Case Report

Examining Discrepancy between Performance on Traditional Measures and Parent Report Measure of Executive Functioning in Autism Spectrum Disorder

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ABSTRACT

There is a growing concern amongst the researchers regarding the ecological validity of the neuropsychological tests used to assess EF in ASD. Traditional EF tests have been criticized for not being unable to tap real-life scenarios that are relevant to and representative of everyday behavior. The present study aimed to examine any potential discrepancy between performance on traditional measures of executive function and behavioural expressions of EF in case of an individual with High Functioning Autism (HFA). The findings highlight the importance of use of ecologically valid measures to gain a more valid assessment of executive functions.

Key words: *Autism spectrum disorder, ecological validity, executive functioning*

INTRODUCTION

Executive functions (EFs) are an umbrella term used to describe higher order cognitive functions such as planning, working memory, impulse control, inhibition, mental flexibility, and self-monitoring.[1] The theory of executive dysfunction in autism[2,3] proposes that people with autism face difficulties in the management of executive abilities, EF deficits in autism have been proposed as a cause of not only rigid and repetitive behavior patterns[4] but also of the core impairments in communication and reciprocal social interaction.[5] However, review for EF in autism report that there is little consensus regarding what domains of EF are impaired.[3] Specifically, findings suggest that individuals with autism do report difficulties in some domains of EFs deficit domains such as in shifting cognitive sets and in maintaining mental flexibility;[3] however, some studies have also found preserved performances in domains such as response inhibition[6,7] and working memory.[8] Overall, researchers who have tried to search for EF deficit profiles in autism report evidence ranging from clear impairments to mixed results to the absence of impairments in some or all domains within EF.[9]

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Of the number of possible reasons for the inconsistency of findings, there is growing concern among the researchers regarding the ecological validity of the neuropsychological tests used to assess EF in autism spectrum disorder (ASD).[10] Traditional EF tests have been criticized for not being designed to tap real-life scenarios that are relevant to and representative of everyday behavior.[11] Neuropsychologists often report this inconsistency in not only just studies examining ASD but also other samples of study, i.e., performance on neuropsychological tests may not be consistent with everyday executive functioning abilities.[12] To reduce the gap between laboratory measure and EF functioning in everyday life, it has been suggested that parent rating scales should be incorporated in studies[13,14] as it allows for the assessment of everyday behavioral manifestations of executive dysfunction allows for a high degree of ecological validity in understanding the real-world needs.[5]

Present study

The present study aimed to examine any potential discrepancy between performance on traditional measures of EF and behavioral expressions of EF in case of an individual with high functioning (HF) autism. Case study approach was taken because characteristics of children with autism differ widely. Even when we speak of the HF subgroup of ASD, the heterogeneity in their characteristics is manifested as variety of strengths, weaknesses, talents, and support needs.[15] Large group designs obscure findings at the level of the individual unit[16] whereas case study helps us to focus on individual units. Geurts *et al.*[17] suggest that in the light of the heterogeneity of ASD, besides reporting findings on a group level, researchers need to report findings on an individual level.

CASE REPORT

AB a 17-year-old male studying in high school the time of testing is the younger of two children living in a joint family consisting of his parents, grandmother, and an elder sister. Mother reports that she had a typical pregnancy with normal delivery. In terms of developmental history, physical development was reported to be within the developmental limits with delayed language development. His mother reports that he began using vocalizations at 3 months of age but was only babbling a few words by 2.5–3 years of age. Overall, AB's mother compared his language development with his elder sister and found delay in expression and comprehension. At the same time, they took him to Action for Autism, New Delhi, where he first received a diagnosis of Autism. The mother states that AB did not undergo any therapy for a long period of time; instead she and her family have been continually involved in teaching AB ever since he started school. AB exhibits a number of talents including artistic skills, attention to details, and musical abilities.

Severity of symptoms

AB exhibited mild-moderate symptoms of autism as assessed by the childhood autism rating scale-2 HF.[18]

Nonverbal and verbal ability

AB obtained a total raw score of 55 out of 60 possible points on Raven *et al.*'s standard progressive matrices (RPM).[19] He obtained 92.5 percentile, and performance intelligence quotient score was found to be 121, which corresponds to an above average range of intellectual functioning. With respect to verbal ability (receptive vocabulary), AB achieved a raw score of 165 corresponding to a below average standard score of 77 on the Peabody Picture Vocabulary Test-IV (PPVT-IV).[20]

METHODS

Measures

Performance tests of executive function

- Inhibition: Color-word interference inhibition test (CW3) of the Delis–Kaplan Executive Function System (DKEFS)[21] is analogous to the traditional Stroop task. It two types of scores: (1) Primary measure (completion time) and (2) optional measures (corrected errors, uncorrected errors, and total errors)
- Flexibility: The color-word interference inhibition/switching test (CW4) of DKEFS has been used. Same as CW3 test, two types of scores have been provided
- Planning: The tower test of the DKEFS was used to assess planning ability of participants
- Working memory: The highly reliable digits backward component of the Digit Span test of from the Wechsler Intelligence Scale for Children-Fourth Edition[22] was chosen.

Parent report measure of executive function

Behavior Rating Inventory of Executive Function (BRIEF)[23] relies on parents' ratings of a child behavior was used to assess everyday behavioral expressions of executive functioning. Ratings for scales: inhibit, shift, working memory, and plan/organize were used.

RESULTS

AB's performance on each measure has been compared to the performance typically developing (TD) controls (n = 14). As can be seen in Table 1, the TD group was matched to AB on age, RPM raw scores, and PPVT raw scores. AB's case profile and raw scores of

Table 1: Descriptive characteristics of AB and control group

	AB	Control group (n=14)		t	P
		Mean	SD		
Age	17.00	15.79	1.91	1.077	0.150
Nonverbal ability					
RPM	55	47.14	9.68	0.78	0.223
Verbal ability					
PPVT	165	174.29	13.12	0.68	0.259

RPM – Raven's progressive matrices; PPVT – Peabody Picture Vocabulary Test; SD – Standard deviation

Table 2: Performance of AB and control group on executive functioning measures

	AB	Control group (n=14)		t	P
		Mean	SD		
Inhibition					
CW3[a]	53	55.64	8.79	0.29	0.388
BRIEF-inhibit	19	15.14	4.05	0.91	0.188
Flexibility					
CW4[a]	58	64.21	10.05	0.60	0.280
BRIEF-shift	20	12.00	3.74	2.06	0.030*
Working memory					
DSB	15	10.21	2.91	1.59	0.067
Working memory	16	12.71	4.37	0.73	0.241
Planning					
Tower test[b]	15	18.21	2.78	1.16	0.142
BRIEF-planning	18	12.85	2.52	1.97	0.036*

[a]Completion time (s); [b]Achievement scores; *P<0.05. CW3 – Color-word interference inhibition test; CW4 – Inhibition/flexibility test; DSB – Digit span backward; BRIEF – Behavior rating inventory of executive functioning; SD – Standard deviation

the comparison group on the different EF measures are presented in Table 2. For the purpose of case-control study, Crawford and Garthwaite[24] have described a modified *t*-test that compares the score of the case with the control group. As can be seen in Table 2, overall nonimpaired performances were reported for all performance measures of executive functioning. On parent report measure, nonsignificant differences were reported for inhibit and working memory scales. However, significant difference was found between AB's ratings and control group's ratings on shift and plan/organize scales of BRIEF.

DISCUSSION

AB's performance on EF tests was found to be unimpaired relative to age, verbal ability, and nonverbal ability-matched TD control group. These findings imply that in comparison with TD peers, executive functioning abilities, hypothesized to be deficit in individuals with autism were found to be unimpaired as assessed through traditional (performance) measures of EF. This is a surprising finding as the executive dysfunction theory states that individuals with autism exhibit inferior performances on EF measures relative to TD peers.[3] Researchers suggest that findings of intact performances on neuropsychological tests do not necessarily translate to absence of difficulties in regulation of EFs.[25-27] Failure to demonstrate EF deficit on performance measures in a HF individual with autism can result from an insufficient level of task difficulty relative to the ability level of participants.[28] Higher functioning individuals show EF deficits only when the task difficulty exceeds a threshold. In fact, researchers suggest that explicit task structure and behavioral instructions[29] are important contributing factors to nonimpaired performances on neuropsychological tests. On the contrary, use of "open-ended" or "ill-structured tests" of EF reveal greatest degrees of impairment in children with ASD.[10]

In support, the findings of the study indicate that while parent's reports of behavioral expressions of inhibition and working memory ability were not significantly different from control group, AB does indeed face difficulty in shifting (flexibility) and planning in everyday life. For instance, AB's mother reports that she usually helps him plan his day and activities. He often finds it challenging to plan and organize for examinations, and school assignments, and household chores. He often needs his mother's help in keeping his room and study table organized. In addition, unimpaired performance on the tests of flexibility for AB is inconsistent with the report of the presence of everyday inflexible behavior such as the refusal to draw anything other than robots, difficulties with sudden change of plans, and repetitive motor behavior.

An interesting finding is that parental reports of difficulties in EFs are restricted to the domains of flexibility and planning. Inhibition and working memory were not reported to be significantly poorer compared to TD peers. Previous researches have also documented inconsistencies in their findings; response inhibition[6,7] and working memory[8,9] have been found spared in individuals, whereas planning and cognitive flexibility have been found to be consistently impaired in autism. Thus, the findings of the present study and previous studies suggest that perhaps mental flexibility and planning are the two most challenging domains of EFs in people with autism.

Overall, the present case highlights the importance of the use of ecologically valid measures such as open-ended and unstructured tasks[11] and parent reports[13] to gain a more valid assessment of EFs in ASD.

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Conflicts of interest

There are no conflicts of interest.

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