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"[S]ome vicious mole of nature": Hamlet's Erratic Behaviour and Brain Neurotransmitter Imbalance

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Abstract
The aim of this paper is to investigate, from a neuroscientific perspective, the complex but still unravelled mystery of Hamlet's inconsistent conduct in Shakespeare's classic tragedy. Adopting the 'medical diagnosis' method, the paper contends that such manifestations of Hamlet's eccentric comportment as depression, social isolation, impulsiveness, sleep disorder, aversion to women, and procrastination, are all salient symptoms of low levels of dopamine, a vital brain neurotransmitter responsible for reward and motivation. The paper concludes that 'dopamine deficiency' in Hamlet's brain has a devastating impact on his mood and outlook on life. It aggravates his depression, adversely affects his disposition, focus, cognition, and motivation and subsequently deprives him of the incentive to act. The significance of this study is that it identifies the reason for Hamlet's hesitation, enhances understanding of the play and enriches representations of the leading role in the play on stage. Shakespeare portrays Hamlet as severely afflicted with such an intricate neural illness (not identified in Elizabethan England then), expertly dramatizing the devastating impact on his protagonist of the acute clash between will and inability. Hamlet's *hamartia* is, consequently, not a fault of his making, not a commonplace Aristotelian tragic error of judgment, or a psychological personality flaw, but - as Hamlet intuitively prophesies – a birth defect, the result of 'some vicious mole of nature.'
Keywords: Delay, depression, dopamine, hesitation, motivation, neuroscience, procrastination, Shakespeare's *Hamlet*

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Introduction

The topic of Hamlet's bewildering behaviour has incessantly haunted the realm of Shakespearean scholarship for centuries. Academics and psychologists have sought to explain the signs of Hamlet's strange conduct, such as anhedonia, indecision, delay, madness, and misogyny. The various hermeneutic schools, including the psychoanalytic theory, employed to unravel Hamlet's enigma, have proved, nevertheless, inadequate and inconclusive. Consequently, readers and audiences of Shakespeare's best-known play have been so endlessly and tantalizingly confounded by Hamlet's 'problem' that they, in their wild fancy, would desperately wish the Prince of Denmark disclosed what precisely made him delay his revenge against his murderous uncle. Hamlet, perplexed by his inactivity and dullness, lamentably, has no better answer to disclose than the disappointing revelation he gives in his last (i.e., seventh) soliloquy: 'I do not know / Why yet I live to say, 'This thing's to do'' (IV.4.44-456)[i]. The present paper seeks to answer the question, "What is the origin of Hamlet's erratic behaviour" that twists the action and leads it to the tragic conclusion?" The paper contends that the answer to this central question in *Hamlet* lies within the realm of neuroscience.

Literature Review

The cause of Hamlet's delay in Shakespeare's most famous play has been a challenge for a great number of critics and researchers since the play had its initial performance in the early 1600s. The large number of studies conducted to identify the cause of Hamlet's baffling hesitation have, nevertheless, not been conclusive. The present paper, therefore, attempts to explore the issue from a new perspective. It will use available research findings in the field of neuroscience to corroborate the premise that Hamlet's problem is pathological not psychological.

Critical opinions on the causes of Hamlet's indecision diverge broadly into two major categories: objective and subjective. On the one hand, a small number of critics, like F. W. Ziegler, L. Klein, and K. Werder, ascribe objective reasons, attributing Hamlet's delay to external difficulties (Furness, 1877; McClure, 1992;). They argue that Claudius is acunning and ruthless ruler surrounded by competent bodyguards; any attempt by Hamlet to kill him would entail the Prince's inevitable doom. Hamlet's uncertainty about the Ghost is another reason those scholars cite. In contrast, most interpretive opinions of the other category relate Hamlet's indecisiveness to personal, inner conflicts. Accordingly, Hamlet experiences an internal conflict between his moral scruples and the sinful nature of revenge. In that vein, Goethe, in *Wilhelm Meister* (1795), presents his 'sentimental' theory of Hamlet's delay, arguing that the Elizabethan bard assigns a challenging task upon a soul unequal to perform it. Nineteenth-century Romantic German critic Schlegel and English poet Samuel T. Coleridge see Hamlet's deferment of Claudius' murder until the last act as evidence of a flawed personality. Schlegel (1809) views *Hamlet* as "a tragedy of thought inspired by continual and never-satisfied meditation on human destiny and the dark perplexity of the events of the world" (Cited in Tredell, 2015, p. 19). S. T. Coleridge aptly gives credit to "Shakespeare's deep and accurate science in mental philosophy" (. Coleridge interestingly remarks, "if there be an overbalance in the contemplative faculty, man thereby becomes the creature of mere meditation, and loses his natural power of action" (Cited in Han, 2001, p. 181). However, this view is arguably not strictly accurate in Hamlet's case.

One of the most notable and detailed scholarly analyses of Hamlet's problem is A. C. Bradley's seminal study. In his extensive interpretation of this Shakespearean tragedy, Bradley (1904) refutes Goethe's 'sentimental' as well as the Klein-Werder interpretations, rejecting any theory that places the cause of Hamlet's delay 'in external difficulties' (p. 74). Bradley protests, "From beginning to end of the play, "Hamlet never makes the slightest reference to any external difficulty […] but he always assumes that he *can* obey the Ghost" (p. 75). Bradley harps, instead, on Hamlet's psychological dilemma and relates it to the protagonist's deep melancholy, which, in Bradley's opinion, is pathological but does not amount to madness. "Melancholy," he declares, is the essence of Hamlet's inactivity and, consequently, his suffering. Bradley does not pinpoint the source of Hamlet's problem but urges fellow critics to continue the mission. He calls, intuitively, upon 'the pathologist' to examine Hamlet's "melancholia" and "determine its species." Coleridge adds, the critic would be "grateful to [the pathologist] for emphasizing the fact that Hamlet's melancholy was no mere common depression of spirits" (p. 96). The present paper humbly intends to navigate towards that destination.

Arguably, the origin of Hamlet's problem is, not psychiatric but pathological, particularly neurological.

> Neuroscience has had a huge impact on psychiatry. Mental illness is now recognized to be the consequence of pathological modifications of the brain, and psychiatric treatments today are focused on correcting these changes […] Mental illnesses today are recognized as diseases of the body, just like cancer or diabetes. (Bear, Connors & Paradiso, 2007, p. 684)

An opposite viewpoint of the Prince is G. W. Knight's, considering Hamlet "a spirit of penetrating intellect and cynicism and misery." In *The Wheel of Fire* (1930), Knight sees Hamlet as a villain, "without faith in himself or anyone else, […] taking delight in cruelty, […] a poison in the midst of the healthy bustle of the court" (pp. 41-42). Knight's is an unwarranted and unfair evaluation of Hamlet's dilemma since the Prince's 'poison', it will be demonstrated, furtively and tragically gnaws into his brain before it seeps outside to affect others.

Conceivably, the most popular and predominant interpretation of Hamlet's dilemma for the latter half of the twentieth century, though now on the wane, has been the Freudian psychoanalytic approach. According to the school's mouthpiece Ernest Jones (1910), a disciple of Sigmund Freud's, the young Prince is unconsciously self-inhibited from avenging his father's murder because he must have been deeply grateful to his uncle who allegedly enacted Hamlet's 'repressed' psychosexual impulses. Ernest Jones's interpretation is arguably overstated and at variance with ample textual evidence. *Hamlet* abounds in lines that demonstrate the protagonist's great love and admiration for his father, on the one hand, and his -disdain and repulsion of his inconstant unfaithful mother, on the other.

Since Freud's psychoanalytic theory of Hamlet emerged, only a few books and articles have been published to shed some new light on the nature of Hamlet's dilemma. In *The Hamlet Doctrine* (2013), Critchley & Webster re-examine *Hamlet* and conclude it is about "nothing" (p. 15), a play in which the true hero emerges to be Ophelia: "Arguably, Ophelia is not just the main

casualty in *Hamlet* but its true tragic hero" (p.113). Having relied on prominent philosophers and psychoanalysts such as Carl Schmitt, Walter Benjamin, Hegel, Freud, Lacan and Nietzsche, they see Hamlet's problem as resulting from "a significant disconnection between thought and action" (p. 13). Thought and action "seem to pull against each other, the former annulling the possibility of the other" (p. 13; 14). Hamlet can close the gap between thought and action, Critchley & Webster argue, "through the ultimate conceit, that is, through *theater*, through play" (p. 15).

Moreover, the last two decades have witnessed sporadic studies that attribute Hamlet's delay broadly to neural reasons (Egnor, 2018; Podrug, 2005; Shaw, 2002). Much like their predecessors, such studies have not pinpointed the cause of Hamlet's delay; they merely reiterate the psychiatric interpretation of Hamlet's delay resulting from depression. The overall critical opinions reviewed above are each partly correct in describing the nature of Hamlet's behaviour; however, they all fall short of identifying the real cause of Hamlet's delay and eccentric behaviour convincingly.

Discussion

Interpretive injustice done to Hamlet, like Knight's view quoted above, reveals a critical tendency to judge the Danish Prince by what he *should* do, not by what – due to his supposed defect – he *could* do. Upon close inspection, Hamlet - intellectual, righteous, brave, and honour-bound- proves to be more burdened with and weakened by brain disorders than his detractors would have realised. His hesitation is only one manifestation, among many, of a severe hidden neurological ailment that hinders him from taking the desired action promptly and meaningfully. As the objective, 'outer-difficulties theory' and the psychoanalytic approach to interpreting Hamlet's delay have proved critically inadequate, a neuroscientific approach towards understanding Hamlet's 'problem' may prove worthwhile.

In Shakespeare's classic tragedy of delay, the dramatic 'battle' is fought and lost in Hamlet's brain. The Prince of Denmark is usually criticized for taking thinking to an extreme at the expense of urgent action, failing to "sweep" to avenge his murdered father, as he passionately undertakes. Initially, to understand Hamlet's delay, it is crucial to comprehend how the human brain functions and how it transfers thoughts into action. The brain comprises numerous nerve cells (neurons), each of which releases neurotransmitters to another nerve cell to transmit information at a site of contact, called a synapsis, making action possible (Bear et al., 2007). These brain neurotransmitters regulate various functions in the body, such as mood, behaviour, attention, sleep cycles, and muscle movement (Berry, 2022). One of these vital neurotransmitters is 'dopamine.' The brain sends this neurotransmitter from one cell to another in response to any kind of reward-stimulating thoughts (Olguín, Guzmán, Garcia & Mejía2016). The chief role of dopamine is to encourage one to act, either to perform a good deed or to avoid a bad one, which means the brain releases it *before a* reward is imminent. Moreover, dopamine, together with another brain hormone, serotonin, is responsible for pleasure and serves to regulate emotions, tune the mood, and encourage one to take action to achieve specific rewards (Bear et al.).

If the dopamine in the brain is insufficient, the nerve cells will not function effectively. Hence, action will fail to occur or take more time (Wender & Tomb, 2017). 'Dopamine deficiency'

symptoms include depression, impulsiveness, muscle tremors and stiffness, restless legs syndrome, procrastination, poor attention levels, and low sex drive (Kwatra, Khan, Quadri & Cook, 2018; Swaim, 2017; Villines, 2019). Other cardinal symptoms include feelings of worthlessness and guilt, suicidal thoughts, insomnia, fatigue and feeling demotivated, mood swings, and delusions (Bear et al.). Upon close analysis of his behaviour, Hamlet displays most signs of this brain impairment.

The primary sign of 'low dopamine' in humans is depression, accompanied by apathy, lack of motivation, and lack of enthusiasm (Schmidt & Reith, 2005). In a chapter titled "Dopamine and Depression," Skolnick (2005) underscores that "The contribution of anhedonia to depressive symptomatology, and the recognition that dopaminergic transmission is critical to reward and motivational processes, refocused attention on the role of the dopaminergic synapse in MDD [i.e., Major Depressive Disorder]" (p. 199). From his initial entry on stage, Hamlet displays distinctive signs of social and physical anhedonia, undue melancholy, desperation, suicidal thoughts and, later, suspicion in almost everyone around him (except Horatio). These are manifestations of a neurological symptom, known as First Episode Psychosis (FEP), caused by 'dopamine deficiency' in the brain (Cadman, 2018). Several neuroscientific studies have provided evidence that links psychosis to disturbances in the production of 'dopamine' (Tost, Alam & Andreas2010). FEP is characterized as having the following signs: 'a worrisome drop in grades' for students, 'a decline in self-care or personal hygiene,' difficulty in thinking, feeling suspicious or uneasy with others, spending more time than is usual in isolation, and, finally, experiencing solid and inappropriate emotions (NAMI, 2020). According to Belujon and Grace (2017), dopamine plays a crucial role in the hedonic deficits described in anhedonia, and is the main symptom of Major Depressive Disorder.

Hamlet exposes signs of MDD well *before* the Ghost appears and tells him a tale of a "foul and most unnatural murder" (I.5.25). His initial appearance on stage shows a listless young man without natural pleasure or enthusiasm. His early exchanges with Claudius and Gertrude reveal salient signs of psychosis, anhedonia, depression, social exclusion, suicidal intentions and hint, arguably, at possible weak academic performance. When Gertrude asks Hamlet to "cast [his] nighted colour off," he cynically retorts that his 'inky cloak, […] customary suits of solemn black,' and other 'shows of grief' are minor signs of mourning compared with 'that within which passeth show' (I.2.68; 77; 78; 82; 85). No sooner is Hamlet alone on stage than he externalizes his overwhelming inner depression, pondering on suicide (I.2.129-132). The worries that Hamlet houses in his conscience surpass the typical anguish resulting merely from his father's death and his mother's second marriage. Claudius' seemingly gentle admonition to Hamlet that "the clouds still hang on you" (I.2.66) emphasises not only the nephew's sad mood but also the social exclusion that has become the norm of his life. Besides, Claudius (I.2.) draws attention to "Hamlet's transformation" and how "nor th' exterior nor the inward man / Resembles that it was" (ll. 5; 6-7). Hamlet's link with reality, moreover, seems shaken; he sees life as "an unweeded garden / That grows to seed," and "all the uses of this world" are to him repulsively "weary, flat, and unprofitable" (I.2.135-136; 134; 133). Whatever Claudius' moral reality is, his words to Hamlet (I.2.87-108) -that the latter is practising his "mourning duties" to an extreme and that Hamlet's "unprevailing woe" is "a fault to nature" (l. 101) - are prophetic, common sense.

Suspicion in others is another symptom of 'psychosis' (Carey, 2021), a sign of low dopamine that Hamlet reveals in his early appearance. As soon as Horatio tells Hamlet of the Ghost's disturbing appearance, the Prince expresses his doubt about how his father died, "All is not well; / I doubt some foul play" (I.2.253-254). Soon after the Ghost narrates the harrowing "tale" of a fratricide (I. 5), Hamlet readily bursts with "O my prophetic soul! / My uncle!" (Ll. 40-41). Hamlet's suspicion also extends beyond his mother to encompass all women: "Frailty, thy name is woman!" (I. 2. 146). Likewise is Hamlet's suspicion in Ophelia, in his two friends Rosencrantz and Guildenstern, and even in the Ghost: "The spirit that I have seen / May be the devil" (I.2.573-74). Moreover, the "mad" role Hamlet allegedly plans to play in public is not only a means of confirming his suspicion of his uncle but also perhaps a stratagem to cover his uncontrollable unhealthy conduct. Hamlet's is not the balanced response of an adult, simply mourning his father's death and expressing his shock at his mother's marriage to his uncle. Hamlet is in despair, one who has lost all ordinary healthy pleasure in "the uses of the world."

At certain turns in the dramatic action, Hamlet's impulsiveness and aggression may be attributed to the dysfunction in his brain of both the serotonin and dopamine chemicals. Several research studies have indicated a link between impulsive aggressions with the imbalance of the functions of these two neurochemical systems, as impairment of the serotonin system function can lead to dysfunction of the dopaminergic system (Seo, Patrick & Kenneal, 2008). The dopaminergic system, in particular, "is involved in behavioral activation, motivated behavior, and reward processing" and "also plays an active role in the modulation of aggressive behaviors" (p. 4). Impulsiveness is a distinctive feature of Hamlet's demeanour throughout the play; it is also a major symptom of 'dopamine deficiency' (Magana, 2019, p. 48). Although thoughtful by nature, Hamlet has a noticeable excitable streak. At times, he is erratic, nervous and unpredictable. Examples of his hot temper and impulsiveness permeate the play. The first time Hamlet seems to act without logical thinking is in (I.4), when he, despite warnings by his companions, hastily follows the Ghost without questioning its identity. His instant decision to trail the Ghost combines recklessness and impulsiveness (ll. 65-67). No sooner does the Ghost begin to tell its story than Hamlet rashly offers to act in a manner that reflects more ostentation than genuine bravery: "Haste me to know't, that I, with wings as swift / As meditation or the thoughts of love, / May sweep to my revenge." (I.v.29-31). As the action unfolds, it becomes clear how farfetched Hamlet's readiness to act is. When his resolve to fulfill the Apparition's command is tested, he begins to question the Ghost's identity. Hamlet's impulsiveness is also obvious in (III.4), when he carelessly stabs Polonius behind the arras, presuming him to be Claudius. Hamlet's leap into Ophelia's grave in (V.1) -giving out his hyperbolic "Forty thousand brothers / Could not, with all their quantity of love, / Make up my sum (ll. 254-256)- is more an unwary act than rational behaviour. Moreover, when Hamlet kills Claudius at the end of the play, he seems to do so as a reaction to Laertes' revelation to him that Claudius had poisoned the drink that Gertrude drank.

Another intriguing impact of 'low dopamine,' reflected in Hamlet's , is his presumed low academic achievement. Recent studies have linked disorder in the dopamine production with disturbance of cognition and lack of motivation. Neuroscience News website quotes a study lead author as providing "a new theoretical account for how dopamine affects learning […] and motivation […] simultaneously" (Role of Dopamine, 2015, para. 4). The issue of Hamlet's

university study and academic performance in the play has surprisingly received little scholarly attention. Although the text sheds little light on Hamlet's university level or progress, it is reasonable to presume that a thirty-year-old philosophy student (V.1.146), who has not yet completed his degree, has profound learning difficulties –which would also cause him further frustration and depression. At the outset of the action, Hamlet is in Denmark, back from University in Germany, to attend his father's funeral and, to his subsequent dismay, his mother's second marriage. In (I.2), both Claudius (ll. 112-117) and Gertrude (ll. 118-119) beseech Hamlet to "remain / Here in the cheer and comfort of our eye" (ll. 115-116) and "go not to Wittenberg" (l.119). If Claudius and Gertrude had been sure that King Hamlet's death was the cause of Hamlet's melancholy, they would have probably recommended him to go back to Wittenberg, as focusing on his studies would soon distract him from his sad thoughts. In contrast, Claudius tells Hamlet forthright, "For your intent / In going back to school in Wittenberg, / It is most retrograde to our desire" (ll. 112-114). Claudius and Gertrude would not try to dissuade Hamlet from going back to university unless they were concerned by the slow academic progress he had been making. This could be one reason, among others, safely harbored in their minds. Nor does Hamlet hesitate to comply: "I shall in all my best obey you, madam" (l. 120). The *Learning Disability Association of America* (2020) informs that learning disabilities are caused by "neurobiological factors that alter brain functioning in a manner which affects one or more cognitive processes related to learning**"** (para. 1). It adds, **"**These processing problems can […] interfere with higher level skills" such as study organization, time management, critical thinking, memory, and attention (Types of Learning Disabilities, para. 1. Hardly can a reader of the play miss the relevance of this association to the protagonist's peculiar conduct. Hamlet's intellect and education are indeed not questionable, but his academic progress as a university student *is*. In *Hamlet,* Shakespeare gives the impression that the protagonist's learning is more the result of his witty observations of life than of book knowledge: "There are more things in heaven and earth, Horatio," Hamlet remarks, "Than are dreamt of in your philosophy" (I.5.166-167).

One of the striking symptoms of 'low dopamine,' apparent in Hamlet's conduct, is 'restless leg syndrome (RSL)' (Johns Hopkins Medicine, n.d. para. 1-5). As dopamine is responsible for motor movement, 'low dopamine' may result in general body fatigue and muscle shaking (Kwatra et al., 2018). This condition, mentions *Web*MD, "can also happen in other areas like the arms, chest, or head" (Dunkin, 2022, para. 5). Mayo Clinic (2020) notes, "Researchers suspect the condition may be caused by an imbalance of the brain chemical dopamine, which sends messages to control muscle movement" (para. 4). Shakespeare's tragedy has a hint about Hamlet suffering from this syndrome. In (I.2), Ophelia reports to her father a frightening encounter in her closet with Hamlet, "*his knees knocking each other*" (l. 80), "And thrice his *head thus waving up and down*" (l. 92; emphasis added). Ophelia's description of Hamlet's untidy clothes and apparent neglect of his appearance and hygiene reveals the Prince's early phase of psychosis (II.1.77-79). This is more than Hamlet simply putting on an "antic disposition" to confuse his uncle and associates. This behaviour confuses Polonius, who believes it is madness, yet admits it is too perfect to be feigned, "Though this be madness, yet there is method in't" (II. 2. 205).

Another fundamental tenet of 'dopamine deficiency' that Hamlet manifestly displays is his anhedonia and loss of pleasure in social relations and meaningful activities (Lamontagne, Melendez & Olmstead, 2018). As already indicated, dopamine is the brain hormone "released

during pleasurable situations and stimulates one to seek out the pleasurable activity or occupation" (Mandal, 2019, para. 6). Hamlet's unusual loss of pleasure in relationships and activities is most evident in his speech to his Wittenberg university mates, Guildenstern and Rosencrantz:

> I have of late –but wherefore I know not – *lost all my mirth*, forgone all custom of exercises; and, indeed, *it goes so heavily with my disposition* that this goodly frame, the earth, seems to me a *sterile* promontory; this most excellent canopy, the air, look you, […] it appears no other thing to me than *a foul and pestilent congregation of vapours*. (II.2.289-296; emphasis added)

Likewise, humankind, though "noble in reason […] infinite in faculty," and "in apprehension […] like a god" to Hamlet, is not more than "this quintessence of dust" (II.2.297; 299; 300-1). That Hamlet's speech above is part of role-playing to deceive his prying 'friends' is unlikely since the essence of the speech is also reiterated in Hamlet's speeches with Horatio and the soliloquies.

Alongside the existing anhedonia from which Hamlet markedly suffers, the Ghost's revelation fails to trigger enough dopamine to motivate the gloomy Prince. At best, Hamlet's brain releases unhappy chemicals to warn him of the intended action of revenge. Thus, Hamlet realises he is not sufficiently motivated to take revenge. Instead, he begins the lengthy process of finding excuses to delay his action. A reasoning cycle begins in Hamlet's *prefrontal cortex*, the part of his brain that is intact and effective. Hamlet feigns madness as a disguise tactic and perhaps a cover to hide his increasingly distinct and embarrassing mental illness. Shakespeare's original audience would have seen Hamlet's pretended madness as a conventional ingredient of the popular revenge tragedy. However, playacting is one of Hamlet's dominant passions. When Hamlet devises the *mousetrap* (II.2), as when he feigns madness, he does so eagerly, with his brain cells presumably spurting an abundance of dopamine as he expects rewards in terms of pleasure as a result. Hamlet relishes acting under the guise of madness and masters the role so well that it becomes hard for the audience to tell if his 'madness' is feigned or real. Hamlet enjoys role-playing and attracting the attention of the audience (i.e., characters on stage and the audience in the theatre), which may arouse the suspicion that Hamlet, like Iago, is a histrionic personality disordered person who arguably suffers from Cluster B personality disorders (Alyo, 2019). That Hamlet awes his audience with the dexterity of playing mad is evident in Polonius' unmistakable admiration of the Prince's performance (II.2.205). When Polonius asks his daughter if she thinks Hamlet is mad, she retorts, "My lord, I do not know; / But, truly, I do fear it" (II.2. 83-84).

Hamlet's inexplicable, misogynistic attitude towards Ophelia, another controversial aspect of the protagonist's morbid behaviour, may be associated with the symptoms of deficient dopamine in the Prince's brain. Low-level dopamine causes the dulling of pleasure and the inability to feel gratification and, consequently, a weakening of libido (Hull, Muschamp & Sato. 2004). "Known as the motivation molecule," exposes Kancel (2016), "Dopamine helps to increase the sex drive of an individual" (p. 16). The brain uses happy chemicals to reward what biologists call "reproductive success;" sex and romance stimulate the brain to release happy chemicals as a reward (Breuning, 2012, p. 17). Love triggers vast neurochemicals and causes one to be happy, while lost love prompts an enormous flow of unhappy chemicals and causes one to be despondent. Hamlet's suddenly troubled relationship with Ophelia, unjustified logically in the play, may be

taken as another symptom that the Prince is afflicted with dopamine deficiency. In the famous scene with Ophelia (III.1), Hamlet, turned misogynist, rebuffs the once-lover Hamlet; "I never gave you aught" (l.97). He unashamedly announces himself anti-marriage and anti-women. Low dopamine levels in the brain, according to a specialized website, "can lead to an inability to feel pleasure from activities we previously enjoyed" (Saeed, n.d. para.4). Hamlet has already told Rosencrantz categorically, "Man delights not me; no, *nor woman neither* […]" (II.2.301-2; emphasis added). A scientific study has shown that "dopamine was active in areas of the brain known as the *basal ganglia*, the same region where it has been observed to respond to positive stimuli, such as food or sex" (ScienceDaily).

Looked at in this perspective, Hamlet is then a man who has lost delight and interest in almost everything in which an ordinary man is interested –striving, focusing, and finding things interesting. Therefore, when his subsequent encounter with Ophelia occurs, not only is Prince Hamlet the moralist, preaching his once-beloved, now suspected of spying on him, to "get … to a nunnery" (II.2.121) so that there would not be another "breeder of sinners"; he is also a man who has little sexual desire that average men have. His "get-thee-to-a-nunnery" speech hides underneath the lack of sexual drive which he is suffering, although he finds occasions to make one or two sexual jokes (Ophelia remarks: "you are keen, my lord, you are keen" to which Hamlet retorts: "It would cost you a groaning to take off my edge" (III.2.231-232)). Hamlet's misogynistic attitude towards Gertrude and Ophelia cannot be taken as part of his plan to avenge his father's murder; perhaps the dramatist plans to embody the protagonist's suspicion of both women. Although Hamlet nicknames "women" frailty, the text offers little evidence that either woman deserves such vociferous censure.

Procrastination, the central problem Hamlet must grapple with throughout the play, is the outcome of his lack of motivation, a prominent sign of low dopamine in the brain (Magana, 2019). Magana refers to a gene that "helps control the level of dopamine between neurons" and plays a role in "regulating procrastination behaviour" (p. 48). When a person meets a challenge and is ready for meaningful action, dopamine is released in response to a reward or reinforcement. "When deciding to act, the neurotransmitter dopamine," explain Michely et al. (2020), "is implicated in a valuation of prospective effort and reward" (p. 1448). The motivation to act is essentially associated with the energizing impact that rewards have on behaviour to engage in specific actions to obtain such rewards. Therefore, individuals are likely to engage inactivities that provide them with pleasure and promise them potential, satisfactory rewards. 'Dopamine deficiency' is thus responsible for reducing the willingness to choose action options or even to initiate actions that fail to maximize reward (Michely et al., 2020). Hamlet, the philosophy student, evidently finds little reward in having to kill a reigning King, with the warrant to kill being merely an apparition of whose reality the sceptical Prince will spend considerable time questioning.

The deficient dopamine transmission seems to dull Hamlet's resolve and weaken his concentration on his lackluster task. Nowell (2012), from Intrinsic Motivation and Magical Unicorn, observes something intriguing about low dopamine level . Because dopamine is responsible for reward and motivation, individuals suffering from low dopamine subsequently "engage in (a) high-risk or sensation-seeking behaviour, and (b) demonstrate a greater than typical

struggle with the boring task" (para. 1) For a person suffering from low dopamine, Nowell (2012) remarks, some tasks are neither attractive nor easy to do. Therefore, when such individuals approach a tedious or unrewarding task, they "begin to scan the environment for something – anything- more immediately and intrinsically rewarding" (para. 4). When a person sees that reward is close and clear, the task requires little mental effort to link the task with the reward. Conversely, if the task is uninteresting, indistinct, and unrewarding, there is difficulty in making a close link between the task and the reward expected.

Hamlet is a case in point. His mission is surrounded by considerable uncertainty, difficulty, and repulsion. The desired reward related to the tasks or activities humans usually do is either missing or blurred in Hamlet's case. Therefore, as he finds the job arduous and tedious, it is, in Nowell's words, "challenging to visualize and anticipate the long-term payoff" (para. 2). This fact may explain why Hamlet looks for tasks in which the reward is immediate and evident to him, such as playacting, devising the Mousetrap playlet, and moralizing and attacking corruption around him - tasks he has the talent for and passion for performing. The clear, immediate, and rewarding activities he opts to perform at the expense of the complex, uncertain, and ugly task of murder make the meditative Prince and student of philosophy surrender to the impact of procrastination throughout the action.

Hamlet's prolonged inactivity and notorious delay are perhaps most distinct in his last soliloquy, which can demonstrate the cause of his problem. As Fortinbras leads his troops to Poland "to gain a little patch of ground / That hath in it no profit but the name" (IV.4.18-19), the Danish Prince belittles himself when juxtaposed with his Norwegian counterpart: "How all occasions do inform against me, / And spur my dull revenge!" (IV.4.32-33). It is intriguing how Hamlet uses the metaphor of circumstances ("occasions"), bringing charges against him ("do inform against me") for his inactivity. He realises the disastrous impact of his inaction on himself and on society about which he claims to care. The following few lines externalise the intense conflict raging in the mind of an intellectual moralist, trying to rationalise, or perhaps justify, his hesitation by aligning it with God-granted thinking and reasoning:

> Sure, he that made us with such large discourse,
> Looking before and after, gave us not
> That capability and godlike reason
> To fust in us unused. (IV.4.36-39)

Hamlet knows he hides his indecision behind the thin screen of 'reasoning.' However, he soon goes from the one extreme of attributing his hesitation to overthinking to the other extreme of ascribing it to "bestial oblivion" or cowardice (Ll. 40-43). Considering these two excesses, Hamlet admits that the cause of his hesitation is neither. He wonders why he cannot act though he seems to have all the requirements for action: "I do not know / Why yet I live to say, 'This thing's to do', / *Sith I have cause, and will, and strength, and means / To do't*" (IV.4.45-46, emphasis added).

Hamlet has the *cause* to avenge his father's honour or redeem his mother's integrity. Hamlet equally has the *will* and determination to perform the act. *Strength* (both mental and

physical) is also available to Hamlet as a prerequisite for action. Finally, the young Prince says he acquires the *means* to punish Claudius. However, what Hamlet lacks to act is the most vital component of acting - *motivation.* He is unaware of this problem, though, indirectly and repeatedly, he blames himself for not being as efficient as the First Player and tries to charge his will with enough vigour to push himself into acting meaningfully. Now Hamlet realises that the First Player has power that he (Hamlet) lacks. In his third soliloquy, Hamlet returns to accusing himself of cowardice (II.2.545-546) as he compares his inactivity with the First Player's passionate speech of Hecuba (II.2.532-539). His ironic reference to his ranting as "most brave" (l. 557) and his self-reproach for unpacking his heart with words, not actions, is confirmation of his acute mental anguish because of his idleness and lack of enthusiasm. To invigorate his resolve towards action, Hamlet resorts instead to a new (but interesting) plan to be sure his uncle is guilty – the play-within-the-play (II.2.579-80). Prince Hamlet is confused and bewildered. His problem lies not in the lack of motivation *per se*, but in what should spark his motivation.

Shakespeare's Hamlet displays other secondary signs and symptoms of low dopamine in his brain that cause his indecision. One sign is sleep disorder (*MedicalNewsToday*). Hamlet refers to his inability to sleep; "Sir my heart," he tells Horatio, "there was a kind of fighting / That would not let me sleep" (V.2.4-5). Another sign of imbalanced dopamine is guilt-ridden feelings and self-blame (*MedicalNewsToday*). Soliloquising in (II.2), Hamlet calls himself "a rogue and peasant slave" (l. 523) and "A dull and muddy-mettled rascal" (l. 540) for failing to avenge his father's murder. As he chides Ophelia in the "get-thee-to-a-nunnery" scene, he proceeds to blame himself as a sinner: "I could accuse me of things that I were better my mother had not borne me" (III. 1. 122-125). It is curious that such a moral, righteous and honourable philosophy student feels guilt-ridden unless that is due to an impairment he unwittingly suffers.

Shakespeare's Hamlet is not a traditional Aristotelian tragic hero who fails and falls because of a weak personality trait or an error of judgment. As a protagonist, Hamlet, is a victim of unusual nature, perhaps of genetics or a neural disturbance. The character that offers the most pertinent description of Hamlet's misfortune is Ophelia. After Hamlet has voiced his misogynistic views to her, she eloquently sums up the dichotomy in Prince Hamlet, the courtier-soldier-scholar: "O' what a noble mind is here o'erthrown!" Using the metaphor of great music gone out of tune, Ophelia regrets seeing the sad transformation of "The expectancy and rose of the fair state, / The glass of fashion and the mould of form" into "That unmatched form and feature of blown youth / Blasted with ecstasy" (III.1.149; 151-52; 158-59).

The celebrated Elizabethan dramatist creates in Hamlet a personality far more convoluted and conspicuously unhealthy and disordered than has been previously critically conceived. 'Dopamine deficiency' may explain the cause of Hamlet's extreme pathological depression and may account for the psychological disorders from which he seems to suffer. Most of the symptoms of "dopamine deficiency" mentioned above indeed intersect with those of 'attention deficit hyperactivity disorder' (ADHD), which results from the low level of dopamine in the brain (Bear et al.).

Conclusion

The central image in *Hamlet*, Yorick's skull, as a head empty of its brain, may be viewed as symbolising Hamlet's imperfect brain: it is ineffective because of its neurotransmitters imbalance. The play's protagonist is a profound moral thinker who faces many intricate issues about existence, corruption, right and wrong, death, and after-life. However, his will to "take arms against a sea of troubles" (III.1.58) is thwarted by man's limited intellectual abilities and by the mysterious workings of a divine power that ironically singles him out in a world 'out of joint,' but deprives him of the ability "to set it right" (I.5.189; 190). Hamlet stands firm heroically in the face of "troubles," although he knows that "to be honest, as this world goes, is to be one man picked out of ten thousand" (II.2.179-180). Rather than committing suicide to end his pain, Hamlet opts to bear "the whips and scorns of time" (III.1.70), only to come to the bitter conclusion that, as he tells Horatio, "There's a divinity that shapes our ends, / Rough-hew them how we will" (V.2.10-11).

Endnote

[1] This and all subsequent references to Shakespeare's *Hamlet* will henceforward be to Bernard Lott's 1968 edition. All citations from the play will follow the pattern 'Act. scene. line number(s).'

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