Infobesity: Cognitive and Physical Impacts of Information Overconsumption

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ABSTRACT
In this paper we describe our work-in-progress in understanding the similarities in the evolutionary adaptations in the human brain dopaminergic reward system activation from food and information stimuli, and propose a framework for understanding daily stress and its interaction with information overconsumption.

Author Keywords
Infobesity; obesity; dopamine; reward system; ventral striatum; addiction; stress; multitasking

INTRODUCTION
These are the days of lasers in the jungle
Lasers in the jungle somewhere
Staccato signals of constant information...

These are the days of miracle and wonder
And don’t cry baby, don’t cry

It is highly improbable that when American songwriter Paul Simon wrote these lyrics to the song “Boy in the Bubble” for the 1986 album Graceland, he had the eventual impact of the Internet or phenomena like social networking websites in mind. After all, the precursor to our modern Internet – the NSFNet – had just been launched that year, and Facebook creator Mark Zuckerberg was only two years old. But the prescient song does look ahead to things that were, and are, to come, that will inevitably bring a mix of miracle, wonder, and unintended consequences. New technologies have the tendency to dazzle and engage us, and we are not always so good at bringing critical thought to bear on the jungle lasers and staccato signals that so enrapure.

Mass production and distribution of food brought about a new age for civilization, enabling us to live and thrive in otherwise inhospitable places – as well as the unintended consequences of obesity, heart disease, and other chronic diet-related syndromes. In any environment where high-calorie, less-nutritious foods are more readily available, our evolutionary adaptation to weather the storms of famine and unpredictability of food availability has become a liability [3]. According to the Centers for Disease Control and Prevention (CDC), the obesity rate in the United States has been increasing at an alarming rate, with no state having less than a 20% obesity rate as of 2010. Childhood obesity has become a major focus of the US Government, as evinced in the creation of the Childhood Obesity Task Force in 2010 [27]. It follows that much time and energy has been spent examining the origins and effects of the cycle of obesity, and the collective body of understanding is growing rapidly – hopefully fast enough to catch up to the epidemic.

A new age of digital mass-production and overconsumption of information is well underway. Knowledge of the world used to come to us only at great expense, but this knowledge meant the difference between life or death, success or failure, and the ability to thrive or the slow descent into oblivion. By virtue of the scarcity of knowledge in the early days of our species, we seem to be predisposed to glut on information the same way our prehistoric selves might have gorged on yak fat (and in the same way our current-day selves eat massive amounts of pie during the holidays!) – to store up resources for the lean days ahead.

Over the past century, light-speed advances in communication and the rapid rate of information distribution have been analogous to the advances in food production. Many recent studies show that our brains experience new information in much the same way they experience pleasurable foods [11,12,13,14,19,25].

The brain registers high-fat foods as highly pleasurable, via the mesolimbic dopamine projection from the ventral tegmental area to the nucleus accumbens [23]. The neurotransmitter dopamine is also implicated in the reward circuitry of Internet interaction – particularly during acts of reciprocity, like those that drive popular online social
networking site games. Brain reward circuitry, including ventral striatum and orbitofrontal cortex, appear to be brought online when a participant has built a reputation for reciprocity [3].

The rapid growth and pervasiveness of social media, with its near-real-time availability and around-the-clock seduction of users to engage has enabled the creation of an information-space equivalent of a Twinkee™. We propose that there are striking similarities between handling of food and information in human patterns of evolutionary adaptations, and subsequent rapid environmental changes that overwhelm them, which can lead to chronic conditions. We also propose that users who understand these impacts and the mechanisms by which they manifest themselves can better fashion an information diet that is healthy and adaptive.

Although information seems to have an ethereal quality that would preclude it from having any tangible, real-world impact on human health, we argue that in fact it can, and does, directly impact the human brain’s reward circuitry and can rewire it in an ever-escalating feedback cycle, resulting in addiction, stress, and sequelae that have a very real impact on human physical and mental health, which in turn affects the macro-level systems of industry, government, and society. We call this information equivalent of obesity, perhaps not very imaginatively, infobesity.

THE LOOP
Do we really experience information and social interaction with the same sort of pleasure that we might get from, say, a hunk of homemade cheesecake? And can the underlying neurocircuitry actually behave in the same maladaptive way in someone who is addicted to Farmville, or to habitually checking their Twitter feeds or Facebook friends’ status updates, as it does in someone who is addicted to junk food? It certainly appears so.

Food addiction appears to emerge from a cycle in part of the brain called the ventral striatum, which is in turn composed of the nucleus accumbens (NA) and the olfactory tubercle. These structures have been studied extensively in humans and other animals, and are generally thought to comprise the core of the brain’s reward system. At the root of the attenuation process is the dampening of dopamine’s effect on various brain structures. The topic of stress, eating, and the reward system has been explored in detail elsewhere [1,5,6], but a high-level simplification is presented here.

Some initial condition, such as stress, causes a person to eat food for non-hunger reasons (e.g., a candy bar, ice cream, or other items not needed for survival), which in turn activates mesolimbic dopamine (DA) pathways. The consumer experiences pleasure as DA D2 receptors in the striatum are activated. This has the temporary effect of stress reduction and an elevated sense of well-being. In the ancient world to which our current bodies are adapted, this cycle works out to the survival advantage of the species. When there is not an overabundance of high-energy foods, natural availability keeps things in check. But in the current world, where snack foods are highly calorific and pervasive, they are too highly available as band-aid solutions to everyday stress, depression, and other forces that might drive us to seek soothing.

This in turn leads to overconsumption of these foods, which causes the reward system to adapt, requiring an ever-increasing amount of highly palatable foods to maintain the same level of stimulation. Our understanding of how the reward system becomes less sensitive to stimuli over time is incomplete, but it appears that a variety of systems interact over time in the continuing presence of high-reward food to reduce that food’s reward value. This is very much the same cycle that drives drug addicts to consume ever-increasing levels of drugs, often to the point of death. Obesity can, and often does, lead to death, albeit in a slower fashion than a drug overdose, through dysregulation of important body systems and an increased load on the body’s faculties.

We propose that there is very little difference in this cycle and that seen in overconsumption of information. Topics like Facebook Addiction are increasingly discussed in popular and academic literature, and the effect of constant real-time streaming of both world news and personal minutiae can be seen in homes and in the workplace. It is very hard to estimate the actual number of human-hours spent on social media sites like Twitter and Facebook. The controversial 2011 Nielsen report State of the Media: the Social Media Report Q3 estimated that people in the United States alone spent over 53 Million hours that year on Facebook. The report has undergone a fair bit of scrutiny, since companies seeking to pump up IPO potential often inflate such numbers, and the methodology for collecting usage data can be difficult and error-prone. Nonetheless, the impact of these new technologies can be seen everywhere, and like any other good thing, too much of it can cause harm.

Facebook, Twitter, instant messaging (IM), texting, and many other modes of electronic interaction provide a cornucopia of opportunities for consuming of information. The potential reward for such consumption seems to be substantial, as Phan et al. have discovered [19]. Real-time staccato signals have the capacity to infiltrate every moment of our lives. Their interruptive nature means we have to handle lots of context switches as we move in and out of Facebook, work tasks, Twitter, back to work tasks, check that Facebook status that just popped up from Aunt Sally, back to work… Unfortunately, all that switching comes at a steep price.

Mark, Gudith and Kloche discovered that frequent interruptions have the unexpected consequence of faster completion of the tasks that were interrupted, but at the cost
of increased stress and frustration, and potentially compromised quality of work [16]. Social media provide an abundant source of potential constant interruptions, which in one sense leads to increased stress due to context switching and extra effort to get back on task, but on the other hand, provide information “snacks” that alleviate some of the stress in the short term via the reward system. If this cycle sounds familiar, it is because it is the very same one that leads to overconsumption of foods and potentially to the stress-overeating-addiction trap.

IMPLICATIONS
If infobesity exists, and if there is such a cycle of stress, overconsumption, and addiction to information, what can be done about it? Fortunately, we know much about the cycle of food addiction: we understand how it is similar to drug and gambling addiction, and even video game addiction [12]. It is not improbable that treatment and prevention models for infobesity follow the same models as these better-studied phenomena.

The first step in breaking the cycle is to understand information as a consumable thing. It is something that has a real presence in the real world, or “IRL” (in real life), and that we are affected and changed by its consumption. This changes our frame of reference for the virtual, replacing it with the visceral. Bits and bytes are intangible, but bags under the eyes are not.

It is then possible to consider the information valence (equivalent to nutritional information) of each piece of information we consume, in much the same way we can analyze that tasty snack cake for caloric content, fat, transfats, and so on, before we consume it. There is currently no such equivalent in the information space for nutritional information – no analog of calories, for example. It is also uncertain if an attempt to categorize and qualify particular aspects of information valence would even be feasible, or if it would simply result in an ambiguous and confusing set of guidelines that no one would understand or use (think Food Pyramid for Facebook) However, the general principle of viewing different kinds of information as having distinct qualities and quantities of import is a crucial step.

One may then consider personal habits, as they are the vehicle of the cycle of overconsumption. By modifying one’s daily allocation of interruptive information, following an information diet, of times during the day to which social media will be attended, the cycle of interrupt-consume-stress can be broken.

FUTURE WORK
Most of the inference in this paper is indirect, stitching together that which is known in related subjects, but a direct observation study would serve well to bolster (or unhinge) our premise. Although ideally we would be able to construct an experimental paradigm that would probe the action of the DA D2 receptor sites in ventral striatum / nucleus accumbens in response to aspects of the proposed cycle, this might be infeasible to do, due to the invasive nature and high cost of imaging (e.g. using PET), so other non-invasive measures would likely need to be explored.

CONCLUSION
Our consumption of information can be likened to our consumption of food, as they have demonstrably similar neural circuits for reward in response to their consumption. The brain rewrites and attenuates itself in response to pervasive presentation of reward-driving “high calorie” information stimuli in the same way it does to high-energy food. This leads to a cycle of increased need for reward and a decreased response to stimuli, which is the basis for addiction. The stress that is present in “modern” everyday life provides a constant motivator for humans to seek solace in reward center activation. Information snacks are used in the same way that food snacks are often used to quell stress. This leads to a cycle of life and work interruptions, which in turn leads to increased stress, completing a dysfunctional cycle. An information diet is the key to ensuring that all forms of social media, email, web, and other forms of electronic information are seen as consumable goods that have mass, take up space, and need to be accounted for by consumers in precisely the same way that daily calories should be.

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REFERENCES


