How Dopamine Levels Change in Response to Screen Time, Alcohol, and Drug Usage

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1 Introduction

The exact same feeling results from cocaine use as from receiving a like on an Instagram post.

1.1 What is Dopamine

Dopamine is both a neurotransmitter and a hormone. Neurotransmitters and hormones work together to maintain homeostasis (i.e., normal physiological function) within the body. Neurotransmitters are chemical messengers that act locally at connection points (synapses) between neurons. This allows signal transduction, which in turn allows electrical signals to propagate (travel) along nerves or nerve bundles (1). Some neurotransmitters, including dopamine, can also act as hormones. Dopamine is known as a monoamine neurotransmitter, a type primarily used within the peripheral and central nervous system (1). Hormones are also chemical messengers but are released into the bloodstream, traveling throughout the body to act on peripheral organs by binding to specific targets on cell surfaces of the intended organ(2). Neurons that release dopamine as a neurotransmitter only exist in the brain; however, when functioning as a hormone, dopamine acts globally on the body's neurological system (2). Dopamine impacts the regulation of various body functions, including movement, memory, pleasure reward, and motivation. Dopamine dysregulation results in either increased or decreased

levels of dopamine and has been directly linked with several mental health disorders and neurological diseases (2,9). These include motor function disorders, such as Parkinson's disease, restless leg syndrome, and others, as well as psychological/emotional disorders, including depression, schizophrenia, and ADHD (2).

1.2 The Importance of Dopamine Signaling

As a neurotransmitter, Dopamine allows you to feel pleasure, satisfaction, and motivation. The positive feelings you experience regarding achievement is simply a surge of dopamine in the brain (6,7). In other words, optimal levels of dopamine are essential for a healthy mood and overall mental well-being (9). Dopamine interacts with membrane receptors belonging to the family of seven transmembrane domain G-protein coupled receptors. The activation of these receptors leads to the formation of second messengers and the activation or repression of specific signaling pathways (8). A dopamine deficit presents as a range of mental illnesses, stress, difficulty sleeping, drug abuse, obesity, or overeating sugar and saturated fat (6,7,9). Low dopamine can also be caused by poorly functioning adrenal glands, as these modulate both aldosterone and catecholamine secretion. The adrenal medulla produces many hormones, including dopamine. Thus, when the adrenal gland is disturbed, so is dopamine production (7).

Research Questions

a. What is the purpose of the investigation
b. How is this investigation relevant to current issues/trends in society?

2 What Is Known About Variation in Levels of Dopamine in Response to Various Stimulations?

2.1 How are dopamine levels measured?

Dopamine levels can be measured, and the level can vary based on inputs like phone use, drug use, and sexual experiences (6). Dopamine is electrochemically detected at carbon-fiber microelectrodes when a potential is sufficient enough to liberate two electrons from dopamine to form dopamine ortho-quinone (6). This provides a current that can be converted to a voltage and measured using a current transducer (6). A Dopamine Blood Test (also known as chromatography) is useful in measuring the amount of dopamine in the blood. Preparation requires fasting for 10-12 hours before the test (2,3).

2.2 Dopamine signaling + Screen time

Our brains release a small amount of dopamine each time we check our phones. Dopamine motivates us to take action, so hearing a notification motivates us to check our devices (3). The problem is that this dopamine boost is temporary and results in a subsequent drop in levels. As such, increased screen time can result in screen addiction, especially in children. Psychologists are finding patterns between dopamine release from screens and lowered impulse control in children. This deficiency in impulse controls results in an increased demand for instant gratification, which screens provide (3). For example, as we all know screen usage triggers a pleasure/reward cycle that, like drugs, has a negative impact on your life. As a result, children can develop screen addiction disorder (3).

2.3 Dopamine Levels + Alcohol

The inverse relationship between alcohol use and dopamine levels results from the changing levels of the euphoric and/or despondent mood (4). The intake of alcoholic substances, makes dopamine levels fluctuate and change outer mood/orientation. These findings suggest that the neurotransmitter system may affect the development of alcohol dependence via the dopaminergic system and shed some new light on the mechanism linking the dopaminergic system functioning to alcohol dependence (4). Using drugs that contain dopamine as part of therapies for alcohol recovery can cause a reverse effect (4). Those with the lineage of alcohol use disorder tend to release more dopamine in the expectation of alcohol (4). As such, when recovering alcoholics intake dopamine as a form of treatment, it may negatively impact the natural production of dopamine from bodily glands and may even be seen as a foreign substance (alcohol) by the body (4). The drug Naltrexone, for instance, is an opiate antagonist that works to remove the pleasure response. Once that is removed, the desire to drink also dissipates, which can aid in the process of recovery (4). The opiates themselves are not a cure. They simply reset the brain's reward system, which correlates drinking (or drug use) with pleasure. More simply, the drugs themselves are normalizing the brain's dopamine levels, not actually calming the patient, though that is the perception (4).

2.4 Dopamine Levels + Drug Use

Just as drug use results in intense euphoria, it also causes larger surges of dopamine, powerfully reinforcing the connection between the consumption of the drug, the resulting pleasure, and the various other external cues linked to the experience (5). Regular drug use actually causes the brain to produce, absorb, and/or transmit less dopamine, resulting in a chemical imbalance within

the brain. When the drugs are no longer active in the brain, dopamine levels can drop, causing uncomfortable withdrawal symptoms and powerful cravings (5). These negative outcomes often cause users to return to drugs in order to avoid experiencing these negative emotions (5). When a dopamine receptor doesn't function correctly, memory recall, hand-eye coordination, retaining new information, and even finding pleasure in previously enjoyable things become increasingly difficult (5). Drugs "alleviate" these issues by producing copious amounts of dopamine, overloading the receptors and resulting in the high that so many individuals chase (5). Over time, however, the drug use starts wearing on the dopamine receptors until they simply stop reacting to the dopamine. This process is known as "building a tolerance" (5). The result is that more drugs are needed to achieve the expected emotional experience, which leads to even more dependence and eventual drug addiction (5).

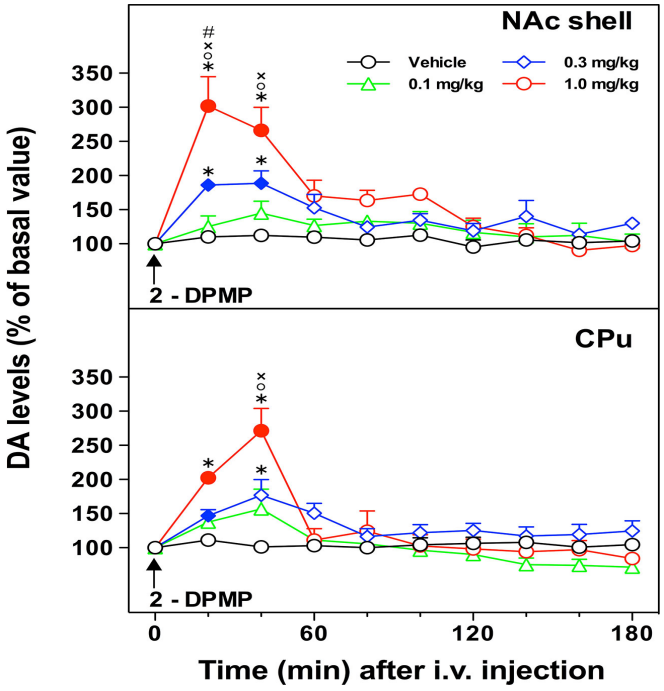

Figure 1: *In vivo* effect of i.v. 2-diphenylmethylpiperidine (2-DPMP) on dopamine (DA) extracellular levels in dialysates from the nucleus accumbens shell and the caudate-putamen of living organisms.

3 Conclusion:

There are many similarities in the effects on dopamine levels from drugs, alcohol, and screen time. The main difference occurs in drug use, as drugs directly target the dopamine receptors, and - as a result - more immediately and aggressively impact dopamine release. What is still unknown is the way that screen time directly results in actual change within the brain, when compared to alcohol and drug use. By taking drugs that do not contain dopamine, we are able to continue to produce dopamine on our own, without inhibition or outside intervention. Due to intaking drugs with dopamine, and (if) a person has a dopaminergic disorder, intaking dopamine could be inherently very bad for them, and lead to opposite results.

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