Beneficial aspects of autism stemming from enhanced visuospatial skills: Result from a comparative study in India

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ABSTRACT

Background: Autism spectrum disorder (ASD) is a relatively common neurodevelopmental disorder characterized by impairments in social interaction and communication, associated with restrictive and repetitive behaviors, interests, and activities. However, there are various positive character traits among individuals suffering from ASD – they are generally honest, decisive, and nonjudgmental. They are also reported to have excellent attention to details, which have been ascribed to their enhanced visual search skills.

Aim: Our study was undertaken to assess these visuospatial perception skills among children with autism and compare the results with that of typically developing (TD) children in the Indian population.

Materials and Methods: A total of 47 children with ASD and 47 age-, gender-, and education-matched TD children were assessed using tests for disjunctive and conjunction search, real-world visual search, and visual working memory.

Results: Children with ASD performed significantly better than the TD children in tests for visual search and were comparable in the test for visual working memory.

Conclusion: Our study showed that children with autism have enhanced visual skills, and this quality can be honed further and be utilized in jobs that require good observation skills and attention to details.

Key words: Autism spectrum disorder, visual attention, visual memory, visual search

INTRODUCTION

Autism spectrum disorder (ASD) is a common, heritable neurodevelopmental condition in which there are impairments in social interaction and communication, as well as restrictive and repetitive behaviors, interests, and activities. The World Health Organization estimates 1 in 160 children globally has an ASD.[1] The prevalence is 1%–2%, and boys are four times more affected than girls.[2] ASD often presents with comorbidities such as epilepsy, attention-deficit/hyperactivity disorder (ADHD), low intelligence, and depression. Assistive technology such as alternative and augmentative communication, occupational therapy, speech therapy, and other behavioral treatments and interventions can help individuals with this condition.[1,3]

Certain positive traits have been ascribed to people with autism – they rarely lie, are nonjudgmental toward others, and they do not suffer from indecisiveness. One distinct
advantage that is attention to details can be attributed to better visual search performance among people with ASD.\[4,5\]

Effective visual search is a demanding cognitive task comprising of visual attention, scanning, processing speed, reaction time, and visual memory, utilized in everyday life and has extensively been studied. Despite several disabilities, individuals with ASD are particularly gifted with this enhanced visual search which was first identified by Plaisted et al.\[6\]. Since then, various studies have used array of neuropsychological tests to assess this function in autistics, although not much work has been done in India. Our study aims at filling this lacuna by assessing visuospatial perception skills among children with ASD and comparing these results with a matched comparison group of typically developing (TD) children in our country.

**MATERIALS AND METHODS**

This comparative observational study was conducted between November 2018 and April 2019. After obtaining permission from the institutional ethics committee, children with ASD were selected from the psychiatry outpatient department (OPD) of a tertiary care hospital of eastern India, whereas the TD children were chosen from various schools of the same state.

Every child coming to our psychiatry OPD, who were diagnosed (by Diagnostic and Statistical Manual of Mental Disorders-5)\[7\] to be suffering from ASD, who did not have any other psychiatric comorbidities (e.g., ADHD, which were ruled out through clinical interview), had at least normal or average IQ as per Malin’s Intelligence Scale for Indian Children,\[8\] were school going, and had basic understanding of English alphabets as well as basic colors were included in our study. These children were newly diagnosed cases of ASD (i.e., drug-naïve and not undergoing any therapy). Normal visual acuity (best-corrected vision of 6/6 in both eyes) and normal color vision were ensured using the Snellen Chart and Ishihara Chart. After informing their parents/guardians about the nature of the study and obtaining valid written consent from them, sociodemographic details of these children were recorded. Then, these children were instructed about the tests (described below), and their responses in each test were recorded. Those who could not complete the tests were excluded from our study. A total of 65 children with ASD matched our selection criteria and were included in our study. However, only 47 of them could complete the tests successfully and were included in the analysis.

Subsequently, 47 children from three schools from the same state were selected after age, gender, and education matching (consent from school authority was taken). These children did not have any psychiatric disorder and served as comparison group. They were given consent forms of our study to be signed by their parent/guardian at home and to be brought to the school the next day. Following the receipt of valid consents, Childhood Autism Rating Scale–Second Edition was administered to rule out ASD in these children.\[9\] Normal visual acuity and color vision were also ensured using Snellen and Ishihara Chart. Subsequently, sociodemographic details were obtained, and the same tests were given to the children, and results recorded. Data from both the groups were then analyzed.

**Tests for visual-spatial perception**

**Disjunctive visual search or feature search test**

In this test, a specific target (red circle) was to be searched among numerous similar objects with different features or distractors (other colored circles) [Figure 1].\[10\]

**Conjunction visual search test**

Here, specific target (red circle) was to be searched among more than one type of distractors which has at least one similar property as the target (red triangles or blue circles).\[10\]

**Inverted letter search test**

Example of real-world visual search test.\[11\] In this test, inverted alphabets were intermixed within strings of normal alphabets (in no particular order), and these oddities were to be identified.

**Visual working memory test**

In our modification of test for visual working memory,\[12\] one particular emoticon chosen randomly out of 16 was shown beforehand to the participant for 5 seconds. Next, he/she was given a set of simple emoticons, and that previously shown emoticon was to be identified.

![Figure 1: Top left – disjunctive or feature search test (find the red dot); top right – conjunction visual search test (find the red dot); bottom left – inverted letter search test (find all the inverted letters); bottom right – visual working memory test (find the previously shown icon)](image-url)
Testing was done in natural lighting conditions, both in OPD and classrooms. Participants were seated in a chair, and at least 25 cm distance was ensured between the eyes and the desk in front. They were instructed about the tests, and a sample test card for each test was given to see whether they understood the task. If they gave correct response in the sample cards, testing was initiated. Each of these four tests was color-printed in 10 cm × 10 cm white paper sheets and was given to the child one by one in no particular sequence. Responses in each of these tests were scored in terms of seconds (using a stopwatch and counting up to 1/10th of a second) taken to complete them. If the participant made any error, he/she was notified of it immediately, so that he/she could change the response. A number of errors/mistakes were not counted, as it directly affects the time taken to complete the test. If the participant could not complete the any test after 90 s, the test was abandoned, and results were not taken for analysis. Data from both the group were compared using statistical software.

RESULTS

A total of 47 cases and 47 controls were included in our study; the participants were age, gender, and education matched. The mean age and the mean year of schooling of both the groups were comparable. Thirty-nine out of 47 in both groups were boys (83%).

The results of the tests for visuospatial perception are summarized in Table 1.

DISCUSSION

The tests for visuospatial perception or commonly termed as visual search are the measures of visual attention, scanning, processing speed, and reaction time. The tests commonly used are disjunctive and conjunction visual search, along with tests of visual working memory. In our study, we have found that children with ASD took lesser time in completing these tasks compared to TD children; the differences in mean time taken by these two groups to complete the tasks were statistically significant (\(P = 0.038\) for disjunctive test and 0.022 for conjunction test). Furthermore, in inverted letter search task, the ASD children group performed significantly faster than the TD children group (\(P = 0.047\)). These results corroborated with some previously done studies which reported superior visual search in autism. However, López Pérez et al. found no relationship between autism and visual search.

In the test for visual working memory, we found no significant advantage of one group over the another (\(P = 0.181\)), though TD children took slightly less time in completing the test compared to children with autism. This was not corroborative to the study done earlier which showed that children with ASD had significantly weaker visual working memory than TD children. Furthermore, ASD individuals are reported to have poor facial expression recognition skills. Although emoticons or emojis are simplified caricature of facial expressions, they lack the intricate details of a facial emotion as compared to real persons or their photographs. This might explain why children with ASD were not significantly poorer performers in this test.

There are various theories pertaining to advantages in visual search of individuals with ASD. One theory stated that persons with autism have enhanced perceptual discrimination. Another theory attributed these skills to an atypically functioning attentional system. It has been reported that the ASD search superiority does not derive from the manner in which attention is deployed, but from anomalously enhanced perception of features of stimulus, which positively associates with severity of ASD symptoms. Concepts of dysregulated hyperphasic locus coeruleus in ASD as a cause of overfocused attention have also been theorized. Weak central coherence is another influential theory. These ASD advantages of visual search are reported to be present at as early as 2.5 years of age.

Despite some limitations such as small sample size, not considering the level of intelligence and severity of ASD as determinants, and not taking comorbidities into account, our study was clearly able to demonstrate superior visual search ability and at least similar visual working memory in children with ASD compared to TD children.

Despite being a debilitating illness, individuals with autism possess certain characteristics which are superior to their peer groups. Enhanced visuospatial skills in the form of superior attention, scanning, reaction time, and

| Tests                                    | Time taken (s) (mean±SD) | Significance \((P)\) | \(t\)  |
|------------------------------------------|--------------------------|----------------------|--------|
| Children with ASD (\(n=47\))            | TD children (\(n=47\))   |                      |        |
| Disjunctive or feature search test       | 3.51±1.10                | 4.00±1.17            | 0.038* | -2.11 |
| Conjunction visual search test           | 3.03±1.09                | 3.59±1.24            | 0.022* | -2.32 |
| Inverted letter search test              | 18.25±2.60               | 19.55±3.8            | 0.047* | -2.10 |
| Visual working memory test               | 8.11±1.32                | 7.75±1.24            | 0.181  | 1.34  |

\(*P\) significant at 0.05 level; \(^†\)Comparison of means of time taken to complete tests using unpaired \(t\)-test. SD – Standard deviation; ASD – Autism spectrum disorder; TD – Typically developing.
discrimination of stimuli are found in these individuals. These skills make them invaluable in situations and career opportunities which demand a methodical approach, keen observation, and attention to details. It certainly reduces burden and provides opportunity and promotes empowerment of people with autism. In fact, major software giants often prefer individuals with ASD and have special program for them. Furthermore, there are scopes that therapy and training can utilize these abilities with success.

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Conflicts of interest
There are no conflicts of interest.

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