What Drives Us? Chasing Reward in a Dopaminergic Society

by Solana Liu

Abstract – An individual's level of motivation is often heavily attributed as a personality trait-it's a quality we group with self-control to embody the ideal achiever capable of success in our society. However, seemingly discrete identification of personality traits understates a major component of the motivational driving force: the dopamine mesolimbic reward system, commonly known as the reward circuit. Activation of this circuit triggers the projection of the neurotransmitter dopamine to the nucleus accumbens and feelings of pleasure (Niehaus et al., 2009). Dopamine also critically mediates feelings of motivational desire, an important determinant of incentive drive, in goal-directed behaviors (Robinson et al., 2000; Palmiter et al., 2008). This mechanism is also common to many of our everyday activities. For instance, exercising and listening to music have been associated with increased levels of dopamine (Petzinger et al., 2015). An evolutionary predisposition to chase reward further suggest dopamine's strength in cultural behavioral manifestations. From the reinforcing effects of cocaine, alcohol, nicotine, food, and music through mediation of the mesolimbic circuit, we're able to connect a variety of seemingly separate intrinsic and extrinsic factors to provide explanatory and predictive power for dopamine's increasing influence on the cultural development of the dopaminergic society we live in today.

I. INTRODUCTION

Countless studies emphasize the importance of dopamine in many life sustaining behaviors. Nigrostriatal dopamine regulates motor control and goal-directed movement and mesolimbic dopamine plays an invaluable role in executive functions like attention which are important in learning (Korchounov et al., 2010). Along with eustress-"good", manageable levels of life stress, mesolimbic dopamine also invigorates action towards desired goals when we face mild challenges. Dopamine activates the behavioral explorative approach response, and thus through feelings such as a sudden creative insight or the feeling of anticipation that precedes highly focused engagement in a task, the challenge is perceived as exciting (Ikemoto 2007).

Executive functions used to maintain attention to the task at hand is coordinated by the prefrontal cortex and is mediated by proper dopamine functioning as well (Hosenbocus et al., 2012). Furthermore, reaching the goal-directed outcome results in a sense of mastery and accomplishment–feelings highly dependent on the release of dopamine (Yau & Potenza, 2013). It is nevertheless evident how dopamine is highly involved in all aspects of behavior from the creation of energizing incentive drive and maintenance of mental focus and concentration to the subsequent production of rewarding pleasant feelings as behavioral reinforcement.

The reward seeking behavior maintains a seductive dynamic as the release of dopamine triggers the feeling of "wanting", an anticipatory craving for additional dopamine-releasing behaviors. This subconsciously manifests in a behavioral bias towards dopamine releasing behaviors, which can comprise everyday activities such as indulging in your favorite comfort food. These small stress relieving activities serve as natural rewards that satisfy physiological drives such as hunger and reproduction and activate the mesolimbic circuit (Blum et al., 2013). Pleasure can also be derived from unnatural rewards, such as alcohol, drugs, or other thrill-seeking behaviors-all which fuel the rush of dopamine (Michaelides et al., 2013).

II. EVOLUTION OF A DOPAMINERGIC SOCIETY

Dopamine not only plays a key role in our everyday functions, but is also attributed as the key to the development of unique human cognitive skills such as abstract reasoning, temporal analysis, and working memory. These physiological adaptations to social, cultural, and environmental changes were enabled 80,000 years ago through dietary changes such as the inclusion of fish oils and increased meat consumption (Adams et al., 2011). Dietary changes overcame previous developmental constraints and resulted in increased development of dopamine receptors allowing increased dopamine processes or improved functioning at the receptor itself.

Hyperdopaminergic effects can be associated with a variety of cultural behavioral manifestations. For instance, hyperdopaminergic effects functionally result in masculine and less emotional behavior (Wersinger & Rissman 2000). Boldness and social risk taking, traits useful in climbing hierarchical ladders, are characterized by the "fearless dominance" trait used to characterize psychopaths. The rising number of psychopaths each year intriguingly parallels the general population's perception of psychopaths through increasingly normalized psychopathic media portrayal (Smith et al., 2013). In addition, the number of disorders correlated to excessive dopamine such as bipolar disorder, OCD, schizophrenia, and Tourette's syndrome rapidly continues to increase yearly, which offers further evidence to support an increasingly hyperdopaminergic society (Nestadt 2010).

A "hyped up" motivation system exaggerates dopaminergic effects and therefore encourages fast paced, driven, competitive, and novelty seeking behaviors-characteristic of our hyperdopaminergic society. This evolutionary predisposition to seek rewards explains increasing obsession with achievements in a highly competitive environment in which we continuously set goals to chase the feeling of satisfaction and fulfillment. High dopamine individuals thrive in these societies and through their influence, shape and further encourage the society's hyperdopaminergic qualities.

The rush to seek rewards as well as the intense culture constructed by conquest and competition can fuel chronic restlessness within our high stress competitive hyperdopaminergic

society. Countless neurochemical studies have demonstrated that in addition to relaxing activities and thrill seeking behaviors, stressful stimuli activate the dopamine system (Belujon & Grace, 2015). Our homeostatic abilities to maintain a constant internal environment in response to environmental changes establishes a subconscious search for external dopamine releasing behaviors. The drive to fulfill immediate cravings may account for the presence of high risk, thrill-seeking activities which maintain a significant cultural presence today. Thrill seeking activities can behaviorally manifest as binge drinking, gambling, or substance use and all are able to fuel to the satisfying rush of dopamine (Michaelides et al., 2013, Avena et al., 2008, McHugh et al., 2014, Michaelides et al., 2013, Adinoff et al., 2004, Gosnell, 2005). Although societal standards intuitively categorize these activities as separate, this understates the common circuit activation between seemingly unrelated behaviors. Even sugar can be classified as addictive substance (Avena et al., 2008, Michaelides et al., 2013) and the cross-sensitization in movement from sugar to cocaine indicates some degree of potentiation between sucrose and psychostimulants (Gosnell, 2005). As dopamine additionally plays a role in stress relief, subconscious reward seeking behavior also suggests a neurobiological incentive for trending stress-relieving cultural practices such as yoga, meditation, and spiritual practices (Krishnakumar et al, 2015, Newberg 2014). Common mesolimbic dopamine activation in both everyday and thrill seeking activities clarifies how culturally encouraged stress behaviorally nurtures the manifestation of a range of dopamine-releasing "self-medicating" behaviors. And thus, in response to acute cravings, we naturally gravitate towards rewarding activities to maintain a homeostatic balance.

III. DOPAMINE DEFICIENCY

The proper functioning and processing of dopamine communicates a message of calm and wellbeing to the rest of the brain. However, it's a delicate balance that the brain battles to maintain. Disruption of dopamine-induced engagement underpins a variety of behavioral disorders which further supports the necessity of properly functioning dopamine. Excessive dopamine can lead to a false sense of euphoria and schizophrenic symptoms whereas insufficient dopamine levels can result in Parkinson's disease, depression, and propensities to addiction (Ducci & Goldman, 2012; Bevilacqua & Goldman, 2009, Korchounov et al., 2010). As dopamine plays crucial roles as the pleasure and anti-stress molecule, inadequate dopaminergic activity stresses out other brain functions resulting in feelings of stress, pain, discomfort, and agitation (Zai et al., 2012). Physical changes in brain areas critical in judgement, decision making, learning, memory and behavior control also occur which behaviorally manifest as motivational deficits, impulsivity, novelty seeking, and a short attention span (Blum et al., 2015). Altered dopaminergic function affects the brain's resting state network connectivity, and is also suggested to impact the efficiency of functional network updates that occurs between tasks (Cole et al., 2013, Schultz & Cole 2016). This is consistent for why those with attention deficit/hyperactivity disorder (ADHD), for example, would have trouble sustaining focus on a task.

Problems in dopamine processing can stem from innate genetic differences, chronic drug use, or long term stress (Aschacher 2013, Weiss et al., 2001, Reist et al., 2007). A specific variant of the DRD2 receptor gene has been posited as the anomaly for resultant neurochemical issue and exists in 30% of the population today (Blum et al., 2008). Regardless of the source of dysfunction, a heightened reward threshold results in a chronically underexcited reward system. Loss in ability to feel various dopaminergic effects in comparison to individuals with properly functioning dopamine processes manifests behaviorally in an inability to derive pleasure from everyday activities.

The brain attempts to adjust to the deficiency by searching for external dopamine releasing behaviors. Thus, these individuals are more likely to self-medicate with thrill-seeking activities which would be able to trigger the release of supa-threshold dopamine. Cocaine, alcohol, nicotine, food, and music are all able to fulfill the reinforcing reward through the common mesolimbic mechanism (Blum et al., 2013). In addition to aberrant reward seeking behavior, the loss of dopamine-induced feelings of calm and well-being compounded by downstream effects from the disrupted cascade impacts the ability to respond to stressors. The consequential outcome automatically predisposes individuals to a higher risk for multiple impulsive, compulsive, and addictive behavioral tendencies ranging from mild anxiety and irritability to attention deficit hyperactivity disorder, alcoholism, eating disorders, and smoking (Blum et al., 2008). Evidence associating a certain variant of the DRD2 gene that results in deficient dopamine functioning with various substance use disorders, pathological gambling, sex addiction, eating disorders, alcoholism, attention deficit hyperactivity disorder, and smoking supports this hypothesis (Noble et al., 1993; Stice et al., 2011; Noble et al., 1991; Nisoli et al., 2007; Need et al., 2006. In fact, the umbrella term Reward Deficiency Syndrome (RDS) conceptually posits the A1 variant as the anomaly that results in the neurochemical inability to drive pleasure from normal, everyday activities (Blum et al., 2008).

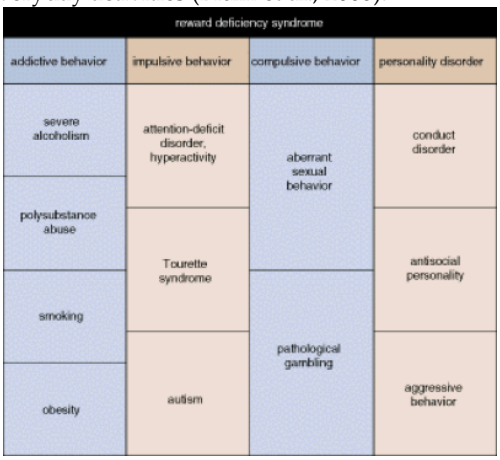

Figure 1: Spectrum of impulsive compulsive, addictive, and personality disorders under Reward Deficiency Syndrome. The disorders are suggested to be based on a common genetic deficiency in the dopamine D2 receptor.

Additional studies propose other genetic polymorphisms that may predispose individuals to reward seeking behavior, but it's imperative to note that any reduction in dopamine function can lead to reward deficiency and results in aberrant substance-seeking behavior and a lack of wellness, which can manifest in a variety of behaviors (Reist et al., 2007).

V. CONCLUSION

Recognizing the driving force of dopamine notes the biological basis underlying our habits and conceptually redefines perceptions of reward seeking behavior within this dopaminergic society. Predisposition for mesolimbic activation clarifies cultural novelty seeking as well as the lure of thrill seeking extrinsic factors. Connecting the biological basis within all reward seeking behaviors moves away from societal misconceptions of various compulsions attributed to problems in the dopaminergic cascade which predispose to unnatural rewards and explains comorbidity between seemingly separate disorders. Furthermore, it anticipates progression away from the social stigma attached to substance use disorders, ADHD, alcoholism, and the spectrum of reward-seeking behaviors that comprise RDS.

Understanding how strongly dopamine is interwoven into our actions can embody a raw perspective of the dopaminergic society we live in. It questions the degree to which our civilization serves as an artificial construct nurtured by our natural human predisposition to chase reward. Western moral values of efficiency, encouraged by dopaminergic projections, shapes many social pressures and expectations. For instance, the ideal of maximum efficiency contributes to shaping the social construction of insomnia and sleep disorders, which continuously increase in number each year (Nunn et al., 2016).

The fascinating implications of understanding our cognitive capabilities and motivational sources provides invaluable perceptual perspective on the complex interactions that influence our thoughts, feelings, and actions. Mediation of these feelings significantly contribute to our comprehension of the psychological notion of pleasure. Studies attribute happiness to finding the right hedonic balance-a state of pleasure without too much "wanting" (Kringelbach & Berridge, 2010). And so despite individual differences, the right ideological views powerfully allow us to drive our own motivational mindset within this dopaminergic society.

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