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A psycho-educational evaluation and profiling of a male crypto-savant with non-verbal low-functioning autism

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Abstract
Severely neurologically impaired individuals, who manifest islets of remarkable skills in specific areas of interest (e.g., drawing, sculpturing, painting, music, memory feats, arithmetic and calendar calculations), are often identified or described as savants. Initially, the term *idiot savant* – a French term that means *unlearned* (idiot) *skill* (savant) – was first used by down (1887) to describe such individuals with very poor general ability, who were unable to live independently on their own but possessed fantastic abilities in specific areas. An estimated prevalence of savantism in the autistic population is 10 percent, whereas the prevalence in the non-autistic population is less than 1 percent. In this paper, the authors have chosen to delve on the psycho-educational diagnostic evaluation and profiling of a *crypto*-savant (or *hidden* savant) boy (YY) with non-verbal low-functioning autism that they have observed, assessed and worked with.

Keywords: autism, crypto-savant, savantism

1. Introduction
At the mention of autistic savantism, the movie *Rain Man* comes to mind and most people still think that an autistic savant is like Raymond Babbitt played by the American veteran actor, Dustin Hoffman, in the movie. Raymond was supposedly to have an excellent procedural memory for baseball player statistics, people listed in a telephone directory and counting cards at a casino in Las Vegas. Is this really an accurate portrayal of an autistic savant?

Going back to more than a century ago, a British physician by the name of John Langdon Haydon Down (b.1828-d.1896) used the term *idiot savant* (Down, 1887) [1] to describe a group of ten individuals, whom he had been observing over a period of time, manifesting remarkable abilities in specific areas but were unable to live independently because of poor general ability in terms of intelligence and adaptive behavior. Today, this term would sound offensive and politically incorrect. Advocates for people with special needs would argue that the term is socially unacceptable or inappropriate. It is not surprising, therefore, there has been a terminological shift. For example, Charness et al. (1988) [2] used the term *monosavant*, while Treffert (1989) [3] has preferred to use *savant syndrome* to describe these *exceptionally talented* individuals. For more detail, interested readers can read up more in the more recent paper by Chua and Chia (2017) [4] as well as others, such as Heaton and Wallace (2004) [5], Selfe (2011) [6] and Treffert (2014) [7].

According to Treffert (2014) [7], approximately fifty percent of the savant cases have autism spectrum disorders while the remaining fifty percent of the cases are associated with other disabilities such as intellectual and developmental disorders. It is important to take note that being a savant does not imply that because the individual is highly talented or gifted, high IQ is expected. In fact, "The reality is that low IQ is not necessarily an accompaniment of savant syndrome; in some cases, IQ can be superior" (Treffert, 2014, p. 564) [7]. Treffert (2014) [7] went on to argue that "Genius and prodigy exist separate from savant syndrome and not all such highly gifted persons have Asperger's Disorder" (p. 564) or autism spectrum disorder.

In fact, as many as one in ten people with autism have such remarkable abilities in varying degrees (Treffert, 2000) [8]. "The majority of autistic savants have low IQs (and hence, intellectually challenged); there are some autistic savants who are highly intelligent" (Exkorn, 2005, p. 69) [9]. In defining autistic savantism, it can be seen as a rare but extra-ordinary condition in which an individual with severe mental disability displays "some 'islands of genius' that stands in marked incongruous contrast to the overall handicap" (Treffert, 2000, p. 15) [8].

For Edelson (1995) [10], an autistic savant refers strictly to an individual with autism who has extra-ordinary skills – typically occurring in art, calendar calculation, mathematics, music and visuo-spatial – not normally manifested by most people. Exkorn (2005) [9] classifies such autistic savant skills under three categories:

1) Splinter skills, e.g., obsessive preoccupations with and memorization of trivia and obscure information (Siegel, 1996) [11];
2) Talented skills, e.g., painting beautiful sceneries (Selfe, 1977 [12]; Wiltshire, 1989 [13]), or possessing a fantastic memory that allows mental performance of difficult mathematical calculations; and
3) Prodigious skills, e.g., the capability to play an entire concerto on a piano after listening to it only once (Charness et al., 1988) [2].

In most cases, "Skills are usually single skills, but multiple skills can occur as well. Whatever the skill it is always associated with massive memory of a habit or procedural type" (Treffert, 2014, p. 564) [7].

However, there is a sub-group of autistic savants who, according to Rimland (1990) [14], "are autistic persons with savant abilities so low functioning that no one knows their savant skills exist" (p. 3). The term *autistic crypto-savants* coined by Rimland (1990) [14] refers to those individuals with autism "who, because of inability to communicate, or unwillingness to communicate, have savant skills which are hidden, or secret, and unknown to those around them, including their parents and teachers" (p. 3).

2. A Brief Background Information about the Case

In this paper, we are presenting a case of a Eurasian boy, YY[1], (aged 11 years 9 months at the time of this study) diagnosed with non-verbal low-functioning autism. Currently, he is still attending a local special school for children with autism. Both his parents and teachers have noted that the boy possesses some kind of hidden artistic talent, which probably suggests that YY displays some kind of an imaginational over excitability[2], in creating objects or anything of special interest to him with Lego bricks. For example, Figure 1 shows YY's imaginative creation of a castle on wheels resembling that of Howl's Moving Castle (as shown in Figure 2) which he never watched before. *Howl's Moving Castle* (Jones, 1986) [15] is a 2004 Japanese animated fantasy movie based on the novel of the same title by a British author, Diana Wynne Jones. Briefly, the movie is about a young hatter named Sophie, who lived in a fictional kingdom, where magic and technology of early 20th century intertwined into one entity. However, Sophie was turned into an old woman by a witch's curse. Later, she met a wizard named Howl and got herself involved in his resistance fighting for his king who was at war with another kingdom. YY has also assembled a tank with simple written instructions (see Figure 3), created an aircraft carrier (see Figure 4A) and made a dog with given 10-step illustrations on an instruction sheet (see Figure 5) – all with Lego bricks

Fig 1: YY was creating his version of Howl's Moving Castle

Fig 2: A screenshot of Howl's Moving Castle

Fig 3: A tank (with given instruction)

Fig 4A: An aircraft carrier

Fig 5: A dog (with 10-step illustraions given)

[1] The actual name of YY 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 Malaysia in 2010 and in Singapore in 2014.

[2] Imaginational overexcitability refers to "a heightened play of the imagination with rich association of images and impressions" (Lind, n.d., para.9)[17].

Among YY's many creations, his aircraft carrier is the most interesting piece of work. Over a short period of time on the same day, he transformed his aircraft carrier (Figure 4B) into a tugboat (Figure 6), which resembles a tugboat shown in Figure 7. Later, he turned his tugboat into a factory building. All these creations were done by YY without looking at any pictures. These creations suggest that YY might possess some form of imaginational overexcitability, which is already described earlier and it can be "seen in spontaneous imagery as an expression of emotional tension" (Sampson, 2013, p.6) [16].

Fig 4B: YY's creation of an aircraft carrier

Fig 5: An aircraft carrier

Fig 6: A tugboat

Fig 7: A tugboat

In addition, YY also loves creating his cartoon characters with angry or sad faces on his clipboard easel (see Figure 8) and such an angry expression speaks very much of his frequent outbursts of frustration. Some of his drawings depict his past unpleasant experiences. Figure 9 shows YY's modified version of Mister Potato with an antenna from *Toy Story* movie

Fig 8: YY was creating his cartoon characters

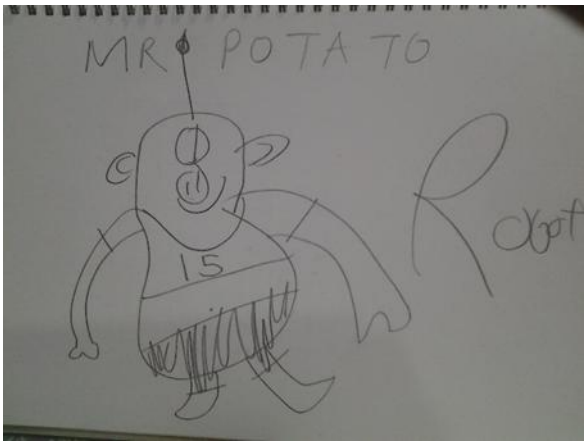

Fig 9: YY's modified version of Mister Potato with an antenna from *Toy Story* movie

Although YY is unable to articulate clearly what he is creating or drawing, he is able to utter one-syllabic to two-syllabic words mainly in naming the things he has created or drawn. As a result, YY's parents were keen to know if the boy might possess some hidden artistic talent that nobody was aware of and requested for a further investigation. A formal consent was obtained from YY's mother before we proceeded to do a

psycho-educational evaluation and diagnostic profiling of all the standardized tests that were previously administered on YY and some questionnaires were done with inputs from his parents.

3. Results from Assessments for Psycho-Educational Evaluation and Profiling

Three levels of psycho-educational evaluation and profiling (PEEP) of standardized assessment results are provided below.

3.1 Level 1 Psycho-Educational Evaluation and Profiling

At Level 1, the PEEP looks at the Broad Autistic Phenotypes based on the results gathered from the administration of selected assessment tools. At the time of carrying out this PEEP, we were unable to obtain the results from the Broad Autistic Phenotype Questionnaire (BAPQ) (Hurley et al., 2007) [18] – 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 – from YY's parents, who have the rights to decide if they want to submit the questionnaire for PEEP. Often these characteristics are milder but qualitatively similar to the defining features of autism. As a result, we did the Autistic Learning and Behavioral Difficulties Inventory (ALBDI) (Chia, Kee, Yusof, & Lim, 2015) [19].

3.1.1 Autistic Learning and Behavioral Difficulties Inventory (ALBDI) (Chia, Kee, Yusof, & Lim, 2015) [19]

This is a screening instrument to determine the areas of learning and behavioral difficulties that an individual with autism encounters in cognition, conation, affect and sensation. YY was then 11 years 9 months old. Table 1 shows the summary of the ALBDI results.

Table 1: ALBDI results

Rating Subscales For ALBDI	Subscale Scores	Probability of ASD
Cognitive Learning & Behavioral Difficulties	6/20	Low Probability
Conative Learning & Behavioral Difficulties	4/20	Low Probability
Affective Learning & Behavioral Difficulties	9/20	Average Probability
Sensory Learning & Behavioral Difficulties	3/20	Low Probability
Total ALBDI Score	22/80	Low Probability

The ALBDI results a low probability of issues relating to YY's autistic learning and behavioral difficulties except for the manifestation of his affective LBD. This means that YY displayed deficit in affective or emotional awareness. It is important to note that having emotional deficit does not mean the boy does not have emotions, but that he manifests difficulties in identifying different types of feelings, expressing feelings, recognizing facial cues in others, having limited understanding of what causes feelings, and displaying detached or tentative connections to others (Serani, 2014) [20] – typical of individuals with alexithymic symptoms that can co-exist with autism including Asperger Syndrome. In fact, alexithymia "represents a personality trait construct characterized primarily by difficulties in the capacity to identify and verbalize emotions" (Donges, Kersting, & Suslow, 2013, p.745) [21] and has been found to be associated with impaired interoception (i.e., the perception of the internal state of one's body) (Shah et al., 2016) [22].

3.2 Level 2 Psycho-Educational Evaluation and Profiling

At Level 2, the PEEP was carried out to identify the Autistic Endophenotypes, which are measurable components (e.g., neurophysiological, neurosensory, biochemical, neuroanatomical, cognitive or neuropsychological) that exist between the behavioral symptoms of a disease and distal genotype (Gottesman & Gould, 2003) [23]. YY's parents were able to provide us with the results of the relevant assessments already done. Several standardized assessments were done by different professionals separately on different days and weeks. We have compiled tables of results gathered from the different assessment reports.

3.2.1 Vineland Adaptive Behavior Scale-2nd Edition (VABS-II) (Sparrow, Cicchetti, & Balla, 2005) [24]

The VAB-II (Sparrow, Cicchetti, & Balla, 2005) [24] measures the personal and social skills of individuals from birth through adulthood. The term *adaptive behavior* refers to an individual's typical performance of the daily activities required for personal and social sufficiency. It was done with YY's parents when YY was 5 years 7 months old. The VABS-II results are tabulated in Table 2 below.

Table 2: VABS-II Results

Vabs-Ii Domains	Standard Scores (95% Confidence Level)	Percentile Rank	Adaptive Level
Communication	67±8	1	Low
Daily Living Skills	71±8	3	Moderately Low
Socialization	65±7	1	Low
Motor Skills (Est.)	94±12	34	Adequate
Adaptive Behavior Composite	71±5	3	Moderately Low

At 5 years 7months old, YY's overall adaptive behavior results show that he was functioning at moderately low level (3rd percentile rank) for his adaptive behavioral skills. His best performance could be seen in motor skills which has been rated at adequate adaptive level.

3.2.2 Learning, Executive, and Attention Functioning Scale (LEAF) (Kronenberger, Castellanos, & Pisoni, 2016) [25]

This assessment of level of functioning broadly measures neuropsychological abilities related to executive functioning and learning (Kronenberger, Castellanos, & Pisoni, 2016) [25]. YY was 11 years 9 months old when this test was done. The results are tabulated in Table 3 below. Words in red suggest YY did not meet the criteria for specific abilities (i.e., within the borderline problem range); the words in blue mean he did not show any problems in those specific abilities.

Table 3: LEAF Scale Results

Nos.	Subscales	Scores	Interpretation
Cognitive Learning			
1	Comprehension & Conceptual Learning	5	Borderline Problem Range
2	Factual Learning	5	Borderline Problem Range
Cognitive-Executive Functioning			
3	Attention	3	No Problem Range
4	Processing Speed	1	No Problem Range
5	Visual-Spatial Organization	0	No Problem Range
6	Sustained Sequential Processing	4	No Problem Range
7	Working Memory	6	Borderline Problem Range
8	Novel Problem Solving	6	Borderline Problem Range
Academic			
9	Mathematics Skills	4	No Problem Range
10	Basic Reading Skills	14	Problem Range
11	Written Expression Skills	15	Problem Range

In addition to displaying borderline problems in cognitive learning, working memory and novel problem solving, YY was found to exhibit serious problems in basic reading and written expression skills. He struggled in comprehension and conceptual learning, factual learning, working memory and novel problem solving. Obviously, YY's difficulties in both basic reading and written expression skills became a big issue in his language development and it is, no wonder, he always feels frustrated when he could not express his emotions or feelings to others so that they could understand him. As already mentioned earlier, this could be an explicit indication of alexithymic symptoms being present.

3.2.3 Wechsler Nonverbal Scale of Ability (WNV) (Wechsler & Naglieri, 2006) [26]

The WNV (Wechsler & Naglieri, 2006) [26] is a nonverbal measure of ability designed for culturally and linguistically diverse groups and those with low incidence disorders as well as for individuals who have other language considerations. The test was done at a public hospital when YY was 5 years 7 months old. His parents have kindly provided the results of the assessment report (see Table 4).

Table 4: WNV Results

WNV Subtests	T Score	Percentile Rank	Descriptor
Matrices	45	31	Below Average
Coding	16	<0.1	Far Below Average
Object Assembly	75	99	Superior
Recognition	34	5	Far Below Average
FSIQ	**Index**	**95% Confidence Level**	**Percentile Rank (Descriptor)**
	84	77-94	14 (Low Average)

The results show that while most of YY's WNV subtests scored in below and far below average ranges, his sterling performance in Object Assembly subtest with a T score of 75 and a percentile rank of 99 has put him in the superior range. This suggests YY has excellent visual-motor coordination, holistic visual integrative style of reasoning and excellent visual memory. In fact, YY was noted to be very good in completing jigsaw puzzles and the WNV results were a good indicator of that performance strength.

3.2.4 Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) (Wechsler, 2004) [27]

WISC-IV (Wechsler, 2004) [27] is designed to measure human intelligence as reflected in both verbal and nonverbal

(performance) abilities. The WISC-IV is used in schools as part of placement evaluations for programs for gifted children and for children who are developmentally disabled. In addition to its uses in intelligence assessment, the WISC-IV is used in neuropsychological evaluation, specifically with regard to brain dysfunction. Large differences in verbal and nonverbal intelligence may indicate specific types of brain damage.

The WISC-IV is also used for other diagnostic purposes. IQ scores reported by the WISC-IV can be used as part of the diagnostic criteria for intellectual and developmental disabilities and specific learning disabilities. The test may also serve to better evaluate children with attention-deficit/hyperactivity disorder (ADHD) and other behavior disorders.

The WISC-IV was administered on two days in February 2017 – as a follow-up to the previous WNV done in 2009. In this paper, we did a comparison of the results obtained from WISC-IV with the published findings from research in order to establish YY's autism spectrum disorder (ASD) profile. The main aim is to establish if YY has what it takes to identify him as displaying symptoms of autistic savant syndrome or autistic crypto-savant syndrome (Rimland, 1990). YY was 11 years 9 months old at the time when WISC-IV was administered.

Scores in blue mean YY has obtained better results above his mean score of 3.7. Scores in red mean YY has obtained poorer results below his mean score of 3.7. Table 5 shows the WISC-IV subtest scaled score results as well as the broad and narrow abilities, which are based on Cattell-Horn-Carroll (CHC) framework of intelligence (e.g., Gf stands for fluid reasoning, which involves the deliberate use of controlled mental operations in novel problem solving done in a flexible manner) associated with each of the WISC-IV subtests (see McGrew, 2005 [28], 2009 [29], for more detail).

Table 5: WISC-IV Results

Wisc Primary Indexes	Subtests	Chc Broad & Narrow Abilities	Scaled Scores	Child's Mean (3.7)
Vci = 53 (0.1 Percnetile Rank)	Si	Gc-Ld	4	Higher
	Vo	Gc-Vl	1	Lower
	Co	Gc-Ko(V)	1	Lower
	(In)	Gc-Ko(V)	(1)	Lower
	(Wr)	Gc-Vl	(1)	Lower
Pri = 86 (18 Percentile Rank)	Bd	Gv-Sr	12	Higher
	Pct	Gf-I	2	Lower
	Mr	Gf-I; Gf-Rg	9	Higher
	(Pcn)	Gc-Ko(Nv)	(6)	Higher
Wmi = 50 (<0.1 Percentile Rank)	Ds	Gsm-Mw; Gsm-Ms	1	Lower
	Lns	Gsm-Mw	1	Lower
	(Ar)	Gq-A3	(2)	Lower
Psi = 70 (2 Percentile Rank)	Cd	Gs-R9	6	Higher
	Ss	Gs-P	3	Lower
	(Ca)	Gs-P	(5)	Higher
Fsiq = 57 (0.2 Percentile Rank)	Na		Na	Na
Dumont-Willis Indexes	Sum of Subscale Scores		Quotients	
Gai	29		66	
Cpi	11		50	

The acronyms used in Table 5 for the WISC-IV subtests: SI stands for Similarities; VO stands for Vocabulary; CO stands for Comprehension; IN stands for Information; WR stands for Word Reasoning; BD stands for Block Design; PCt stands for Figure Concepts; MR stands for Matrix Reasoning; PCn stands for Figure Completion; DS stands for Digit Span; LNS stands for Letter-Number Sequencing; AR stands for Arithmetic; CD stands for Coding; SS stands for Symbol Search; and CA stands for Cancellation.

Similarly, the letter codes used in the CHC framework of broad and narrow abilities (e.g., Gc-KO represents crystallized intelligence for general/verbal information; Gc-VL represents crystallized intelligence for lexical knowledge; Gf-I represents inductive fluid reasoning; Gf-RG represents deductive fluid reasoning) are standard codes. It is not within the scope of this paper to delve into the CHC theory of cognitive abilities. Readers interested to know more may want to refer to McGrew (2005 [28], 2009 [29]) for more detail.

3.2.5 Test of Non-Verbal Intelligence-Third Edition (TONI-3) (Brown, Sherbenou, & Johnsen, 1997) [30]

The TONI-3 (Brown, Sherbenou, & Johnsen, 1997) [30] is an assessment of intelligence, aptitude, abstract reasoning, and problem solving. This language-free test is ideal for evaluating those with questionable or limited language ability. This test was done when YY was 11 years 9 months old (see Table 6 below).

Table 6: TONI-3 Results

TONI-3		
Raw Score	**Age-Equivalence**	**NVIQ**
22	10:09	98
Percentile Rank		45

According to Siegel (1996) [11], TONI-3 is administered "to provide the basis for separating many of the effects of mental retardation from autism spectrum disorder" (p.17). For a child with ASD, the NVIQ has to be above 80 in order to be considered non-impaired or without mental retardation. By using this level of NVIQ of 98 or equivalent non-verbal mental age of 10 years 9 months as a baseline, we are essentially asking "How does YY's behavior in each autistic symptom area compare to what he should typically be able to do at this mental age?"

3.2.6 Sensory Profile (SP) (Dunn, 1999) [31]

The aim of this profile is to ascertain if YY has any sensory-related processing problem that could have interfered with his thinking/learning. YY's parents were the respondents to this questionnaire. Scores and words in red depict sensory problems while scores and words in blue mean typical of a normal individual with no sensory issues (see Table 7 below for the results). YY was then 7 years 10 months old.

Table 7: SP Results

Section On Processing	**Score**	**Max**	**Descriptor**
A. Auditory Processing	40	40	Typical
B. Visual Processing	44	45	Typical
C. Vestibular Processing	48	55	Typical
D. Touch/Haptic Processing	84	90	Typical
E. Multisensory Processing	22	35	Definite
F. Oral Sensory Processing	41	60	Probable
G. Sensory Processing Related To Endurance/Tone	43	45	Typical
H. Modulation Related To Body Position & Movement	39	50	Probable
I. Modulation Of Movement Affecting Activity Level	20	35	Probable
J. Modulation Of Sensory Input Affecting Emotional Responses	17	20	Typical
K. Modulation Of Visual Input Affecting Emotional Responses & Activity Level	15	20	Typical
L. Emotional/Social Responses	55	85	Probable
M. Behavioral Outcomes Of Sensory Processing	16	30	Typical
N. Items Indicating Thresholds For Response	12	15	Typical
Sensory Factors	**Score**	**Max**	**Descriptor**
1. Sensory Seeking	60	85	Probable
2. Emotionally Reactive	51	80	Probable
3. Low Endurance/Tone	43	45	Typical
4. Oral Sensory Sensitivity	33	45	Typical
5. Inattention/Distractibility	27	35	Typical
6. Poor Registration	33	40	Typical
7. Sensory Sensitivity	20	20	Typical
8. Sedentary	10	20	Probable
9. Fine Motor/Perceptual	7	15	Definite
Short Sensory Profile: Quadrants	**Score**	**Max**	**Descriptor**
1. Tactile Sensitivity	34	35	Typical
2. Taste/Smell Sensitivity	9	20	Definite
3. Movement Sensitivity	15	15	Typical
4. Under-Responsive/Seeks Sensation	24	35	Probable
5. Auditory Filtering	26	30	Typical
6. Low Energy/Weak	30	30	Typical
7. Visual/Auditory Sensitivity	23	25	Typical
8. Total	161	190	Typical

From Table 7, the results suggest that YY had difficulties coping with multisensory processing with a strong preference for visual rather than auditory stimuli. YY was also quite sensitive to taste and smell. He also showed a definite problem in his fine motor/perceptual sensory factor.

According to the study done by Bennett and Heaton (2017), autistic savants displayed a typical Short Sensory Profile with definite problem in tactile/haptic processing and under-responsivity or seeking/seeker type, and probable problems in taste/smell (gustatory-olfactory) processing, movement/motor processing and visual/auditory processing. However, findings in Bennett-Heaton study show that non-savants with ASD exhibited definite problem in Short Sensory Profile as well as in tactile/haptic processing, movement/motor processing, visual/auditory processing and under-responsivity or seeking/seeker type, but only probable problem in taste/smell (gustatory-olfactory) processing.

YY's sensory profile did not match exactly that of autistic savant or non-savant with ASD noted in the findings of Bennett and Heaton (2017) except for movement/motor processing and under-responsivity or seeking/seeker type (see Table 8 below).

Table 8: SP and CSP-2 Results

Autistic Savant identification via Sensory Factors (Bennett & Heaton, 2017) [32]		**YY's results of SP and CSP-2**	
Autistic Savant	**Non-Savant with ASD**	**SP Results**	**Child SP-2 Results**
Short SP total = Typical	Short SP total = Definite	Typical	Not Applicable
Tactile/Haptic Processing = Definite	Tactile/Haptic Processing = Definite	Typical	More than other
Taste/Smell (Olfactory-Gustatory Processing = Probable	Taste/Smell (Olfactory-Gustatory Processing = Probable	Definite	Not Applicable
Movement/Motor Processing = Probable	Movement/Motor Processing = Definite	Probable	More than other
Under-Responsivity or Seeking/Seeker = Definite	Under-Responsivity or Seeking/Seeker = Definite	Probable	Much more than others
Visual/Auditory Processing = Probable	Visual/Auditory Processing = Definite	Typical	Just like the majority of others

3.2.7 Child Sensory Profile-Second Edition (CSP-2) (Dunn, 2014) [33]

The aim of this Sensory Profile-2 (or Child Sensory Profile-Second Edition) (Dunn, 2014) [33] is to find out YY's sensory perceptual motor registration, modulation, integration and response. In this profiling, the caregiver questionnaire was used with YY's parents as respondents to complete CSP-2 as they wanted to find out the child's sensory problems in order to know how best to manage or cope with his challenging behavior. YY was 11 years 9 months old at the time of CSP-2 administration. Tables 9, 10 and 11 below show the CSP-2 results.

Table 9: CSP-2 Sensory Quadrant Results

Sensory Quadrants	**Raw Scores**	**Descriptors**	**Comments**
Seeking (Seeker)	Father: 64/95 Mother: 40/95	Father: Much More Than Others (81-100%) Mother: Normal	According to Father's score, the child showed much more than others (81-100%) in the sensory seeking/seeker profile. In other words, YY displayed hyposensitivity more than others in his peer group and so he seeks sensory input at a higher rate than others.
Avoiding (Avoider)	Father: 45/100 Mother: 37/100	Father: Normal Mother: Normal	Normal sensory avoidance profile.
Sensitivity (Sensor)	Father: 44/95 Mother: 39/95	Father: More Than Others (61-80%) Mother: Normal	According to Father's score, the child showed more than others (61-80%) in the sensory sensitivity profile. In other words, YY detected/noticed sensory input at a higher rate than others in his peer group.
Registration (Bystander)	Father: 36/110 Mother: 33/110	Father: Normal Mother: Normal	Normal sensory registration profile.

This section of the CSP-2 provides the Quadrant Grid: Seeking/Seeker, Avoiding/Avoider, Sensitivity/Sensor and Registration/Bystander. It concerns the degree to which YY is bothered by sensory input. In this case, for his sensory profile, YY has a Much More Than Others score in the Seeking/Seeker pattern at a higher rate (81-100%) than others and a More Than Others score in the Sensitivity/Sensor pattern at a higher rate (61-80%) than others. As a result of his hyposensitivity, he tends to seek out additional stimulation from his environment in order to have a sense of what is happening in the world around him.

Table 10: CPS-2 Sensory Section Results

Sensory Sections	Raw Score	Descriptor	Comments
Auditory Processing	Father: 13/40 Moher 10/40	Father: Normal Mother: Normal	Just like the majority of others
Visual Processing	Father: 7/30 Mother: 1/30	Father: Normal Mother: Normal	Just like the majority of others
Touch/Haptic Processing	Father: 26/55 Mother: 19/55	Father: More Than Others (61-80%) Mother: Normal	According to Father's score, YY with a More Than Others score displayed problems in his touch or haptic processing at a higher rate (61-80%) than others. He has no problem to touch the things around him but not when he is touched (by others).
Movement/Motor Processing	Father: 20/40 Mother: 12/40	Father: More Than Others (61-80%) Mother: Normal	According to Father's score, YY with a More Than Others score displayed problems in his movement/motor processing at a higher rate (61-80%) than others. In other words, he probably performs poorly in physical education and sports.
Body Position or Proprioceptive Processing	Father: 12/40 Mother: 8/40	Father: Normal Mother: Normal	Just like the majority of others
Oral Sensory Processing	Father: 37/50 Mother: 34/50	Father: Much More Than Others (81-100%) Mother: Much More Than Others (81-100%)	This is the only sensory section that both parents share the same concern (81-100%) for YY. There are two important aspects of oral sensory processing that need to be addressed. First, there is a need to work on YY's oral sensory motor skills, i.e., awareness of his jaws and jaw movement, tongue and lips, in order to develop his speech. Second, there is also a need to take a look at his oral-gustatory preference. It is important to take note of the kind of food YY prefers to eat and there should be a mixture of different food texture and hardness.

According to YY's Father, the boy displayed problems in oral-motor and hapto-motor processing and coordination and would choose to seek or sense tasks involving touch and movement that he prefers. Both parents share the same concern regarding YY's oral sensitivity which is affecting the development of his oral sensory motor skills and his gustatory preference for certain food based on sensory hardness and fracturability (e.g., cereal-based food) as well as taste/fragrance. The hardness of food plays an important role in the selection and ingestion of food and it could be a conditioned stimulus for conditioned food aversion (Food Sciences Blog, 2014) [34]. Among the most important *organoleptic* (related to stimulation of sense organs) properties, a food's mouthfeel is probably the least understood and most neglected by food developers.

Table 11: CSP-2 Behavioral Section Results

Behavioral Sections	Raw Score	Descriptor	Comments
Conduct	Father: 21/45 Mother: 28/45	Father: Normal Mother: More Than Others (61-80%)	YY's Mother expressed more of her concern for his conduct.
Social Emotional	Father: 29/70 Mother: 25/70	Father: Normal Mother: Normal	Just like the majority of others.
Attentional	Father: 22/50 Mother: 12/50	Father: Normal Mother: Normal	Just like the majority of others

The above results in Table 10 suggest that YY displayed problems relating to his conduct in terms of completing given hands-on activities, stubbornness and temper tantrum. It is important to take note that temper tantrum is not the same thing as meltdown. A meltdown is an extreme emotional/behavioral response to stress or overstimulation and it is an uncontrolled reaction to overwhelming stress. It is triggered by a fight, flight or freeze response to a stimulus. Unlike meltdowns, temper tantrums are goal-directed behavior intended to manipulate another individual into doing something. They involve premeditation and planning to achieve an outcome.

The results of YY's sensory profile suggest that of a seeker/sensor (from Father's scores) with conduct issues relating to hands-on tasks (e.g., coloring, writing or drawing), stubbornness and temper tantrum (from Mother's score), which certainly requires some kind of behavior management. It is important to note that the validity of the results in CSP-2 relies heavily on the accuracy and honesty of the caregiver(s) who answered the questionnaire. The CSP-2 results have to be triangulated with results obtained from other standardized Psycho-educational assessments in order to pinpoint the child's main issues of concern.

3.3 Level 3 Psycho-Educational Evaluation and Profiling

At Level 3, the PEEP focuses on Autistic Spectrum Conditions. The Autistic spectrum conditions (ASCs) are common pervasive neuro-developmental conditions which

typically pre-set in early childhood and manifest with characteristic impairments in communication and social relationships, alongside unusually repetitive behaviors and restricted interests.

3.3.1 Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) (Lord et al., 2012) [35]

The ADOS-2 (Lord et al., 2012) [35] is an observational assessment of Autism Spectrum Disorders (ASDs). The ADOS-2 is a semi-structured, standardized assessment of communication, social interaction, play, and restricted and repetitive behaviors. It presents various activities that elicit behaviors directly related to a diagnosis of ASD. By observing and coding these behaviors, the information obtained can be used to inform diagnosis, and for treatment planning and educational placement. ADOS-2 Module 2 has been selected for administration with YY, who was then 11 years 9 months old. Table 12 below is a summary of the ADOS-2 Module 2 results.

Table 12: ADOS-2 Module 2 Results

Autistic Spectrum Conditions	**Algorithm Scores**	**Sub-Total Scores**
Social Affect		
1. Communication	2	12
2. Reciprocal Social Interaction	10	
Restricted & Repetitive Behavior	**Algorithm Score**	**Sub-Total Score**
3. Restricted & Repetitive Behavior	4	4
Overall Score	16	16
ADOS-2 Classification/Diagnosis	Autism	
ADOS-2 Comparison Score	7	
Level of AS-related symptoms associated with this Comparison Score	Moderate	

When comparing YY's ADOS-2 results with the findings in the study done by Bennett and Heaton (2017) [32], he met all except the last item on Imagination/Creativity (see Table 13).

Table 13: ADOS Results

Autistic Savant identification via ADOS (Bennett & Heaton, 2017) [32]		**YY's ADOS Results**
Autistic Savant	**Non-Savant with ASD**	
Total = 8-9 Autism cut-off = 10; ASD = 7	Total = 6-7 Autism cut-off = 10; ASD = 7	Total = 16 ADOS-2 Classification: Autism Level of Severity: Moderate
Communication = 2-3 Autism cut-off = 4; ASD = 2	Communication = 2 Autism cut-off = 4; ASD = 2	Communication = 2
Reciprocal Social Interaction = 6 Autism cut-off = 6; ASD = 4	Reciprocal Social Interaction = 4-5 Autism cut-off = 6; ASD = 4	Reciprocal Social Interaction =10
Stereotyped Behaviors & Restricted Interests = 1	Stereotyped Behaviors & Restricted Interests = 1	Stereotyped Behaviors & Restricted Interests = 4
Imagination/Creativity = 0.4-0.5	Imagination/Creativity = 0.9-1.0	Not Applicable

4. Discussion

Level 1 PEEP: Autistic Learning and Behavioral Difficulties

YY's ALBDI scores suggest that the boy has a low probability of overall issues relating to autistic learning and behavioral difficulties except for the average probability in the manifestation of his affective (9/20) learning and behavioral difficulties (e.g., unexplained sudden emotional outbursts, meltdowns and/or temper tantrums). In other words, poor affect (or affective state) influences the boy's social cognition, which concerns how one processes social information, especially its encoding, storage, retrieval and application to social situations. According to affect heuristics, YY reflects a tendency to rely on automatically occurring affective responses to visual/auditory stimuli to guide his judgment of them. In other words, every visual/auditory stimulus can evoke an affective evaluation (Kahneman, 2003, 2011) [36]. Figure 1 shows the relationship between cognition and affect via social cognition; between cognition and conation via volitional conation, i.e., free will or freedom of choice; and between conation and affect via socio-emotional behavior (Huitt, 1999) [37].

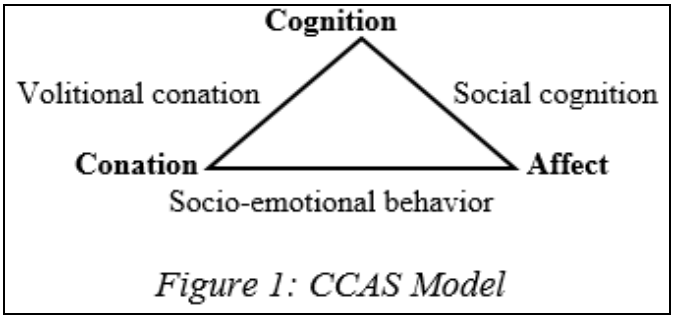

Figure 1: CCAS Model

Level 2 PEEP: Autistic Endophenotype

At Level 2, given that YY at the age of 5 years 7 months has been diagnosed with autism (with WNV FSIQ of 84) previously at the National University Hospital in 2009, YY's current WISC-IV results show that all his indexes except PRI fall below the normative IQ range between 85-115 suggesting normative weakness for VCI, WMI and PSI. His PRI is just within the normative IQ range at the lower normative level.

The VABS-II results show that, at the age of 5 years 7 months, YY displayed moderately low level of adaptive functioning in terms of communication (Standard score=67±8), daily living skills (Standard score=71±8) and socialization (Standard score=65±7). His performance in motor skills (Standard score=94±12) was adequate at that time of assessment. Although children with a primary diagnosis of autism may also have intellectual disability (ID), children with a primary diagnosis of ID may manifest symptoms of autism because of their cognitive delay, without having the full autism phenotype. Moreover, symptomatological overlap of autism and ID can be significant making diagnosis for autism/ASD complicated. For example, delays in verbal communication and symbolic play as well as repetitive behaviors (Vig & Jedrysek, 1999) [38] are associated with autism and ID and so cannot inform the differential diagnosis (Pennington, McGrath, & Peterson, 2009) [39]. The most reliable symptoms for differentiating between autism/ASD and ID in clinical diagnosis are in the socialization (social cognition) domain. YY scored lowest on VABS-II socialization domain. Because social interaction skills emerge early in development, they can be assessed even in children with delayed development. Children with autism/ASD are more likely to manifest impairments in social skills (e.g., imitation, joint attention, and eye gaze modulation (Vig & Jedrysek, 1999) [38]. For this reason, best-practice parameters recommended for autism/ASD assessment should include an assessment of cognitive ability (TONI-3 was used in administration to determine YY's non-verbal cognitive ability), so that behavioral symptoms can be interpreted within the context of the child's developmental level (Ozonoff, Goodlin-Jones, & Solomon, 2005) [40].

YY's LEAF Scale results suggest that YY is having severe academic problems especially in basic reading and written expression skills. He struggles with cognitive learning, which includes comprehension, conceptual learning and factual learning, and in cognitive-executive functioning, especially the working memory and novel problem solving. His WISC-IV results confirm these findings. Executive functioning skills are highly related to adaptive behavioral domain in individuals with ASD (Gilotty et al., 2002) [41].

YY's TONI-3 results show that the child has no mental retardation despite his language impairment and poor memory ability. With NVIQ of 98 (or equivalent non-verbal mental age of 10 years 9 months) as a baseline, it is easier for educational therapists to intervene by comparing YY's behavior in each autistic symptom area to what he should typically be able to do at this non-verbal mental age of 10 years 9 months.

His WISC-IV results are also indicative of autism according to the autism/ASD profiles as shown in both his unitary/interpretable VCI (53) and non-unitary/non-interpretable PRI (86) subtest scores. His non-unitary/non-interpretable FSIQ of 57 (mildly intellectually impaired; WISC-IV) below the cut-off FSIQ of 80 suggests that he has Low-Functioning Autism (LFA) and even lower than the cut-off FSIQ of 60 indicating that he displayed ASD-L (ASD with Language Impairment) (Raiford, Drozdick, & Zhang, 2015) [42], but ASD-ADHD has to be ruled out since the LEAF Scale results do not indicate any problem in his attention in the cognitive-executive functioning. His VCI < PRI with a difference of 33 points (above the cut-off difference of 23 allowed in WISC-IV scoring and interpretation; and hence, the need to determine his GAI since FSIQ would be non-interpretable because the wide VCI-PRI discrepancy; see Klin et al., 1995 [43]) is typical of an individual with autism/ASD with suspected unusually large or uncommon personal strength/key asset or unusually large or uncommon personal weakness/high-priority concern. In most autistic cases, PSI < WMI but in YY's profile, his unitary/interpretable WMI of 50 (mildly intellectually impaired; WISC-IV) < unitary/interpretable PSI of 70 (borderline deficient; WISC-IV). This pattern suggests that YY can process information better than his memory recall.

In the computation of YY's non-interpretable FSIQ, low standard scores in unitary/interpretable WMI and unitary/interpretable PSI are included and that explains his suppressed intellectual capacity. Hence, GAI would be a good index to gauge YY's intellectual ability. However, VCI is unitary/interpretable but, because PRI is non-unitary & non-interpretable, GAI, if computed, is also non-interpretable. As a result, clinical judgment is needed since both FSIQ & GAI are non-interpretable. That means the need for the clinical/educational diagnostician to decide on which index – FSIQ or GAI – should be used to explain most sensibly about YY's intellectual ability. When his non-interpretable GAI (general cognitive capacity) of 66 is taken into consideration, without WMI and PSI scores taken into computation, YY shows a better intellectual ability. This is indicative of his hidden cognitive capacity described as being cryptic. His subscale scores in BD and Coding subtests are above their respective narrow ranges of mean scores for individuals with ASD (described in the WISC-IV examiner's manual). The other MR, PCn and Cancel subtests are found to be within their respective narrow ranges of mean scores for individuals with ASD. The subscale scores of the remaining subtests are found to be below their respective narrow ranges of mean scores for individuals with ASD.

In addition, we have to examine YY's unusually large or uncommon personal strength in PRI with a difference 21, above the cut-off score of 13.5 at. 10base rate, indicating his key asset; and a large or uncommon personal weakness found in his WMI with a difference of 15 exactly at the cut-off of 15.0 at. 10base rate, indicating a high-priority concern for his memory deficit, especially working memory, which is also

found to be in the borderline problem range in the LEAF Scale.

According to the CHC Classification of Broad and Narrow Abilities for the WISC-IV subtests, YY performed better in the following broad and narrow abilities when relating to his personal mean subtest scaled score of 3.7: Gc-LD (spoken to), Gc-KO(nv), Gf-I, Gf-RG, Gs-P, Gs-R9 and Gv-SR indicative of his personal strength in fluid reasoning, visual [non-verbal/nv] processing and [visual] processing speed. He performed very poorly in the following broad and narrow abilities, i.e., Gc-KO, Gc-VL, Gq-A3, Gs-P, Gsm-MS and Gsm-MW that are indicative of his personal weakness in comprehension knowledge, quantitative knowledge, working memory [short-term memory] and [auditory] processing speed (see McGrew, 2005 [28], 2009 [29], for detail on interpretation).

When examining further using the CHC clinical clusters, we found that YY's Gf, Gv and Gf-nv are above his personal index mean and better than the other clinical clusters Gf-v, Gc-VL, Gc-KO, Gc-ltm and Gc-sm. He has good fluid reasoning, especially non-verbal fluid reasoning through visual processing that is better than his verbal fluid reasoning, which is very poor because of his extremely poor verbal ability, i.e., poor Gc-VL and Gc-KO, and these are also confirmed by his poor oral sensory processing scored on the CSP-2; and extremely poor memory and processing speed, i.e., Gc-ltm and Gc-sm. His poor Gf-v, Gc-VL, Gc-KO, Gc-ltm and Gc-sm that are holding him back in expressing his thoughts and feelings, and as such, they will cause him to behave inappropriately and/or feel frustrated.

The WISC-IV results also suggest YY displays symptoms typical of LFA except for BD and Coding subtests and his better performance in these two subtests suggests that YY has some hidden or cryptic abilities especially in visual-motor-spatial coordination and nonverbal reasoning as well as visual-motor dexterity and learning from visual-kinesthetic stimuli.

Level 3 PEEP: Autism Spectrum Conditions

At Level 3, the ADOS-2 Module 2 results suggest that YY has moderate autism with ADOS-2 comparison score of 7 (a total algorithm score of 16). His algorithm score for Communication is 2 (ASD cut-off score = 2, while Autism cut-off score = 4); for Reciprocal Social Interaction is 10 (Autism cut-off score = 6 while ASD cut-off score = 4); and for Stereotyped Behaviors & Restricted Interests is 4 (for both Autism and ASD cut-off score = 1). Hence, YY is more in the ADOS-2 category of the classical autistic disorder or simply, autism, than in the ADOS-2 category of ASD.

5. Conclusion

In order to arrive at our conclusion if YY is indeed an autistic crypto-savant, we have set several guiding questions for ourselves to answer.

Our first question is: *Is YY autistic?*

The results gathered from the battery of assessments administered suggest that YY has the classical Autistic Disorder (or simply known as Autism) (refer to the ADOS-2 results). His current autism profile identifies him as having Moderate Autism (refer to the ADOS-2 results).

YY's WISC-IV results are compared with the samples of prototypical autism with ID and the prototypical autism without ID provided by Saulnier and Ventola (2012) [44] (see Table 14). The term sample is used to reiterate that even within prototypical cases, there is always individual variation – there are no norms to represent a collective whole.

Table 14: Comparison of YY's WISC-IV Results with Prototypical Autism with/without Intellectual Disability (ID) WISC-IV Profile (Saulnier & Ventola, 2012) [44]

YY's Moderate Autism WISC-IV Profile	Prototypical Autism with ID WISC-IV Profile	Prototypical Autism without ID WISC-IV Profile
VCI ▪ Sim (4) ▪ Vocab (1) ▪ Comp (1) ▪ Info (1)	**VCI** ▪ Sim (3) ▪ Vocab (2) ▪ Comp (1) ▪ Info (5)	**VCI** ▪ Sim (12) ▪ Vocab (10) ▪ Comp (7) ▪ Info (13)
PRI ▪ BD (12) ▪ PCpt (2) ▪ MR (9) ▪ PCpn (6)	**PRI** ▪ BD (6) ▪ PCpt (5) ▪ MR (8) ▪ PCpn (--)	**PRI** ▪ BD (13) ▪ PCpt (12) ▪ MR (16) ▪ PCpn (--)
WMI ▪ DS (1) ▪ LNS (1) ▪ Arith (2)	**WMI** ▪ DS (3) ▪ LNS (--) ▪ Arith (2)	**WMI** ▪ DS (10) ▪ LNS (8) ▪ Arith (10)
PSI ▪ Cod (6) ▪ SS (3) ▪ Cancel (5)	**PSI** ▪ Cod (1) ▪ SS (2) ▪ Cancel (5)	**PSI** ▪ Cod (6) ▪ SS (9) ▪ Cancel (12)

Our second question is: *How do we differentiate YY's condition between autism and intellectual disability (ID)?*

In differentiating autism from ID, YY scored lowest in his performance on the domain of socialization on VABS-II at the preschool age (5 years 7 months), which is the most reliable symptom to identify Autism from ID. Overall results from VABS-II (see Table 2) show that YY's adaptive functioning was moderately low at the standard score of 71±5 (3 percentile rank) lagging behind his FSIQ of 84 (14 percentile rank) on WNV (see Table 4), TONI-3 NVIQ of 98 (45 percentile rank) (see Table 6) and PRI of 86 (18 percentile rank) (see Table 5), observed in many children with autism, but ahead of VCI of 53 (0.1 percentile rank), WMI of 50 (<0.1 percentile rank) and FSIQ of 57 (0.2 percentile rank) (see Table 5).

However, there is disconnect between YY's IQ and his adaptive skills. This may be frustrating for those with autism

whose IQ scores are much higher but their adaptive functioning (as in YY's case) is similar to those with mild to moderate ID (Duncan & Bishop, 2015) [45]. As a result, this group of autistic individuals with higher IQ scores but poor adaptive functioning will find it hard to hold down a job and function normally or appropriately enough to be accepted by their workplace peers (Gerhardt, 2014) [46] or even by the community where they live.

Our third question is: How can we be sure that YY is or isn't mentally retarded/impaired*?*

YY's NVIQ of 98 provides "the basis for separating many of the effects of mental retardation from autism spectrum disorder" (Siegel, 1996, p.17) [11]. In other words, the NVIQ or equivalent non-verbal mental age of 10 years 9 months indicates that YY has no mental retardation/impairment (refer to the TONI-3 results).

Our fourth question is: Is YY a high-functioning or low-functioning autistic?

YY's WISC-IV results suggest that the boy has Low-Functioning Autism (Siegel, 1996) [11] (also refer to the WISC-IV results) and it has been noted in the LEAF Scale scores showing YY's problems in his cognitive learning and executive functioning and academic performance, but not so in his attention.

Our fifth question is: Does YY have language impairment?

His WISC-IV and CSP-2 results also point to his language impairment (with definite oral sensory processing challenges) indicating that YY has Autism with Language Impairment (Raiford et al., 2015) [42]. His poor VCI score, which is also > PRI score (Klin et al., 1995) [43], in the range of mild mental retardation, is also indicative of his poor verbal development, especially in his language, which is affecting his basic reading and written expression skills, as shown in the results of his LEAF Scale.

Our sixth question is: Which is YY's weakest area in terms of his cognition?

YY's WISC-IV results point to his significant weakness in WMI and suggesting that it is of high-priority concern. Children with autism are often characterized by relatively poor memory for complex visual and verbal information and spatial working memory with relatively intact associative learning ability, verbal working memory, and recognition memory (Williams, Goldstein, & Minshew, 2006) [47]. It has been observed during the WISC-IV administration that YY followed rigidly a certain pattern of completing each of the given task in a systematic order on these following subtests: Coding, Symbol Search and Cancellation.

Our seventh question is: Is YY autistic savant or autistic without savantism?

YY's WISC-IV results do not suggest that his profile falls into either of the category of Autistic Savantism or the High-Functioning Autism without Savantism.

Our eighth question is: Can YY be an autistic crypto-savant?

Because of YY's hidden unusually or uncommon personal strength amidst his personal weaknesses, his autistic spectrum condition can be described as cryptic. Rimland (1990) [14] has defined autistic crypto-savants by referring to "autistic individuals who, because of inability to communicate, or unwillingness to communicate, has savant skills which are hidden, or secret, and unknown to those around them, including their parents and teachers" (p.3). In other words, the term *Autistic Crypto-Savantism* (Rimland, 1990) [14] can be used here to describe YY.

In regards to the definition of autistic crypto-savantism, we feel the term needs a fine tuning to include non-impaired NVIQ $\geq$ 85 (the normative ran ge of WISC-IV indexes is between 85 and 115. Anything below 85 is considered weak or poor and anything above 115 is considered strong or good) despite inadequate adaptive functioning skills, especially in communication, and socialization is the worst because of autism. We propose a re-definition of an autistic crypto-savant as "a low-functioning autistic individual with poor adaptive functioning ability, especially with little or no ability to communicate, but a non-impaired non-verbal intelligence quotient (NVIQ), and possesses certain savant skills that are hidden from or unknown to those around" (Lim & Chia, 2017) [48].

Our ninth question is: What is the final diagnosis for YY's condition?

In our joint concluding comment, YY is identified as a moderate low-functioning autistic crypto-savant with language impairment, especially in his poor oral sensory processing. Hence, YY is unable to engage in conversation with others.

Our last question is: What more could have been done in the diagnosis of YY's condition*?*

From our face-to-face encounters with YY during our observation and assessment, we noticed the boy did display emotions and feel empathy. However, because of his lack of verbal ability to express emotions (characterized by difficulties identifying and describing his own emotions from internal bodily sensations due to his impaired interoception[3]) as a result of language impairment (with manifestation of alexithymic symptoms), he could become easily frustrated when nobody understands him.

We recommend that some kind of alexithymia screening test such as the Children's Alexithymia Measure (Way et al., 2010) [50] be done so that an appropriate treatment can be provided to raise YY's emotional awareness to cope with his emotional frustration and reduce his inappropriate behavioral outbursts. With the emotional problems under control, it would be easier for YY's teachers to work with him in class and make learning meaningful to him.

[3] Interoception refers to the perception of a diversity of physical states beyond emotions, and that includes heart rate, respiratory effort, temperature, fatigue, hunger, thirst, satiety, muscle ache, pain and itch (Brewer, Cook, & Bird, 2016[49]; Rimland, 1990, para.1) [14].

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