OCCASIONAL PAPER

Pictures as a neurological tool: lessons from enhanced and emergent artistry in brain disease

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Pictures created spontaneously by patients with brain disease often display impaired or diminished artistry, reflecting the patient’s cerebral damage. This article explores the opposite: those pictures created in the face of brain disease that show enhanced or enduring artistry, and those that emerge for the first time in artistically naïve patients. After comments on background issues relating to the patient and the viewer, the paintings and drawings are considered in relation to the heterogeneous conditions in which this artistic creativity is seen. These conditions include various dementias—most notably frontotemporal lobar dementia, stroke, Parkinson’s disease, autism and related disorders and psychiatric disease, epilepsy, migraine and trauma. In the discussion, it is argued that evidence of underlying brain dysfunction revealed by these pictures often rests on the abnormal context in which the pictures are created, or on changes in artistry demonstrated by a sequence of pictures. In the former, the compulsive element and sensory and emotional accompaniments are often important features; in the latter, evolving changes are evident, and have included depiction of increasing menace in portrayal of faces. The occurrence of synaesthesia, and its relation to creativity, are briefly discussed in respect of two unusual patients, followed by considering the role of the anterior and frontal lobes, mesolimbic connections and the right hemisphere. In at least some patients, impaired inhibition leading to paradoxical functional facilitation, with compensatory changes particularly in the right posterior hemisphere, is likely to be pivotal in enabling unusual artistry to emerge; preservation of language, however, is not a prerequisite. Many patients studied have been artists, and it appears possible that some of those with an artistic predisposition may be more likely to experience pathologically obsessive creativity. The discussion concludes that occasionally pictures created by these rare individuals unexpectedly prove to be an invaluable but little studied tool for investigating the dysfuncioning brain.

Keywords: enhanced; enduring; emergent; artistry; tool

Abbreviations: FTLD = frontotemporal lobar degeneration; SPECT = single-photon emission computed tomography

Introduction

 Pictures created spontaneously by a patient with brain disease sometimes present the opportunity for studying that disease and revealing underlying mechanisms of cerebral dysfunction. Such pictures are the subject of the present article, which focuses on artistic creativity that is enhanced, is associated with an ‘improvement in technique’ (Drago et al., 2006), preserved when it might be expected to diminish or cease, or in particular that newly emerges. These forms of creativity are considered together because precise nosology can prove challenging, and what represents improvement, and what constitutes emergent...
Artistry, can be unclear. Notwithstanding their different forms, however, it will be argued that pictures provide a unifying tool for studying the processes that gave rise to them.

Creative artistry in the face of neurological disease is surprising and counter-intuitive, and contrasts with those pictures showing obvious deterioration, which, as with early cessation of artistry, is unsurprising and even predictable. Moreover, artistry depicting deterioration has already been extensively studied and illustrated, in particular those pictorial changes that follow stroke or accompany slowly progressive degenerative disease, and so will only be referred to briefly.

Beyond the scope of this contribution are pictures produced by normal individuals experimentally or under the influence of hallucinogens or other substances, the nature of creativity in general, the anatomical and physiological bases for how the brain ‘sees’ pictures, ‘the neurology of art’ (Zeki, 1999), and processes subserving neuroaesthetics.

The patient’s artistic background and the viewer’s perspective: some preliminary considerations

Accepting how common are dementia and stroke, the accounts of enhanced artistic output in these and other neurological disorders are rare or very rare. However, enhanced artistry is probably under-reported, since new or preserved visual or musical ability was found in 17% of 69 patients with frontotemporal dementia studied retrospectively by Miller et al. (2000). Furthermore, there are also anecdotal accounts in the media of emerging and compulsive artistic output after brain injury (e.g. http://weburbanist.com/2009/07/12/stroke-of-genius-abilities-borne-of-brain-damage), many of which do not appear in the medical literature.

The patient’s artistic background

Strikingly, many case reports describe professional or gifted amateur artists. Although by definition emergent artistry cannot apply to these individuals, defining previous artistic skills is sometimes contentious, and thus particularly when artistry first develops late, is it truly new, or does it sometimes simply represent an enhancement of pre-existing ability? While some patients are undeniably artistically naïve, others have had previous interest in or aptitude for art. For instance, Seeley et al.’s (2008) remarkable patient with primary progressive aphasia, Anne Adams, described as acquiring new artistic talents, nevertheless ‘had a lifelong interest in art and music and occasionally pursued painting as a hobby, but she was not an accomplished painter, and her early work consisted of simple drawings and architectural watercolours’ (Seeley et al., 2008). Similarly, a patient with frontotemporal dementia who took up sculpting was ‘Always interested in art’ (Patient 4 in Miller et al., 1998), and the background relationship, if any, between an interest in art, and a wish and ability to achieve visual artistic output, remains unclear.

Other uncertainties are how detailed the enquiry has been of individuals’ past artistic creativity, and also whether previous creativity in other, non-visual spheres is of relevance—recalling the patient with Parkinson’s disease who developed late-onset poetic skills on starting treatment (Schrag and Trimble, 2001), and patients with frontotemporal dementia who retained preserved abilities in inventiveness, music, games playing and constructional abilities (Miller et al., 2000). This is an important issue when considering related issues discussed below: whether those patients who exhibit new artistic output after brain damage are different in having a latent, unfulfilled artistic gift; whether those with a longstanding artistic ability or even appreciation have specific, selectively enhanced cerebral function in those domains that is further enhanced by disease or by impaired development; and whether those with an artistic predisposition are more susceptible to ‘pathological’, obsessional enhanced creativity.

The pictures discussed here have mostly been created spontaneously by the patient, or with encouragement from others (e.g. Midorikawa et al., 2008), as with the severely demented patient who started to draw when given pencils by his wife (Thomas Antéron et al., 2002); savants’ artistic skills too may have been encouraged. Not considered are drawings that do not emanate from patients’ own creativity but are instigated as part of formal neuropsychological assessment (Caplan, 2006).

The viewer’s perspective

The published material available when assessing artistic creativity comprises pictures made by brain-damaged individuals, and patients’ and others’ descriptions of the creations. Evaluation relies on opinion and judgement; thus it may be obvious that the left half of a picture is unexpectedly missing in a portrait painted after a right hemisphere stroke, but changes in style and other more subtle aspects may be open to very differing interpretations.

A striking example of divergent views concerned pictures painted by a patient with presumed Alzheimer’s disease, which were considered to show ‘dramatic’ deterioration (Cummings and Zarit, 1987), but which others considered were ‘stunning’ and ‘typical of Impressionism’ (Wright, 1988), and ‘the work of a genius’ that ‘could compete with the best attainments of modern art’ (Abis dla Clara, 1988). Another example discussed below relates to the prolific artistic production of a patient with Parkinson’s disease: one critic judged the drawings as ‘showing originality, attitude, and a strong sense of color and kinesthesia’, whereas another thought the artwork ‘naïve and unoriginal’ (Walker et al., 2006).

Neurological conditions in which enhanced artistic output occurs

Providing the basis for the later Discussion, this section reviews the enhanced and emergent artistry of these unusual patients, who are considered according to their underlying clinical conditions.
A number of case reports that describe representative patients and their pictures are summarized in the sections that follow.

**Dementia**

**Frontotemporal lobar degeneration**

Current interest in the subject of emergent artistic skills was kindled in 1996, when Miller et al. (1996) reported that a patient with frontotemporal dementia had developed startling new artistic creativity in the face of advancing dementia.

Around that time, there had been other hints that unusual or at least altered artistic skills occurred in this condition. Tanabe et al. (1996) described a patient with ‘Pick’s disease’ or ‘semantic dementia’, a 58-year-old high school teacher with an 8-year history of semantic memory impairment whose MRI brain scan showed ‘lobar atrophy with temporal predominance’. The authors, who noted that ‘His hobby was painting and he has given private exhibitions’, reproduced pictures painted before and ‘after’ his illness, and commented: ‘The…paintings from after his illness are realistic and precise in the reproduction of what he perceived…However, the…paintings lack artistic techniques, seen in the…paintings from before his illness, such as omission and accentuation, by which he appears to give individuality to his works’.

In the same year, Snowden et al. (1996) observed that patients with semantic dementia can copy drawings ‘sometimes to a strikingly proficient level’. These authors showed drawings accomplished by a severely demented patient, which became ‘more veridical’ as the dementia increased. However, it was Miller et al.’s (1996) seminal letter in The Lancet that drew specific attention to the paradoxical phenomenon of emerging artistic creativity in the presence of a specific brain disease. They described a 68-year-old male with a 12-year history of frontotemporal dementia, who, at the age of 56 years, started to paint having had no previous interest in art:

‘Over the next decade he drew with increasing precision and detail. He repeated his subject matter, experimenting with different colours, gradually improving the presentation. The first paintings featured brightly coloured shapes. By 57, colours became harder and object edges were cleanly defined. His first drawings were done quickly, but later works were crafted with care; he took hours to complete single lines. Between ages 63 and 66 his work won awards at local art shows. At age 67 his work began to deteriorate and by 68 he drew bizarre doll-like figures.’

At the age of 64 years, 8 years after the onset of his illness, he painted the picture shown in Fig. 1. When assessed 4 years later, he had a Mini-Mental State Examination score of 15, with evidence of a fluent semantic anoma and a mild comprehension deficit. An MRI brain scan showed bitemporal atrophy, and single-photon emission computed tomography (SPECT) revealed bitemporal hypoperfusion affecting the right more than the left side; frontal perfusion was normal and the highest perfusion was in the right posterior parietal and occipital cortices.

Amongst 10 patients with the temporal variant of frontotemporal lobar degeneration (FTLD) studied a year later, two showed maintained or enhanced artistic skill (Edwards-Lee et al., 1997). In the case previously reported in 1996 (Patient RTLV4), it was confirmed that ‘Over the next 10 years his painting skills steadily improved’ with ‘new development of outstanding artistic ability’. The other patient (LTLV2) had bilateral temporal atrophy, particularly on the left, on his MRI brain scan, and a similar distribution of hypoperfusion on SPECT. ‘Previously a portrait painter, he maintained his ability to sketch’.

Miller et al. (1998) later included their first patient again, and described four more patients who developed new artistic skills amongst 69 patients with FTLD. All five patients had taken up artistic activities: three took up painting, one took up photography and one took up small-scale sculpture, and it was noted that patients became intensely preoccupied with their art. In four of the five patients, there was evidence on SPECT or autopsy of anterior temporal lobe involvement, particularly of the dominant hemisphere, and sparing of the dorsolateral frontal cortex. Visual neglect does not seem to have occurred, and visual skills were spared; language and social skills, however, were badly affected. During the years of dementia progression, various changes in their artistic output occurred.

Patient 1: 5 years after taking up drawing lessons at the age of 53 years, ‘His first drawings were simple still lifes of vases and bridges. His precision improved and he began painting pictures of Indians and buildings recalled from his youth. His final paintings were churches and haciendas remembered from childhood’.

Patient 2: 4 years after taking up art classes when aged 51 years, ‘she completed her first paintings, which depicted rivers, ponds, and rural scenes recalled from childhood’; a few years later ‘she produced realistic copies of paintings’; and after a
are two reports of patients who were proficient artists long before their FTLD developed.

Mell et al. (2003) described a patient who was a talented artist and high school art teacher. Coming from an Asian background (country not stated), she emigrated to the USA as a teenager, where she attained a Master of Fine Arts qualification. Originally specializing in Western watercolour and traditional Chinese brush painting, she initially painted landscapes and representational pieces. Around the age of 49 years, there was evidence of the onset of a dementing illness with progressive aphasia, and clinical features consistent with FTLD. Her MRI brain scan showed bifrontal atrophy particularly on the left, with mild left temporal atrophy. As the dementia progressed over 15 years, her pictures changed:

‘As language declined, paintings became wilder and freer… intricate designs and patterns of the horoscope figures were replaced by large, intensely colored figures; complex patterning was pushed to the background. Her choice of colors changed, with large swatches of red, turquoise, and purple now dominating the pictures… and her last pieces were no longer realistic, reflecting an intensely emotional and impressionistic style, with less detail.’

Another patient, simply described as ‘an artist’, when assessed at the age of 65 years had an 8-year history consistent with FTLD, and her MRI scan revealed bilateral anterior temporal lobe atrophy (Drago et al., 2006). Forty of the patient’s pictures were assessed; 18 had been painted before her illness began, six at the start of her illness and 16 during the fully symptomatic stage. Assessment of the pictures was made by 18 ‘judges’: ‘individuals not formally trained in art, rather than professional artists’. There was considered to have been progressive improvement in the patient’s ‘technique’, but a similarly progressive decline both in ‘closure’ (i.e. How complete is the painting?) and ‘evocative impact’.

Compared with normal controls, patients both with frontaltemporal and semantic dementias sometimes produce drawings that are particularly bizarre and show more facial distortion as evident from pictures solicited by the investigators (Rankin et al., 2007). Furthermore, four patients with frontotemporal dementia were reported as exhibiting changes in their spontaneous drawings of faces. These changes comprised distortion, menace, skeletal-like features and ‘alienness’, suggesting disruption of facial empathy (Mendez and Perryman, 2003), and the patients had evidence of hypoperfusion in the right temporal lobe as well as bifrontal regions. Contrarily, however, increasingly bizarre facial features were painted by a patient in whom frontotemporal dementia plus amyotrophic lateral sclerosis affected predominantly the left hemisphere (Liu et al., 2009).

A particularly unusual patient producing new and dramatic artistry in the face of progressive dementia was described by Seeley et al. (2008). The patient, Anne Adams, suffered from primary progressive aphasia. Due to pathologically proven corticobasal degeneration, the brunt of the illness was borne by the left fronto-insular, temporal and striatal regions. Until the age of 46 years, she had been interested, but not accomplished, in art. Over the following years, and long before her aphasia developed, she became obsessively occupied in her art, spending ‘often the

Further 2 years ‘Brown and yellow became dominant colors in her paintings’ (Fig. 2), but within a year she had stopped painting; ‘Her last paintings were slightly distorted family portraits’.

Patient 3: between the ages of 38 and 40 years until the age of 50 years ‘…he photographed buildings and people…Pictures were acquired in a compulsive manner, and he photographed them from multiple angles to achieve the “perfect” image.’ He also ‘carved wax miniature animals using candle drippings’.

Patient 4: at about the age of 50 years she ‘sold gourds with paintings of Santa Claus and sculpted small wooded scenes. Her work steadily improved for 3 years and then declined’.

Patient 5: previously reported (Miller et al., 1996; Edwards-Lee et al., 1997).

Thomas Antérion et al. (2002) reported another patient who had no prior artistic interests and who was diagnosed with FTLD, but in whom there was frontotemporal atrophy on CT scan imaging and decreased perfusion in frontal regions on SPECT. Even when his dementia had advanced to its terminal stage and he was inert and mute, not only on being given pencils did he begin to draw, but he did so every day and at the same hour:

‘His drawings of people showed infantile representations. Individual features such as arms, hands, legs, head, eyes, mouth, nose, and ears were accurately defined and proportioned. He produced stereotypes and particular motives as women faces with curious braids. He also drew landscapes, houses, and churches with perspective and accurate spacial [sic] relationships between objects and humans. Most of his work focused on self-portraits. He drew stereotypical pictures of a cowboy figure [possibly self-portraits] and…When the patient’s mother died…on the same day, he drew a church and a death head…’

The patients with FTLD described so far first took up art around the time their dementia began, i.e. creativity emerged. In contrast
majority of her waking hours’ in painting. From previously having painted ‘simple drawings and architectural watercolours’ as a hobby (Fig. 3), her paintings became ‘far more vibrant, colourful and multifaceted’. Remarkably, she then ‘began to represent auditory stimuli in visual form...’ and used a complex but exact scheme to very precisely represent Ravel’s Boléro pictorially, the musical components featured in every bar being translated into visual components in her painting she entitled ‘Unravelling Boléro’ (Fig. 4). Later she represented $\pi$ in her picture ‘pi’, using ‘a visual matrix to capture the random nature of the expansion.’ Only at the age of 60 years did speech impairment begin, from which time her artistic output showed ‘Increasing photographic realism’, featuring increasing symmetry, structural detail and often depictions of objects or buildings (Fig. 5)—even when she had become mute yet still able to use her right hand for painting.

From the artistic perspective, the key features associated with this patient’s artistry were the burst of artistic creativity later in life, several years before her speech impairment and other features of her dementia began; the obsessional nature of her creativity; the continuation of painting even when grossly disabled; and the sequential changes in her art, from premorbid conventional if not mundane pictures (Fig. 3) to highly complex transmodal art—exemplified by her translation of musical features of Boléro into visual images (Fig. 4) and $\pi$ into a visual matrix—and then to more symmetrical and realistic pictures (Fig. 5).

**Alzheimer’s disease**

Typically during the progression of Alzheimer’s disease various stylistic changes leading to frank deterioration and eventual cessation of painting have been reported, particularly evident in professional artists, and several such cases have been summarized (Crutch et al., 2001; Crutch and Rossor, 2006). However, surprisingly, preservation of artistic skills in the face of severe dementia has also been reported.

A striking example is the highly talented professional painter, Danae Chambers, whose dementia started at around the age of 49 years (Fornazzari, 2005). Clinical and later neuropsychological assessments were consistent with Alzheimer’s disease; her MRI brain scan revealed mild to moderate brain atrophy, and SPECT showed hypoperfusion in the posterior parietal and temporal areas, particularly on the left. Despite progressive deterioration, and even when her Mini-Mental State Examination score had reached 8 of 30: ‘...she continued to paint with her usual talent and creativity...’, and only after 10 years into her illness and when she was sufficiently impaired to be unable to take care of herself:

‘she demonstrated for the first time some difficulties with her painting techniques. They consisted of unusual figure ground, loss of proportion in the facial features, and loss of proportionality and dark sombre colors. Even 8 months prior to her hospitalization she was able to show tremendous insight into her painting difficulties and she even tried to correct her errors...’

Another well-documented patient with probable Alzheimer’s disease, the professional artist Carolus Horn, painted well into 10 years of his illness (Maurer and Prvulovic, 2005). Various progressive stylistic changes reflecting artistic deterioration were noted, some of which may have been triggered by visual hallucinations during the later stages of the illness.

Arguably the most celebrated artist thought to have achieved a late artistic revival in the face of dementia was the famous Dutch–American painter de Kooning (Espinel, 1996). His artistic output initially comprising realistic drawings and portraits gradually changed to abstract expressionism. In his seventies, he developed a syndrome characterized by anterograde amnesia and behavioural changes, and he ceased to paint. A few years later, however, he started to paint again, but his paintings had changed, becoming very large scale, entirely abstract works, some of which have been considered masterpieces.

There has been astonishment that such creativity could emerge in the face of brain dysfunction, which during his later years meant that he could not carry out activities of daily living and he was legally unable to manage his own affairs. Although often attributed to Alzheimer’s disease, there was never objective evidence to corroborate this diagnosis (Zaidel, 2005), whereas alcoholism, malnutrition, prescription drugs and depression have been recorded (Stevens and Swan, 2005). It seems that the late emergence of de Kooning’s creativity cannot necessarily be ascribed
to Alzheimer’s disease, and these other potentially more reversible causes of dysfunction may have been important, not least because of dramatic cognitive improvement after he ceased binge drinking (Stevens and Swan, 2005).

Corticobasal degeneration

The patient with primary progressive aphasia due to corticobasal degeneration reported by Seeley et al. (2008) has been discussed earlier. More typical clinical features of the condition were seen in the patient reported by Kleiner-Fisman et al. (2003). They described a 68-year-old professional artist with presumed corticobasal degeneration, characterized by progressive cognitive impairment, gait difficulties, left arm postural tremor, dystonia and myoclonus. MRI brain scanning showed generalized atrophy, particularly affecting the right side, and SPECT revealed marked hypoperfusion of the whole right hemisphere and left frontal region. With the progression of his disease his artwork changed:

‘His premorbid illustrations were realistic and understated using subtle tones with generous use of shades of brown. In contrast, his current work featuring a Hungarian fairy tale revealed the bold use of bright colors and was highly stylized with generous amounts of paint...’ resulting in ‘some parts of the painting being elevated due to thick application of paint, particularly on the right side of the canvas.’

He started to repeatedly revise his paintings, added large amounts of bright contrasting colours applied with generous brush strokes, but he became increasingly dissatisfied with his work and eventually stopped painting.

Whether the transient change in the nature of his painting is an enhancement in creativity is a matter of judgement, but there seems little doubt that he was able to continue his artistic output at least during the early stages of his illness.

Stroke

Both right and left-sided strokes often result in obvious impairment of artistic output, at least transiently. There are numerous and usually extensively illustrated accounts of such impairments, which likely reflect the site of the cerebral damage and changes that may evolve as restorative and compensatory processes ensue (for reviews, see Jung, 1974; Bäzner and Hennerici, 2006, 2007).

However, a stroke can also lead to ‘surprisingly appealing stylistic changes’, which Chatterjee (2006) termed ‘Enhanced
Expressivity’. Amongst the examples he cites are two painters described by Annoni et al. (2005).

One patient was a right-handed lithographer and self-taught painter, who tended to depict ‘simplified human representations, semi-figurative scenes, and original geometric shapes. His pictorial language was rather naïve, influenced by primitive expressive styles’. Although the patient himself was unaware, a month after a stroke affecting V1 and V2 of the left occipital region, the style of his painting and drawing had changed:

‘Human limbs and hands were thinner, sharper, and more stylised and the details simplified. Compared to his previous paintings, there was an overall simplification as a result of monochromatic colour choices, more stylised figures, and unreferenced background spaces. He also introduced the luminous features that appeared in his scotoma… two independent judges… concluded there was simplification and increased abstraction, symbolism, and role of luminosity.’

The second patient mainly painted landscapes, and was considered a ‘figurative-impressionist’. Two weeks after a small left paramedian thalamic infarct he resumed painting, initially with his left hand, achieving the same successes as previously, but it was others who noted his style had altered:

‘[He] switched from a “figurative” to a more “realistic” art, in which colour intensity, a search for more realistic shape consistency, a focus on detail, and a more structured organisation of space were the most important features… Two independent judges concluded that, after stroke, there was more geometric organisation and use of bolder colours and a greater relevance of each detail of the painting…’

The patient also reported some other unusual features. He became ‘more sensitive to the hidden beauty of nature’ and ‘wanted to live and paint spontaneously, explore the world, and represent it in its raw strength’, and lost interest in impressionism. It was the use of the left hand that led him into this new artistic dimension: ‘…he discovered that figures executed with his left hand had more emotional strength and bolder colours, whereas, in those painted with the right hand, the lines, contours, and perspectives were clearer. He realised that his creativity was increased by the use of the left hand…’, and the same subject, painted with the left, right, or both hands ‘…demonstrated that the painting produced using the left hand employed more vivid colours’.

The subtle changes in these two artists’ painting style are different from many of the more striking examples reported of impaired artistic output after stroke, and features such as the different form of paintings executed by the second patient, depending upon which hand he used, point to more complex factors that sometimes underlie artistic output.

In contrast to these talented painters with their focal ischaemic lesions is the builder who, at the age of 51 years, sustained a subarachnoid haemorrhage and then developed obsessive artistic output (Lythgoe et al., 2005). Having had no previous interest in art, some months after the haemorrhage, he started to paint and draw obsessionally for most of the day, and also took up writing and sculpture. Hundreds of his drawings, mainly of faces, were asymmetric, but he then embarked on huge drawings sometimes covering whole rooms of his house. The authors commented:

‘The artist’s first drawings are suggestive of a left hemispatial neglect… His early works are naïve, colorful, and passionate… Many of his early paintings and poetry comprise of self-investigation of the changes in behavior he had experienced…’, and a recent sculpture made 3 years after the haemorrhage ‘demonstrates a striking interpretative skill alongside a growing technical aptitude.’

A CT scan 16 days after the event showed no focal lesion, but a neuropsychological assessment showed features suggestive of mild frontal dysfunction.

A particularly striking example of emergent artistic output, together with very unusual additional features, has recently been reported (Thomas-Anterion et al., 2010). The 36-year-old hairdresser sustained a stroke involving the left posterior insula and adjacent parietal operculum including SII. She had residual right-hand weakness, right hemianesthesia to thermal and pinprick stimuli, and central post-stroke pain. Having had no previous
artistic interests, 6 months after the stroke she became obsessively interested in art, and she would paint continuously for several hours, sometimes without sleep and on several consecutive days. She was nevertheless able to stop painting or change the subject of her painting whenever she wished, which the authors considered excluded a dependency on perseveration. They characterized her paintings thus:

‘...she painted large-scale figurative series, rich in colour. The size was sometimes large enough to cover a whole room. Ninety-two percent of the 120 paintings were painted with warm colours. Figures included naivety, colour and passion. She produced many figurative paintings representing females... and scenes recalling cultural aspects in her personal life (she lived on an African island for the first 20 years of her life) but MB could also paint abstract pictures...flowers, fruits and objects.' (Fig. 6)

In addition, this patient presented a particularly unusual synaesthetic feature to her paintings: links between the colours of her paintings, her happiness during painting, and the severity of her post-stroke pain: ‘She described her intense feelings of happiness when she used warm colours, in particular orange and red, the use of which was associated with less pain...On several occasions, she had to paint with cold colours (green, blue and grey)...[but] She often had to stop painting because blue and especially grey were unpleasant'.

The exacerbation of her pain occurred specifically with these three colours and applied in increasing order of frequency to green, blue and grey, but did not occur when viewing these colours around her or in others' paintings. The phenomenon occurred whether the patient was painting spontaneously or 'to order', and whether the painting was figurative or abstract.

**Parkinson's disease**

Although Parkinson's disease usually causes no alteration in artistic output (Lakke, 1999), Walker et al. (2006) reported a patient with longstanding Parkinson’s disease treated with levodopa/carbidopa, who had previously demonstrated ‘artistic tendencies’ and sketched occasionally (Walker et al., 2006). He started to continuously produce several pastel drawings a week, sometimes two per day, this change occurring several months after starting and then increasing dopamine agonist treatment with ropinirole. He later developed inappropriate social behaviour, and neuropsychological evaluation showed features of mild dementia. He attributed his increased creativity to his changed medication, which he was not eager to alter since he considered it improved his artistic output—although others had conflicting opinions (see above).

An unusual case of artistic output changing as a result of subthalamic stimulation and changes in medication in a patient with Parkinson's disease was reported by Witt et al. (2006). The patient, an architect who had frequently painted, had a 16-year history of Parkinson's disease treated with dopaminergic medication. On account of severe motor and mood fluctuations, deep brain stimulation of the dorsal border zone of the subthalamic nucleus was instituted. The fluctuations disappeared, and his mood remained constantly elevated.

‘He reported that he had been drawing much more than usual since surgery and he spontaneously displayed some of his art during the ward round. His wife reported he had been quite prolific, concentrating exclusively on female acts, their house being full of these [sic]. Not only was he more creative, but his topics and style had obviously changed as he had never painted nudes before. Neither he nor his wife reported hypersexual behaviour since surgery nor any other behavioural changes.’

Over the following 2 years, the strength of stimulation was slowly increased, and at the same time the dosage of his medication was reduced by 45%. ‘Two years later he stated that his interest in painting nudes had gradually vanished’, and the authors argued that the postoperative increase of hedonism, as evidenced by the transient change in painting style (Fig. 7), was likely attributable to the brief period of subthalamic stimulation that was added to the dopaminergic treatment.

**Autism and savant states, Outsider Art and art associated with psychiatric disease**

Do the sometimes impressive or even outstanding pictures produced by the autistic individual or savant, the Outsider Artist, and those with schizophrenia or other psychiatric disorder contribute to an understanding of how the brain functions or malfunctions? The literature on art undertaken by these individuals is enormous, but for several reasons it is difficult to reach definitive answers. These reasons include: evolving definitions and classification of autism, the savant state and Asperger’s syndrome—sometimes encompassed now by the term pervasive developmental disorder; the nature of Cardinal’s ‘Outsider Art’ (Cardinal, 1972) and its earlier version termed in French ‘Art Brut’ by Dubuffet (1973); changeable diagnoses in an individual patient—for instance, some artists initially thought to have schizophrenia have later been diagnosed with Asperger’s syndrome or autism (Cardinal, 2009); and the uncertain nature and aetiology of these ill understood disorders. Furthermore, the boundary between normal and abnormal individuals may sometimes be difficult if not impossible to define.

Amidst these uncertainties, and recognizing that considering these disorders together risks unwarranted simplification, a few aspects are clear. In the case of autism (for review, see Treffert, 2009), there are several well-described examples of art that has been produced by even very young autistics. Although not the first such patient, the most famous, described in Lorna Selfe’s (1977) classic account, was Nadia, the child who from the age of 3.5 years mainly and repeatedly drew highly realistic horses (Fig. 8). The unusual features of her obsessional drawings have been extensively discussed (Chatterjee, 2004, 2006), including her ability to achieve mental rotations of 2D representations, yet there was no creativity or originality (Zaidel, 2005), and as she grew...
Figure 6 Pictures painted ~6 months after her stroke by patient MB, who had had no previous artistic interests. (A and B) Figurative paintings of females; (C) an abstract, and (D) ‘The guitar in the pool’. The cold colours when she painted D induced increased neuropathic pain. Reprinted from Thomas-Antérion et al., Pain 2010; 150: 121–7, by permission of Dr Catherine Thomas-Antérion.

Figure 7 Pictures painted by a patient with Parkinson’s disease treated with deep brain stimulation. Left, representative painting before deep brain stimulation; right, painting 3 months after electrode insertion and slight reduction in dopaminergic dosage. The change in nature and style of painting is striking. From Witt et al., Journal of Neurology 2006; 253: 955–6, with kind permission from Springer Science + Business Media and Dr Karsten Witt.
older and her extremely limited language skills developed, so her drawings became more conventional. Other famous examples include the artistic output of Stephen Wiltshire, who was able to draw astonishingly faithful architectural representations at the age of \( \sim 7 \) years (Sacks, 1995). Hou et al. (2000) have noted that the six artistic savants they reported included a strong preference for a single art medium, a restricted focus on artistic themes, repetition, compulsion and a seeking for perfection, all of which enabled remarkable artistry to be achieved.

Further examples of autistic artists and their work, and the relationship of autistic to Outsider Art, have been considered, among others, by Cardinal (2009) and Maclagan (2009). Acknowledging that some artistic output of autistics appears strange, strangeness of art has also been considered a defining aspect of Outsider Art and Art Brut, and has been related too to art of the psychotic. Yet Prinzhorn, in his pioneering study of art of the mentally ill, concluded ‘We cannot say with certainty that any given picture comes from a mentally ill person just because it bears certain traits…’ (Prinzhorn, 1972). This view parallels the comment that the criteria for Outsider Art ‘are sufficiently flexible to embrace not only art arising within the context of extreme mental dysfunction, but also art produced by individuals who are quite capable of handling their social lives…’ (Cardinal, 2009).

Thus, apart from the creative drive often amounting to obsession, it does not appear to this writer that there are definitive features of their sometimes spectacular art that are diagnostic or even indicative of any specific underlying disorder or trait, or of specific neural mechanisms that might be associated with or revealed by the artistry. Exemplified by the precociousness of the autistic artist, however, the context in which the picture is created may be all important, and this aspect is discussed below.

**Epilepsy**

Recently, Thomas et al. (2010) reviewed the relationship between epilepsy and artistic output, concluding ‘Rather than the expected association between epilepsy and creativity…there are relatively few artists of renown who had epilepsy’ (Thomas et al., 2010).

A patient who developed obsessional painting output after a probable encephalitic illness was described by Sacks (1995). Although thought possibly attributable to temporal lobe epilepsy, the absence of any investigations makes that diagnosis entirely speculative. In contrast, Finkelstein et al. (1991) provided a unique albeit brief report of a patient with epilepsy, which contributes further valuable information and has important implications for mechanisms discussed below. A mosaic artisan ‘who had not been known for artistic activity’ had attacks consistent with left frontotemporal epilepsy on the basis of clinical features, interictal sleep-deprived sphenoidal EEG findings, SPECT imaging and neuropsychological evaluation. In some of his attacks, during which he was non-communicative, stared aimlessly and could become aggressive for 40 min followed by sleep, ‘the patient impulsively began drawing’. An example of his drawing, showing remarkable skill particularly since it was made during an attack, is shown in Fig. 9. The authors suggested ‘…the right hemispheric functions remained intact during the attack of spreading depression in the left hemisphere. The patient’s impulsive artistic creativity may represent a “release phenomenon” of the complex visuospatial skills of the right (subdominant) hemisphere’. 

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**Figure 8** Drawing created before the age of 4 years by the autistic child, Nadia. From Nadia, A Case of Extraordinary Drawing Ability in an Autistic Child, by L Selfe, p. 16, Copyright Elsevier, 1977.

**Figure 9** A picture drawn during an episode of transient cognitive impairment experienced during the patient’s epileptic seizure. From Finkelstein et al., Behavioral Medicine 1991; 17: 91–4, reprinted by permission of Taylor & Francis Group.
Migraine
Numerous examples of visual disturbances experienced both during the migraine attack and interictally have been reproduced in a definitive account of the subject (Podoll and Robinson, 2008), and much online material too has been posted by hundreds of those with migraine (Podoll, 2006). For some migraineurs an attack prevents any creativity, but for others an attack is the inspiration to paint during the migraine, and while most pictures are created by lay migraineurs, some have been painted by professional artists.

What cerebral dysfunction do migraineurs’ pictures reveal? The pictures, often incorporating features such as scotomas and fortification spectra, provide evidence of the variety of the various visual and perceptual disturbances. However, only on the rare occasions when scientists have deliberately illustrated the visual disturbances during their migraine attacks have illustrations contributed to clarifying some of the mechanisms subserving migraine, notably the visual aura (Schott, 2007).

Therefore, migraine is of importance in the context of artistic creativity being an intermittent disorder that can be a cause of inspiration. That some patients are creative during creativity being an intermittent disorder that can be a cause of inspiration. That some patients are creative during the migraine, and while most pictures are created by lay migraineurs, some have been painted by professional artists.

Trauma
Bogousslavsky has noted that traumatic brain damage sustained during World War I resulted in emergent painting by the poet Apollinaire following a right-sided anterolateral head wound, and in changes in Braque’s cubist style of painting after he had been trephined (Bogousslavsky, 2005).

Discussion
Pictures created spontaneously by a patient with brain disease are rarely envisaged as important tools for investigating their malfunctioning brain. It is evident from the numerous examples outlined earlier, however, that pictures can indeed reveal information that is not only invaluable but unattainable in other ways, nowhere more so than when artistic creativity is unexpectedly maintained, enhanced or—most strikingly—when it newly emerges in the artistically naïve.

Pictures: tools providing objective evidence of brain dysfunction
Viewing any individual picture by a patient with brain dysfunction rarely says much about that dysfunction. However, the context in which a picture is created, or evidence from a sequence of pictures—sometimes just comprising two—can provide some objectivity when considering the phenomenon of enhanced artistry, and both aspects apply particularly to emergent artistry.

The context of the artistic creation
Contrasting with viewing fine art, in which the context of its creation may be of interest, unknown or irrelevant, the context in which artistic output occurs in the presence of neurological disease can sometimes suggest its pathological basis. Thus, it is the atypical or uncharacteristic context or circumstances in which the picture is created that is relevant.

For example, for an artist to suddenly start to create wall paintings so large as to fill up whole rooms (Lythgoe et al., 2005; Thomas-Antéron, 2010) or uncharacteristically start drawing pictures of an erotic nature (Witt et al., 2006), are features that are out of keeping and, as Cummings commented (cited by Laino, 2003), may signal emerging brain dysfunction. However, abnormal circumstances apply strictly to that individual, and thus differ from those ‘normal’ painters who have habitually drawn on walls or produced erotic art. In another sphere, for a child of 3 years to start exceptionally skilful drawing is a highly atypical circumstance from a pedagogical and cultural perspective; very young children do not normally exhibit the striking artistic capabilities seen in rare autistic savants. Rarely, even doodles can suggest brain dysfunction (Schott, 2011). For instance, compared with the everyday, normal doodler, Dostoevsky’s numerous, often bizarre doodles littered throughout much of his handwritten texts could be considered a manifestation of hypergraphia and his presumed temporal epilepsy; the frequency with which they appeared suggests compulsiveness, a phenomenon that is considered next.

The compulsive element
The most striking ‘out of context’ aspect of unexpected artistic creativity experienced by many patients is the hectic urge to create, which has been variously described as compulsive (Miller and Hou, 2004), obsessive (Lythgoe et al., 2005), impulsive (Finkelstein et al., 1991) and irresistible (Thomas-Antéron et al., 2010). This phenomenon suggests that these patients’ creative compulsion is a major, integral part of the neurological disturbance, and painting ceaselessly for hours or even days, drawing at the same hour each day (Thomas-Antéron et al., 2002), repeating the identical drawing hundreds of times (Rosso et al., 2001), and artistic attempts repeated on numerous occasions so as to achieve perfection (Miller et al., 1998), are all features suggesting compulsive behaviour.

Also striking is that the urge to create often seems to develop early during the illness, and may be the first element of creativity; for example, two of the patients described by Miller et al. (1998) attended art classes seemingly even before they started their spontaneous artistry, and Anne Adams’ artistic creativity developed several years before her progressive aphasia emerged (Seeley et al., 2008). Compulsive behaviour that leads to inordinate repetition could even be a factor generating creativity seen in some autistic savants (Happé and Frith, 2009). Whether those with an artistic
background are more susceptible to compulsive artistry is discussed below, but also of note is that another theoretically important susceptibility factor, the patient’s previous psychological background, is rarely reported, although a patient with FTLD and previous bipolar disorder has been described (Liu et al., 2009).

Because of the disparate underlying disorders, the compulsion cannot be attributed to any specific disease or focal lesion, but the basis may include disruption of frontotemporal-limbic-subcortical circuitry (for discussion and references, see Rosso et al., 2001; Chatterjee, 2006).

Sensory and emotional accompaniments

Perhaps a contributory factor in the artistic compulsion seen in some patients is the exhilaration occasionally described. Although in the face of brain disease many patients show withdrawal, depressive and other negative features, occasionally marked positive sensory and emotional features are reported by these artistic patients. Descriptions include being ‘more sensitive to the hidden beauty of nature’ and wanting ‘to live and paint spontaneously, explore the world, and represent it in its raw state’ (Annoni et al., 2005); lights and sounds being ‘exquisitely intense and painful’ (Miller et al., 1996); ‘intense feelings of happiness’ when painting with warm colours (and unpleasant feelings painting with cold colours) (Thomas-Anterion et al., 2010), and becoming ‘emotionally relieved’ (Kulisevsky et al., 2009). In the context of autism, Baron-Cohen et al. (2009) have drawn attention to the role of sensory hypersensitivity in the autistic’s attention to detail.

Sequences of pictures

Important evidence suggesting brain dysfunction is when artistic output unexpectedly changes. Necessarily only recognized in retrospect, changes are revealed by means of a sequence of pictures, and frequent references to such changes have been made above. Changes presumably reflect the origin and nature of the causative cerebral disturbance, and emergent artistic production—when pictures arise unheralded from nothing—is the most dramatic and unexpected sequential change that occurs, but sequences often reveal more subtle changes, and a few examples relevant to enhanced artistry are commented on below.

Changes in elements of pictures

Changes in style or form have often been observed. For instance, changes from the abstract to the realistic have been described, most notably the sequence of pictures painted by Anne Adams discussed earlier, in which transmodal creativity and abstract pictures changed to more symmetrical images, and then gradually to realistic images as her dementia illness progressed (Seeley et al., 2008). This eventual realism is in concordance with the realistic creations shown by others with FTLD and emergent artistry (Miller et al., 1998), and sometimes reflects recall of remembered scenes and images. However, the reverse too has been noted, with changes from a figurative and realistic to an abstract style, examples including patients with progressive aphasia associated with frontotemporal dementia (Mell et al., 2003), Alzheimer’s disease (Crutch et al., 2001), and Parkinson’s disease after starting dopaminergic therapy (Kulisevsky et al., 2009). A particularly striking example revealing the power of sequential pictures is the progressive menace evident in the faces portrayed in Fig. 10; such portraits are witnesses to the loss of empathy characteristic of FTLD (Neary et al., 1998; Rankin et al., 2005), to which may be linked these patients’ cognitive egocentrism (Bellard et al., 2001).

Changes in colour used by different artists have also been observed. For example, amongst patients with dementia, brown and yellow became characteristic for one patient (Patient 2 in Miller et al., 1998); for another, there was change from shades of brown to ‘bold use of bright colors’ (Kleiner-Fisman et al., 2003); and predominance of red, turquoise and purple in another (Mell et al., 2003).

All these artistic changes become evident, or at least documented, only after the patient’s disease had emerged. While sequential changes can prove an indicator of possibly changing brain function, change in artistry has rarely alerted viewers (or the artist) that brain disease is occurring, and it is at present not possible to interpret any specific change in isolation. Furthermore, neither atypical context nor sequential changes necessarily indicate brain dysfunction, and over-interpretation needs to be avoided. Thus many artists ranging from Rembrandt to Picasso have changed their style of painting over the years, and Henri (‘Le Douanier’) Rousseau, ‘Grandma’ Moses, and Beryl Cook are examples of acclaimed artists whose creativity only started in later life, which re-emphasizes that the context and circumstance in which artistry occurs can be pivotal.

Synaesthesia

Two remarkably contrasting patients reported above are pertinent to the phenomenon of synaesthesia and artistic creativity. The patient described in Seeley et al. (2008) undertook crossmodal mapping of the components of Boléro from the musical to the visual domain:

‘For intensity, rhythm and duration, she performed direct transformations, choosing natural visual analogues for auditory elements (e.g. height for volume when considering intensity). For elements without a concrete intermodal representation, she performed more abstract transformations (e.g. shape for note quality...). For still other elements, she applied her own aesthetic preferences to create novel transmodal schemes (e.g. colour for pitch...).’

Strikingly, however, she did not experience synaesthesias. Her remarkable transmodal creativity, an example of creative cognition (Mulvenna, 2007), was seemingly a manifestation of her intellect and artistic skill, together with her drive and obsession, which might have been mediated by uninhibited right cortical structures and their connections (see below).

In contrast are the involuntary transmodal phenomena experienced by the similarly obsessive, late-onset artist, MB, in whom somatosensory features (pain) and emotional experiences were related to the colours she used when painting (Thomas-Antérion et al., 2010). This patient’s symptoms represent acquired synaesthesia, the causative site and cause being focal ischaemic damage.
mainly affecting the posterior third of the left insular cortex, which recalls another patient with acquired synaesthesia after thalamic stroke (Beauchamp and Ro, 2008). Various possible mechanisms have been proposed, including excess connectivity or disinhibited feedback as a consequence of plasticity or axonal sprouting (Armel and Ramachandran, 1999; Hubbard and Ramachandran, 2005; Beauchamp and Ro, 2008). But, in addition, the possible link between synaesthesia and creativity is intriguing, since there is evidence of higher levels of creativity in normal synaesthetes (Mulvenna et al., 2004; Pollak et al., 2007). Furthermore, recalling that Patient MB’s infarct affected the left hemisphere, in at least some instances of synaesthesia the posterior parietal cortex emerges as a region of particular importance (Esterman et al., 2006; Mulvenna and Walsh, 2006), an aspect discussed below in the context of the right hemisphere and paradoxical functional facilitation.

**Some possible clinical (artistic)—anatomical associations**

Considering the numerous conditions in which enhanced, unexpectedly preserved or emergent artistic creativity occurs, it is
evident that such artistry is neither disease-specific, nor culturally based: emergent artistry has been observed in FTLD in uneducated Japanese individuals (Midorikawa et al., 2008), and in a stroke victim living on an African island for the first 20 of her 36 years (Thomas-Anterion et al., 2010), suggesting that emergence of artistry reflects innate rather than learned skills acquired in the West. Furthermore, the presumed causative underlying conditions can be acute or chronic, diffuse or circumscribed, and present from early childhood to late age.

In the light of this extraordinary heterogeneity, but also the few patients studied, and the paucity and imprecision of much of the neuroanatomical data, focussing on clinical (artistic)—anatomical associations is fraught with difficulty. Nevertheless, some local theories in relation to artistic creativity (Griffiths, 2008) might contribute to understanding the processes that generate these patients’ pictures, and localization is tentatively explored in the following sections.

The anterior temporal and frontal lobes

Although in FTLD left anterior temporal lobe atrophy does not necessarily result in enhanced artistry even in creative artists (Finney and Heilman, 2007), there is consistent evidence from many of the patients described earlier, particularly those with the semantic variant, that dysfunction of the anterior temporal lobes is important if not crucial for the production of unexpectedly enhanced artistry; in some cases frontal lobe involvement is present too (Mell et al., 2003; Seeley et al., 2008). While the left temporal lobe is usually more affected than the right, when empathetic artistry becomes impaired the right temporal lobe may be particularly involved, although the orbitofrontal cortex (Viskontas et al., 2007), as well as a number of other cortical and subcortical regions (Mendez and Perryman, 2003; Mendez, 2004) have also been implicated.

Further confirmation that involvement of left temporal lobe function is often crucial in patients’ artistry comes from instances of transient impairment of that function. These instances include the single case report of left frontotemporal involvement in epilepsy cited above, and experimental evidence that transient inactivation of the left frontotemporal cortex (and to some extent the left motor cortex) using repetitive transcranial magnetic stimulation resulted in brief improvement in copying a drawing of a horse (Young et al., 2004).

It has been suggested that in FTLD there is gradual disconnection between the anterior temporal lobes and the orbitofrontal regions, but not dorsolateral and medial frontal regions that subserve initiative and planning (Zaidel, 2005). The orbitofrontal involvement leads to social disinhibition, and with preserved function in parietal and occipital regions, facilitated visual input and constructive abilities occur (see below). Flaherty (2005) has also emphasized the mutually inhibitory nature of temporal and frontal lobe interactions, and in those conditions where temporal lobe dysfunction occurs, the creativity to which the frontal lobes contribute can then emerge. While the left opercular–insular cortial ischaemic lesions in the patient reported by Thomas-Anterion et al. (2010) might have resulted in a form of focal frontotemporal disconnection, thereby allowing more detailed clinical—anatomical correlation, this proves difficult in view of the very extensive projections of that region (Augustine, 1996).

Mesolimbic connections

The rare instances of enhanced artistic output in patients with basal ganglia disease and its treatment suggest that mesolimbic dopaminergic projections also play an important part in this creativity, particularly when this is compulsive. Thus creative drive is thought to increase not only with abnormalities of temporal lobe function and ‘release’ of frontal lobe-mediated creativity, but also by involvement of the dopaminergic mesolimbic system (Flaherty, 2005).

The right hemisphere

The importance of the right hemisphere has already been suggested in respect of synaesthesia and of visual expressions of artistic facial empathy in patients with FTLD. But its importance is evident too from several other perspectives, as discussed below.

Reversal of inhibition, and paradoxical functional facilitation

Many aspects discussed earlier converge on Kapur’s (1996) concept of paradoxical functional facilitation, whereby impairment in one brain area reverses inhibition in other areas, or results in ‘compensatory augmentation’, both resulting in counter-intuitive, paradoxical improvement in function. Thus left frontotemporal disease, persistent as in FTLD, or transient as a consequence of epileptic seizures or repetitive transcranial magnetic stimulation, might release inhibited non-dominant, right parietal lobe function that subserves visuospatial aspects of art and its production (Mendez, 2004). Supporting evidence emerges from a recent experimental study of creativity assessed neuropsychologically in patients with stroke, resected meningioma and head injury. There was an increased ‘originality index’ in patients with left posterior parietal and temporal cortical lesions, and the larger the lesion the greater the originality; lesions of the right medial prefrontal cortex were associated with impaired creativity. This study, from which the authors concluded that increased originality may require inhibition of the left hemisphere, again suggests the importance assumed by the intact right hemisphere (Shamay-Tsoory et al., 2011).

The importance of the right hemisphere in artistic output contrasts with the relative lack of importance of the left hemisphere, at least in professional artists, as repeatedly shown by preserved artistry in the presence of aphasia from stroke—first recognized by Bonvicini and then by Alajouanine and others (Alajouanine, 1948; Boller, 2005): ‘...the painter escapes because of the insignificant part played by language in “plastic realization”’ (Compston, 2008). In a non-visual domain, and recalling Anne Adams’ visual Boléro, it has been suggested that the changed character of musical composition evident in Ravel’s Boléro and his Concerto for the Left Hand may too be manifestations of early left hemisphere disease and release of right hemisphere creativity, before aphasia and an inability to compose ensued (Amaducci et al., 2002).
Chiming too with Kapur’s (1996) suggestion is not only that hemisphere function in childhood develops later on the left (Chiron et al., 1997), but that the savant syndrome may be associated with left hemisphere dysfunction and right hemisphere bias (Snyder, 2009). Development of speech in an autistic patient such as Nadia might then paradoxically inhibit the right hemisphere’s artistic potential and ‘prevent’ further development in precocious but often static artistic ability.

This concept of interhemispheric inhibition had also been entertained previously, for instance by Gardner (1977) in relation to strokes affecting painters, when noting ‘the relative independence of (or even interference between) linguistic and artistic capacities’ (emphasis added) (Gardner, 1977), and by Mell et al. (2003) who posulated in FTLD ‘that language…may even inhibit…certain types of visual creativity’. Such inhibition recalls the intrahemispheric inhibition between the frontal and temporal lobes discussed in the preceding section.

**Evidence for compensatory changes and the right parietal lobe**

If left temporal or frontotemporal lobe dysfunction is important in releasing or generating preserved, enhanced or emergent visual artistry, and this artistry is heavily dependent on right posterior hemisphere—particularly parietal lobe—function, is there objective evidence supporting enhancement of this region’s function? From structural and functional imaging studies, Seeley et al. (2008) found that in their patient with primary progressive aphasia there were indeed increased grey matter volume and hyperperfusion in the right posterior neocortical areas. Similarly, as noted above, Miller et al. (1996, 1998) had previously reported that their patient with frontotemporal dementia had shown on SPECT the highest perfusion in the right posterior parietal and occipital cortices. Although bilateral parietal region thickening in an artistic savant has been described (Wallace et al., 2009), and noting that structural differences in cerebral grey matter occur in those with musical skills (Gaser and Schlaug, 2003), it remains unknown whether there are functional and structural changes in the right posterior hemisphere in normal visual artists. If there are, changes could be due to innate factors or a consequence of extensive practice and occupational choice and skills (Seeley et al., 2008; Spreng et al., 2010).

**Susceptibility to obsessional creativity?**

Many of the pictures discussed here support Ribot’s three substrates underpinning creativity (Ribot, 1973): (i) an innate trait that ‘becomes manifest as soon as circumstances allow’—the artistic background of many patients and the onset of disease fulfil this criterion; (ii) a compulsion to create—a feature extensively discussed earlier and (iii) creative individuality—the pictures are not only characteristic of the patient, but in many instances disease has released conventional constraints, resulting in spontaneous and sometimes less conventional artistry.

With rare exceptions, as in the patient reported by Liu et al. (2009) and cited above, little is known about patients’ premorbid psychological history. However, creative individuals are more likely to experience affective disorders and in particular bipolar disease, and those with bipolar disease experience increased creativity during the hypomanic phase (Jamison, 1980, 1989), suggesting that those with a longstanding artistic or creative disposition are already more susceptible to developing abnormally enhanced if not pathologically obsessive creativity. Normal individuals with high creativity have higher baseline frontal blood flow compared with those with low creativity (Carlsson et al., 2000), and so if disease results in disinhibition of the frontal lobes, obsessional creativity may be more likely to ensue. Further, in keeping with the creative person’s susceptibility to obsessionality is the increased risk of the dopamine dysregulation syndrome in patients with Parkinson’s disease who were previously in a creative or artistic profession (Schwingenschuh et al., 2010), an observation also reiterating the importance of the mesolimbic system in artistic creativity referred to above.

**Creativity challenged?**

While diminished artistic novelty in an artist with the primary progressive aphasia form of FTLD (Finney and Heilman, 2007) might challenge any generalizations about enhanced artistic potential in these conditions, a further challenge has come from a recent experimental study of patients with the frontal variant of FTLD (fvFTLD). This study assessed creativity using a standardized test of creativity and neuropsychological tests of frontal function, and SPECT to determine perfusion patterns (de Souza et al., 2010). Compared with non-demented patients with Parkinson’s disease and healthy controls, patients with fvFTLD had impaired creativity and prefrontal hypoperfusion, particularly in the frontal pole.

However, de Souza et al. (2010) then concluded: ‘The emergence of artistic talent in patients with fvFTLD is explained by the release of involuntary behaviors, rather than by the development of creative thinking’, and also recommended avoiding consideration of ‘pseudo-creative production, or the emergence of “artistic talent”, as a mastered mental production’. For the present author, however, the notion of pseudo-creation and identification of ‘artistic talent’ create more difficulties than enlightenment; rather, they emphatically confirm the importance of patients’ pictures. The evidence for creativity surely lies in the creation itself rather than in perfusion patterns or psychological tests; indeed, even in artists, ‘no specific neuropsychological tests have been designed to assess art following brain damage’ (Zaidel, 2005).

**Conclusion**

One would have anticipated transient or relentless disintegration of creativity in the face of cerebral disease, but the pictures painted by some patients reveal the reverse is sometimes true. It is their pictures that so eloquently provide the evidence. They demonstrate that maintained, improved or—most strikingly—emergent artistry can occur as a result of a variety of brain disorders. Yet much remains puzzling—including why this creativity is so uncommon, what singles out patients who reveal this unusual artistry, and the precise underlying mechanisms that may be
References


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