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The *Artistic Spark* and Therapeutic Power of Self-Expression in Parkinson's Disease

Neurological disorders are the leading cause of disability in the world. Parkinson's disease (PD) affects 3 percent of the population over the age of 65, making it the second most common neurological disease after Alzheimer's (Lew & Young, 2014). Further, a 2017 global study (Feigin et.al) estimated that the number of people affected by PD more than doubled from 1990 to 2015. PD is the fastest-growing neurodegenerative disease in global prevalence, disability, and deaths (Dorsey et al., 2018). In response to this prevalence, physicians and researchers have been looking beyond pharmacological treatments to therapies that can improve the quality of life of PD patients. Amongst these efforts are studies that empirically connect PD's pathology to patient anecdotes of sudden bursts of artistic creativity and increased desire to express oneself via the visual arts, called the *artistic spark* (Pelowski et al., 2021). Not only does the emerging *artistic spark* in PD patients open a window for better understanding both the symptomatic and neurophysiological bases for PD and of our creative experiences, but it supports a broader understanding of human engagement with the visual arts and its diagnostic, rehabilitative, and therapeutic potential. The first part of this literature review presents existing research on the *artistic spark* of PD and investigates the mechanisms that underlie the creative process. The second part of this review interrogates research on art therapy that harnesses creative mechanisms to ease PD symptomatic strain on physical and mental wellbeing. Improving the quality of life of those with an incurable, debilitating disease such as PD necessitates further study into such non-pharmacological treatments that -- in combination with pharmacological treatments -- can better provide symptomatic support to both motor and nonmotor impairments.

PD Pathology and Current Treatments

Formally known as *paralysis agitans,* Parkinson's disease is a slowly progressing neurodegenerative disorder of aging, commonly diagnosed in patients in their sixties." PD impacts the ability of neurons in the basal ganglia to produce, release, and reuptake the neurotransmitter dopamine (DA), leading to the loss of these dopaminergic cells and deterioration of the vital synapses that govern motor control and cognitive function. Clinicians often diagnose patients with PD after the onset of hallmark motor symptoms -- such as rest tremors, rigidity, difficulty with coordinating movement, and a decline in sensory and visual function -- that gradually worsen to become a severe source of disability (Dorsey et al., 2018). PD degradation of dopaminergic synapses also hinders cognitive function, often exhibited by motivational and perceptual impairments, as well as deficits in language processing and emotional regulation (Fröhlich, 2016). Individuals with Parkinson's disease are challenged by both motor and non-motor symptoms, experiencing a gradual reduction of functional independence and an increase of social withdrawal, further reducing the quality of life of those afflicted with PD.

Though PD cannot be cured and the progression of the disease cannot be slowed, pharmacological and non-pharmacological treatments provide symptomatic support by increasing cerebral dopamine levels. These pharmacological treatments target motor manifestations, while various therapies and interventions target nonmotor manifestations of the disease. Pharmacotherapy for PD encompasses medications that increase dopamine levels in the brain's direct and indirect pathways, delay the development of motor fluctuations, and affect other neurotransmitters (Lauring, 2019). The most effective pharmacotherapy for PD increases dopamine production via levodopa, a medication that crosses the blood-brain barrier and is converted to dopamine to the central and peripheral nervous system by dopa decarboxylase. Levodopa preparations in combination with decarboxylase inhibitors are the most powerful dopaminergic agents; motor fluctuations can be delayed by continuous dopaminergic stimulation (Chand & Litvan, 2007). Dopamine agonists also delay the development of motor fluctuations by stimulating dopaminergic receptors, but are less potent and have more adverse side effects. Various motor and nonmotor symptoms of Parkinson's disease are responsive to non-pharmacological treatments such as physical therapy, occupational therapy, and adaptive equipment. Physical activity and cardiovascular exercise have also been shown to improve many motor symptoms of PD (Chand & Litvan, 2007). Increased field interest in non-pharmacological PD treatments has revealed a new promising therapy that responds to a creative phenomenon specific to PD, called *artistic spark.*

Parkinson's Disease and the *Artistic Spark*

Artistic creativity is defined as "the ability to produce innovative aesthetic works," while *creativity*, more broadly, is "the ability to generate ideas that are both novel and useful or influential in a particular social setting" (Inzelberg, 2013). To conceptualize creativity from a research perspective, neuroscientists refer to Anna Abraham's "Four Ps" (2013): *place* (external factors such as social environment), *person* (internal factors such as traits and skills), the *process* of creative ideation (approaching creativity within the context of the cognitive operations), and *product* (the output of creative ideation). Abraham's approach to studying artistic creativity helps researchers link symptoms of both neurodegenerative and neuropsychiatric diseases to the emergence of talent after clinical diagnoses. This connection inspires a field of research that investigates what Pelowski et al. (2021) call the *artistic spark*: the "neurobiology underlying the way we create and respond to art."

This approach to studying creativity was popularized by research that evaluated the nature of the *artistic spark* in patients with post-traumatic stress disorder, chronic anxiety, and dementia (Inzelberg, 2013). Although many clinical characteristics and social implications of Parkinson's disease are widely understood due to the disorder's large global prevalence, case reports and studies of the *artistic spark* in those with Parkinson's disease only emerged roughly two decades ago. In the first published study on this phenomenon, Lakke (1999) presents 40 professional artists who displayed enhanced artistic capabilities while undergoing dopaminergic treatment, showing "continuing and maturing creativity" in produced artwork. Lakke also indicates altered stylistic modes by which these PD artists self-reflect and express their mood, reporting "awkwardness with perpendicular strokes," an "unusual manner of hatching," and "changes in format [and] theme." A surge of subsequent studies supports Lakke's observations, reporting that a statistically significant number of PD patients (undergoing dopaminergic treatment) experience a sudden and new awakening of artistic creativity and passion for the

visual arts, despite -- and even because of -- the motor and cognitive changes of PD (Matos et al., 2021). This sudden awakening of artistic creativity isn't a rare occurrence in the PD population. A survey of several hundred patients (Joutsa et al., 2012) reported that this phenomenon is experienced in upwards of 20 percent of Parkinson's cases, occurring in both established artists and those who have never shown artistic interest before the *artistic spark*.

Large collections of case evidence provide consistent support for this unexpected increase in PD patient desire to create visual art, finding significant patterns related to individuals who displayed changed creativity within the visual arts and both increased desire and motivation to produce such art. Amazingly, despite experiencing hallmark PD motor impairments (such as bradykinesia and rigidity) and visuospatial deficits, many patients describe feeling "freer and more spontaneous" while creating art (Pelowski et al., 2021). Pinker (2002) presents an artist who felt as though the aesthetic and technical quality of her paintings were enhanced after beginning dopaminergic pharmacotherapy: "The new style is less precise but more vibrant… I have a need to express myself more." On one hand, the motor deficits associated with PD affect the mechanisms and techniques artists use to produce their artwork: rigidity and lack of mobility make painting, sculpting, and drawing techniques extremely difficult. Remarkably, professional artists afflicted with PD surmount these motor impairments, using different techniques and altering their styles and aesthetics to better communicate their attitudes and emotions. It's even argued that, when presented to art critics, these changes in artistic motivation, style, theme, and technique objectively improve the quality of these PD artists' work (Lauring et al., 2019). However, most importantly, the *artistic spark* provides artists afflicted with PD a renewed sense of both creative and functional freedom in their modes of artistic expression and in daily life.

Some studies report cases in which this augmented artistic expression bestows more than just a *sense* of functional freedom in established artists. Chatterjee et al. (2006) describe a graphic designer with PD who experienced a new urge to paint, as the new medium alleviated his motor disabilities. While painting, the patient reported feeling "in complete control, despite being frustratingly impaired in other [motor and cognitive] contexts." Though the patient's motor abilities remained impaired during daily activities (he was bradykinetic, rigid, had a resting tremor, and had difficulty writing), his paint strokes were fluid: "[The patient's] artistic movements demonstrated exquisite control over larger amplitude winding movements, without any resemblance to freezing while doing so." Fascinatingly, the *artistic spark* physically alleviates motor symptoms in some cases of PD and improves the patients' quality of life.

This awakening of artistic creativity has also been observed in art novices with PD, who report that a newfound artistic motivation provides the same alleviation of motor and cognitive impairments. Walker et al. (2006) describe a patient who started producing "excessive amounts" of pastel drawings after an increase in DA agonist medication. Not only was this patient's art praised by established artists for "originality, attitude, and a strong sense of color and kinesthesia," but it was also successfully sold in fine art galleries. Similarly, a couple of months after beginning prescribed levodopa, a patient in Chacko et al. (2019) started drawing, painting, and sculpting after a sudden creative awakening: "It's like when I draw or paint I am in a different world, I forget everything. I don't think about my illness, instead, I just want to paint. My brain works perfectly and it takes my hands and fingers where it wants to… It just happens and it makes me immensely happy. When I draw or paint, I feel useful, I feel normal." In the

cases of PD patients without artistic experience, the *artistic spark* provides a *new* outlet for introspection and self-expression: an alternative to the conventional modes frustratingly impaired by neurodegeneration that allows patients a return to both "normal" expressive and functional freedom.

Although PD's motor and cognitive symptoms often compromise conventional modes of self-expression, the *artistic spark* encourages deep reflection and intense expression in PD patients via the visual arts -- regardless of the patients' prior artistic involvement. Research suggests that this sudden rush in creativity can counteract the decline in functional freedom and the motor and cognitive impairments experienced by PD patients; in some cases, these symptoms temporarily disappear during creative activity (Walker et al., 2006). However, enhanced motivation and creativity in the visual arts among individuals afflicted with PD presents a paradox for researchers and practitioners: how (biologically-speaking) does a neurodegenerative disease prototypically characterized by impairments of motor and cognitive function augment creative behavior?

Neurological Correlates to the *Artistic Spark*

It's important to note that participants in Lakke's 1999 study reported undergoing a series of "trance-like" states in which they experienced "redoubled focus and urge" to produce and create a greater quantity of visual art. These individuals indicated that beginning and undergoing dopaminergic treatment often brought about such behavior. The pastel artist presented in Walker et al. (2006) "obsessively" produced several new pieces each week after his physician increased his DA agonist prescription: the patient himself accredited his creative awakening to dopaminergic treatment and subsequently resisted pharmacotherapy changes. The graphic designer-turned-painter of Chatterjee et al. (2006) "described himself as being obsessed by his art, with a 'sense of bursting forth' when making art," leading researchers to conclude that the patient's extreme artistic motivation was a result of both PD pathology and levodopa administration. Pelowski et al. (2019) note how some patients formed an addiction to the creative process after beginning dopaminergic therapy: some would abuse their medication to feel a stronger creative desire -- some even refused to sleep or eat to preserve creative momentum. In fact, in all of the case studies and research presented in the previous section, all PD patients' changes in artistic desire occurred post-diagnosis, as soon as they began pharmacological dopaminergic treatment.

Out of the 20 percent of PD patients who experience the *artistic spark*, 33 percent directly tie their artistic awakening to changes in their dopaminergic medication (Joutsa et al., 2012). Anecdotally, this creative drive was diminished -- and in some cases disappeared entirely -- when dopaminergic treatment was reduced or ceased altogether. Moreover, Lhommée et al. (2014) empirically demonstrated that the *artistic spark* could be induced by administering dopaminergic medication (dopamine agonists) to patients who had just been diagnosed with PD -- and that it disappeared after treatment withdrawal. Alternatively, Shimura et al. (2012) present a semi-professional artist with PD whose style shifted from abstract to realism before the onset of motor impairments, representing an important body of evidence where changes in visuospatial perception (and therefore artistic creativity) occur in the presymptomatic stages of PD, before pharmacological intervention. However, these two seemingly contradicting pieces of evidence

converge when relating dopamine signaling to the neuroarchitecture of the brain. According to Pelowski et al. (2021), three primary pathways regulate dopamine transmission throughout the brain: the nigrostriatal pathway, the mesocortical pathway, and the mesolimbic pathway. Neuronal degradation in PD can occur in individual pathways or a combination of these pathways, contributing to the idiosyncrasy in both the types and severity of symptoms -- and by extension, of the *artistic spark*.

Neuronal degeneration begins in the substantia nigra and ventral tegmental areas of the nigrostriatal pathway, dramatically reducing dopamine regulation in regions responsible for motor control (Lhommée et al., 2014). This dopaminergic dysregulation supports the *artistic spark's* early manifestation in PD chronology in two ways. First, motor impairments necessitate changes in artists' style and technique, as deficits in visuospatial awareness (abnormalities in contrast sensitivity, irregular eye movements, and reduced visual recognition) contribute to stylistic changes from realism to abstraction documented by Pinker (2002). Lack of functional motor range and deficits in movement coordination explains Lakke's (1999) observations of "awkwardness with perpendicular strokes" and "unusual manner of hatching." Second, sudden awakenings of artistic creativity and increased creative drive can be explained by PD patients' need to communicate through forms of expression not impacted by PD pathology (Lhommée et al., 2014). The disruption of dopamine signaling in the nigrostriatal pathway unmasks these gradually debilitating motor symptoms, leading to a diagnosis of Parkinson's disease. The subsequent initiation of dopaminergic treatment restores functional independence; patients report experiencing the *artistic spark* at this early point, and in some cases, even before PD diagnosis. Hence, Walker et al. (2006) argue that even subtle creative changes affiliated with loss of motor control can be used as an early diagnostic tool for PD.

In the early stages of PD, the two other dopaminergic pathways (the mesocortical and mesolimbic pathways) remain largely undamaged. Through dopamine signaling, these pathways regulate emotion, introspection, idea generation, motivation, impulsive control, and responses to reward (Pelowski et al., 2021). Even though dopaminergic pharmacotherapy is administered to enhance signaling in the nigrostriatal pathway, it increases dopamine concentration in the brain as a whole, augmenting the mesocortical and mesolimbic pathways that are largely unaffected by PD pathology. This enhanced signaling consequently supercharges dopaminergic activation of these pathways, enhancing associated behavior and cognition already at baseline. Dopamine agonists especially augment the reward system and addictive responses to pleasure, increasing the activation of neuronal circuits that regulate responses to gambling, shopping, eating -- and interestingly enough -- creativity (Lhommée et al., 2014). Like psychedelic drugs, dopamine agonists have a high affinity for the D3 receptors expressed in the mesolimbic pathway. Therefore, Lhhommée et al. (2014) argue that dopamine agonists promote creative ideas and their expression by inducing artistic trances similar to hallucinations: the *artistic spark* is a state of altered perception and creative inspiration facilitated by dopaminergic pharmacotherapy. On the other hand, Pelowski (2021) explains that pharmacological augmentation of the mesolimbic pathway encourages the *artistic spark.* Greater freedom of association, idea generation and sense of reward in the realm of artistic production encourages a positive feedback loop in the creative process itself; PD patients become 'addicted' to the expressive power of the visual arts.

Empirical research on the effects of dopaminergic pharmacotherapy provides a neurochemical explanation for the creative phenomena documented by case studies. Current understandings of the *artistic spark*'s neurological basis point to two causes of this sudden artistic awakening; these two causes occur independently and chronologically as PD progresses. First, degradation of the nigrostriatal pathway causes motor impairments that alter artistic styles and necessitate nonconventional forms of self-expression. Second, dopaminergic pharmacotherapy that targets motor symptoms also increases activity in pathways that regulate behaviors associated with the creative process. Dopamine agonists augment goal-directed behaviors with an artistic reward component, explaining the sudden awakening of artistic motivation experienced by many PD patients after beginning dopaminergic treatment.

Self-expression through the visual arts is an extremely rewarding process, as it allows us to evaluate and portray our own emotions, attitudes, and world reflections. As Lhommée et al. (2014) explain: "Art is the expression of the soul and the PD patient's soul has a lot to express." As motor deficits impair conventional modes of expression, the visual arts provide PD patients a means to communicate with a world in which their challenges are socially stigmatized and widely misunderstood. Lhommée et al. (2014) emphasized that the *artistic spark* in PD allows patients to "sublimate the accumulation of symptomatic and social frustrations of living with PD": the inability to eat without a feeding tube, no longer being functionally independent, or losing the ability to speak to loved ones. These therapeutic effects of the *artistic spark* led Lhommée et al. to characterize increased creative behavior as a *positive* symptom of PD. Therefore, understanding the neurological mechanisms of the *artistic spark* in PD is paramount to designing treatments that address the non-motor symptoms of PD and further enhance patients' quality of life. The *artistic spark* opens a promising window for non-pharmacological therapies that tap into PD patients' creative awakening and increase overall wellbeing through artistic expression.

Promises of Art Therapy

By modulating dopaminergic activity in the primary neurological pathways impacted by PD pathology, the *artistic spark* provides a conduit for motor rehabilitation and general wellbeing in patients. This phenomenon supplements growing interest from researchers in holistic medicine and art therapy, who suggest that specific changes in art production in those afflicted with a variety of neurological disorders and neuropsychiatric diseases (including post-traumatic stress disorder, chronic anxiety, Alzheimer's disease, and other dementias) may provide a unique basis for therapy, diagnosis, or further understanding of these diseases (Stuckey and Nobel, 2010). Though art therapy improves the physical, mental, and emotional wellbeing of those who suffer from these conditions, only anecdotal and uncontrolled studies have reported the benefits of art therapy in PD.

Nevertheless, studies that document the *artistic spark*'s improvement of PD patient quality of life motivate a call for future research into the impact of art therapy on specific PD symptoms. The aforementioned patients in Chacko et al. (2019) not only account that creating art helps them positively cope with PD, but also that "such a creative outlet makes them feel good and thus enhances their sense of wellbeing. They felt more productive and useful, and [producing art] gave them a sense of purpose in life." Artistic expression holds promising clinical

significance: art therapy that supports patients' *artistic spark* provides helpful methods to reduce depression, anxiety, and stress (prominent comorbidities of PD) while increasing patient mood and self-esteem. Moreso, Lauring et. al (2019) argue that producing introspective artwork is especially beneficial when accepting and coping with a diagnosis of a life-altering illness. Art production is driven by a reward system augmented by dopaminergic pharmacotherapy, creating a positive feedback loop that confronts PD's reduction of motivation to pursue everyday activities (Matos et al., 2021). Hence, both Lauring et al. (2019) and Chacko et al. (2019) call for this usefulness to be further understood and practiced in clinical settings.

In the first study of its kind, Cucca et al. (2021) demonstrate a statistically significant relationship between proctored art therapy and amelioration of PD motor impairments. More specifically, researchers report "ameliorated visual exploration and visuospatial" after 10 weeks of 90-minute art therapy sessions. Therapies were individualized to meet idiosyncratic motor limitations, but generally involved patient exposure to a broad range of different artistic styles and techniques in clay manipulation, painting, and drawing. At the conclusion of the art therapy program, PD patients' visual exploration patterns had reached the levels of healthy controls, demonstrating the therapy's restoration of PD-impacted neural circuits that govern visuospatial ability. Further, Cucca et al. (2021) found that art therapy facilitated neural reorganization of visual and perceptive networks, impacting larger motor functions such as balance and movement coordination. This study sets an exemplary precedent for future research into the efficacy of art therapy in PD and how such treatment can supplement current pharmacological interventions.

Cucca et al. (2021) close a large gap in the literature on PD art therapies, connecting both anecdotal and empirical evidence of the *artistic spark*'s neurological effect to the clinical and therapeutic benefits of self-expression. However, this publication's findings only support art therapy's amelioration of visuospatial deficits, just one out of the myriad of symptoms experienced by those with PD. Even though visual impairments *do* impact a broad range of motor and cognitive abilities (visuospatial awareness is important in balance and perception of the environment), future research must explicitly find statistically significant evidence of art therapy's effectiveness in rehabilitating PD's motor impairments such as bradykinesia, rigidity, and movement coordination. In order to bring art therapy into wider clinical practice, future studies must replicate and expand upon the findings of Cucca et al. (2021), confirming the precise mechanisms of both visual network reorganization and the improvement of other PD symptoms. Interestingly enough, published literature has not yet outlined a general art therapy design that effectively targets any PD symptoms.

As seen in this review, understanding the mechanisms and therapeutic potential of the *artistic spark* requires knowledge from a variety of perspectives, translating the neurological mechanisms of a symptomatic phenomenon into efficacious treatments for PD. Therefore, further exploration of the *artistic spark* in PD, its neurological correlates, and its efficacy in art therapies would benefit from a collaborative research initiative from several disciplines. Research into the effectiveness of art therapy in Parkinson's disease would especially benefit from the expertise of those who developed well-researched and clinically established art therapies for a wide variety of neurodegenerative and neuropsychiatric diseases. More so, systematic studies that monitor the long-term effects of developed art therapies necessitate research methods that use validated creativity scales capable of quantifying the extent of

patients' *artistic spark* over time and across cultural contexts. This review investigates current literature that demonstrates how patient engagement with the visual arts stimulates and modulates dopaminergic activity in PD-affected brain regions; this *artistic spark* provides a conduit for motor rehabilitation and general wellbeing in patients. Further understanding and exploring the special neuronal constellation that facilitates this sudden creative awakening and artistic motivation in PD patients may shed light on the 'pathophysiology' of the creative process itself. Above all, understanding the phenomenon of the *artistic spark* can better provide symptomatic support to both motor and nonmotor impairments that improve the quality of life of those afflicted with Parkinson's disease.

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