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A CASE STUDY OF A YOUNG ADULT SAVANT ARTIST WITH TUBEROUS SCLEROSIS COMPLEX

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Abstract:
BK[ii] is a case of a young adult who has Tuberous Sclerosis with Savant Syndrome. Tuberous Sclerosis Complex (TSC) is a rare multisystem genetic disease that causes non-cancerous (benign) tumours to form in different organs, primarily in the brain, eyes, heart, kidney, skin and lungs (NINDS, 2006). The aspects of TSC that most strongly impact quality of life are generally associated with the brain: seizures, developmental delay, intellectual disability and autism. Current estimates place TSC affected births at 1 in 6000. The prevalence of Savant Syndrome is approximately 10% in the autistic population and less than 1% in the non-autistic population, making the combination rare. Extraordinary skills, such as remarkable abilities in calendar dates and mathematical calculation, artistic or musical talent, and eidetic memory, are markedly incongruous to the overall handicap in the individual (Treffert, 2009). The authors of this paper present the psycho-educational diagnostic evaluation and profiling of a young savant artist (BK) with Tuberous Sclerosis Complex and autism spectrum conditions whom they have worked with.

Keywords: tuberous sclerosis complex (TSC), savant syndrome

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[ii] The actual name of BK has been kept anonymous and those years during which he has undergone different assessments have also been changed to ensure full confidentiality in adherence to the Personal Data Protection Act (PDPA) enacted in Singapore in 2014.

1. Introduction

In the face of a rare disease that results in significant cognitive and social impairment, one could say that to produce remarkable works of art requires 'talent against all odds'. Yet such talent exists and examples have been discovered and verified and the unique elements to each continue to astound both researchers and lay people alike. The authors of this paper present the research and findings of a young Chinese man, BK, who, despite having Tuberous Sclerosis Complex (TSC) with significant impairment, paints extraordinary images of remarkable quality, suggesting he also has Savant Syndrome.

1.1 Tuberous Sclerosis Complex

Tuberous Sclerosis Complex (TSC) is classified as one of the rare diseases in the world with a prevalence affecting approximately 1 in 6000 births. It occurs in all races and ethnic groups and in both males and females. TSC is an autosomal dominant disorder that can be inherited from one parent with TSC or can result from a spontaneous genetic mutation. It is caused by mutations of at least two different genes, the TSC1 gene or the TSC2 gene (Crino, Nathanson and Henske, 2006). Children have a 50 percent chance of inheriting TSC if one of their parents has this condition, however only one-third of TSC cases are known to be inherited. The other two-thirds result from spontaneous and unpredictable mutations occurring during conception or very early development of the human embryo.

TSC causes typically benign tubers (hamartia) or tumours (hamartomas) to grow on vital organs leading to a wide range of physical and neuropsychiatric disorders. Epilepsy is present in 70%-90% of individuals with TSC and often develops within the first year of life. Developmental and behavioural disorders including autism spectrum conditions (ASC) or autism spectrum disorders (ASD), are also frequently diagnosed in TSC (Prather and de Vries, 2004). According to research studies, ASC affects between 17% and 63% of individuals with TSC, a prevalence dramatically higher than that of the general population (Ridler, Suckling, Higgins, de Vries, Stephenson, Bolton, and Bullmore, (2007). Mental retardation and early onset of epilepsy in TSC, in particular infantile spasms, are associated with the development of ASC/ASD in such individuals. In addition, there is evidence of an association between temporal lobe epileptiform foci with ASC/ASD in TSC. Self-injurious behaviour and other behaviours such as ADHD, aggression, behavioural outbursts and OCD can also occur in some patients with TSC (Staley, Montenegro, Major, Muzykewicz, Halpern, Kopp, Newberry, and Thiele, 2008).

1.2 Savant Syndrome

The phenomenology of Savant Syndrome confirms that it is a rare, enigmatic condition. According to Treffert (2010), "*[S]avant [S]yndrome is a rare, but extraordinary, condition in which persons with serious mental disabilities, including autistic disorder, have some 'island of genius' that stands in marked, incongruous contrast to overall handicap*" (p.1). The prevalence in the autistic population is approximately 10% and markedly fewer (1%) among non-autistics but who have developmental disabilities (Treffert, 2014). In other words,

approximately 50% of cases with Savant Syndrome have autism as the underlying developmental disability and 50% are associated with other disabilities. Unlike TSC, which is represented impartially between genders, males with Savant Syndrome outnumber their female counterparts by as many as six to one (Treffert, 2010).

Savant Syndrome is hallmarked by the paradoxical special skills amidst discernible disability or handicap. In his research, Treffert (2009) identified that remarkable skills are found in only a relatively narrow discrete range of five general categories: (1) Music, usually performance based and most often the piano; (2) Art, usually drawing, painting or sculpting; (3) Mathematics; including lightning calculating or the ability to compute prime numbers, for example, in the absence of other simple arithmetic abilities; (4) Calendar calculating, which is an obscure skill in non-savants and; (5) Mechanical or spatial skills, including the capacity to measure distances precisely without benefit of instruments, the ability to construct complex models or structures with painstaking accuracy or the mastery of map making and direction finding.

Some other skills have also been reported, although less often, such as knowing the time without having to look at a clock, an uncanny ability to know and understand how animals feel, unusual sensory discrimination in smell, touch, or vision including synaesthesia, prodigious language (polyglot) ability, untaught mechanical or computer literacy skills, an unexplainable capability to commit maps to memory, outstanding knowledge in specific fields such as neurophysiology, statistics or navigation, and so on (Chia, 2008). Typically, a single special skill exists, however, in some instances several skills exist simultaneously. Whatever the particular savant skill, it is always linked to phenomenal, sometimes eidetic memory (Treffert, 2006).

Exkorn (2005) classifies autistic savant skills into three categories: 1) Splinter skills, 2) Talented skills, and; 3) Prodigious skills. Splinter skills are most common and savants with these skills display obsessive preoccupations with and memorization of trivia and obscure information such as license plate numbers of vehicles and sports statistics, which they commit to memory. Talented skills are more highly developed and specialized than splinter skills. Savants with talented skills can be very artistic and draw or paint beautiful sceneries, or for some, have a fantastic memory that allows them to work out difficult mathematical calculations mentally. Prodigious skills are the rarest. Prodigious savants have spectacular skills that would be remarkable even if they were to occur in non-handicapped individuals. Fewer than 30 known prodigious savants in the world display such extraordinary skills, which could include for instance, the capability to play an entire concerto on the piano after listening to it only once (Chia, 2008).

In summary, there are several features that distinguish a savant artist from other artists: the underlying disability; innate ability without teaching or training; talent which typically 'explodes' on the scene at a very early age; obsessive preoccupation with the skill; prolific output of product on a continuous basis; and literal, eidetic-like memory with massive capacity in the area of expertise (Treffert, 2010).

2. Background Information about the Case

The authors of this paper present this case of a young Chinese man, BK[1], 31 years 1 month old at the time of this study, who had previously been diagnosed with tuberous sclerosis complex (TSC) from a young age. One of the authors has known the family for years and observed remarkable artistic skills that warranted further investigation. The authors met the young man and his family and viewed his art work and determined that psycho-educational assessment and profiling would help to determine if BK also qualifies for the diagnosis of Savant Syndrome.

2.1 Medical History

According to the previous assessment reports (dated 1987, 1991, and 2011) from a public hospital in Singapore, and another report from an overseas institution (undated), BK was diagnosed with infantile spasms with hypsarrhythmia and TSC with autistic features (score in the mildly-moderately autistic area on the Childhood Autism Rating Scale) and extremely low mental capacity (with Performance IQ of 47 at < 0.1 percentile rank with 95% confidence interval between 43 and 57 based on Wechsler Adult Intelligence Scales 3rd Edition/WAIS-III administration). Being non-verbal, BK was unable to complete the WAIS-III assessment and no Verbal IQ and Full-Scale IQ could be computed. In addition, his standard scores based on the administration of Vineland Adaptive Behaviour Scales – 2nd Edition (VABS-II) showed that his low adaptive behaviour composite score was 26±7 with < 1 percentile rank. The various VABS-II subdomains also showed low standard scores and adaptive levels: Communication = 21±7, Daily Living Skills = 46±8, Socialization = 23±7, and Motor Skills (estimated) = 47±0, all at < 1 percentile rank and low adaptive level. BK was also diagnosed with allergic rhinitis and lesion in the abdomen ventral to the aorta and inferior vena cave. He was on medication for his epilepsy at that time.

BK underwent an MRI scanning on 20th November 1991 at a public hospital in Copenhagen, Denmark. The MRI uses magnetic fields and radio waves to produce images of thin slices of tissue (tomographic images). During the scanning, the magnitude and rate of energy release that occurs as the protons resume the alignment (T1 relaxation) and as they wobble (precess) during the process (T2 relaxation) are recorded as spatially localized signal intensities by a coil (antenna) built within the MRI device. Computer algorithms analyse these signals and produce detailed anatomic images. The technique used with BK involved (i) T1 weighted sagittal images; (ii) T2 weighted axial images; (iii) pre- and post-contract T1 weighted axial images; and (iv) pre- and post-contrast T1 weighted coronal images (see Figures 1a, 1b and 1c). Findings from the MRI report indicated that multiple tiny nodules could be found in the subependymal regions of the lateral ventricles bilaterally. None of these nodules had demonstrated enhancement. Focal areas of T2 prolongation were seen in the subcortical white matter and cortex bilaterally. These lesions also failed to show any enhancement following gadolinium contrast. Small (less than 1 cm) cystic structure which follows

CSF signal intensity was seen posterior to the right lateral ventricle near the splenium. No other definite focal lesions were identified.

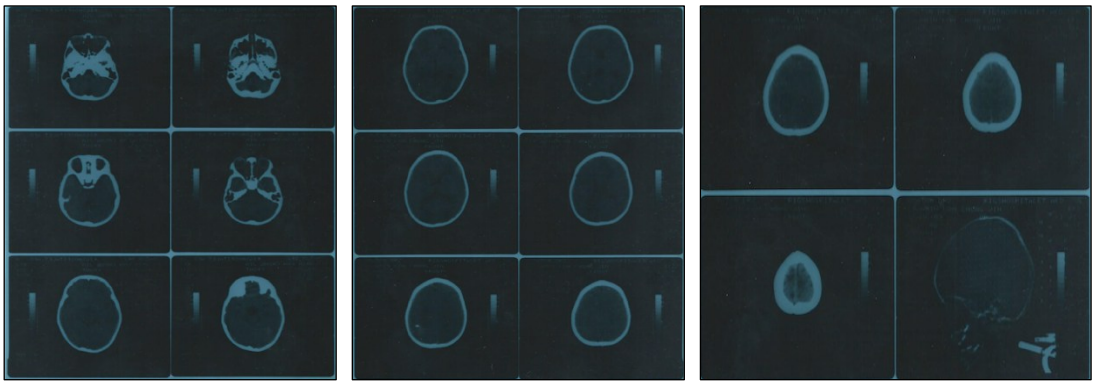

Fig. 1a Fig. 1b Fig. 1c

Figure 1: Detection of Intracranial Calcifications by MRI

In a study conducted by Oot et al. (1986), it was reported that while the MRI images raised the possibility of calcification but were less definitive than the Computed Tomography (CT) findings. In fact, in another earlier study done by Holland et al. (1985), it was reported that calcification was falsely suspected to be present in 45% of non-calcified intracranial abnormalities by MRI. Hence, it is important to err on the side of caution in BK's case especially when one is uncertain of the neuroradiological results.

2.2 Family History

When BK was diagnosed with infantile spasms at the age of 10 months, doctors prescribed Prednisolone and Mogadon daily. As a result, the seizures subsided. Plans to tail off the Prednisone after a few weeks and follow up with another Electroencephalogram (EEG), were not achieved due to the family's decision to relocate to Dubai where the father was given a job posting. This move was the beginning of a 15-year global journey that the family would embark upon to accompany the father at each new job posting that included Dubai, Copenhagen, San Francisco, Paris, Seoul, Frankfurt, and Singapore.

The frequent changes in location meant constant changes and gaps to BK's therapy and support. At times, he made progress, while at others he regressed due to gaps in therapy and different approaches to support as well as language barriers. Some locations had more services available to provide to BK and the family while others only provided support in their national language or used methods incompatible with BK.

During his time in Paris, the family discovered BK's gift in music. After hearing a friend play the piano, BK was able to recall the melody and replayed the tune immediately on the piano. However, it was a single occurrence and BK was not subsequently exposed to music or a piano while in Paris and the incident was forgotten. When the family relocated to Frankfurt, the parents hired a piano teacher for BK. It started out well and BK was making progress. As time progressed, the teacher attempted to introduce new piano books for advanced lessons. BK resisted and became

increasingly frustrated leading to a breakdown in the relationship with the piano teacher. BK then abandoned lessons and has not touched a piano since that time.

When the family relocated back to Singapore in 2002, BK was able to join a centre that supports youths with autism. Upon reaching 18 years of age, however, he had to leave the centre in search of support for adults. The parents reported that he has shown considerable regression since that time.

BK began to paint in August 2014 when he participated in a church event to paint a mural on the side of the church. Since that time, he has expressed keen interest in painting. Upon a recommendation from a friend, the parents took BK to an art class where he has been going to once a week since that time. It soon became evident that BK had a talent for painting and he has since worked to produce many works that give evidence to his eye for detail, colour, texture, and stroke application, as seen in Figures 2 to 6.

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

3. Assessment

Several standardized assessments were administered at Twinkle Intervention Centre in Singapore to determine BK's condition in terms of his cognitive capacity and sensory responsivity.

3.1 Stanford-Binet Intelligence Scales-5th Edition (SB-5)

The Stanford-Binet Intelligence Scales-5th Edition (SB-5) (Roid, 2003a) was administered to determine BK's intellectual capacity. The SB-5 measures five cognitive abilities in both nonverbal and verbal formats with a total of 10 subtests (Roid, 2003b). Each of these subtests will be described briefly below.

- Fluid Reasoning (FR):

It measures a student's ability to use inductive or deductive reasoning while solving both verbal and nonverbal problems.

- Knowledge (KN):

It assesses your child's understanding of general information, vocabulary, social behavioural standards, and common sense that kids within the same age range are also expected to know.

- Quantitative Reasoning (QR):

It assesses an individual's abilities with basic math concepts (such as identifying numbers and solving math word problems) as well as patterning, sequencing, ordering, classifying, comparing, and numerical problem-solving skills.

- Visual-Spatial Processing (VS):

It measures each student's ability to identify patterns, relationships, spatial orientations, and how individual pieces relate to whole images on display as well as solve problems using pictures, images, diagrams, geometric shapes, maps or tables.

- Working Memory (WM):

It assesses a child's ability to access information he or she has just seen or heard and how that data is inspected, transformed or sorted when answering a question or solving problems, such as repeating number and letter sequences in order, tapping blocks in a predetermined pattern or identifying visual and verbal absurdities shown on the test.

Table 1 shows the SB-5 subtests with a brief description of the subtests and their factors.

Table 1: A Brief Description of the SB-5 Subtests (Roid, 2003a)

Fluid Reasoning	Knowledge	Quantitative Reasoning	Visual-Spatial Processing	Working Memory
Early reasoning	Vocabulary	Non-verbal quantitative reasoning (non-verbal)	Form board and form patterns (non-verbal)	Delayed response (non-verbal)
Verbal absurdities	Procedural knowledge (non-verbal)	Verbal quantitative reasoning	Position and direction	Block span (non-verbal)
Verbal analogies	Picture absurdities (non-verbal)			Memory for sentences
Object series matrices (non-verbal)				Last word

BK's SB-5 normed total and subtest scores are shown in two separate tables: Table 2 (Non-Verbal/NV Domain) and Table 3 (Verbal/V Domain).

Table 2 and Table 3 show that both BK's Verbal Intelligence Quotient (VIQ) based on all the five verbal subtests and Non-Verbal Intelligence Quotient (NVIQ)

based on all the five non-verbal subtests are in the moderately impaired or delayed intellectual capacity.

Table 2: BK's Non-Verbal (NV) Subtests of SB-5

Subtests	Raw Score	Scaled Score	Standard Score
NV - Fluid Reasoning (NV-FR)	17	1	
NV – Knowledge (NV-KN)	5	1	
NV - Quantitative Reasoning (NV-QR)	3	1	
NV - Visual Spatial (NV-VS)	8	1	
NV – Working Memory (NV-WM)	9	1	
Total Sum of Scores for NVIQ	--	5	42

Table 3: BK's Verbal (V) Subtests of SB-5

Subtests	Raw Score	Scaled Score	Standard Score
V - Fluid Reasoning (V-FR)	2	1	
V – Knowledge (V-KN)	17	1	
V - Quantitative Reasoning (V-QR)	3	1	
V - Visual Spatial (V-VS)	3	1	
V – Working Memory (V-WM)	0	1	
Total Sum of Scores for VIQ	--	5	43

Table 4 shows BK's standard scores for all the combined five non-verbal/verbal (NV/V) subtests in SB-5. His four SB-5 quotients are shown in Table 5.

Table 4: Sum of Scaled Scores for BK's combined Non-Verbal/Verbal Subtests

Subtests	Sum of Scaled Scores	Percentile Rank	95% Confidence Level
Fluid Reasoning (FD)	2	<0.1	44-60
Knowledge (KN)	2	<0.1	45-61
Quantitative Reasoning (QR)	2	<0.1	46-62
Visual Spatial (VS)	2	<0.1	44-60
Working Memory (WM)	2	<0.1	45-61

Table 5: BK's Four SB-5 Quotients[iii]

Quotients	Standard Score	Percentile Rank	95% Confidence Interval
NVIQ	42	<0.1	39-51
VIQ	43	<0.1	39-51
FSIQ	30	<0.1	37-45
AbIQ	47	<0.1	44-60

Each of the four SB-5 quotients (Roid, 2003a, 2003b) is briefly explained as follows:

- Non-Verbal Intelligence Quotient (NVIQ):

This is the normed combined score taken from the five non-verbal subtests.

- Verbal Intelligence Quotient (VIQ):

This is the normed combined score taken from the five verbal subtests.

[iii] Abbreviations for Non-Verbal Intelligence Quotient (NVIQ), Verbal Intelligence Quotient (VIQ), Full Scale Intelligence Quotient (FSIQ) and Abbreviated Battery Intelligence Quotient (AbIQ) will be used throughout this paper.

- Full Scale Intelligence Quotient (FSIQ):

This is the normed combined score taken from all 10 non-verbal and verbal subtests.

- Abbreviated Battery IQ (AbIQ):

This is computed to provide a quick estimate of two major cognitive factors: fluid reasoning and crystallized ability.

As shown in Table 5 above, BK's SB-5 NVIQ-VIQ profile shows that his NVIQ is equivalent to VIQ (i.e., NVIQ ≡ VIQ) by a difference of 1 point. The minimum SB-5 NVIQ-VIQ difference of 9-10 points is required for significance at the .05 level (Roid, 2003b). His NVIQ-VIQ profile is typical of individuals with extremely low intelligence i.e., he has intellectual and developmental disorder (Roid & Barram, 2004).

A combination of the standard scores from both NVIQ and VIQ was used to compute the FSIQ. BK's FSIQ is 40. Since BK's FSIQ is less than 70, it indicates that he shows moderately impaired or delayed verbal and non-verbal skills.

During the SB-5 administration, BK displayed short attention-concentration span that interfered with the testing procedure. Hence, AbIQ, which offers a more valid estimate of BK's true intelligence, was computed as it is more representative of the full battery for him. The AbIQ is used here as its short administration time helps to minimize off-tasks behaviour and maximize attention (Roid, 2003b). BK's AbIQ is 47. However, care should be taken when interpreting the AbIQ as it may overestimate true abilities (Roid & Barram, 2004). BK's FSIQ < AbIQ by a difference of 7 points. The minimum difference required for significance at the .05 level is 10-11 points as outlined in the SB-5 Test Manual (Roid, 2003b).

BK's AbIQ of 47 coincided exactly with his previous Performance IQ of 47 based on WAIS- III administration. His NVIQ based on SB-5 administration is 42, one point lower than his VIQ. His Full-Scale IQ based on SB-5 administration is 40. All the standard scores are in the moderately impaired or delayed range (40 to 54). The SB-5 IQ range (deviation IQ) and the IQ classification (descriptors for the nine ranges) are shown in Table 6 below.

Table 6: Description and Classification of the SB-5 IQ Range

IQ Range ("deviation IQ")	IQ Classification
145-160	Very gifted or highly advanced
130-144	Gifted or very advanced
120-129	Superior
110-119	High average
90-109	Average
80-89	Low average
70-79	Borderline impaired or delayed
55-69	Mildly impaired or delayed
40-54	Moderately impaired or delayed

3.2 Test of Non-Verbal Intelligence-3rd Edition (TONI-3)

The Test of Nonverbal Intelligence-Third Edition (TONI-3) (Brown, Sherbenou, & Johnsen, 1997) is designed to test non-verbal abstract/figural problem solving in several content areas: shape, position, direction, rotation, contiguity, shading, size and movement.

The SB-5 results (see Tables 2, 3, 4 and 5 above) clearly indicate that BK has intellectual impairment. The TONI-3 was administered to determine BK's non-verbal problem-solving ability in term of his deviation quotient. The TONI-3 results (see Table 7) show that BK's performance in the test was less than 70, which means his NVIQ is in the very poor range.

Table 7 shows BK's deviation quotient is 64 (very poor) with an equivalent age of 5 years 9 months as compared with his current chronological age of 31 years 1 month. The Deviation Quotient (NV) of 64 places BK in the mildly impaired or delayed range of nonverbal cognitive ability. This non-verbal standard score based on the TONI-3 administration is one level higher than the results of the standard scores based on the SB-5 administration.

Table 7: BK's TONI-3 Scores

TONI-3 Scores	Scores	Age Equivalent	Descriptor
Deviation Quotient	64	--	Very poor
Standard Error of Measurement (SEM)	4	--	--
Percentile Rank	< 1	--	--
Total Raw Score	4	--	--
Age Equivalent	4	5 years 9 months	Extremely impaired

3.3 Sensory Profile

The Sensory Profile (Dunn, 1999), the caregiver's version of questionnaire (by proxy), was completed by BK's mother as BK is not cognitively capable of completing the Sensory Profile Self-Questionnaire. The aim of profile is to ascertain if BK has any sensory-related processing, modulation and/or emotional-behavioural problems that could have interfered with his thinking/learning. Moreover, it is also to find out BK's Sensory Profile factors (see Table 8) as well as the Sensory Profile summary of his sensory processing, modulation, and behaviour and emotional responses to external/internal stimuli (see Table 8).

Table 8 highlights two areas of concern regarding (1) low endurance/tone and (2) sedentary about BK. According to Whitney (2016), low endurance/tone means "*the lack of supportive muscle tone, usually with increased mobility at the joints; the person with low tone has limbs that are floppy, appear to not be attached to the body, and have awkward movement patterns. This lack of muscle tone results in poor ability to act in a sustained state of alert performance*" (para. 18).

Table 8: BK's Performance in the Sensory Profile (Caregiver Version) Factor Scores

Factor	Factor Raw Score Total	Typical Performance	Probable Difference	Definite Difference
Sensory Seeking	70/85	√		
Emotionally Reactive	65/80	√		
Low Endurance/Tone	22/45			√
Oral Sensory Sensitivity	30/45		√	
Inattention/Distractibility	24/35		√	
Poor Registration	30/40		√	
Sensory Sensitivity	14/20		√	
Sedentary	8/20			√
Fine Motor/Perceptual	10/15	√		

Table 9 (i.e., 9a, 9b and 9c) shows those sensory areas where BK is still exhibiting definite issues of concern, especially in these three main Sensory Profile (Dunn, 1999) areas: (1) sensory processing related to endurance/tone; (2) modulation of sensory input affecting emotional responses; and (3) behavioural outcomes of sensory processing.

Table 9a: BK's Raw Scores in the Area of the Sensory Processing of the Sensory Profile

Sensory Processing	Section Raw Score Total	Typical Performance	Probable Difference	Definite Difference
Auditory Processing	30/40	√		
Visual Processing	6/45	√		
Vestibular Processing	45/55		√	
Touch Processing	65/90		√	
Multisensory Processing	27/35	√		
Oral Sensory Processing	45/60		√	

Table 9b: BK's Raw Scores in the Area of the Sensory Modulation of the Sensory Profile

Sensory Modulation	Section Raw Score Total	Typical Performance	Probable Difference	Definite Difference
Sensory Processing related to Endurance/Tone	22/45			√
Modulation related to Body Position & Movement	41/50	√		
Modulation of Movement affecting Activity Level	19/35		√	
Modulation of Sensory Input affecting Emotional Response	11/20			√
Modulation of Visual Input affecting Emotional Response & Activity Level	12/20		√	

Table 9c: BK's Raw Scores in the Area of Behaviour and Emotional Responses of the Sensory Profile

Behaviour & Emotional Responses	Section Raw Score Total	Typical Performance	Probable Difference	Definite Difference
Emotional/Social Responses	68/85	√		
Behavioural Outcomes of Sensory Processing	18/30			√
Items indicating Thresholds for Response	10/15		√	

3.4 Gilliam Autism Rating Scale (GARS)

Gilliam Autism Rating Scale (GARS) (Gilliam, 1995) is an individually-administered, norm-referenced screening measure designed in a rating scale-format. Its purpose is to identify individuals suspected with autism as well as other severe behavioural problems. The GARS measure provides an overall score known as Autism Quotient (AQ), which is computed from three or four subscales: (1) Stereotyped Behaviours; (2) Communication; (3) Social Interaction; and/or (4) Developmental Disturbance.

From the GARS administration, BK's AQ of 102 is 12 points above 90. This indicates that he is probably autistic. The scaled scores of 8 through 12 or AQ of 90 through 110 are within the average range for an individual with autism in the normative sample. According to Gilliam (1995), "*[A]pproximately 50% of the subjects with autism scored in this* range" (p. 17).

BK's Autism Quotient (AQ) of 102 is above 90, as shown in Table 10. He is probably autistic. Scaled score of 8 through 12 or AQ of 90 through 110 are within the average range for an individual with autism in the normative sample. "*Approximately 50% of the subjects with autism scored in this range"* (Gilliam, 1995, p.17).

Table 10: BK's Gilliam Autism Rating Scale (GARS) scores

Subtests	Raw Score	Scaled Scores	Percentile Rank	SEM
Stereotyped Behaviours	19	10	50	1
Communication	29	13	84	1
Social Interaction	20	8	25	1
Developmental Disturbances	6	10	50	1
Sum of Scaled Scores	--	41	--	--
Autism Quotient (AQ)	--	102	55	3
Probability of Autism		Average		

3.5 Broad Autism Phenotype Questionnaire (BAPQ)

The Broad Autism Phenotype Questionnaire (BAPQ) (Hurley et al., 2007) is used to find out about a set of personality and language characteristics that reflect the phenotypic expression of the genetic liability to autism, in non-autistic relatives of autistic individuals. The BAPQ includes both self-and informant-report versions. It consists of "*three subscales corresponding to the triad of characteristics associated with the primary diagnostic domains of autism: (1) social abnormalities, (2) pragmatic language difficulties and (3) rigid personality and a desire for sameness*" (Sasson et al., 2013, p. 135).

In this case, it was done by BK's mother but was aborted or could not be used for analysis because most items were not completed.

3.6 EQ-SQ Questionnaire for Adults

The Empathy Quotient (EQ) and Systemizing Quotient (SQ) Questionnaire (EQ-SQQ) was developed in order to examine trends in gender typical behaviour in adults (Baron-Cohen et al., 2003; Baron-Cohen & Wheelwright 2004; Wheelwright et al., 2006). The EQ-SQQ constitutes both EQ and SQ self-report questionnaires with a Likert format and contain a list of statements about real life situations, experiences and interests where empathizing or systemizing skills are required.

The questionnaire was done by BK's mother (by proxy) since BK is unable to understand the items stated in it. Like the BAP Questionnaire, it was also aborted or could not be used for analysis because most items were not completed.

4. Conclusion and Recommendation

BK's earlier diagnosis done at a public hospital in Singapore showed that he has Tuberous Sclerosis Complex (TSC) – an autosomal dominant disorder resulting from mutations in the TSC1 or TSC2 gene. Epilepsy is present in 70%-90% of individuals with TSC and often develop within the first year of life. Developmental and behavioural disorders including autism spectrum conditions (ASC) or autism spectrum disorders (ASD), are also frequently diagnosed in TSC.

According to research studies, ASC affects between 17% and 63% of individuals with TSC, a prevalence dramatically higher than that of the general population. Mental retardation and early onset of epilepsy in TSC, in particular infantile spasms, are associated with the development of ASC/ASD in such individuals. In addition, there is evidence of an association between temporal lobe epileptiform foci with ASC/ASD in TSC.

As a follow-up to the current assessment done, these results will be reviewed in the context of other available information and the current operating definition of savant syndrome. According to Treffert (2010), *"[S]avant [S]yndrome is a rare, but extraordinary, condition in which persons with serious mental disabilities, including autistic disorder, have some 'island of genius' that stands in marked, incongruous contrast to overall handicap*" (p. 1). Based on this definition, we can safely confirm that BK displays signs of Savant Syndrome in the area of art due to his extensive "literal memory" capacity that exists with this skill of painting. "*Compared to other artists, a number of distinguishing features characterize the savant artist: underlying disability; innate ability without teaching or training; talent which typically 'explodes' on the scene at a very early age; obsessive preoccupation with the skill; prolific output of product on a continuous basis; and literal, eidetic-like memory with massive capacity in the area of expertise"* (Treffert, 2010, p. 21).

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