

# Cognitive Development in Children with Autism Spectrum Disorder: A Piaget's Cognitive Developmental Approach

Received: 13 November 2021

Accepted: 09 December 2021

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## Abstract

*Children with autism spectrum disorder often experience difficulties in cognitive skills related to understating, comprehending, analyzing, synthesizing, evaluating, and differentiating between two objects. The present study objective to investigate the effect of Piaget based cognitive tasks on the cognitive skills of children with autism spectrum disorder (ASD). Eight children with ASD were selected through purposive sampling and assigned for the intervention program. To measure IQ, the Non-Verbal performance test Raven's colored progressive matrices test was used, and the Indian scale for assessment of autism (ISAA) was used to measure the level of autism spectrum disorder. The IQ was obtained above 80, mild level of ASD, and 6-12 years of the children were placed for this study. The cognitive skills of children were assessed pre- (before) and post- (after intervention). An intervention program based on Piaget's cognitive tasks was implemented on ASD children for four weeks (six days per week) with 30 minutes per session. The total scores on cognitive skills of ASD children were enhanced in the post-test score. The effects of the Piaget's cognitive tasks (concrete operational stage: conservation task, classification, and particular reasoning) intervention were most evident in the task performance rating scale on tasks conservation, classification, and particular reasoning. Children with ASD can benefit from the Piaget based cognitive tasks to enhance cognitive skills. The study findings emphasize the effectiveness of the cognitive skills on Piaget based cognitive tasks intervention, which parents may use, psychologists, special educators who work with ASD children.*

**Keywords:** Autism spectrum disorder, cognitive skills, and Piaget based cognitive intervention

Autism spectrum disorder (ASD) is a neurological developmental condition. Individuals with ASD often experience cognitive deficits such as irregular cognitive abilities or skills. Sansoti, (2010) reported that children with ASD generally have cognitive abilities within the average range or above the range of IQ.

Cognitive skills are defined as abilities such as understanding, knowledge, comprehension; all these proceed by including thinking, knowing, and problem-solving abilities planning. All are high-level cognitive functioning of the persons.

The cognitive factor plays a significant role in one disorder and has a secondary associated role in others because pathways may involve shared processes at the etiological, neural, and cognitive levels (Pennington, 2006). The core assumption of Piaget's theory is that

the children are active thinkers, the concept of better understanding about the world around them by passing through several different cognitive stages and concluded that conservation task might be easy to adopt in paradigm (Siegler & Ellis, 1996). Piaget (1954) focuses on the transition from one stage of operation to another stage children can adapt to their environment, can be acquired by the joint operation of assimilation and accommodation and adaptation. Golan and Baron-Cohen (2006) found that problems in generalization of learning result from a cognitive ability in autism and have a problem in generalizing and grouping conceptualization due to loss of information given and functional differences between and among specific system elements. Siegel (1973) reported that the conservation task was also easy to adopt in the paradigm. Piaget has conceptualized that the concrete

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operational stage (7 -11 years) is a significant turning point in cognitive development further emphasized that a child has to develop conservation ability which is defined as “conservation is an ability to understand about conservation of liquid, length, number, and area. The ability to pass conservation tasks provides clear evidence of operation and conservation of liquid for which children stated that the amount of liquid has not changed”. The child engaged to recognition about change in one aspect of the water (in height) is rewarded for by chance in other aspects.

Further, he emphasized that during this stage child can be able to pass this task. Moreover, focused that children can pass hierarchical classification ability during the age of 7-10 years of the child age in which they can also face inclusion problems which indicate that they are more aware of hierarchical classification and focus on the relationship between general and two specific categories at the same time that is three relations at once. Classification ability can be observed in the child during play activity as they spent more time in sorting and resorting from collection items. The child also improves seriation ability in which the child can able to order items by following quantitative dimensions such as length and weight. The child can arrange sticks in a row but make after using many trials and error methods. Six-seven years old age child is able to make plan accordingly. They can create the series efficiently by beginning with the smaller rather than moving to larger until the ordering is completed by mentally applying seriate it is called transitive interpretation. While working with children, they found that school-age children understand spatial reasoning abilities about space, including direction, distance, and map. The child can comprehend distance improves during middle childhood, as a spatial conservation task and reported child can understand space and direction (Roberts & Aman, 1993). Found that 8-10 years of the old child can give clear and well-organized directions for getting from one place to another. Furthermore, the child can develop operational thinking and use a mental walk strategy to imagine another person's movements along a route/maze (Guvain & Rogoff, 1989). A cognitive map is an ability in which a child can draw spaces such as school and house. In school grades, children's maps become more organized. It is concluded that during this stage, the child can develop cognitive abilities such as concept formulation, differentiate between objects, correlation,

distance, money concept, number concept, abstract thinking, generalization, conservation, drawing ability.

Several studies have shown the efficiency of the Piaget-based cognitive tasks on children's cognitive skills in various studies. However, while reviewing the literature, very few studies Piaget based cognitive development has been conducted in the Indian context for children with autism spectrum disorder. Thus, the present researcher examined the effects of Piaget based cognitive tasks intervention.

The objective of this study was to investigate the effectiveness of the Piaget based cognitive task intervention to improve the cognitive skills such as conservation skills, classification skills, and spatial reasoning skills of children with autism spectrum disorder.

### Method

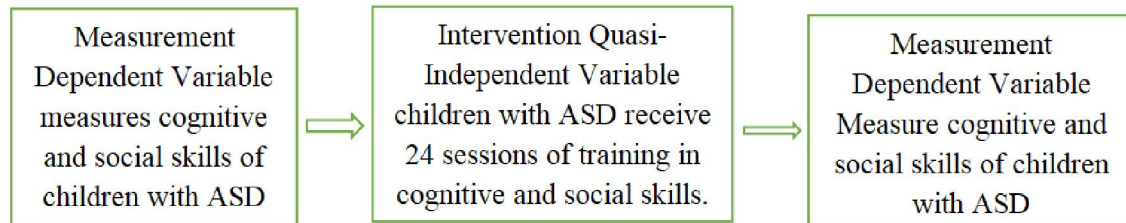
**Participants:** A total number of eight children, two girls and six boys with autism spectrum disorder aged between 6-12 years old and a prior clinical diagnosis by a child psychiatrist from a Delhi-based clinic, were considered under this study. Further, the diagnosis was verified by the admiration of the Indian scale for assessment of autism in ASD children.

**Instruments:** To measure IQ of the children Non-Verbal performance test of intelligence Raven's colored progressive matrices test of intelligence was used, and Indian scale for assessment of autism (ISAA) was used to measure the level of autism spectrum disorder. The Cognitive skill assessment scale for ASD children was used. For this scale, content validity has been considered, the following formula calculated quantitative analysis. The formula for determining the validity of this test is content validity, and quantitative analysis had administered using the Content Validity Ratio (Lawshe, 1975). A total number of experts(N) Number who rated the object as essential (E) out of 77 items 13 items from the test have already been removed as those items show negative values. The remaining 64 items were finalized under both domains (cognitive and social) to assess the cognitive and social skills of ASD children for providing an intervention training program. After 20 days, the test was re-administered on the same sample to establish the test-retest reliability of the tool. The reliability coefficient

and reliability index for the test has been established by applying procedure of internal consistency reliability (0.93), indicating a high degree of internal consistency (0.62 to 0.81), test re-test reliability of tool (0.60 to 0.85) in the domain for the total score was 0.83

( $p < 0.001$ ). Above 80 and mild level of ASD children was included in this study.

**Research design & procedure:** A quasi-experimental single group research design was used to investigate the effect of Piaget based cognitive tasks to enhance cognitive skills for ASD children.



**Figure 1: The One-Group Pretest-Posttest Quasi-Experimental Design**

The four-week Piaget based cognitive skills were conducted with 30 minutes per session and a total of 24 sessions, weekly six days in a week. Before starting the intervention program, the cognitive skills assessment scale was administered to measure baseline cognitive skills in children with autism spectrum disorders. The post-test was also administered after completion of the intervention program to measure cognitive skills in ASD children.

The stages of intervention were as follows.

**The first stage:** During this stage, consent was obtained from parents, taking case history details assessment was conducted to know the IQ and level of ASD children.

**The second stage:** Pre-testing conducted before the intervention training program to obtain baseline score on ASD children.

**The third stage:** Conducted intervention on ASD children.

**The fourth stage:** Post-test administered after intervention provided, cognitive skills assessment test and task performance rating scale were administered on ASD children.

**Intervention:** The researcher developed the intervention training program manual based on Jean Piaget's cognitive developmental theory, review of literature, and recommendation. Cognitive skill tasks were designed to target conservation, classification, seriation, spatial reasoning, direction, distance, and cognitive mapping skills. The learning objective in each session becomes more complex from the previous

session. Physical and verbal prompting was given to the children to complete tasks.

#### **Administration of Piaget based tasks**

Based on Piaget's cognitive theory and existing literature reviews, tasks were designed based on Piaget's cognitive theory concrete operational stage, and the following tasks were administered on ASD children.

#### **Conservation task**

**Conservation Task Length:** In this task, children were shown two sticks that were kept in front of the child, and the child was asked to determine their lengths as to whether they were short, long, or equal in length.

**Conservation Task Number:** In this task, the researcher showed two rows of the counter placed in one-to-one correspondence. One of the row was drawn and asked whether each row was still had the same number.

**Conservation Task Liquid:** in this task, children were shown two glasses with the same level of water, and the child was asked to determine their equality as to whether they could identify the amount of liquid. The liquid of one bottle is poured into a tall bottle and asked the child whether each bottle is the same amount.

**Conservation Task Area:** under this task, children were introduced to the identical sheet of cardboard wooden block placed on the chart in an identical position, and the child was asked whether each cardboard had the same amount of shape in the area.

#### **Classification task**

**Shorting and Resorting Task,** in this task, the children were shown 36 various colored (red, green, yellow, and white) shapes and sizes (circle, rectangle,

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square, and star), and the child was asked to be categorized/ classified based on colored and shapes and size accordingly.

*Block Design Task:* In this task, children were shown wooden blocks along with pattern cards, and the child was asked to arrange the blocks according to the design shown in the picture. Block design gradually increased from a simple to a complex pattern. The child used the trial and error method it required more time to understand and perform this task the child.

*Seriation Position Task:* In this task, children were shown three different colored sticks, and the child was asked to the pairing of different colored sticks. By observing that stick A is longer than stick B is more extended than stick C, the child must make the mental inference that A is more extended than C. This task requires the child to assimilate triangulation at once A-B, B-C, A-C. The trial and error method used by the child required more time to understand and perform this task by the child.

### Spatial reasoning task

*Distance Task:* to perform this task, children were introduced to two small trees out of modeling clay, and it was placed on a table at which the child was seated. Next, put a block between the trees, and the child was asked whether the trees were nearer together, or still the same distance separately.

*Direction Task:* in this task, children were asked to tell or point out an object's name on his or her left and right side. The child was responding accordingly.

*Cognitive Map Task:* In this task, children were shown a set of worksheets that included various dots with numbers, and the child was asked to join all dots and numbers tighter.

### Results & discussion

The mean age (7.65years, SD= 1.18) and mean IQ (91.25, SD= 4.35) of the children with ASD was ascertained.

**Table 1: Descriptive statistics of Mean, SD, and Paired t-Test Score of the children on Cognitive Skills Test(N=8)**

Skills	Mean Pre-Test	Mean Post Test	SD Pre- Test	SD Pre- Test	Paired t-test Score	Level of significance
Cognitive	67.35	85.12	14.19	17.04	6.20	.000

Table 1 suggests that score improved after the cognitive skills program provided to ASD children mean 85.12 than to children's score before intervention mean

score 67.37 and score on Paired t-test are 6.20 at .000 level. These results indicate that the intervention had a significant effect on cognitive skills.

**Table 2: Effects of Piaget Based Conservation task in Children with ASD (N=8)**

Conservation Tasks	Mean Pre-Test	Mean Post Test	SD Pre- Test	SD Post- Test	Paired t-test Score	Level of Significance
Length	2.75	4.25	.463	.535	7.00	.000
Liquid	2.50	3.75	.535	.707	3.98	.000
Number	2.13	4.25	.641	.463	7.60	.000
Area	1.88	4.75	.354	.707	10.28	.000

Table 2 Piaget based conservation tasks, the result showed a significant difference in the conservation tasks summary variable defined as the total of all four variables (length, liquid, number, area) before and

following the intervention (paired t-test score 7.00, 3.98, 7.60, 2.72 and 10.28 significance at .000). These results indicate an improvement in the conservation task following the full intervention for all 8 participants.

**Table 3: Effects of Piaget Based Classification Task in Children with ASD (N=8)**

Classification Tasks	Mean Pre-Test	Mean Post Test	SD Pre- Test	SD Post-Test	Paired t-test Score	Level of Significance
Shorting and resorting	2.00	4.75	.535	.707	8.75	.000
Block Design	2.38	4.38	.744	.744	5.37	.000
Seriation Position	2.00	4.50	.756	.756	6.61	.000

Piaget based classification tasks, the result showed a significant difference in the conservation tasks variable defined as the total of all four variables (shorting and resorting, block design and seriation

position) before and following the intervention (paired t-test score 8.75, 3.42, 5.37, -6.61, and -3.31 significance at .000). These results suggest the improvement in conservation task following the full intervention for all 8 participants (Table 3).

**Table 4: Effects of Piaget Based Spatial Reasoning Task in Children with ASD (N=8)**

Spatial Reasoning Task	Mean Pre-Test	Mean Post Test	SD Pre- Test	SD Post-Test	Paired t-test Score	Level of Significance
Distance	1.88	4.13	.835	.991	4.91	.000
Direction	1.75	4.50	.707	.756	7.51	.000
Cognitive Map	2.25	4.13	.707	.835	4.84	.000

Piaget based spatial reasoning tasks, the result showed a significant difference in the conservation tasks variable defined as the total of all four variables (distance, direction, and cognitive map) before and following the intervention (paired t-test score 4.91, 7.51, 4.84 significance at .000) (Table 4). These result improved the conservation task following the full intervention for all 8 participants.

Mean and SD values of the all three tasks, namely conservation, classification, and spatial reasoning cognitive tasks measures improved significantly after intervention. The children have demonstrated a better understanding of conservation, classification, and special reasoning abilities as a result of the intervention. They could make a more relevant understanding of cognitive skills. However, children showed better cognitive skills on the Piaget's cognitive approach.

### Discussion

The present study sought to examine the effect of Piaget's cognitive developmental tasks on the cognitive skills of ASD children. The present study's findings showed that the Piaget based cognitive tasks intervention efficiently improved the cognitive skills of children with autism spectrum disorder. These findings support previous studies investigating the effectiveness of cognitive skills intervention based on Piaget tasks in other countries. The child develops a logic of classes,

relations, and numbers at this stage. He or she may give reasons in terms of objects, but they could not link anyone objects to any other except. In this stage, children were able to make reverse actions. Following discussion had been made. Conservation tasks training provided to autism spectrum disorder on conservation task, it is categorized into four tasks. Conservation task length, children were presented with two sticks associated in front of the child and instructed them to admit their equity. Further, one of the sticks is the move to the right. The child was asked whether they were still the same. During the training session, repeated instructions were provided to the child after a few sessions, and they could perform better. Out of eight children, only six children were able to perform perfectly. However, two of them had poorly performed on this task. The second task is to provide training on this task equality. Further, one raw was drawn out, and the child was asked whether each raw still had the same number. During training sessions, it has been observed that the task was quite complicated for these children. This task was performed by a few children only.

Training provided on liquid. In this task, the child presented two jars (glass) filled to the same level with the water. The child sees that they are equal. The liquid of one bottle was poured into a tall bottle. Further, the



child asked whether each bottle had the same amount. Within a few training sessions, this task was performed by all eight children quarterly. Finally, training was conducted on the last task of conservation of area. During a training session, the child and researcher each have identical sheets of cardboard wooden block placed on the chart in an identical position. Further, the child was asked whether each cardboard had the same shape in the area. All children performed this task within a few sessions.

The training provided on classification tasks, namely shorting and resorting, was conducted on ASD children. In this task, the children were shown 36 various colored (red, green, yellow, and white) shapes and sizes (circle, rectangle, square, and star). Further, the child was instructed to place each card into the correct place, they are not told on what basis to sort the cards, but their first sorting strategy is rewarded with approval for a certain number of cards presented. After a run of correct shorting responses, the tester no longer accepts using the original sorting strategies simply saying no, incorrect. Literature reviews suggested that most people switch strategies. For example, if they were previously sorting by color, they switch to sorting by shape or by number. This task was completed by all eight children correctly. The block design task, children were instructed to arrange blocks as the design shown in the pattern cards. During training sessions, the researcher repeated the task as that child could learn this task by observing and imitating, the child used trials and error methods. All children were finished this task. Further, training was provided on seriation tasks like understanding serial position child was presented two different colored sticks, and the child was instructed to the pairing of different colored sticks. From observing that stick A is more extended than stick B is more protracted than stick C, Children must infer that A is more extended than C. Piaget's class inclusion task. Task requires children to assimilate triangulation at once, A-B, B-C, A-C. Training given to children at the initial stage children were confused but slowly understood the task. Within a few sessions, they were learned to perform the task. All ASD children performed this task.

Training provided on spatial reasoning, tasks were conducted on ASD children to understand and comprehend distance, direction, and cognitive map ability. Training conducted on distance task child was presented to make two small trees by modeling clay and place them separately on a table at which the child

is seated. Next, put a block between the trees. Then ask the child whether the trees are nearer or together or still the same distance separately. While providing training to ASD children, it has been observed that initially, they feel difficult to understand how to perform. After a few sessions' four children were able to differentiate distance. Furthermore, four children could not perform this task even given several sessions. The exposure was given on the task of direction. For this task, the researcher asked the child to name an object on his or her left and right side. For this task, very few training sessions were given to ASD children. They were able to perform this task perfectly. Intervention training provided to ASD children to understand the cognitive map, the child has presented a set of shapes and sizes of dots to joint and scribbling on the page which included circle, square, cross, triangle, diamond size, and dots simple to complex by using pencil and asked the child to draw as mentioned. Initially, children were needed to focus on a particular task. Children used the trails and error method. Gradually they have developed the ability to draw a picture as given. After a few sessions, children were trained to draw the above shapes without any error. Many investigations have been observed some particular deficits in the ability of autistic children to attend to several dimensions of a stimulus. The present study was supported by this study Lovaas, Schreibman, Koegel, and Rehm (1971) investigated the autistic children required more training sessions to learn this cognitive task and autistic children revealed marked performance for one of the components. Lancy and Goldstein (1982) studied concept-acquisition tasks administered on autistic children on the seriation task, height was the relevant dimension and children were required to choose the second tallest among four boxes. Finally, children were tested for understanding their understanding of numerical invariance. Results revealed that all normal and autistic children could solve the classification task by using the ability to categorize objects by shape, applying the rule, and applying this rule to solve the problem and reported that normal and autistic children were solved the classification task. The study also reported that most autistic children were also able to solve the ordination and seriation task. The present study supported by this study Sigman and Ungerer (1981) evaluated preoperational assessment procedures performance in many areas like multiple classifications, ordinal relations, and conservation of mass, liquid, and number. All these tasks utilized visual

stimulation as input and nonverbal motor responses as output and maximized the performance potential of autistic children. In this research, all autistic children were able to sort objects based on one dimension and used two dimensions, and only one categorized the objects by applying all three dimensions. Half of the autistic children passed the tasks of ordinal relations and conservation of mass, and two passed the task for conservation of length and number. Both studies suggested that when appropriately evaluated, some autistic children were capable of functioning at a stage as per their age. Another study conducted by Maltz (1981) reported that concrete discrimination (e.g. matching task) autistic children perform better than mentally retarded and the normal children and found that the deficits appeared to be comparatively to the amount of abstraction were necessary for problem-solving.

### Conclusion

The present study's findings support the efficiency of the Piaget based cognitive tasks intervention in improving the cognitive skills of ASD children. Piaget based activities were conducted, the result showed a progression of improvement on concept mastery on cognitive skills, which included conservation, hierarchical classification, and spatial reasoning for the experimental group, compared with pre-post test score on cognitive skills domain, the study had found significant improvements in social skill. Pre-test conducted for baseline skills of ASD children after completion of 4-

week intervention further post-test was conducted, and the score was compared with pre and post-test it has been observed that activity/task based on Piaget based approach had found to be effective on cognitive skills for ASD children. It indicated that the Piaget approach with a purposeful design effectively promotes positive improvements in cognitive skills for autism spectrum disorder children.

In light of the above, understanding about Piaget based cognitive tasks intervention program for ASD children, furnishing helpful information, understanding, meaning, and practice to guide and measure intervention effects for future research. However, the cognitive-based Piaget approach may be a valuable intervention for ASD children. The researcher recommends that the Piaget-based cognitive skill intervention incorporate the special education and rehabilitation of children with ASD in the Indian context. In particular, psychologists, special educators, and parents can use this method to improve the cognitive skills of children with ASD. In addition to this, future research needs to be conducted in the remaining stages of Jean Piaget's cognitive developmental approach on ASD children in the Indian context.

**Acknowledgement:** I would like to thank Dr. Subodh Kumar, Member Secretary, RCI, for his contributions concerning the construction of the cognitive skills assessment scale. Special thanks to Dr. Arpan Kumar, Director, OT for Kids for data collection work, and parents of children with autism spectrum disorder.

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