



Fleeing Vesuvius: The psychological roots of resource over-consumption

Posted by [nate hagens](#) on May 11, 2011 - 8:50am

The essay below is an updated and edited version of a post I wrote here a few years ago, [I'm Human, I'm American and I'm Addicted to Oil](#). Richard Douthwaite, Irish economist and activist, (and a fellow at the Post Carbon Institute), invited me to contribute it as a chapter in the just released book [Fleeing Vesuvius](#), which is a collection of articles generally addressing "how can we bring the world out of the mess it finds itself in"? My article dealt with the evolutionary underpinnings of our aggregate behavior - neural habituation to increasingly available stimuli, and our penchant to compete for status given the environmental (cultural) cues of our day. And how, after we make it through the likely upcoming currency/claims bottleneck, we would be wise to adhere to an evolutionary perspective in considering a future (more) sustainable society.



Here is my updated chapter from Fleeing Vesuvius

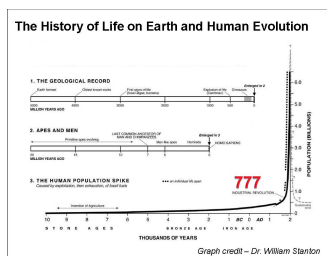
The psychological roots of resource over-consumption

Humans have an innate need for status and for novelty in their lives. Unfortunately, the modern world has adopted very energy- and resource-intensive ways of meeting those needs. Other ways are going to have to be found as part of the move to a more sustainable world.

Most people associate the word "sustainability" with changes to the supply side of our modern way of life such as using energy from solar flows rather than fossil fuels, recycling, green tech and greater efficiency. In this essay, however, I will focus on the demand-side drivers that explain why we continue to seek and consume more stuff.

When addressing 'demand-side drivers', we must begin at the source: the human brain. The various layers and mechanisms of our brain have been built on top of each other via millions and millions of iterations, keeping intact what 'worked' and adding via changes and mutations what helped the pre-human, pre-mammal organism to incrementally advance. Brain structures that functioned poorly in ancient environments are no longer around. Everyone reading this page is descended from the best of the best at both surviving and procreating which, in an environment of privation and danger where most 'iterations' of our evolution happened, meant acquiring necessary resources, achieving status and possessing brains finely tuned to natural dangers and opportunities.

This essay outlines two fundamental ways in which the evolutionarily derived reward pathways of our brains are influencing our modern overconsumption. First, financial wealth accumulation and the accompanying conspicuous consumption are generally regarded as the signals of modern success for our species. This gives the rest of us environmental cues to compete for more and more stuff as a proxy of our status and achievement. A second and more subtle driver is that we are easily hijacked by and habituated to novel stimuli. As we shall see, the prevalence of novelty today eventually demands higher and higher levels of neural stimulation, which often need increased consumption to satisfy. Thus it is this combination of pursuit of social status and the plethora of *novel activities* that underlies our large appetite for resource throughput.



Status

Evolution has honed and culled 'what worked' by combining the substrate of life with eons' worth of iterations. Modern biological research has focused on the concept of 'relative fitness', a term for describing those adaptations that are successful in propelling genes, or suites of genes, into the next generation and that will have out-competed those that were deleterious or did not keep up with environmental change. Though absolute fitness mattered to the individual organisms while they were alive, looking back it was 'relative fitness' that shaped the bodies and brains of the creatures on the planet today.

Status, both in humans and other species, has historically been a signaling mechanism that minimised the costs of competition, whether for reproductive opportunities or for material resources. If you place ten chickens in an enclosure there will ensue a series of fights until a pecking order is established. Each bird quickly learns who it can and cannot beat and a status hierarchy is created, thus making future fights (and wastes of energy) less common. Physical competition is costly behaviour that requires energy and entails risk of injury. Status is one way to determine who one can profitably challenge and who one cannot. In our ancestral environment, those men (and women) that successfully moved up the social hierarchy improved their mating and resource prospects. Those at the bottom of the status rung did not only possess fewer mating opportunities but many did not mate at all. Status among our ancestors was probably linked to those attributes providing consistent benefits to the tribe: hunting prowess, strength, leadership ability, storytelling skills etc. In modern humans, status is defined by what our modern cultures dictate. As we are living through an era of massive energy gain from fossil fuels, pure physical prowess has been replaced by digital wealth, fast cars, political connections, etc.

It follows that the larger a culture's resource subsidy (natural wealth), the more opportunity there is for 'status badges' uncorrelated with basic needs such as strength, intelligence, adaptability, stamina, etc. Though 'what' defines status may be culturally derived, status hierarchies themselves are part of our evolved nature. Ancestral hominids at the bottom of the mating pecking order, *ceteris paribus*, are not our ancestors. Similarly, many of our ancestors had orders of magnitude more descendants than others. For example, scientists recently discovered an odd geographical preponderance for a particular Y chromosome mutation which turns out to be originally descended from Genghis Khan. Given the 16 million odd male descendants alive today with this Y marker, Mr. Khan is theorised to have had 800,000 times the reproductive

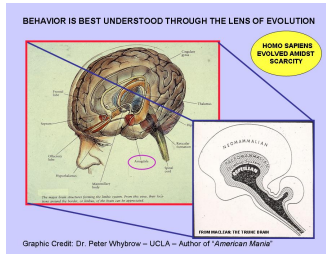
success than the average male alive on the planet in 1200 AD. This does not imply that we are all pillagers and conquerors — only that various phenotypic expressions have had ample opportunity to become hardwired in our evolutionary past. [1]

Mating success is a key driver in the natural world. This is all studied and documented by evolutionary research into the theory of “sexual selection”, which Charles Darwin once summarised as the effects of the “struggle between the individuals of one sex, generally the males, for the possession of the other sex.” [2] Biologists have shown that a primary way to reliably demonstrate one’s ‘quality’ during courtship is to display a high-cost signal — e.g. a heavy and colourful peacock’s tail, an energy-expending bird-song concert, or a \$100,000 sports car. [3] These costly “handicap” signals are evolutionarily stable indicators of their producer’s quality, because cheap signals are too easy for low-quality imitators to fake. [4]

In this sense ‘waste’ was an evolutionary selection! Think of three major drawbacks to a male peacock of growing such a hugely ornate tail:

1. the energy, vitamins and minerals needed to go into the creation of the tail could have been used for other survival/reproductive needs,
2. the tail makes the bird more likely to be spotted by a predator,
3. If spotted, the cumbersome tail makes escape from a predator less likely.

Overall, though, these negative “fitness hits” must have been outweighed by the drab female peahen’s preference for males with larger, more ornate tails. With this filter, we can understand the rationale and prevalence of Veblen goods (named after the 19th-century economist who coined the term ‘conspicuous consumption’) — a group of commodities that people increasingly prefer to buy as their price gets higher because the greater price confers greater status. This biological precept of signalling theory is alive and well in the human culture.



Novelty

Modern man evolved from earlier hominids under conditions of privation and scarcity at least until about 10,000 years ago. The period since then has been too short a time to make a significant change to millions of years of prior neural sculpture. Nature made the brain’s survival systems incredibly efficient. The brain is based on about 40% of all our available genes and consumes over 20% of our calorific intake. Incremental changes in how our brains recognise, process and react to the world around us either contributed to our survival and thus were carried forward, or died out.

Some changes affected *salience*, the ability to notice what is important, different or unusual. Salience recognition is part of what’s called the mesolimbic dopamine reward pathway. This pathway is a system of neurons integral to survival efficiency, helping us to instantly decide what in the environment should command our attention. Historically, immediate feedback on what is ‘new’ was critical to both avoiding danger and procuring food. Because most of what happens around us each day is predictable, processing every detail of a familiar habitat wastes brain energy. Such activity would also slow down our mental computer so that what are now minor distractions could prove deadly. Thus our ancestors living on the African savanna paid little attention to the stable mountains on the horizon but were quick to detect any movement in the bush, on the plains, or at the riverbank. Those more able to detect and process ‘novel cues’ were more likely to obtain rewards needed to survive and pass on their suites of genes. Indeed, modern experimental removal of the (dopamine) receptor genes in animals causes them to reduce exploratory behaviour, a key variable related to inclusive fitness in animal biology. [5]

We are instinctually geared for individual survival — being both reward-driven, and curious. It was these two core traits that the father of economics himself, Adam Smith, predicted in *The Wealth of Nations* would be the drivers of world economic growth. According to Smith, uniting the twin economic engines of self-interest (which he termed self-love) and curiosity was ambition — “the competitive human drive for social betterment”. About 70 years later, after reading Adam Smith’s *Theory of Moral Sentiments*, Charles Darwin recognised the parallel between the pursuit of wealth in human societies and the competition for resources that occurred among animal species. Our market system of allocating resources and ‘status’ can therefore be seen as the natural social culmination for an intelligent species finding an abundance of resources.

But, as we shall soon see, the revered Scottish philosopher could not have envisioned heli-skiing, Starbucks, slot machines, Facebook, email and many other stimulating and pleasurable objects and activities that people engage in today and to which they so easily become accustomed.

The mesolimbic dopaminergic reward system

“Americans find prosperity almost everywhere, but not happiness. For them desire for well-being has become a restless burning passion which increases with satisfaction. To start with emigration was a necessity for them: now it is a sort of gamble, and they enjoy the sensations as much as the profit.” Alexis de Tocqueville, *Democracy in America* 1831

Traditional drug abuse happens because natural selection has shaped behaviour-regulation mechanisms that function via chemical transmitters in our brains. [6] Addicts can become habituated to the feelings they get from cocaine, heroin or alcohol, and they need to increase their consumption over time to get the same neurotransmitter highs. This same neural reward architecture is present in all of us when considering our ecological footprints: we become habituated via a positive feedback loop to the ‘chemical sensations’ we receive from shopping, keeping up with the Joneses (conspicuous consumption), pursuing more stock profits, and myriad other stimulating activities that a surplus of cheap energy has provided.

An explosion of neuroscience and brain-imaging research tells us that drugs of abuse activate the brain’s dopamine reward system that regulates our ability to feel pleasure and be motivated for “more”. When we have a great experience — a glance from a pretty girl, a lovemaking romp in the woods, a plate of fresh sushi, hitting 777 on a one-eyed bandit, catching a lunker pike, watching a sunset, hearing a great guitar riff etc. — our brain experiences a surge in the level of the neurotransmitter dopamine. We feel warm, ‘in the zone’ and happy. After a while, the extra dopamine gets flushed out of our system and we return to our baseline level. We go about our lives, looking forward to the next pleasurable experience. But the previous experience has been logged into our brain’s limbic system, which, in addition to being a centre for pleasure and emotion, holds our memory and motivation circuitry. [7] We now begin to look forward to encores of such heady stimuli and are easily persuaded towards activities that promise such a chemical reprise. These desires have their beginnings outside our conscious awareness. Recent brain-

imaging research shows that drug and sexual cues as brief as 33 milliseconds can activate the dopamine circuitry, even if a person is not conscious of the cues. Perhaps there are artistically shaped sexual images hidden in advertisements for whiskey after all...

Historically, this entire system evolved from the biological imperative of survival. Food meant survival, sex meant survival (of genes or suites of genes), and additional stockpiles of both provided success relative to others, both within and between species. There was a discrete payoff to waiting hours for some movement in the brush that signaled 'food', or the sound of a particular bird that circled a tree with a beehive full of honey, etc. Our pattern recognition system on the Pleistocene would have been a grab-bag of various environmental stimuli that 'excited' our brains towards action that correlated with resources (typically food). In sum, the brain's reward pathways record both the actual experience of pleasure as well as ensuring that the behaviours that led to it are remembered and repeated. *Irrespective of whether they are 'good' for the organism in the current context — they 'feel' good, which is the mechanism our brain has left us as a heritage of natural selection.*

The (very important) mechanism of habituation

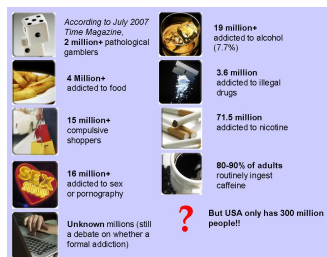
Habituation — getting used to something — and subsequent substance abuse and addiction develops because of the way we learn. Learning depends crucially on the discrepancy between the prediction and occurrence of a reward. A reward that is fully predicted does not contribute to learning. [8] The important implication of this is that learning advances only to the extent to which something is unpredicted and slows progressively as a stimuli becomes more predictable. [9] *As such, unexpected reward is a core driver in how we learn, how we experience life, and how we consume resources.*

Dopamine activation has been linked with addictive, impulsive activity in numerous species. Dopamine is released within the brain not only to rewarding stimuli but also to those events that predict rewards. It has long been known that two groups of neurons, in the ventral tegmental and the substantia nigra pars compacta areas, and the dopamine they release, are critical for reinforcing certain kinds of behaviour. Neuroscientist Wolfram Schultz measured the activity of these dopamine neurons while thirsty monkeys waited for a tone which was followed by a squirt of fruit juice into their mouths. After a series of fixed, steady amounts of juice, the volume of juice was suddenly doubled. The rate of neuron firing went from about 3 per second to 80 per second. But after several trials, after the monkeys had become habituated to this new level of reward, their dopamine firing rate returned to the baseline rate of 3 firings per second after the squirt of juice. The monkeys had become habituated to the coming reward! The opposite happened when the reward was reduced without warning. The firing rate dropped dramatically, but eventually returned to the baseline rate of 3 firings per second. [10]

The first time we experience a drug or alcohol high, the amount of chemical we ingest often exceeds the levels of naturally occurring neurotransmitters in our bodies by an order of magnitude. [11] No matter how brief, that experience is stored in our neural homes for motivation and memory — the amygdala and hippocampus. Getting drunk with your friends, getting high on a ski-lift, removing the undergarments of a member of the opposite sex for the first time — all initially flood the brain with dopamine alongside a picture memory of the event chemically linked to the body's pleasurable response to it. As such we look forward to doing it again, not so much because we want to repeat the activity, but because we want to recreate that 'feeling'.

But in a modern stimuli-laden culture, this process is easily hijacked. After each upward spike, dopamine levels again recede, eventually to below the baseline. The following spike doesn't go quite as high as the one before it. Over time, the rush becomes smaller, and the crash that follows becomes steeper. The brain has been fooled into thinking that achieving that high is equivalent to survival and therefore the 'consume' light remains on all the time. Eventually, the brain is forced to turn on a self-defence mechanism, reducing the production of dopamine altogether — thus weakening the pleasure circuits' intended function. At this point, an 'addicted' person is compelled to use the substance not to get high, but just to feel normal — since one's own body is producing little or no endogenous dopamine response. Such a person has reached a state of 'anhedonia', or inability to feel pleasure via normal experiences. Being addicted also raises the risk of having depression; being depressed increases the risk of self-medicating, which then leads to addiction, etc. via positive feedback loops.

In sum, when exposed to novel stimuli, high levels of curiosity (dopamine) are generated, but it is the *unexpected reward* that causes their activation. If I order a fantastic array of sushi and the waiter brings me a toothpick and my check, I am going to have a plunge in dopamine levels which will create an immediate craving for food. It is this interplay between expected reward and reality that underlies much of our behavioural reactions. Ultimately, as it relates to resource consumption, repeated use of any dopamine-generating 'activity' eventually results in tolerance. Withdrawal results in lower levels of dopamine and continuous use is required to keep dopamine at normal levels, and even higher doses to get the 'high' levels of initial use. Consumers in rich nations are arguably reaching higher and higher levels of consumption tolerance. If there was such a thing as 'cultural anhedonia', we might be approaching it.



America's Addictions - Time Magazine - July 2007

America and addiction

It would be pretty hard to be addicted directly to oil; it's toxic, slimy and tastes really bad. But given the above background, we can see how it is possible to become addicted to the energy services that oil provides. Humans are naturally geared for individual survival — curious, reward-driven and self-absorbed — but modern technology has now become a vector for these cravings. Material wealth and the abundant choices available in contemporary US society are unique in human (or animal) experience; never before in the history of our species have so many enjoyed (used?) so much. Within a culture promoting 'more', it is no wonder we have so many addicts. High-density energy and human ingenuity have removed the natural constraints on our behaviour of distance, time, oceans and mountains. For now, these phenomena are largely confined to developed nations — people living in a hut in Botswana or a yurt in Mongolia cannot as easily be exposed to the 'hijacking stimuli' of an average westerner, especially one living in a big city in the West, like London or Los Angeles.

Many activities in an energy-rich society unintentionally target the difference between expected and unexpected reward. Take sportfishing for example. If my brother and I are on a lake fishing and we get a bite, it sends a surge of excitement through our bodies — what kind of fish is it? How big is it? etc. We land an 8-inch perch! Great! A minute later we catch another 8 inch perch — wow, there must be a school! After 45 minutes of catching nothing but 8-inch perch, our brain comes to expect this outcome, and we need something bigger, or a different species, to generate

the same level of excitement, so we will likely move to a different part of the lake in search of 'bigger' and/or 'different' fish. (Though my brother claims he would never tire of catching fish 8-inch perch I think he's exaggerating). Recreational fishing is benign (if not to the fish), but one can visualise other more resource-intensive pastimes activating similar circuitry. New shoes, new cars, new vacations, new home improvements, new girlfriends are all present on the modern unexpected reward smorgasbord.

The habituation process explains how some initially benign activities can morph into things more destructive. Weekly church bingo escalates to \$50 blackjack tables; the *Sports Illustrated* swimsuit edition results, several years down the road, in the monthly delivery (in unmarked brown packaging) of *Jugs* magazine or webcams locked in on a bedroom in Eastern Europe; youthful rides on a rollercoaster evolve into annual heli-skiing trips, etc. The World Wide Web is especially capable of hijacking our neural reward pathways. The 24/7 ubiquity and nearly unlimited options for distraction on the internet almost seem to be perfectly designed to hone in on our brains' g-spot. Shopping, pornography, gambling, social networking, information searches, etc. easily out-compete the non-virtual, more mundane (and necessary) activities of yesteryear. Repetitive internet use can be highly addictive, though psychiatrists in different countries are debating whether it is a true addiction. For better or worse, the first things I do in the morning is a) check what time it is, b) start the coffee machine then c) check my e-mail, to see what 'novelty' might be in my inbox. Bills to pay, and e-mails from people who are not important or interesting, wait until later in the day, or are forgotten altogether.

There are few healthy men on the planet today who do not respond in social settings to the attention of a high-status, attractive 20- to 30-something woman. This is *salient* stimuli, irrespective of the man's marital status. But here is one example of where nature and nurture mesh. Despite the fact that 99+% of our history was polygynous, modern culture precludes men from running around pell-mell chasing women; we have rules, laws, and institutions such as marriage. However, habituation to various matrimonial aspects combined with exposure to dozens or even hundreds of alternatives annually in the jet age may at least partially explain the 60%+ divorce rate in modern society.

The entire brain and behaviour story is far more complex than just one neurotransmitter but the pursuit of this particular 'substance' is clearly correlated with anxiety, obesity, and the general increasing of conspicuous consumption in our society. That dopamine is directly involved is pretty clear. Parkinson's Disease is a condition where dopamine is lacking in an area of the brain necessary for motor coordination. The drug, Mirapex, increases dopamine levels in that area of the brain, but since pills are not lasers, it also increases dopamine in other areas of the body, including (surprise) the reward pathways. There are numerous lawsuits currently pending by Parkinson's patients who after taking the drug, developed sex, gambling, shopping and overeating compulsions. [12]

Our brain can also be tricked by the food choices prevalent in an abundant-energy society. We evolved in situations where salt and sugar were rare and lacking and signaled nutrition. So now, when we taste Doritos or Ben and Jerry's Chocolate Fudge Brownie ice cream, our reward pathways say 'yes yes — this is good for you!!' Our 'rational' brain attempts to remind us of the science showing obesity comes from eating too much of the wrong type of foods, but often loses out to the desire of the moment. Fully 30% of Americans are now categorised as obese. And, since we are exporting our culture (via the global market system) to developing countries, it is no surprise that China is following in our footsteps. From 1991 to 2004 the percentage of adults who are overweight or obese in China increased from 12.9% to 27.3%. [13] Furthermore, we can become habituated to repeated presentation of the same food type; we quickly get tired of it and crave something different. [14] We like variety — in food and in other things. Finally, when we overstimulate the brain pleasure centres with highly palatable food, these systems adapt by decreasing their own activity. Many of us now require constant stimulation from palatable (fatty) food to avoid entering a persistent state of negative reward. It is this dynamic that has led scientists to recently declare that fatty foods such as cheesecake and bacon are addictive in the same manner as cocaine. [15] And as we shall see, both what we eat and experience not only alters our own health, but also makes it more difficult to act in environmentally benign ways.

Impulsivity, discount rates and preparing for the future

Overconsumption fueled by increasing neural high water marks is a problem enough in itself, but such widespread neural habituation also diminishes our ability to think and act about the coming societal transition away from fossil fuels. Economists measure how much [we prefer the present over the future](#) via something called a 'discount rate'. (See Mark Rutledge's essay in this book). A discount rate of 100% means we prefer the present completely and put no value on the future. A discount rate of 0% means we treat the future 1000 years from now equally the same as 5 minutes from now.

Certain types of people have steeper discount rates than others; in general, gamblers, drinkers, drug users, men (vs. women), low IQ scorers, risk-takers, those exhibiting cognitive load, etc. all tend to show more preference for small short-term rewards rather than waiting for larger, long-term ones. [16] On average, heroin addicts' discount rates are over double those of control groups. Furthermore, in tests measuring discount rates and preferences among opium addicts, opioid-dependent participants discounted delayed monetary rewards significantly more than did non-drug using controls. Also, the opioid-dependent participants discounted delayed opium significantly more than delayed money, more evidence that brain chemicals are central to an organism's behaviour and that money and other abstractions are secondary. [17] Research has also shown that subjects deprived of addictive substances have an even greater preference for immediate consumption over delayed gratification. [18]

Even if we are not snorting cocaine or binge drinking on a Tuesday night, in a world with so much choice and so many stimulating options vying for our attention, more and more of our time is taken up feeding neural compulsions. In any case, facing large long-term risks like peak oil and climate change requires dedicated long-term thinking — so having neural wiring that, due to cultural stimuli, focuses more and more on the present instead, is a big problem.

The fallacy of reversibility A.K.A "The ratchet effect"

Though our natural tendency is to want more of culturally condoned pursuits, many such desires do have negative feedbacks. For instance, I can only eat about three cheeseburgers before my stomach sends a signal to my brain that I am full — and at 4 or 5 my stomach and esophagus would fill to the level I couldn't physically eat another. However, this is not so with virtual wealth, or many of the "wanting" stimuli promoted in our economic 'more equals better' culture. Professor Juliet Schor of Boston University has demonstrated that irrespective of their baseline salary, Americans always say they'd like to make a little more the following year. [19] Similar research by UCLA economist Richard Easterlin (whose "Easterlin Paradox" points out that average happiness has remained constant over time despite sharp rises in GDP per capita.) followed a cohort of people over a 16-year period. The participants were asked at the onset to list 10 items that they desired (e.g. sports car, snowmobile, house, private jet, etc.) During the 16 study, all age groups tested did acquire some/many of the things they originally desired. But in each case, their *desires increased more than their acquisitions*. [20] This phenomenon is termed the "Hedonic Treadmill". I believe this behaviour is at the heart of the Limits to Growth problem, and gives me less confidence that we are just going to collectively 'tighten our belts' when the events accompanying resource depletion get a little tougher. That is, unless we somehow change what it is that we want more of.

The Ratchet Effect is a term for a situation in which, once a certain level is reached, there is no going back, at least not all the way. In evolution the effect means once a suite of genes become ubiquitous in a population, there is no easy way to 'unevolve' it. A modern example of this is obesity — as we get fatter the body creates more lipocytes (cells composing adipose tissue). But this system doesn't work in reverse; even though we can lose some of the weight gain, the body

After peak oil/peak credit, the ratchet effect is likely to mean that any rules requiring a more equitable distribution of wealth will not be well received by those who amassed wealth and status when oil was abundant. In biology, we see that animals will expend more energy defending freshly gained territory than they would to gain it if it was unclaimed. In humans, the pain from losing money is greater than the pleasure of gaining it. Economists describe and quantify this phenomenon as the endowment effect and loss aversion. And, as an interesting but disturbing aside, recent research suggests that the dopamine that males receive during acts of aggression rivals that of food or sex. [20] [21] All these different dynamics of 'what we have' and 'what we are used to' will come into play in a world with less resources available per head.

Old brain, new choices

Humans have always lived in the moment but our gradual habituation to substances and activities that hijack our reward system may be forcing us, in aggregate, to live so much for the present that we are ignoring the necessity for urgent societal change. Unwinding this cultural behaviour may prove difficult. The sensations we seek in the modern world are not only available and cheap, but most are legal, and the vast majority are actually condoned and promoted by our culture. If the rush we get from an accomplishment is tied to something that society rewards we call it ambition, if it is attached to something a little scary, then we label the individual a 'risk taker' and if it is tied to something illegal — only then have we become an 'addict' or substance abuser. So it seems culture has voted on which ways of engaging our evolutionarily derived neurotransmitter cocktails are 'good' to pursue.

Drug addiction is defined as "*the compulsive seeking and taking of a drug despite adverse consequences*". If we substitute the word 'resource' for 'drug', have we meaningfully violated or changed this definition? That depends on the definition of 'drug'. "*A substance that a person chemically comes to rely upon*" is the standard definition but ultimately it is any activity or substance that generates brain chemicals that we come to require/need. Thus, it is not crude oil's intrinsic qualities we crave but the biochemical sensations to which we have become accustomed arising from the use of its embodied energy.

Take stock trading for example. Neuroscience scans show that stock trading lights up the same brain areas as picking nuts and berries do in other primates.

I think people trade for

1. money/profit (to compete/move up the mating ladder),
2. the feeling of being 'right' (whether they ever spend the money or not) and
3. the excitement/dopamine they get from the unexpected nature of the market puzzle.

While these three are not mutually exclusive, it is not clear to me which objective dominates, especially among people who have already attained infinite wealth. (Technically, infinite wealth is their annual expenses divided by the interest rate on Treasury bills. This gives the sum of money that would provide them with an income to buy all they want forever). When I worked for Lehman Brothers, my billionaire clients seemed less 'happy' on average than the \$30k-a-year clerks processing their trades. They had more exciting lives perhaps, but they were not happier; that is, their reward baseline reset to zero each morning irrespective of the financial wealth they had amassed in previous days or years. They wanted 'more' because they were habituated to getting more — it was how they kept score. Clearly, unless you inherit, you don't get to be a billionaire if you are easily satisfied.

MRI scans show that objects associated with wealth and social dominance activate reward-related brain areas. In one study, people's anterior cingulate (a brain region linked to reward) had more blood and oxygen response to visual cues of sports cars than to limousines or small cars. [22] Brain scans show that we respond to the [anticipation of reward](#), not the reward itself, a finding that has profound implications

If compulsive shopping was a rational process, and our choices were influenced only by need, then brand-name t-shirts would sell no better than less expensive shirts of equal quality. The truth is that many shopping decisions are biased by corporate advertising campaigns or distorted by a desire to satisfy some competitive urge or emotional need. For most of us, the peak 'neurotransmitter cocktail' is the moment we decide to buy that new 'item'. After a brief euphoria and a short respite, the clock starts ticking on the next craving/purchase.

Adaptation executors

There is a shared mythology in America that we can each enjoy fame and opulence at the top of the social pyramid. 78% of Americans still believe that anybody in America can become rich and live the good life [23]. Although in our economic system, not everyone can be a Warren Buffet or Richard Branson — there are not enough resources — it is the carrot of potential reward that keeps people working 50 hours a week until they retire at 65. All cannot be first. All cannot be wealthy, which makes our current version of capitalism, given the finite resources of the planet, not dissimilar from a Ponzi scheme.

Envy for status is a strong motivator. Increasing evidence in the fields of psychology and economics shows that above a minimum threshold of income/wealth, it's one's relative wealth that matters, not absolute. In an analysis of more than 80,000 observations, the relative rank of an individual's income predicted the individual's general life satisfaction whereas absolute income and reference income had little to no effect. [24] The "aspiration gap" is economic-speak for the relative fitness/status drive towards who/what is at the top of the cultural status hierarchy. For decades (centuries?), China has had a moderate aspiration gap, but since the turbo-capitalist global cues have spread across Asia, hundreds of millions of Chinese have raised their pecuniary wealth targets.

Economist Robert Frank asked people in the US if they would prefer living in a 4,000-square-foot house where all the neighboring houses were 6,000 square feet or a 3,000-square-foot house where the surrounding houses were 2,000 square feet. The majority of people chose the latter — *smaller in absolute terms but bigger in relative size*. A friend of mine says that when he last visited Madagascar, the 5th poorest nation on earth, the villagers huddled around the one TV in the village watching the nation's most popular TV show *Melrose Place*, giving them a window of desire into Hollywood glitz and glamour, and a beacon to dream about and strive for. Recently, a prince in the royal family of U.A.E. paid \$14 million for a licence plate with the single numeral "1". "I bought it because I want to be the best in the world", Saeed Abdul Ghafour Khouri explained. What environmental cues do the kids watching TV in the U.A.E. or the U.S. receive?

As a species, we are both cooperative and competitive depending on the circumstances, but it's very important to understand that our neurophysiological scaffolding was assembled during long mundane periods of privation in the ancestral environment. This is still not integrated into the Standard Social Science Model that forms the basis of most liberal arts educations (and economic theory). A new academic study on relative income as a primary driver of life satisfaction had over 50 references, *none of which* linked to the biological literature on status, sexual selection or relative fitness. Furthermore, increasing cognitive neuroscience and evolutionary psychology research illustrates that we are not the self-interested 'utility maximisers' that economists claim, but are highly 'other regarding' — we care about other people's welfare as well as our own. Though high-perceived relative fitness is a powerful behavioural carrot, inequality has pernicious effects on societies; it erodes trust, increases anxiety and illness, and leads to excessive consumption. [25] Health steadily worsens as one descends the social ladder, even within the upper and middle classes [26].

When a child is born, he has all the genetic material he will ever have. All his ancestors until that moment had their neural wiring shaped for fitness maximisation — but when he is born, his genes

will interact with environment cues showing those ways to compete for status, respect, mating prospects, and resources etc. which are socially acceptable. From this point forward, the genes are 'fixed' and the infant goes through life as an 'adaptation executor' NOT a fitness maximiser. What will a child born in the 21st century 'learn' to compete for? Historically, we have always pursued social status, though status has been measured in dramatically different ways throughout history. Currently, most people pursue money as a short-cut fitness marker, though some compete in other ways — politics, knowledge, etc. Thus, a large looming problem is that the Chinese and other rapidly developing nations don't just aspire to the wealth of average Americans — they want to get the whole hog to be millionaires.

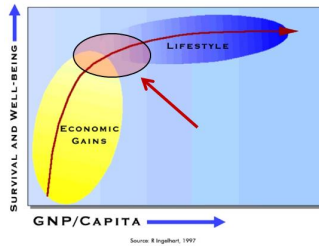
Conclusions

We are a clever, ambitious species that evolved to live almost entirely off of solar flows. Eventually we worked out how to access stored sunlight in the form of fossil fuels which required very little energy/natural resource input to extract. The population and growth trajectory that ensued eventually oversatisfied the "more is better" mantra of evolution and we've now developed a habit of requiring more fossil fuels and more clever ways to use them every year. There also exists a pervasive belief that human ingenuity will create unlimited substitutes for finite natural resources like oil and water. Put simply, it is likely that our abundant natural resources are not only required, but will be taken for granted until they are gone.

This essay has explored some of the underlying drivers of resource depletion and planetary consumption: more humans competing for more stuff that has more novelty. Our economic system turns natural resources into dollars, and then turns dollars into brain chemicals + waste. The self-ambition and curiosity that Adam Smith hailed as the twin engines of economic growth have been quite effective over the past 200 years. But Adam Smith did caution in *Moral Sentiments* that human envy and a tendency toward compulsions, if left unchecked, would undermine the empathic social relationships that would be essential to the successful long-term operation of free markets. Amidst so much novel choice and pressure to create wealth, we are discovering some uncomfortable facts, backed up by modern neurobiology, that confirm his concerns. In an era of material affluence, when wants have not yet been fully constrained by limited resources, the evidence from this ongoing American experiment conclusively shows that humans have trouble setting limits on our instinctual cravings. What's more, our rational brains have quite a hard time acknowledging this uncomfortable but increasingly obvious fact.

This essay raises more questions than it answers. If we can be neurally hijacked, what does it suggest about television, advertising, media, etc? The majority of the neuro-economic sources I used in writing this were a *byproduct* of studies funded by neuromarketing research! How does 'rational utility' function in a society where we are being expertly marketed to pull our evolutionary triggers to funnel the money upwards? How does Pareto optimality — the assumption that all parties to an exchange will be made better off — hold up when considering neuro-economic findings? Recent studies show that American young people (between ages of 8-18) use 7.5 hours of electronic media (internet, Ipad, Wii, etc) per day and, thanks to multi-tasking, had a total of 11 hours 'gadget' exposure per day! [27] The children with the highest hours of use had markedly poorer grades and more behavioural problems. How will these stimuli-habituated children adapt to a world of more expensive resources and the reversal of the labor subsidy (requiring more physical work on tasks)?

Not all people pursue money, but our cultural system does. An unbridled pursuit of profits has created huge disparities in digitally amassed monetary wealth both within and between nations, thus holding a perpetually unattainable carrot in front of most of the world's population. It is not just the amount we consume that is unsustainable, but also the message we send to others, internationally, nationally and in our neighbourhoods.



Meeting in the middle? The arrowed circle on this Inglehart Curve represents the highest level of well-being/survival consistent with a low level of resource use. It is therefore a target at which a society should aim. (Source: N. Hagens and R. Inglehart 1997)

At the same time, traditional land, labour and capital inputs have been subsidised by the ubiquity of cheap energy inputs, and more recently by a large increase in both government and private debt, a spatial and temporal reallocator of resources. These cheap energy/cheap credit drivers will soon be a thing of the past, and this will curtail future global growth aspirations. When this happens, and we face the possibility of currency reform and what it might mean to start afresh with the same resources but a new basket of claims and assumptions, we will need to remember the neural backdrops of competition for relative status, and how people become habituated to high neural stimuli. Perhaps, given the supply-side limits and neural aspirations, some new goals can be attempted at lower absolute levels of consumption by at least partially lowering the amplitude of social rank.

We cannot easily change our penchant to want more. We can only change cultural cues on how we define the 'more' and thereby reduce resource use. In the cross-cultural study referenced in the diagram above, we can see that well-being increases only slightly as GNP increases above some minimum threshold. The arrowed circle would be a logical place for international policymakers concerned about planetary resource and sink capacity to aim to reach via taxes, disincentives to conspicuous consumption and subsidies. However, I fear that nations and governments will do little to slow their consumption and will get increasingly locked into defending the status quo instead.

In a society with significant overall surpluses, people who actively lower their own economic and ecological footprint might get by very well because their relative status — which is typically above average — allows them to make such reductions without reaching limits that compromise their well-being. As these people allocate time and resources away from financial marker capital and towards social, human, built and natural capital, they have an opportunity to redefine what sort of 'wealth' we compete for and thus potentially lead by example. However, personal experience with people in the lifestyle section of the chart leads me to believe that they will probably continue to pursue more resources and status even if it doesn't improve their well-being.

Put aside peak oil and climate change for the moment. Though it is difficult, we have it in us as individuals and as a culture to make small changes to the way our brains get 'hijacked' and, as a result, achieve more benign consequences. For example, we can choose to go for a jog/hike instead of sending ten emails and websurfing, we can choose to have a salad instead of a cheeseburger, we can choose to play a game or read a story with our children instead of making business phone calls. But most of these types of choices require both prior planning and discipline if our brains are not to fall into the neural grooves that modern culture has created. It takes conscious plans to change these behaviours, and for some this will be harder than for others. But in choosing to do so, besides slowing and eventually reversing the societal stimulation feedback loop, we are likely to make ourselves healthier and happier. In neuro-speak, many of the answers

facing a resource-constrained global society involve the rational neo-cortex suppressing and overriding the primitive and stronger limbic impulses.

So, ultimately, we must start to address new questions. In addition to asking source/sink questions like 'how much do we have' we should begin asking questions like 'how much is enough?' Reducing our addictive behaviours collectively will make it easier to face the situations likely to arise during an energy descent. Changing the environmental cues on what we compete for, via taxes or new social values, will slow down resource throughput and give future policymakers time to forge a new economic system consistent with our evolutionary heritage and natural resource balance sheet. We will always seek status and have hierarchies in human society but unless we first understand and then integrate our various demand-side constraints into our policies, culture and institutions, sustainability will be another receding horizon. Though there is probably no blanket policy to solve our resource crisis that would both work and gain social approval, an understanding of the main points of this essay might be a springboard to improve one's own happiness and well-being. Which would be a start...

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