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Article in Behavioral Neuroscience · January 2013

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## **The Awakening of Artistic Creativity and Parkinson's Disease**

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## **Abstract**

Despite the prominent loss of motor skills, artistic capacities remain preserved in Parkinson's disease (PD). Furthermore, artistic creativity may emerge in art-naïve PD patients treated with levodopa and dopamine agonists. The present review discusses reported PD patients who developed enhanced artistic skills under antiparkinsonian therapy and the course of this phenomenon in the clinical context. It is unclear whether creative drive is related to dopamine dysregulation, and the mechanisms remain speculative. The delineation of the particular constellation that enables this emergence in PD patients may shed light on the comprehension of the concept of creativity in general.

## **Key words**

Parkinson's disease, creativity, artistic creativity, creative drive, dopamine dysregulation

"Artistic creativity" can be defined as the ability to produce innovative esthetic works. Alternatively, "creativity" is the ability to generate ideas that are both novel and useful or influential in a particular social setting (Chakravarty, 2010; Flaherty, 2005). The link between neuropsychiatric illness and creativity (Andreasen, 1987; Blumer, 2002; Kyaga et al., 2011), the emergence of talent after temporal damage (Miller, Ponton, Benson, Cummings, & Mena, 1996), stroke (Bogousslavsky, 2005) or frontotemporal dementia have long been discussed in the literature (Mell, Howard, & Miller, 2003; Miller et al., 1998; Miller et al., 1996). However, enhanced artistic creativity or creative drive has only recently been attributed to Parkinson's disease (PD), a disease posing a paradox for *augmented* creative behavior, since it is prototypically characterized by the *loss* of motor and executive abilities. The following review discusses the relationship between PD and emergence of artistic creativity.

### **I. Enhanced Artistic Creativity In PD – Evidence From Case Vignettes**

A Parkinson Art Project, comprising the work of 40 artists, demonstrated no decline in pictorial capacity in artists who become parkinsonian, in contrary to the initial hypothesis of a possible loss in their skills (Lakke, 1999). Furthermore, several patients with enhanced artistic capabilities under dopaminergic treatment were reported. PubMed search (May 2012) with the keywords "creativity and dopamine" or "creativity and Parkinson's disease" revealed 22 articles and PsycNET search with the keywords "creativity and dopamine" 26 articles. The details of reported enriched artistic capacities in PD patients are summarized in Table 1.

## **The Form of Art**

Although the genre of art was not specifically studied in PD patients, there were pictures, sculptures, novels, and poetry reported. Schrag et al., (Schrag & Trimble, 2001) described a PD patient who never wrote before, but belonged to a family of poets, who then composed poems that won in an annual contest of the International Association of Poets. The patient described by Bindler et al., (Bindler, Anheim, Tranchant, & Vidailhet, 2011) with no previous writing talent, developed literary writing skills leading to the publication of a historical book that won a literary prize. Another patient described by the same group was embroidering napkins and also developed writing skills. Her texts were found worthy of being broadcasted on the radio.

Visual arts were also described in this context. Walker et al., (Walker, Warwick, & Cercy, 2006) observed a patient with prior painting skills who produced excessive amounts of pastels under dopamine agonists. The art was appreciated due to it being naïve, voluminous and having a strong sense of color and kinesthesia. It was sold in local galleries. Chatterjee et al., (Chatterjee, Hamilton, & Amorapanth, 2006) treated a 68 year old graphic designer who felt an urge for painting under dopaminergic treatment. His drawing often used vivid colors. Surprisingly, the patient reported motor improvement while drawing feeling "in complete control, despite being frustratingly impaired in other contexts". In general, he was bradykinetic, rigid, had a resting tremor and his writing was micrographic. By contrast, his artistic movements were fluid, demonstrating exquisite control over larger amplitude winding movements, without any resemblance to freezing while

doing so. Graphic impairment particularly was most evident with distal movements. The specific artistic style he adopted emphasized larger amplitude proximal movements that were relatively preserved. Chatterjee et al., (Chatterjee et al., 2006) suggested that a possible mechanism that might influence this discrepancy between spontaneous movements and those involved in painting might be related to differences in proximal versus distal target reaching, an observation previously described in PD (Chatterjee et al., 2006; Flash, Inzelberg, Schechtman, & Korczyn, 1992). It is also recognized that in PD, visuomotor coordination of the arm, being a higher cognitive function is not correlated with the motor disability of the executing limb such as tremor, rigidity or bradykinesia (Inzelberg, Schechtman, & Hocherman, 2008).

Pinker (Pinker, 2002) mentioned the paintings of Dr. Johanne Vermette, an artist and physician with PD, who felt that her paintings were enhanced since her illness was diagnosed two years ago. "The new style is less precise but more vibrant....I have a need to express myself more". While the artist and patient felt more creative since PD onset, she considered that medication may play a role in enhancing imagination. The possible relationship between the characteristics of such visual arts and reported retinal changes in PD is not known (Bodis-Wollner, 2009; Inzelberg, Ramirez, Nisipeanu, & Ophir, 2004).

### **The Effect of Predominantly Affected Body Side**

Canesi et al., (Canesi, Rusconi, Isaias, & Pezzoli, 2012) who studied 18 PD patients with enhanced creativity found no correlation between side of disease onset and

creativity scores. They used the Torrance Test of Creative Thinking which combines indices of verbal and visuo-spatial creativity on the basis of theoretical concepts: flexibility, fluidity, originality, and elaboration. Drago et al., (Drago, Foster, Skidmore, & Heilman, 2009) also found no differences in visuo-spatial creativity evaluated by the Abbreviated Torrance Test for Adults, but observed that patients with PD and right-side onset showed a decrease in verbal creativity not related to decreased fluency.

Schrag et al., (Schrag & Trimble, 2001) who described a patient with novel poetic skills that appeared on dopaminergic therapy debated whether a possible contributory mechanism could be hypergraphia. On the other hand, they also pointed out that hypergraphia has no meaningful content which was not the case of this patient.

### **Effects of Deep Brain Stimulation (DBS)**

Drago et al., (Drago, Foster, Okun, et al., 2009; Drago, Foster, Skidmore, et al., 2009) described a patient with 20 years of PD who underwent left STN-DBS. When seen in clinic, she complained that being on DBS interfered with her artistic creativity and art appreciation. She felt that before the DBS placement her art was less realistic, more colorful and abstract. On the judgment task while “on” left DBS, versus “off” DBS, there were significant reductions in her appreciation of artistic technique. The authors asked the patient to rate dimensions of paintings such as Evocative Impact, Aesthetics, Novelty, Technique, Closure and Representation. The appreciation of

Closure and Technique were affected by DBS. When “off” DBS, creativity index measured by the Abbreviated Torrance Test for Adults was above average, but when switched “on” her creativity index was below average.

Another patient who underwent DBS which was placed on the dorsal border zone of the STN developed an urge for nude paintings while his prior taste for painting included architectural figures only (Witt, Krack, & Deuschl, 2006).

## **II. Is Augmented Creativity in Parkinson's Disease Medication/Dose Related and is it Part of Dopamine Dysregulation Syndrome?**

Dopamine dysregulation syndrome (DDS) is a drug addiction-like state marked by self-medication with inappropriately high doses of dopaminergic medications, particularly levodopa and dopamine agonists (Weintraub & Nirenberg, 2012). DDS is part of impulse control disorders (ICD), a serious and well-recognized complication of dopamine replacement therapy which comprises compulsive gambling, buying, sexual behavior, hobbyism, hoarding – the acquisition and failure to discard a large number of items of little or no objective value and punding - repetitive, purposeless behaviors characterized by an intense preoccupation with specific items or activities such as arranging or taking apart objects (Weintraub & Nirenberg, 2012). Bindler et al., (Bindler et al., 2011) observed a patient who wrote a prize-winning book on historical research while his daily medications (including a dopamine agonist) were augmented up to a daily levodopa equivalent dose of 1000 mg. He then developed DDS; underwent DBS and lowering of the dose to 530 mg led to the loss of his "writing talent". A second patient examined by the same authors also showed a



dependency between writing talents and treatment. The creative skills appeared after the introduction of a dopaminergic agonist and under a daily levodopa equivalent dose of 950 mg. Dose reduction resulted in a subsequent loss of writing abilities. This last patient did not present DDS symptoms and created a different embroidery napkin every day, in a different way than punding. (Evans & Stegeman, 2009; Fasano & Petrovic, 2010).

Kulisevsky et al., (Kulisevsky, Pagonabarraga, & Martinez-Corral, 2009) observed an amateur artist with PD who had diminished interest in art a few months prior to PD diagnosis and developed better skills after the initiation of therapy at a daily levodopa dose of 475 mg daily. His painting skills and interest gradually increased to an excessive amount, actually after the addition of 4 mg of cabergoline. Painting became his only interest. After months of spending the whole day painting, he began to continue into the night, interfering with sleep. The patient was conscious of the progressively disruptive nature of his painting activity on family relationships, but he regarded his art work as positive for him as he was able to move more easily and he felt emotionally relieved. However, the authors observed no manic or obsessive-compulsive symptoms. He showed no DDS symptoms or other impulsive behavior. The cessation of cabergoline resulted in a pause in painting. The elevation of levodopa alone was not effective in returning to paint. It is only after the initiation of the dopamine agonist pramipexole that the patient resumed painting, and even progressed to a level where he could sell his art for earning. Self-satisfactory daytime production without night painting was achieved while on pramipexole 0.35mg and levodopa 250mg three times a day.

If creativity in PD is part of DDS this would imply that creative patients show a tendency for impaired impulse control. This question was raised by Canesi et al., (Canesi et al., 2012) who studied 36 PD patients; 18 with increased artistic-like production (PD-c) and 18 without increased artistic-like production (PD-nc), and 36 healthy controls matched for age and sex. Observably, PD-c developed an overproduction of artistic-like work after starting dopaminergic treatment and spent most of the day pursuing their newly acquired artistic interests, disregarding their social life and daily duties, a feature that could actually resemble compulsive behavior and punning (Fasano & Petrovic, 2010). However, creative drive, which arose in some PD patients after the introduction of dopaminergic therapy, was not associated with enhanced impulsivity or impulse control deficit. Therefore, the authors believed that the development of creativity during dopaminergic treatment is unlikely to become a "red flag" of possible occurrence of any pathological repetitive behavior (Canesi et al., 2012). Other patients however, showed a peculiar change in the painting content. The post-DBS patient described by Witt et al., (Witt et al., 2006) was an architect who frequently painted on architectural themes before surgery, with no other painting styles. While he became more creative, he developed an urge for painting nude figures under levodopa and cabergoline treatment. After reduction of dopaminergic medication by 45% and after DBS calibration, his interest in painting nudes vanished.

Some authors pointed to the fact that the relationship between creativity and dopaminergic medication may be "addictive" with subsequent abuse of dopaminergic medication classifiable as drug abuse (Ambermoon, Carter, Hall,

Dissanayaka, & O'Sullivan, 2012) . A playwright with PD reported that his medication enhanced his capacities in writing. The patient had symptoms of ICD including buying scratch cards, hypersexuality, and psychosis with paranoid ideation and morbid jealousy. He was repeatedly instructed to reduce his medication dose, but he admitted that he needed the higher dose treatment for his creative writing. After being switched to levodopa monotherapy and clozapine, his paranoid thoughts vanished and he was still able to write (Schwingenschuh, Katschnig, Saurugg, Ott, & Bhatia, 2010). The four patients described by Schwingenschuh et al. (Schwingenschuh et al., 2010) were artists who consumed high doses of levodopa and dopamine agonists up to the development of DDS, psychosis and/or severe dyskinesias. All refused to diminish the medication doses feeling that their creativity was dose dependent. The authors noted the use of ergot dopamine agonists in all; however some also continued to express the same drive with non-ergot agonists.

### **III. Proposed Mechanisms of Creativity in PD**

Several hypotheses, which are not mutually exclusive, were proposed: creativity expresses sublimation; creativity is due to hyperactivity and behavioral disinhibition; development of artistic activities is a consequence of enhancing premorbid personality; or creativity is due to stimulation by dopamine agonists.

A possible mechanism is disinhibition in a way reminiscent of the artistic skills emerging in frontotemporal dementia (Miller et al., 1998; Miller et al., 1996).

Neuroimaging analyses of a patient with primary progressive aphasia revealed that, despite severe degeneration of left inferior frontal insular, temporal and striatal

regions, this patient showed hyperperfusion in the right posterior neocortical areas implicated in heteromodal and polysensory integration. Another form of disinhibition is behavioral, as a hypothetical mechanism of creativity is part of impulsivity (Bindler et al., 2011; Schwingenschuh et al., 2010). As described above however, not all patients with enhanced artistic creativity demonstrated symptoms of ICD (Canesi et al., 2012; Kulisevsky et al., 2009).

It was proposed that in addition to intelligence, domain-specific knowledge and special skills; necessary pre-requisites for creativity: divergent thinking, novelty seeking behavior, some degree of suppression of latent inhibition and a subtle degree of frontal dysfunction are also required (Chakravarty, 2010). In PD, however, some of newly emergent artists had no prior artistic skills (Schrag & Trimble, 2001) or high intelligence (Schrag & Trimble, 2001).

Novelty seeking can be a positive trait leading to creativity (Chakravarty, 2010; Djamshidian, O'Sullivan, Wittmann, Lees, & Averbeck, 2011). Novelty seeking is strongly linked to ICD. Djamshidian (Djamshidian et al., 2011) compared 27 PD patients with impulse control behavior abnormalities to 25 without such symptoms and 24 healthy controls. They used a computerized task in which three post-cards were presented. The participants were required to select one of the three pictures, and after the option was selected, they were told whether they had "won" or "lost". Following an inter-trial interval, the participants were again presented with the three choice options and they could make another decision. They were told to pick the most often rewarded picture as many times as possible to maximize their winnings. During the task, as the participants were making their choices and learning the

reward value of the pictures, novel stimuli were introduced. This was done by replacing one of the images from which participants had been choosing with a new image, which could be familiar or unfamiliar and was then a novel choice option. PD patients with impulse control behavior pathology were more attracted to newly introduced pictures, than either PD patients without impulse control abnormalities or normal controls, regardless of their medication status. That is, acute dopaminergic changes did not affect novelty seeking. On a chronic basis however, Bodi et al., (Bodi et al., 2009) found that young, never-medicated PD exhibit markedly reduced novelty seeking and reward processing. Dopamine agonists such as pramipexole and ropinirole increased both novelty seeking and reward processing.

It is thought that creative innovation often occurs during low arousal states and creative people often manifest features of affective disorders (Chakravarty, 2010; Kyaga et al., 2011). Although affective changes often occur in PD (Aarsland, Pahlhagen, Ballard, Ehrt, & Svenningsson, 2012), patients with enhanced creativity reported in the literature and shortly described in this review were not especially depressed or hypomanic. Anxiety was addressed only in a patient who lacked creativity and was more anxious during "off" periods (Schwingenschuh et al., 2010). Another model of creative idea generation incorporates the temporal and frontal lobes and the limbic system (Flaherty, 2005). This model gives the example of interictal hypergraphia, namely augmented writing behavior, which is not of artistic context. This is in contrast to PD patients who under dopaminergic treatment became accomplished poets or writers (Canesi et al., 2012; Schrag & Trimble, 2001).

It is probable, however, that most patients have no valuable artistic content but rather an enhanced creative drive.

Flaherty (Flaherty, 2011) suggested that creativity may depend on goal-driven motivation, which is mostly correlated with midbrain dopaminergic system (Flaherty, 2011). Reduced latent inhibition, which is the capacity of the brain to filter irrelevant stimuli from conscious awareness, is supposed to be the biological basis of creativity that facilitates original recombinant ideation. High dopamine levels may disrupt latent inhibition (Chakravarty, 2010) via alterations in the mesolimbic and mesocortical dopaminergic pathways, which are involved in the modulation of reward, motivation, inhibitory control, and decision-making (Antonini, Berlucchi, Marzi, & Sprague, 1979; Kulisevsky et al., 2009). This could potentially be linked to the fact that dopaminergic drugs may stimulate creativity, whilst, on the other hand, dopamine antagonists may suppress creative motivation. The stimulation of these pathways by dopaminergic drugs may reduce inhibitory control (Antonini et al., 1979), possibly leading to greater artistic-like production, especially if abnormal and intermittent dopaminergic stimulation targets brain regions relatively spared by the disease itself.

It is indeed remarkable that all reported PD patients with emergent creativity were treated with dopaminergic agents including levodopa and a dopamine agonist (Table 1). Although some authors suggested the role of ergot agonists, similar phenomena occurred also with non-ergots (Table 1). It thus seems the required constellation for emergent new talents or the enhancement of an existing minor one; is the presence of PD and exposure to levodopa and a dopamine agonist. Furthermore, it also seems

that sometimes artistic talent is dose or DBS dependent (Kulisevsky et al., 2009; Schwingenschuh et al., 2010; Witt et al., 2006).

If indeed dopaminergic drugs may serve as creativity enhancers, it would be expected that this phenomenon would also appear in other diseases where similar drugs are used. Indeed, two patients with restless leg syndrome treated with dopamine agonists developed punding. One was undergoing treatment with pergolide and subsequently cabergoline; punding (consisting of repeatedly painting and cleaning her house) only stopped when the drugs were withdrawn (Evans & Stegeman, 2009). However, the painting had no creative or artistic component. The question concerning the possible effect of dopamine on creativity can be addressed in conjunction to psychostimulant (psychedelic, hallucinogenic) substances, another class of drugs that mimic or enhance the action of dopamine. Both levodopa and dopamine agonists used in PD or restless legs syndrome treatment and psychostimulants act on the dopaminergic reward pathway and increase the dopaminergic activity in the ventral striatum (Ambermoon et al., 2012). Among these, phencyclidine blocks dopamine reuptake and cannabis increases the mesolimbic dopaminergic transmission (Oleson & Cheer, 2012; Urban & Martinez, 2012). Although amphetamine and cocaine do not act directly at dopamine receptors, they reinforce dopaminergic activity at the nucleus accumbens and frontal cortex (Urban & Martinez, 2012). Despite their extensive use as possible enhancers of artistic talent, their effect on creativity is a controversial and lately revisited issue (Frecka, More, Vargha, & Luna, 2012; Sessa, 2008). The question remains unanswered, especially because the link between creativity and stimulants

was studied in a number of small trials and case reports as reviewed by Sessa (Sessa, 2008). It is yet unclear whether psychostimulants increase some aspects of creativity, alternatively only modify self-rated perception of talent or have no influence on artistic abilities (Frecska et al., 2012; Jones, Blagrove, & Parrott, 2009; Sessa, 2008).

### **Summary and Future Directions**

Artistic talent may emerge in art-naïve PD patients treated by levodopa and dopamine agonists as part of DDS or without such accompanying symptoms. While such skills, if moderate in nature, may improve the quality of life of PD patients, it can be more routinely used for occupational therapy. Systematic studies with consecutive patient interviews using validated creativity scales are mandatory to detect the risk factors and extent of this phenomenon in PD and restless legs syndrome treated with dopamine agonists. Functional MRI studies during the process of creative drive or creative artistic ideation may be helpful for the visualization of involved networks both in neurologically healthy individuals and in PD patients. The understanding of the special constellation that enables this creative emergence in PD patients may shed light on the pathophysiology of creativity.

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Table 1

**Articles reporting enhanced artistic creativity in Parkinson's patients**

<b>Authors</b>	<b>Age/ Sex</b>	<b>PD years</b>	<b>Art form</b>	<b>LD</b>	<b>DA</b>
(Bindler et al., 2011)	49/M 55/F	16 10	Historical book Embroidering Writing	+	+
(Canesi et al., 2012)	59±7.5 /NA	8.9 ±3.5	Painting 15/18 Sculpture 5/18 Poetry 9/18 Multiple 14/18	+	NA
(Chatterjee et al., 2006)	68/M	15	Painting	+	PRX
(Kulisevsky et al., 2009)	47/M	1	Painting	+	CBG, PRG
(Pinker, 2002)	late /F thirties	2	Painting	NA	NA
(Schrag & Trimble, 2001)	55/M	4	Poetry	+	LIS
(Schwingenschuh et al., 2010)	50/M 62/M 37/M 66/F	10 17 9 18	Playwright Writing Painting Painting	+	CBG PRG, ROP CBG, ROT CBG, PRG, ROP
(Walker et al., 2006)	NA/M	11	Painting	+	ROP
(Witt et al., 2006)	65/M	16	Painting	+	CBG

\* (Drago, Foster, Okun, et al., 2009) reported a 69 year old women artist with 20 years of PD whose creativity diminished after left STN-DBS.

LD= levodopa; DA= dopamine agonist; CBG=cabergoline; LIS=lisuride; PRG=pergolide; PRX=pramipexole; ROP=ropinirole; ROT=Rotigotine; NA= not available