

Analysis of the opponent process model



**ASSIGN
BUSTER**

1. Introduction

The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; *DSM-5*; American Psychiatric Association, 2013) has defined tolerance as a “diminished effect with the same amount of substance” which requires a “need to increase dose to achieve intoxication or desired effect.” Withdrawal was defined as “experiencing the characteristic withdrawal syndrome for the substance taken to relieve or avoid withdrawal symptoms.”

In early 1970s, Richard Solomon suggested that every process has an affective state followed by a secondary opponent process (Solomon & Corbit, 1973, 1974). With the repeated exposure of certain substance, the primary process becomes weaker while the opponent process is strengthened. Our bodies need to reach and maintain a certain state of equilibrium, such as, body temperature, level of glucose and oxygen in blood. Consumption of drugs changes the normal states of our bodies and therefore, would seek to restore such homeostatic stability.

The behavioural phenomenon of addiction results from the repeated use of certain drugs where people find themselves craving for that particular drug (Solomon & Corbit, 1974).

2. Opponent Process Model

1. Process A: Initial Drug Taking

This is the initial exposure of the drug upon consumption and the drug user’s subjective experience of the substance. There is usually a high level of pleasure and a low level of withdrawal.

The addictive substance must be capable of giving pleasure, at least sometime during its early use (Solomon & Corbit, 1974).

2. Process B: Tolerance

Tolerance occurs after repeated exposure of the addictive substance.

State B (or the opponent process) starts to strengthen in order to match the magnitude of state A (level of pleasure). Overtime, the levels of pleasure from using the drug decreases while the levels of withdrawal increases. As withdrawal symptoms and craving intensify and become longer lasting, the drug user will attempt to get rid of these aversive feelings by continuous use of the substance. Drug addicts will start to develop the motivation to keep using the drug despite a lack of pleasure they initially experience.

3. Process A + B: Withdrawal

Initially, the pleasurable rewarding part of the drug experience (Process A) is bigger than the negative withdrawal state (Process B). After repeated exposure of the drug, state A gradually decreases with state B starting to strengthen. If the drug addict wants to keep getting the pleasurable feelings or simply if he/she wants to avoid aversive symptoms, the arousing substance will need to be more strongly reinforced in order to produce state A and eliminate state B. He/she will need to administer a larger dose to offset the effect of tolerance.

This is evident in Solomon and Corbit's study (1973), where a well-addicted smoker rarely experiences the B state, as he smokes so frequently, aversive symptoms rarely occur.

3. Empirical studies and Neurological evidence

Addictive behaviour in animals

The behaviour phenomenon of addiction has been shown to be present in animals. Hoffman, Stratton, Newby, and Barrett (1970) have conducted a study on behavioural control of ducklings by an imprinting stimulus.

Generally, ducklings show very few distress cries right after hatching. If they were then exposed to a white, moving object, they look intently at it.

Further, any distress vocalisations tend to disappear when they focus on the object. However, if the moving object was subsequently removed, the ducklings show a burst of distress crying that last for several minutes and then disappear. With the repeated actions of presenting and removing the imprinting stimulus, the frequency and intensity of distress crying increased. This finding demonstrated that the presentation of the moving stimulus was eliminating the distress of the ducklings, which means they are exhibiting criteria for addictive behaviours.

The addictive patterns established in ducklings are similar to opiate, alcohol, amphetamine or cigarette addiction (Solomon & Corbit, 1973). Drug users learn to employ the drug with a stronger dose to elicit a pleasurable state A in order to get rid of the intensely aversive state B. Such cycle will not rise if state B fades out to baseline very quickly.

Opiate

Jaffa (1965) has described the opponent process model in terms of opiate consumption. The user would first experience a “rush” (an intensely pleasurable feeling), followed by a period of less intense euphoria. With

repeated consumption, the user suffers aversive, painful and frightening somatic withdrawal symptoms, together with a feeling of craving. With opiates, state B may last a longer time and would take longer for it to return to baseline. Now, state A is no longer “euphoric” rather “normal”, the rush is no longer experienced. However, state B becomes even more physiologically disturbing than before, the craving aspect is now extremely intense, aversive and enduring.

Wikler (1971) has suggested that positive reinforcers would temporarily reduce the feeling of craving. Examples include, a drug container, syringe, needle prick or a room full of satisfied addicts. They tend to function as a conditioned stimulus to arouse a conditioned pleasurable A state to oppose the B state.

Similar outcome has been found by Solomon and Corbit (1973), where they considered the major problems with cigarette withdrawal being the stimuli associated with absence of cigarettes. For example, no stores, empty pockets, lack of money or non-smokers who don't offer you cigarettes. These stimulus would produce some degree of conditioned craving within drug users, which in turn leads to an increased frequency of dosages.

Cocaine

Baker and colleagues (2014) attempted to infer positive and negative affective states involved by measuring ultrasonic vocalisations (USVs) in rats. They examined USVs when calculating body levels of cocaine were clamped at below, or above subjects' self-determined drug satiety thresholds. Rats were found to acquire stable cocaine self-administration behaviour where

<https://assignbuster.com/analysis-of-the-opponent-process-model/>

they increased lever presses, cocaine infusions earned and total drug consumption. USVs measurements indicated that positive affects were predominantly observed during the drug loading period, but declined quickly to near zero during maintenance. Whereas, negative affect was observed at sub-satiety cocaine level, but relatively absent when body levels of cocaine were clamped at or above subjects' satiety thresholds.

The findings were consistent with self-reports from human drug users, who described the transition from positive to negative affect after psychostimulant use (Breiter et al., 1997; Volkow et al., 1997).

Neurological Basis

Grace in 1995 has suggested that the repeated administration of cocaine causes more uptake sites to become blocked and subsequently more dopaminergic binding to auto-receptors and thus a tonic inhibition of dopamine neurons. The decrease in dopamine release at the synaptic cleft can perhaps account for the rewarding state of drug use.

In addition, researchers have attempted to explain the transition from positive to aversive state. It was suggested that lateral habenula and its projections to the rostromedial tegmental nucleus may have played a role in this process (Brudzynski, 2008). Neurons in both structures receive projections from many of the same hypothalamic structures implicated in the production of aversive vocalisations. Further, neurons in the rostromedial tegmental nucleus are capable of inhibiting dopamine neurons and positive responses to cocaine (Jhou et al., 2013). As a result, these constant changes in the brain may account for the development of mechanisms that oppose

the euphoric effects and produce subsequent negative affect, tolerance and withdrawal (Koob, 2008, 2009a; Mutschler & Miczek, 1998a).

References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Baker, D. J., Simmons, S. J., Servilio, L. C, Bercovicz, D., Ma, S., Rott, D. H., ...West, M. O. (2014). Ultrasonic vocalizations: evidence for an affective opponent process during cocaine self-administration. *Psychopharmacology*, *231*, 909-918. Doi: 10. 1007/s00213-013-3309-0
- Breiter, H. C., Gollub, R. L., Weisskoff, R. M., Kennedy, D. N., Makris, N., Berke, J. D., ... Hyman, S. E. (1997). Acute effects of cocaine on human brain activity and emotion. *Neuron*, *19* (3), 591-611.
- Brudzynski, S. M., (2008). Communication of adult rats by ultrasonic vocalization: biological, sociobiological, and neuroscience approaches. *ILAR J*, *50* (1), 43-50.
- Grace, A. A. (1995). The tonic/phasic model of dopamine system regulation: its relevance for understanding how stimulant abuse can alter basal ganglia function. *Drug Alcohol Depend*, *37* (2), 111-129.
- Hoffman, H. S., Sthattton, J. W., Newby, V., & Barrett, J. E. (1970). Development of behavioral control by an imprinting stimulus. *Journal of Comparative and Physiological Psychology*, *71*, 229-236.
- Jaffe, J. H. (1965). Drug addiction and drug abuse. In L. Goodman & A. Gilman (Eds.), *The pharmacological basis of therapeutics*. (3rd ed.) New York: Macmillan.

- Jhou, T. C., Good, C. H., Rowley, C. S., Xu, S., Wang, H., Burnham, N. W., ... Ikemoto, S. (2013). Cocaine drives aversive conditioning via delayed activation of dopamine-responsive habenular and midbrain pathways . *J Neurosci*, *33* (17), 7501–7512.
- Koob, G. F. (2008). Hedonic homeostatic dysregulation as a driver of drug seeking behaviour. *Drug Discov Today Dis Models*, *5* (4), 207–215.
- Koob, G. F. (2009a). Dynamics of neuronal circuits in addiction: reward, antireward and emotional memory. *Pharmacopsychiatry*, *42* , S32–S41.
- Mutschler, N. H., & Miczek, K. A. (1998b). Withdrawal from a self-administered or non-contingent cocaine binge: differences in ultrasonic distress vocalizations in rats. *Psychopharmacology (Berl)*, *136* , 402–408.
- Solomon, R. L., & Corbit, J. D. (1973). An opponent-process theory of motivation: II. Cigarette addiction. *Journal of Abnormal Psychology*, *81* (2), 158-171.
- Solomon, R. L., & Corbit, J. D. (1974). An opponent-process theory of motivation: I. Temporal dynamics of affect. *Psychological Review*, *81* (2), 119-145.
- Volkow, N. D., Wang, G. J., Fischman, M. W., Foltin, R. W., Fowler, J. S., Abumrad, N. N., ... Shea, C. E. (1997). Relationship between subjective effects of cocaine and dopamine transporter occupancy. *Nature*, *386* (6627), 827–830.
- Wikler, A. (1971). Some implications of conditioning theory for problems of drug abuse. *Behavioral Science*, *16* , 92-97.