priorities. The reason highly stimulating versions of food and sex can hook us—even if we're not otherwise susceptible to addiction—is that our reward circuitry evolved to drive us toward food and sex, not drugs.

To say this another way, there are no innate circuits for seeking heroin, alcohol, or cocaine. Yet there are various brain circuits devoted to seeking out and consuming both food and sex. And, while we like a good meal, sexual arousal and orgasm release the highest levels of rewarding neurochemicals (dopamine and opioids). That's as it should be: reproduction is our genes' #1 job.

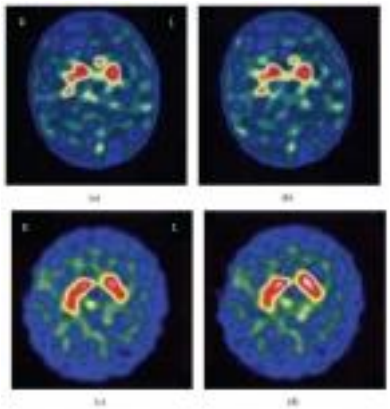
Behavioral & chemical addiction share many of the same fundamental mechanisms & brain changes

Recent research reveals that behavioral addictions (food addiction, pathological gambling, video gaming, Internet addiction and porn addiction) and substance addictions share many of the same fundamental mechanisms leading to a collection of shared alterations in brain anatomy and chemistry.

This is not surprising as drugs can only enhance or inhibit existing physiological functions. The specific way a drug alters cellular function is called its "mechanism of action". All drugs and behaviors that can potentially cause addiction share one important mechanism of action: elevation of dopamine in the nucleus accumbens (also called the reward center).

Addiction-related brain changes include:

1. **Sensitization** *("A super memory of pleasure")*: Rewired nerve connections cause the reward circuitry to buzz in response to addiction-related cues or thoughts. This Pavlovian memory makes the addiction more compelling than other activities in the addict's life. Cues, such as turning on the computer, seeing a pop-up, or being alone, trigger intense cravings for porn. Some describe a sensitized porn response as 'entering a tunnel that has only one escape: porn'. Maybe you feel a rush, rapid heartbeat, even trembling, and all you can think about is logging onto your favorite tube site. These are examples of sensitized addiction pathways activating your reward circuit, screaming, 'Do it now!' (Studies reporting sensitization in porn users: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)



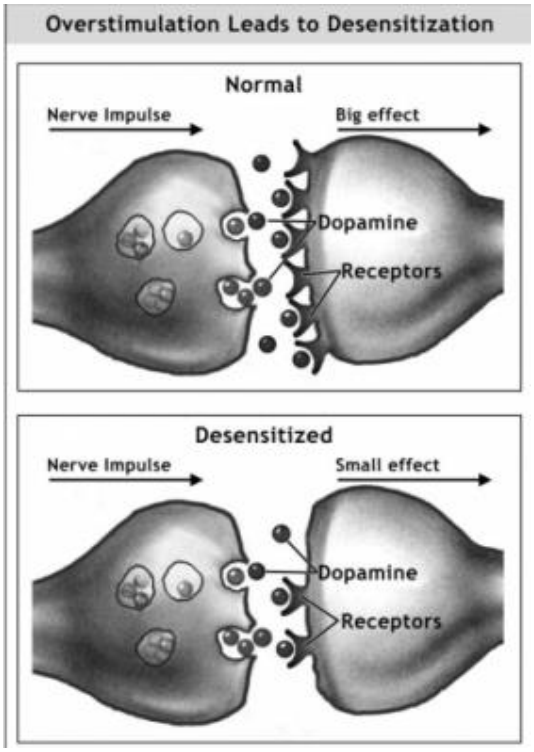
2. **Desensitization** ("A *numbed pleasure response*"): Among other changes, dopamine and opioids decline, as do certain dopamine receptors and opioid receptors. This leaves the individual less sensitive to pleasure, and "hungry" for dopamine-raising activities/substances of all kinds. Desensitization often manifests as the need for greater and greater stimulation to

achieve the same buzz ('tolerance'). Some porn users spend more time online, prolonging sessions through edging, watching when not masturbating, or searching for the perfect video to end with. Desensitization can also take the form of escalating to new genres, sometimes harder and stranger, or even disturbing. Remember: shock, surprise or anxiety can jack up dopamine. (Studies reporting desensitization in porn users: 1, 2, 3, 4, 5)

3. **Hypofrontality** (*"Willpower erodes"):* Alterations in frontal-lobe gray matter and white matter correlate with reduced impulse control and the weakened ability to foresee consequences. Hypofrontality shows up as the feeling that two parts of your brain are engaged in a tug-of-war. The sensitized addiction pathways are screaming 'Yes!' while your 'higher brain' is saying, 'No, not again!' While the executive-control portions of your brain are in a weakened condition the addiction pathways usually win. (Studies reporting "hypofrontality" in porn users: 1, 2, 3, 4, 5, 6)
4. **Dysfunctional stress circuits** - which can make even minor stress lead to cravings and relapse because they activate powerful sensitized pathways. (Studies reporting dysfunctional stress responses in porn users: 1)

Are these the only brain changes? No. Each of these broad-brush indicators reflects multiple subtler addiction-related cellular and chemical alterations—just as the scan of a cancer tumor wouldn't show associated subtler cellular/chemical changes. Most of the subtler changes can't be assessed in human models due to the invasiveness of the technologies required. However, they have been identified in animal models. See this review describing brain changes in both drug and behavior addictions: Natural Rewards, Neuroplasticity, and Non-Drug Addictions (2011)

More pleasure seeking leads to less pleasure (desensitization)



As sensitization and cravings compel you to use porn, overstimulation of the reward circuitry leads to a localized rebellion. The nerve cells bombarded by dopamine say "enough is enough." If someone continues to scream, you cover your ears. When dopamine-sending nerve cells keep pumping out dopamine, the receiving nerve cells cover their "ears" by reducing dopamine (D2) receptors. To make matters worse, D2 receptors help put the brakes on over-consumption, so their loss means cravings are harder to resist. Desensitization also involves a decline in both dopamine and opioids. Finally, a 2014 brain study on porn users found that greater porn use was associated with greater desensitization (loss of reward circuit grey matter, less sexual arousal).
The cycle of desensitization mimics other addictions:

bingeing→ cravings→ numbed pleasure response→ cravings→ bingeing escalates→ further decline in dopamine, opioids and their receptors→ further desensitization...

And soon you are hooked on porn, because nothing else is anywhere near as interesting to your brain. From your genes' perspective, it's the perfect design—to keep you fertilizing frantically—before this "valuable mating opportunity" slips away.

Desensitization numbs you to everyday pleasures, while sensitization makes your brain hyper-reactive to anything associated with your porn addiction. Over time, this dual-edged mechanism can have your reward circuitry buzzing at the hint of porn use, but less than enthused when presented with the real deal. Desensitization is not "damage." Your nerve cells could rebuild lost dopamine or opioid receptors in a flash. Rather, desensitization represents a negative feedback system in overdrive (probably maintained by epigenetic changes).

If these two neuroplastic changes could speak, desensitization would be moaning, "*I can't get no satisfaction*" (low dopamine signaling), while sensitization would be poking you in the ribs and saying, "*Hey buddy, I got just what you need*," which happens to be the very thing that caused the desensitization.

A numbed pleasure response (desensitization), combined with a deep brain pathway leading to cravings and short-term relief (sensitization), is what drives most addictions.

Escalation and rewiring

Developing tolerance (numbed pleasure response) means an addict needs more of his/her "drug" to get the same effect. Heavy porn users sometimes notice that as tolerance builds for their earlier tastes, they move in new directions in their search for intense arousal. Many seek out what shocks them—perhaps because "forbidden" and "fear-producing," plus sexual arousal, offer a bigger brain-chemical kick...at least for a time.

So, it's not unusual to start out your porn career with an image of a famous hottie's fine butt—and months later find you have "progressed" to girls with goats or violent rape scenes. Keep in mind that that when an addict escalates to new genres or logs more hours of use in search of satisfaction, he is driven by desensitization. His fundamental sexual orientation has not changed.

The more intense the associated events (orgasm + video), or the more they are repeated, the stronger the wiring. Each experience wires the new tastes into the brain. If your sexual tastes have changed so has your brain.

Definition of addiction?

Some still believe that only chemicals, not behaviors such as internet porn use, can cause addiction. However, neuroscientists who study the effects of addiction on the brain know differently. Experts in the field define addiction in many ways. A simple model for understanding addiction is to apply the four Cs:

1. *Compulsion* to use
2. *Continued* use in spite of adverse consequences

3. Inability to *Control* use
4. *Craving* - psychological or physical

Addiction may be accompanied by physical dependence and withdrawal symptoms. Many heavy porn users are surprised by the severity of their withdrawal symptoms, which overlap with those experienced by cocaine addicts and alcoholics. (Take this quiz to see if the addiction process is taking hold in your brain.)

The American Society of Addiction Medicine (ASAM): 'Sexual behavior addictions exist!'

The real addiction experts, the American Society for Addiction Medicine, emphasize this simple concept based on decades of research: *Exhibiting the signs, symptoms and behaviors associated with addiction indicates the underlying brain changes have occurred.*

The American Society of Addiction Medicine (ASAM) hammered what should have been the final nail in the porn-addiction debate coffin in August, 2011, ten months after YBOP went online. America's top addiction experts at ASAM released their sweeping new definition of addiction. The new definition echoes the major points made on this website. Foremost, behavioral addictions affect the brain in the same fundamental ways as drugs do. In other words, *addiction is one disease (condition), not many*.

For all practical purposes, this new definition ends the debate over whether sex and porn addictions are "real addictions." ASAM explicitly states that sexual behavior addictions exist and must be caused by the same major brain changes found in substance addictions. In fact, a newly created behavioral addiction category appears in the new DSM-5, and, in time, Internet addictions will have to be added to bring the DSM into alignment with addiction research (see - National Institute of Mental Health director says the DSM is flawed and outdated.)

Those who shout "pseudoscience" at the mention of internet porn addiction either have a political agenda or are unaware of recent advances in addiction neuroscience. Here's a excellent peer-reviewed journal article of where addiction neuroscience is with respect to porn addiction: Pornography addiction – a supranormal stimulus considered in the context of neuroplasticity (2013).

Brain studies confirm what we already knew

Numerous brain studies on porn users have been published since this article first appeared in January, 2011. All support the porn addiction model:

The above studies provide very strong support for hypotheses put forth by YBOP a few years ago. The findings include:

1. The 3 major addiction-related brain changes: sensitization, desensitization, and hypofrontality.
2. More porn use correlated with less grey matter in the reward circuit (dorsal striatum).
3. More porn use correlated with less reward circuit activation when viewing sexual images.
4. More porn use correlated with disrupted neural connections between the reward circuit and prefrontal cortex.
5. Addicts had greater prefrontal activity to sexual cues, but less brain activity to normal stimuli (matches drug addiction).

6. 60% of compulsive porn addicted subjects in one study experienced ED or low libido with partners, but not with porn: all stated that internet porn use caused their ED/low libido.
7. Enhanced attentional bias comparable to drug users. Indicates sensitization (a product of DeltaFosb).
8. Greater wanting & craving for porn, but not greater liking. This aligns with the accepted model of addiction - incentive sensitization.
9. The younger the porn users the greater the cue-induced reactivity in the reward center.
10. Higher EEG (P300) readings when porn users were exposed to porn cues (which occurs in other addictions).
11. Less desire for sex with a person correlating with greater cue-reactivity to porn images.
12. More porn use related with lower LPP amplitude when viewing sexual photos: indicates habituation or desensitization.
13. Dysfunctional HPA axis which reflects altered brain stress circuits.

To summarize the current state of addiction neuroscience:
For political reasons, brain research *isolating* internet porn addicts from plain old Internet addicts has been very slow in arriving. In addition to the above brain studies on porn users, over 130 brain studies on "Internet addicts" have been published, and *all have found the same fundamental brain changes as seen in drug addicts*. The studies did not assess what percentage of research subjects were addicted to internet porn. However, it would be illogical to conclude that high levels of internet porn use cannot change the brain, when junk food, video games, gambling, and "the Internet" have already been proven to do so.

While slow to arrive, every single neuroscience based study published (or in the press) on internet porn users supports the premise that internet porn use can cause addiction-related brain changes. So do recent neuroscience-based reviews of the literature:

1. Sex Addiction as a Disease: Evidence for Assessment, Diagnosis, and Response to Critics (2015), which provides a chart that takes on specific criticisms and offers citations that counter them.
2. For a thorough review of the neuroscience literature related to Internet addiction subtypes, with special focus on internet porn addiction, see - Neuroscience of Internet Pornography Addiction: A Review and Update (2015). The review also critiques two recent headline-grabbing EEG studies which purport to have "debunked" porn addiction.
3. Should Compulsive Sexual Behavior be Considered an Addiction? (2016). Excerpt: "*Overlapping features exist between CSB and substance use disorders. Common neurotransmitter systems may contribute to CSB and substance use disorders, and recent neuroimaging studies highlight similarities relating to craving and attentional biases. Similar pharmacological and psychotherapeutic treatments may be applicable to CSB and substance addictions*"
4. Compulsive Sexual Behaviour as a Behavioural Addiction: The Impact of the Internet and Other Issues (2016). Excerpts: "*more emphasis is needed on the characteristics of the internet as these may facilitate problematic sexual behaviour.*" and "*clinical evidence from those who help and treat such individuals should be given greater credence by the psychiatric community*."

The above studies and reviews are supported by decades of extensive addiction research which has found:

- That both behavioral and chemical addictions share the same fundamental brain changes and mechanisms.

- That when animals & humans exhibit the signs, behaviors and symptoms of an addiction, corresponding brain changes are also present.
- That addiction-related brain changes (both behavioral and chemical) are triggered by accumulation of DeltaFosB.
- That all brain research done thus far on Internet addiction (which includes porn use) reveals the same kinds of brain changes as seen in drug addicts.
- That Internet addiction and porn use studies have demonstrated causation of various symptoms and brain changes.
- The DSM-5 field studies conclude that hypersexual disorder exists. (However, "hypersexual" is a misleading term, which denies the behavioral addiction research findings.)

What about studies that refute porn addiction?
There are none. Perhaps you have read headlines or articles describing studies that claim to refute porn addiction. Check out the names of the studies. I guarantee you will find one of these three papers:

Nicole Prause is the lead author on studies 1 and 2, and is the second author on paper #3. Contrary to the authors' claims, studies one and two actually support the porn addiction model. This page contains the YBOP analysis along with three peer-reviewed critiques of study #1. This page contains the YBOP analysis along with three peer-reviewed analysis of study #2. All of the peer-reviewed analysis are in agreement with the YBOP critiques.

What's going on here? Nicole Prause, by her own admission, vehemently rejects the concept of porn addiction. For example, a quote from this recent Martin Daubney article about sex/porn addictions:

"Dr Nicole Prause, principal investigator at the Sexual Psychophysiology and Affective Neuroscience (Span) Laboratory in Los Angeles, calls herself a **"professional debunker" of sex addiction."**

In addition, Nicole Prause's former Twitter slogan suggests she may lack the impartiality required for scientific research:

"Studying why people choose to engage in sexual behaviors **without invoking addiction nonsense"**

Finally, it should be noted that Nicole Prause now offers (for a fee) her "expert" testimony against "sex addiction". It seems as though Prause is attempting to sell her services to profit from the *claimed* anti-porn addiction conclusions of her two EEG studies (1, 2), even though peer-reviewed critiques say both studies support the addiction model.

The third paper is not a study at all. Instead, it claims to be a "review of the literature" on porn addiction and porn's effects. Nothing could be farther from the truth. The lead author, David Ley, is the author of *The Myth of Sex Addiction* and the Nicole Prause is the second author. Ley & Prause not

only teamed up to write paper #3, they also teamed up to write a *Psychology Today* blog post about paper #1. The blog post appeared 5 months *before* Prause's paper was formally published (so no one could refute it). You may have seen Ley's blog post with the oh-so-catchy title: "Your Brain on Porn - It's NOT Addictive". Ley religiously denies both sex and porn addiction. He has written 20 or so blog posts attacking porn-recovery forums, and dismissing porn addiction and porn-induced ED. Read more about Ley & Prause and their collaborations here.Interestingly,David Ley also profits from denying sex and porn addiction. At the end of this Psychology Today blog post Ley states: "*Disclosure: David Ley has provided testimony in legal cases involving claims of sex addiction.*"

The following is a very long analysis of paper #3, which goes line-by-line, showing all the shenanigans Ley & Prause incorporated in their "review": The Emperor Has No Clothes: A Fractured Fairytale Posing As A Review. It completely dismantles the so-called review, and documents dozens of misrepresentations of the research they cited. The most shocking aspect of the Ley review is that it omitted any study that reported negative effects related to porn use or found porn addiction! Yes, you read that right. While purporting to write an "objective" review, these two sexologists justified omitting hundreds of studies on the grounds that these were correlational studies. Guess what? Virtually all studies on porn are correlational . There are, and pretty much will be, only correlational studies, because researchers have no way to find "porn virgins" or keep subjects off of porn for extended periods in order compare effects. (Thousands of guys are quitting porn *voluntarily* on various forums, however, and their results suggest that removing internet porn is the key variable in their symptoms and recoveries.)

For quick refutation of the naysayers' pseudoscience watch Gabe Deem's video: PORN MYTHS - The Truth Behind Addiction And Sexual Dysfunctions

Internet porn addiction is not sex addiction

Sex addiction requires real people; porn addiction requires a screen and an Internet connection. The majority of guys we see started on internet porn long before any sexual contact: young guys who rewired their adolescent sexuality to clicking, searching, voyeurism, multiple tabs, HD streaming hardcore - long before their first kiss. Does this sound like a Tiger Woods-esque addiction? No.

Any debates on porn addiction should therefore exclude all mention of sex addiction or how "normal male behavior" is being pathologized. When did *normal* sexual behavior evolve into staring at a screen, masturbating with your non-dominant hand while clicking through scene after scene, searching for "the one" to finish off? Watch a great talk given at the 2015 Society for the Advancement of Sexual Health (SASH) annual conference: Porn Addiction Is NOT Sex Addiction.

Can masturbation play a role in this addiction?

Of course, but masturbation is not required. That said, frequent ejaculation in animals leads to several brain changes that inhibit dopamine, and thus libido, for several days. Under normal circumstances, sexual satiety (defined differently for each species) leads to males taking a time out from sexual activity. Sexually satiated porn users may override these inhibitory mechanisms by escalating to more extreme porn, or spending more time watching. Both goose dopamine. Pushing past "I'm done" signals can lead to the accumulation of DeltaFosB. Certainly, eating to obesity

causes the accumulation of DeltaFosB. However, without the lure of internet porn, how many guys would just give it a rest? Most all. For more, see Does Frequent Ejaculation Cause A Hangover?

Note: Many debates about porn addiction (existence or effects) I've seen devolve into debates about masturbation. This is nonsensical and completely muddies the discussion. YBOP is only concerned with internet porn use, not the pros, cons, or frequency of masturbation.

Many symptoms, one cause: Neuroplastic brain changes
People arrive here with lots of different symptoms, which they're not always *sure* are due to their heavy porn use. Confusion is understandable because the symptoms look so different:

There's good reason to believe these symptoms can often arise from addiction-related brain changes, as the reward circuit contains structures that influence emotions, moods, cognitive function, stress response, the autonomic nervous system, and the endocrine system. For example, many of the above complaints such as social anxiety, depression, low motivation, ED, and concentration problems, have been linked to low dopamine and low or altered D2 receptors. For the neurobiology of the many benefits ex-porn users experience, see Porn, Masturbation and Mojo: A Neuroscience Perspective.

Rebalancing the brain (Rebooting)
If this phenomenon is underlying *your* symptoms, you need to *restore the sensitivity of your reward circuit*, *weaken sensitized addiction pathways,* and *strengthen executive control*. We call this process **"rebooting."** The best way to reboot is to give your brain a rest from all intense *artificial sexual stimulation*—including porn, fantasizing about porn, chat rooms, erotic stories, surfing for pictures—until it bounces back to normal responsiveness.

Those addicted to porn often find the rebooting process easier and faster when they drastically reduce or eliminate masturbation. This abstinence from masturbation and orgasm isn't a lifestyle; it's a *temporary* method for deepening recovery and reducing relapses into porn. Obviously, this process is initially very difficult. The brain can no longer rely on the artificially intense "fix" of dopamine (and other neurochemicals) associated with heavy porn use.

In addition to desensitization, porn use strengthens nerve connections linking the short-term relief of internet porn with any trigger your brain associates with porn (sensitization). Triggers such as being home alone, sexy images, or stress and anxiety, can activate your brain's porn rut. The only way to weaken these subconscious links is to stop using (reinforcing) that brain pathway, and seek your mood medicine elsewhere. Eliminating porn and porn fantasy leads to "un-wiring" and eventual weakening of sensitized pathways and cravings.

The other half of the rewiring process involves spending time with real potential mates. Affectionate contact is healthful for both partners and can help you rewire your arousal to real people. When to have sex? After a time-out (the length of which varies depending upon individual circumstances), some guys find that resuming sexual activity with a real partner is especially helpful, as long as they (and their partners) don't try to force ejaculation until it happens naturally.

Eliminating porn use often strengthens your executive control, which resides in your frontal cortex (behind your forehead). Assessing risk, making long-range plans, and controlling impulses are under the control of the frontal cortex. The term *hypofrontality* is often used when describing how addictions weaken and inhibit these self-control circuits. It takes time, and consistency, to return these circuits to full working order.

Remember: Your freedom lies in rebalancing your brain. Then you can choose whether you will activate your porn-arousal pathway or some pathway that yields results you prefer. Needless to say, rebooting doesn't guarantee you can safely use internet porn in the future. The human brain remains vulnerable to a downward spiral from too much of any intense stimulus, and your brain has a sensitized porn pathway, which can always be reactivated.

Many have stopped using porn and recovered their lives. So can you.

For a more in-depth understanding of the science behind internet porn addiction, read these articles in sequence (follow the embedded links for citations):

- Intoxicating Behaviors: 300 Vaginas = A Lot of Dopamine: We are easily hooked by supernormal versions of natural rewards
- Porn, Novelty and the Coolidge Effect: Without the Coolidge Effect there would be no internet porn
- Porn Then and Now: Welcome to Brain Training: "Are we the first generation to masturbate left-handed?"
- What happens when you ejaculate too much?: Overriding sexual satiation mechanisms may have consequences.
- Why Shouldn't Johnny Watch Porn If He Likes?: Sexual brain training matters—especially during adolescence
- Why Do I Find Porn More Exciting Than A Partner?: Neuroscience reveals how internet porn can trump real sex
- Are Sexual Tastes Immutable?: It's time to distinguish 'sexual orientation' from reversible 'sexual tastes'
- Can You Trust Your Johnson?: Is internet porn making male sexuality more plastic?
- Recent Internet Addiction Brain Studies Include Porn: Brain research on Internet addiction points in only one direction
- Porn, Pseudoscience and ΔFosB: Can you spot these 5 familiar myths about porn addiction?
- The Other Porn Experiment: What can informal control groups of former porn users show us?
- Porn, Masturbation and Mojo: A Neuroscience Perspective: Ex-porn users usually get their mojo back. Why?
- Young Porn Users Need Longer To Recover Their : Is high-speed porn use rewiring adolescent sexuality?
- Porn Addiction is Not Sex Addiction--And Why It Matters
- Toss Your Textbooks: Docs Redefine Sexual Behavior Addictions: American Society of Addiction Medicine releases their sweeping new definition of addiction and FAQ's.