

Neuropsychological Assessment of Children with Attention Deficit Hyperactivity Disorder

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ABSTRACT: *The purpose of the present study was to find out the differences in the cognitive performance of children with ADHD. Barkley (1997) suggested that children with ADHD involve problems with inhibition and self control which is associated with poor executive function. In order to be sensitive to the cognitive problems that some children with ADHD have, Cognitive Assessment System (CAS) and Standard Progressive Matrices were administered on four children diagnosed with ADHD. present case studies would help in understanding the: 1) neuropsychological aspect of ADHD in children; 2) utility of CAS in diagnosis of ADHD subtypes; 3) ADHD and IQ are directly related to poor academic performance of children with ADHD. Individual case profile was prepared for data analysis using case study method. The results of the current study demonstrated that children with ADHD displayed impaired performance on all the four scales of Cognitive Assessment System. The results of the current study suggest that CAS scores on different scales may help clinicians to identify those adolescents who have cognitive processing deficits. Feedback on CAS scores on different scales may help teachers to identify the areas where improvement and further help is required. The study opens avenues for future research in the area of cognitive processing.*

I. INTRODUCTION:

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most prevalent neurobehavioral conditions of childhood, affecting a substantial proportion of the population. The available literature suggests that neuropsychological assessment provides information that can potentially reduce risks for poor outcomes and improve quality of life among children with ADHD (Pritchard AE 2012). Controlled studies directly examining the impact of neuropsychological assessments in improving outcomes among children with ADHD are needed.

According to Dr B K Rao, Chairman, ASSOCHAM Health Council (2011) prevalence of children diagnosed with ADHD has gone up from four per cent to 11 per cent in the past six years in India. More boys are affected by ADHD than girls. A growing body of evidence supports a model in which multiple genetic and environmental factors interact during early development to create a neurobiological susceptibility to the disorder; the expression of which is mediated by alterations within different and diverse neural networks and deficits in the neuropsychological functions that these sub serve. Individuals with ADHD present difficulties in several domains of attentional and cognitive functions: problem solving, planning, orienting, alerting, cognitive flexibility, sustained attention, response inhibition, and working memory.

Increasingly, neuropsychologists must justify the necessity of often costly and time-consuming neuropsychological assessments in the diagnosis and treatment of common childhood disorders, such as Attention-deficit/Hyperactivity Disorder (ADHD). (Pritchard AE, Nigro CA, Jacobson LA, Mahone EM.(2012). Cognitive Assessment System which utilizes the PASS theory of intelligence, loads heavily on those areas of functioning that are most affected by ADHD. ((Naglieri & DAS, 1997)) There are four basic cognitive processes that the CAS examines: Planning is a cognitive process that provides cognitive control, use of knowledge, intentionality, and self-regulation. Planning is critical to all activities where the person has to determine how to solve a problem, which includes self-monitoring and impulse control as well as generation Successive Processing is a cognitive process used when stimuli are arranged in a specific serial order to form a chain-like progression., evaluation, and execution of strategies for problem solving. Attention is a cognitive process that provides focused, selective cognitive activity over time and resistance to distraction. Attention is involved when a person selectively focuses on particular stimuli and inhibits responses to competing stimuli. Simultaneous Processing is a cognitive process used to integrate stimuli into groups.

Methodology and Procedure

The sample consisted of children diagnosed as having ADHD by Psychiatrist in Allahabad. The sample consisted of 3 males and 1 female. The sample size was based on the availability of children having ADHD.

Tools Used

Two tests were administered on each child separately, namely Cognitive Assessment System (CAS) and Standard Progressive Matrices (SPM)

1. Cognitive Assessment System (CAS)
2. Standard Progressive Matrices (SPM)

Description of Cognitive Assessment System (CAS)

Rationale: Cognitive Assessment System (CAS) was administered to examine the cognitive profile of the individual with ADHD.

CAS is based on the PASS model of cognitive processing, which was initially described as an information processing model by Luria (1973). Das, Naglieri and Kirby (1994) conceptualized the PASS model as a new approach to the assessment of cognitive processes i.e., planning, attention, simultaneous and successive processing.

CAS is organized into 4 different scales with subtests in each of the four scales. Each scale has a normative mean of 100 and SD of 15. The test is both reliable and valid for children. The Full-scale reliability ranged from .85 to .90 (mean = .87) and the average reliability for the Basic battery scales was .85 (planning), .84 (attention), .90 (simultaneous), and .90 (successive). PASS scales has been used to assess those with attention deficit, mental retardation, learning disabilities, or traumatic brain injury. For scoring CAS each subtest obtained a raw score, which were converted to scaled scores and further a total scaled score is obtained for each of the 4 scales. Standard scores were further obtained for each scale and the percentile rank at which the standard score falls.

Description of Standard Progressive Matrices (SPM)

Rationale: The test was administered with the purpose of assessing the intellectual functions of the children having ADHD.

Standard Progressive Matrices was published in 1938 by J.C.Raven. Raven's SPM is a test of observation skills and clear-thinking ability. It offers insight about someone's capacity to observe, solve problems, and learn. SPM was designed to cover the widest possible range of mental ability and to be equally useful with persons of all age whatever their education, nationality or physical condition.

The scale consists of 60 problems divided into five sets of 12. In each set the first problem is as possible self evident. The problems that follow become progressively more difficult. All the subjects, whatever their age, are given exactly the same series of problems in the same order and asked to work at their own speed, without interruption, from the beginning to the end of the scale. A person's total score provides the index of intellectual capacity.

Both the tests were administered simultaneously by the researcher. In order to establish rapport with the children having ADHD and for the smooth functioning of the test the child was made to sit comfortably. The purpose and procedure of administering the tests was explained. The test was administered when condition was feasible for proper test behavior. The instruction for each test was given accordingly and the tests were completed.

Note: Names of children with ADHD have been changed.

Findings and Interpretation

Case I

Ayush Kesarwani was a 14 year old boy who was brought to the clinic by her mother after he had problems in adjustment in school and at home along with poor academic performance. The child has been visiting the clinic for a year. He was the student of class 8th. He belonged to lower economic status with his father the only bread winner in the family with the salary of 4500 per month. He lived in a nuclear family and had only one younger sister. He was very reserved, well dressed and well combed. He was neatly dressed and backcombed his hair. During the test he got up twice from his chair and seemed very restless. Due to which the testing time was prolonged. The child pretended to be listening very carefully but he was not able to follow the instructions. His eyes were poised down and he hardly had an eye contact initially. As the tests proceeded he was able to gain enough confidence to look up when he left.

Table No. 1: Scaled Scores, Standard Score and Interpretation on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing

S.No.	Subtests of CAS	Scaled Score	Standard Score	Interpretation
1.	Planning	22	83	Low Average
2.	Simultaneous Processing	20	83	Low Average
3.	Attention	18	75	Below Average
4.	Successive Processing	07	53	Well Below Average
	Full scale score	69	65	Below Average

Table No.1 shows the Scaled Scores and Standard Scores on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing. The findings of the above table show that the standard score on Planning and Simultaneous Processing was 83 which was low average. Standard score on Attention was 75 which was below average and on Successive scale the standard score was 53 which was well below average. On the full scale the adolescent was below average.

Figure No. 1: Percentage on Scaled Score of Planning, Simultaneous Processing, Attention & Successive subtests of CAS

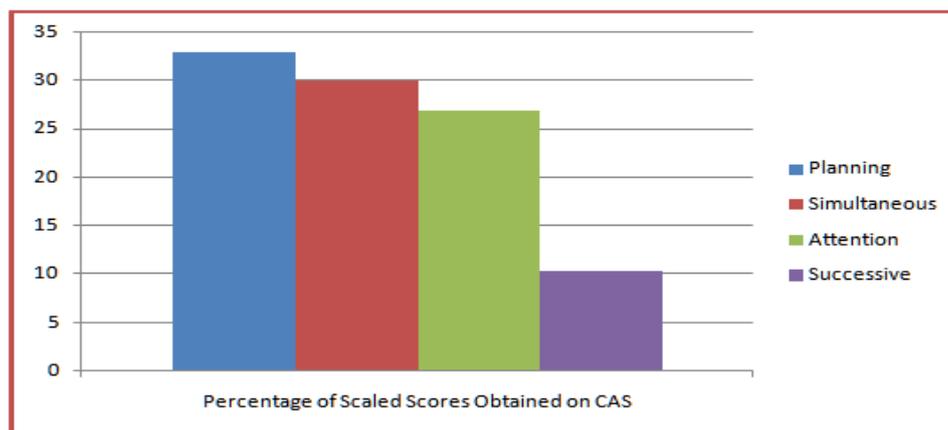


Figure No. 1 shows the Percentage on Scaled Score of Planning, Simultaneous Processing, Attention & Successive subtests of CAS. The finding depicts that the adolescent scored highest percentage on Planning (32.8%) scale followed by Simultaneous Processing (29.9%) then Attention (26.9%) & Successive Processing (10.4%) respectively.

Normative performance category states very poor performance on all three scales except on Planning Scale which was fairly better. The overall performance on all the scales implies that the subject was below average. It implies diffused cognitive impairment. Comparatively he was better on Planning followed by Simultaneous scale. It could be noted that the items on Planning scale consisted of numbers and alphabets with which the child must have been familiar. He scored below average on Attention scale showing his weakness in paying attention to a particular stimuli thereby depicting deficiency in one of the major criteria for ADHD. He scored more on nonverbal matrices than on verbal subtest on Attention scale. His better performance on Planning scale than on Attention scale indicates the adolescent can be diagnosed as ADHD I (Inattentive) subtype. His physical appearance and his inability to maintain eye contact while talking and his tendency to be easily distracted by any movement in the room were all responsible for his lower scores on full scale which depicts that on the whole the child was below average on cognitive functioning as measured with the help of CAS.

His mother also reported that he had difficulty in completing tasks that require mental effort and consistent attention. These deficits mark the deficits in executive functioning of the child and is supported by Leitner, Yael, Doniger, et, al. (2007) who found significant impairment in ADHD children in memory, visual-spatial, verbal and attention domains. According to Klingberg T et, al. (2005) executive functioning deficits are believed to play an important role in ADHD.

His performance on successive scale was well below average. The successive scale was a verbal scale which required use of vocabulary and intricate mental processes. Since the child was weak in attention as indicated by the score on CAS he was not able to concentrate on words spoken by the researcher. Another characteristic of items on the scale was that the sentences hardly made any sense.

His raw score on SPM was 30 with percentile score 25 which could be interpreted as definitely below average. Research that uses samples drawn from clinics often report lower IQ. Students with ADHD were about 7 to 15 points below comparison (Barkley 1991) samples on standardized IQ tests, including samples of siblings. Barkley (1995) concluded that hyperactive-impulsive behavior has an “inherent association” with diminished verbal IQ while also noting that these scores may reflect test-taking attentional difficulties. He was academically weak, which was the main reason for psychiatric referral as told by his mother.

Case II

Adeeba was 12 years old female student of class 6th of English medium school. She belonged to middle class family and was youngest among three siblings. As being the youngest she was a pampered girl. Her performance was relatively good in the class but could not score marks of her caliber as she made careless mistakes as reported by the class teacher. She was identified from the school on the basis of a Vanderbilt Diagnostic Teachers Rating Scale. She was a girl with bright eyes and was eager to answer questions. She took a lot of interest in the test and was very excited. Neatly dressed and well manner but at times she was so keen to finish the task that she would blurred the answers. She had difficulty in sitting in one position and following instructions carefully.

Table No. 2: Scaled Scores, Standard Score and Interpretation on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing

S.No.	Subtests of CAS	Scaled Score	Standard Score	Interpretation
1.	Planning	23	85	Low Average
2.	Simultaneous Processing	21	81	Low Average
3.	Attention	35	110	High Average
4.	Successive Processing	31	102	Average
	Full scale score	110	93	Average

Table No.2 shows the Scaled Scores and Standard Scores on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing. The findings of the above table show that the highest standard score was obtained on Attention scale which was high average. The second highest Standard score was obtained on Successive scale which was average. The third highest Planning and Simultaneous Processing was 83 which was low average. Standard score on 75 which was below average and on the standard score was 53 which was well below average. On the full scale the adolescent was below average.

Figure No. 2: Percentage of Scaled Score on Planning, Simultaneous Processing, Attention & Successive subtests of CAS



Figure No. 2 shows the Percentage on Scaled Score of Planning, Simultaneous Processing, Attention & Successive subtests of CAS. The finding depicts that the adolescent scored highest percentage on Attention (31.8%) & Successive Processing (28.2%) respectively.

Normative performance category states average performance on full scale, her standard score on full scale being 93. Her performance on two scales namely Planning and Simultaneous Processing was low average which depicts that the child was weak in planning things for herself therefore suffers from symptoms like frequent fidgetiness with hands or moving when required to sit and abundance of restlessness as observed during the administration of the tests. Her problems in Planning affected her scores on Simultaneous Processing which is a higher cognitive process used to integrate stimuli into groups involving a lot of self control on the part of the individual which lacked in the child. Difficulty with planning rather than attentional processing as measured by the CAS may be a cause for ADHD. This finding was consistent with Barkely's (1997) view that ADHD is a failure of self-control (e.g., Planning from PASS) rather than a failure of attention. Her performance was best on Attention scale with high average which shows that the child was good in focused attention as well as sustained attention since Cognitive Assessment System is designed to measure the ability to pay attention. The trend of the present score where there is ability to pay attention with low score on Planning could be interpreted and diagnosed as ADHD -H (Hyperactive). The hyperactive tendency of the individual was responsible for her deficit in planning. The overall performance on all the scales indicates that the subject was average in cognitive functioning and above average on one scale i.e. on Successive Processing.

She performed better on successive processing scale as compared to simultaneous processing scale. This may be because two out of three subtests on simultaneous processing scale required the task to be finished within time limit whereas on successive scale the subtests required no time limit. Adolescents with ADHD have been shown to demonstrate slowed processing speed relative to typically developing peers, across a wide variety of such tasks including: graphomotor speed rapid "automatized" naming speed (Willcutt et al., 2010) and, reaction time on computerized tasks (Wodka et al., 2007). On SPM she scored 39 which can be interpreted as intellectually average. The child was academically good. During the testing she was involved and was able to relate easily to the corresponding figures.

Table No. 3: Scaled Scores, Standard Score and Interpretation on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing

S.No.	Subtests of CAS	Scaled Score	Standard Score	Interpretation
1.	Planning	19	77	Below Average
2.	Simultaneous Processing	27	94	Average
3.	Attention	18	75	Below Average
4.	Successive Processing	18	75	Below Average
	Full scale score	82	74	Low Average

Table No.3 shows the Scaled Scores and Standard Scores on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing. The findings of the above table show that the highest standard score was obtained on Simultaneous Processing scale which was 94 which was average. The second highest Standard score was obtained on Planning scale was 77 which was below average. The third highest standard score was obtained on Attention and Successive Processing was 75 which was below average. Standard score on Full scale was 74 which was well low average.

Figure No. 3: Percentage of Scaled Score Planning, Simultaneous Processing, Attention & Successive subtests of CAS

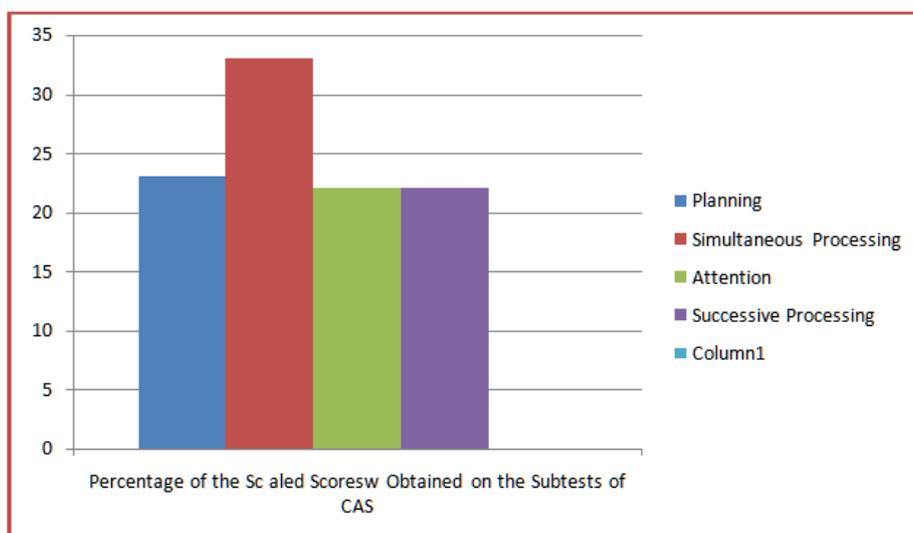


Figure No. 3 shows the Percentage on Scaled Score of Planning, Simultaneous Processing, Attention & Successive subtests of CAS. The finding depicts that the adolescent scored highest percentage on Planning (23%) scale followed by Simultaneous Processing (33%) then Attention (22%) & Successive Processing (22%) respectively.

Normative performance category states that on full scale the child was on low average category which depicts that the child was weak in cognitive processes. Low score on Planning depicts low average which correlates with other studies for instance Dehn (2000) in his study found that group of children with ADHD earned significantly low score on Planning scale. Depending upon PASS potential for assessment of children with ADHD, Paolitto in 1999 found that Planning scale helped to differentiate children with ADHD from demographically matched sample. Therefore it shows that children with ADHD have problems in planning which is related to the executive function.

The child was low on average on attention and successive processing as well. The present performance of the child on CAS depicts weakness in cognitive processing of the child a condition which marks the lack of self control and this limited self-control leads to poor response inhibition and interferes with executive functions, including working memory and problem solving. Since the performance of the child was poor on both the scales of Planning and Attention the child can be diagnosed as having ADHD –C (Combined type). The performance of the child on Simultaneous processing was average which was the best as compared to the other three scales. This shows that the cognitive ability to deal with

Keeping in view with the association between ADHD and intelligence SPM was used to tap the IQ level of children having ADHD. The subject's total raw score on SPM was 40 with percentile score of 50 which shows that the child was intellectually average.

Case IV

The subject was a 14 year old boy student of 8th standard studying in an English medium school. He belonged to the middle class nuclear family. It took time to establish rapport since the boy was reluctant to participate in the test. Later the child was convinced to participate by the researcher. He took time to follow the instructions. He was all the time searching for the eraser or pencil. He was quite fast while talking and could not wait for the next question, was in a hurry to finish. Though he was a bit nervous initially but later he gained confidence and was very supportive throughout the test.

Table No. 4: Scaled Scores, Standard Score and Interpretation on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing

S.No.	Subtests of CAS	Scaled Score	Standard Score	Interpretation
1.	Planning	12	63	Well Below Average
2.	Simultaneous Processing	20	78	Below Average
3.	Attention	16	71	Below Average
4.	Successive Processing	16	71	Below Average
	Full scale score	64	52	Well Below Average

Table No.4 shows the Scaled Scores and Standard Scores on Scales of Cognitive Assessment System namely Planning, Simultaneous Processing, Attention and Successive Processing. The findings of the above table show that the highest standard score was obtained on Simultaneous Processing scale which was 78 which was below average. The second highest Standard score was obtained on Planning scale was 63 which was well below average. The third highest standard score was obtained on Attention and Successive Processing was 71 which were below average. Standard score on Full scale was 52 which was well low average.

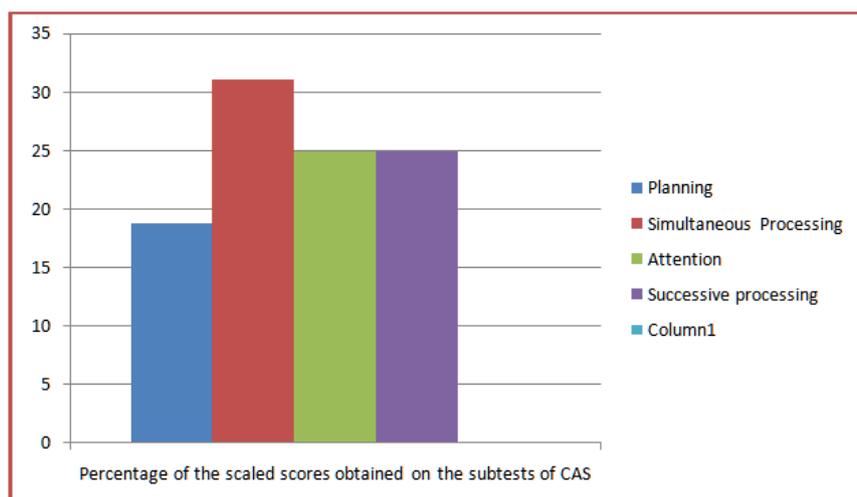


Figure No. 3 shows the Percentage on Scaled Score of Planning, Simultaneous Processing, Attention & Successive subtests of CAS. The finding depicts that the adolescent scored highest percentage on Planning (18.8%) scale followed by Simultaneous Processing (31.2%) then Attention (25%) & Successive Processing (25%) respectively.

Normative performance category depicts that on full scale the child scored well below average. Overall performance of the subject was very poor having severe deficit in each scale and therefore in each cognitive processes. His performance on Planning scale was well below average which is in accordance with the findings of Naglieri and Das (2005) that individuals with ADHD have been found to have distinct PASS profiles, with deficits in the planning function, rather than the attention function as measured on the Cognitive Assessment System (CAS). Poor planning in children with ADHD lead to limited self-control, difficulty with organization, impaired rule governed judgment, and challenges with emotional regulation. This tendency further affects the performance of the child on all the scales thereby resulting in poor cognitive as well as intellectual ability. Therefore his scores on attention and successive processing were below average which supports the view that ADHD children are much slower at processing simple information (Rucklidge & Tannock, 2002). Naglieri and Das argued that their findings suggested the ADHDHI and ADHD-C subtypes may be characterized by deficits in planning while the ADHD-IN subtype is characterized by a deficit in attention.

On SPM his percentile score was 50 which can be interpreted as having average IQ.

Conclusion:

From the above case studies the following conclusions can be drawn:

- Adolescents with ADHD were weak in cognitive functioning depicting impairments on all neuropsychological measures.
- Adolescents with ADHD who were comparatively weak on Planning than on Attention could be diagnosed as ADHD-H (Hyperactive)
- Adolescents with ADHD who were weak in Attention and comparatively better in planning could be diagnosed as ADHD-I (Inattentive)
- There was variability in scores obtained on CAS by each child with ADHD
- Performance on Planning Scale stood as a strong predictor of cognitive weaknesses of ADHD in children.
- On SPM which is an IQ test, most of the adolescents were intellectually average which means that the children were average on intellectual functioning.

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