Chapter 4

Methodology

i. Sample

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METHODOLOGY

Sample

The sample of the present study was comprised of 30 participants divided into two groups of 15 individuals with autism and 15 individuals with intellectual impairment, age ranging from 7 years to 21 years.

The two groups were matched by

1. Intelligence level (IQ: 70-80)

2. Age group

*Inclusion Criteria for selection of sample:*

- Only the participants with borderline intellectual impairment and autism are considered.
- The participants, belongs to special school of West Bengal, Kolkata.
- Belongs to middle-class status.

*Exclusion Criteria for selection of sample:*

- Other than autism and borderline intellectual functioning any other disability or chromosomal abnormalities (e.g. down syndrome), is excluded.
- The comorbid conditions like ‘Psychiatric’ and ‘Medical’ problems with the selected participants are excluded.
Variables

Here Dependent variable was Executive Functioning (EF) measured by

- Composite Measure of EF; assessed by
  - Tower of London Test

- Visuospatial Working Memory Span; assessed by
  - Block Span test

- Mental Flexibility; assessed by
  - Trail making Part B test

Independent variables by which training was conducted

- Working Memory - training by
  - Object Span
  - Picture Span

- Set Shifting - training by
  - Maze learning
  - Shape sorter

Intelligence and Age were the controlling variables. Here Intelligence was measured by

- Raven’s Colour Progressive Matrices
Design of the Study

Population
Autism & Intellectual

Sample

1) Persons with Autism, Mild to Moderate as measured by CARS, N=15
2) Persons with Intellectual Impairment, N=15

Matched by
- Age (7 yrs. – 21 yrs.)
- Intelligence (IQ: 70 – 80) (as measured by CPM)

Measures before training

- Tower of London Test
- Block Span test
- Trail making Part B test

Training sessions

<table>
<thead>
<tr>
<th>Measures</th>
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<tr>
<td>Object Span</td>
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<tr>
<td>Picture Span</td>
<td>10-12</td>
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<td>Maze</td>
<td>15-16</td>
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<tr>
<td>Shape sorter</td>
<td>10</td>
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</table>

One to one and thrice a week

In total, a participant receives 49 to 50 sessions of training

A single session is comprised of:

- Object span training-10 trials
- Picture span training-10 trials
- Training with Maze-10 trials
- Training with Colour shape sorter-10 trials
Tests and Tools used

Intelligence

Performance box of The Colored Progressive Matrices (CPM) can be used satisfactorily with people who are suffering from physical disabilities, aphasias, cerebral palsy as well as people with intellectual impairment.

Raven’s Progressive Motives or RPM was designed primarily as a measured of Spearman’s ‘g’ factor or general intelligence (Ravens, 1936). In keeping with spearman’s theoretical analysis of ‘g’ factor this test requires chiefly the relation among abstract item. RPM is deliberately designed to top reasoning and abstract conceptualization. The RPM is available in 3 forms differing in level of difficulty. The Standard Progressive Matrices or SPM (1996) is the form suitable for average individuals between the age of 6 and 80 years. An easier form is Colored Progressive Matrices (CPM) in 1990 is available for younger children and special groups, who cannot be adequately tested with SPM for differently abled. (Raven 1936) The third form is Advanced Progressive Matrices or APM (1994) was developed for above average adolescents and adults.

Once the intellectual capacity to reason by analogy has developed, the Standard Progressive Matrices (SPM) sets A, B, C, D and E is the most suitable scale to use. Before this stage of mental development reaches or in case where intellectual activity has become impaired, CPM can be used to access the degree to which a person can think clearly or the level to which his intellectual functions have deteriorated.

The 3 sets of 12 problems constituting the CPM are arranged to access the chief cognitive processes of which children less than 11 years of age are usually capable. The 3 sets together
provide 3 opportunities for a person to develop or consistent theme of thought and the scale of 36 problems as accurately as possible, mental development up to maturity.

Presenting the test as colored illustrations printed in a book or as bounds and movable pieces, makes the problem to be solved obvious, with the least possible verbal explanation.

Since, the present study concerns the differently able population; CPM is the apt test to use for the purpose of assessment of intellectual ability. Also, sometimes it is indeed difficult for the researcher to convey the test instruction to such population. The performance box of CPM consisting movable pieces is of great help to convey them the task to perform.

Score in the test is the total number of problems solved correctly when allowed to work quietly through the series from the beginning to the end. Here score 1 is abstained for every correct item. The summation of scores of each set is the total raw score.

From the obtained raw score, I.Q is derived from CPM table XIX and XX (Orme’s Extrapolated Norms; Board form).

Instruction for administrating the test was given in common language along with signs and gestures to make the subjects understand their task. Standardized instructions cannot be given (as stated in normal) because of their inability to understand and comprehend language.

**A comprehensive measure of executive functions: Tower of London (TOL; Culbertson & Zillmer, 2005)**

TOL is used as a holistic measure of executive functioning.

The origin of TOL suggests that, Shallice (1982) developed the Tower of London (TOL) task initially to measure planning and problem solving skills for the patients with damage to the
frontal lobes. They were presented with a model where three beads were strategically placed on three pegs having descending heights. The participants were then asked to perform the complex task of manipulating beads from a predetermined and pre-set ‘start position’ on a different arrangement of pegs to match the position of beads in the model. In Shallice’s study, problem solving ability was determined by the number of excess moves made on the TOL problems. That is, the number of additional moves above the minimum number of moves needed to solve the problem was the dependent measure of problem solving. Excess moves are inversely related to problem solving ability i.e. the larger the number of excess moves, the poorer the problem solving ability.

Some questioned the ecological validity of the TOL (Philips et al., 1999) but still it is widely used by many investigators to compare the problem solving and planning ability of individuals with genetic disorders (Azadi, Seddigh, Tehrani-Doost, Alaghband-Rad, & Ashrafi, 2009), in neurodevelopmental disorder (autism, attention-deficit hyperactivity disorder) and neurobehavioral development (Weinberger, Berman, Gold, & Goldberg, 1994), its integral role in the performance of everyday activities of living (Shallice & Burgess, 1991a) and its association to a number of developmental and acquired neuropsychological disorders (Anderson, Anderson, & Lajoie, 1996; Baker et al., 2001; Culbertson & Zillmer, 1998; Krikorian, Bartok, & Gay, 1994). Such derivations of Shallice’s original TOL have been created for the assessment accuracy of the deviant groups. Some researchers also used computerized versions of the TOL (Bugg et al., 2006; Ouellet et al., 2004). These tests are derived from several sources and standardized in to many versions namely:-

- a stand-alone test by William Culbertson and Eric Zillmer (published by Drexel University)
• a child/adolescent version that is part of the original NEPSY neuropsychological battery of tests by Marit Korkman, Ursula Kirk, and Sally Kemp (although removed from the second edition)
• a computerised variant, known as the Stockings of Cambridge test, is available as part of the Cambridge Neuropsychological Test Automated Battery (CANTAB).

In the current study the version of Tower of London\textsuperscript{DX} by William Culbertson & Eric Zillmer is used to assess EF has a holistic measure of EF. Culbertson and Zillmer modified the Shallice’s version of TOL to enhance the clinical utility as measure of childhood executive functioning (Culbertson and Zillmer 1998). The example of a goal state and the start position is as follows:

![Diagram of Tower of London DX](image)

\textbf{Fig.1 A sketch of Tower of London\textsuperscript{DX} Problem (Source: Culbertson and Zillmer 1998)}
Participants were presented with a prearranged sequence of three different colored beads on three different sized pegs. They were required to move the beads to match a goal state determined by the examiner and shown on a parallel board of pegs, in as few moves as possible and in accordance with pre-specified rules and time. Scores were recorded in record form provided for children and adults. There were 3 trial problems and 10 test problems. TOL scoring is done for seven dimensions viz.:-

I. Total correct t score
II. Total move score
III. Total initiation time
IV. Total execution time
V. Total time
VI. Total time violation
VII. Total rule violation

**Working memory**

Working memory involves the processes used to temporarily store and manipulation of information for a very short period. The following are the measures of WM as taken in the present study

**Visuospatial Working memory span test** is administered where the examiner taps to four blocks with a fifth cube and the subjects is required to repeat the same sequence of four taps as the examiner did. The tapping is performed in different sequence. This test is adopted from *NIMHANS Neuropsychological Battery for Children.*
**Mental flexibility**

Shifting refers to the ability to shift back and forth between tasks and mental sets (Miyake et. al., 2000). It is the ability to shift to a different thought or action according to changes in a situation. Poor mental flexibility (used here interchangeably with the term set shifting) is illustrated by perseverative, stereotyped behavior, and difficulties in the regulation and modulation of motor acts. Perseveration in autism has been attributed to a deficit in mental flexibility. One example of this is seen when performing the Wisconsin Card Sorting Task (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993; Nelson, 1976).

In this study, set shifting was evaluated using the:–

**Trail-Making Part B test** Trail-Making Test (TMT) was originally used in 1944 for assessment of general intellectual and was incorporated in the Army Individual Test of General Ability (Tombaugh, 2004). Later in 1950s, the test was included Halstead Reitan Battery (Tombaugh, 2004) since many researchers (Reitan, 1958) researchers used the test to assess cognitive dysfunction due to brain damage. The Trail Making Test is now chiefly a neuropsychological test commonly used as a clinical diagnostic tool. It mainly tests visual attention and task switching performance. Poor performance is known to be associated with many types of brain impairment, in particular frontal lobe lesion.

As a child connects the dots puzzle, TMT is of similar kind of task to connect a sequence of 25 consecutive targets. There are two parts in the test: in the first part (Part A), the targets are all numbers (1, 2, 3, etc.) and the test taker needs to connect them by a pen/pencil on a sheet of paper or computer screen in sequential order; in the second part (Part B), the subject alternates between numbers and letters in ascending order (1, A, 2, B, etc.) (Bowie & Harvey, 2006). The
test administrator corrects the error if it is made by the test taker, before he makes the next move in the target dot (Bowie & Harvey, 2006).

TMT is basically a speed test where the test taker’s goal is to finish both parts as quickly as possible and the time of completion is the measure and primary performance metric. The error rate made by the test taker is not recorded separately in the paper and pencil version of the test neither it is a measure but however the assumption is that if errors are made it will be by default reflected in the completion time of the test (Tombaugh, 2004).

Part A of the test primarily determines the cognitive processing speed and Part B of the test measures the executive functioning (task switching and mental set shifting) (Tombaugh, 2004). The TMT administered can be scored by both a cut-off score (Reitan & Wolfson, 1993) or a standard norm. In the present study, the norm was referred.

Literature suggests that individuals with autism showed a deficit in this test in comparison to a group of normal control men matched for age, IQ, and education level (Rumsey & Hamburger, 1988).

**The tools used for training sessions:**

*For working Memory: (a) Object span task and (b) Picture span task*

Memory span is the ability to hold the longest list of items that an individual can reproduce in correct sequence immediately after presentation on 50% of all trials. In Psychology and Neuroscience it is widely used for research purpose. The items required to hold may include words, numbers, letters, pictures, objects and sequences of blocks etc. Memory span is a sort of common measure of short term memory.
Memory span tasks have been of great help as a supportive of phonological loop as a part of working memory since the formulation of Baddeley and Hitch Model of Working Memory (Baddeley et al., 1998; Baddeley, 1996). Briefly, according to this theory working memory is under the in control of chiefly 3 mechanisms: the visuospatial sketchpad, the central executive, and the phonological loop. The phonological loop deals with sound or phonological information. It is having a phonological store and articulatory rehearsal component that facilitates learning and memory by storing information in the former and rehearsing it in the later (Karatekin & Canan, 2004). Items having more similar feature are difficult to remember and it is called the phonological similarity effect. Likewise, the more dissimilar the items are in a list, the easier and smoother it is to recall them. (Chow et al., 2016).

There are a number of determinants affecting memory span viz. extrinsic and intrinsic factors. Extrinsic factors involve those factors present in the testing situation itself. These factors are needed to be controlled otherwise it may foster statistically inaccurate and unreliable results. Other factors are intrinsic factor (e.g. age) that pertains to the individual, and these factors which are the basis of "true" memory span.

Ideally in a typical test of memory span, a list of random numbers or letters are verbally read out loud or simply visually presented on a computer screen at the rate of one per second. Initially the task begins with two to three numbers, increasing one at a time until the person produce it in incorrect sequence and commits errors. The predictable patterns and recognizable patterns are usually avoided. At the end of the presentation of a sequence, the person is asked to recall the items in order. The average digit span for normal adults without error is 7(+- 2) (Miller 1956.)
In the present study objects and pictures are used instead of random number and letters. This is to seek attention of the participants with autism and borderline intellectual impairment. Pictures and objects are more attractive and vivid than words itself.

(a) Object Span: Models of different fruits, vegetables and animals were used for intervention. The models were made up of clay and plastic materials. These colorful and attractive models were very commonly used for teaching children names of the object.

(b) Picture Span: Cards were made with different pictures of fruits, vegetables and animals which were used for intervention.

For set shifting training (a) mazes and (b) color shape sorter

(a) Mazes were used similar to that of Porteus maze for intervention. Arrangements were so made by the piece of wood so that one path can be easily blocked once the mental set is established. The participants need to change the mental set to shift to the next path to reach the goal. In august 1914 the Maze series was first described at the Melbourne meeting of the British Association for the advancement of science. Since 1913 the maze series and Goddard Revision of the Binet-Simon Scale having been struggling together for the purpose of meeting the problem of the more accurate diagnosis of feeblemindedness. Several hundred children had been examined in the ordinary school classes and segregated on the basis of their performance on the Goddard Revision of the Binet-Simon scale. In special educational efforts, it was observed that their classification by Binet mental age did not reflected adequately their practical intelligence. Lack of ordinary prudence and planning capacity distinguished the feeble-minded just as much as did poor memory, insufficient common knowledge or restricted vocabulary. In addition the scale was a verbal facility and practice performance was not closely related. The writer therefore
began experimenting with other test approaches. Maze-threading seemed to examine, best of all, certain socially essential traits or abilities not covered by the Binet scale. The test designs as first published went only high as twelve and thirteen years, in which three trials were allowed. In 1918 a study reported correlations between Maze and Goddard-Binet of 0.7 for 200 mental defectives, 0.69 for 190 normal children. For 263 normal children examined by the Stanford Binet revision the coefficient was by 0.77. In 1919 the writer went from the University of Melbourne to direct the psychological laboratory at Vineland, New Jersey, succeeding Dr. H.H Goddard. This standardization was test by Professor Cyril Burt in London in 1921. The table of norms compiled by him showered that, with the exception of five, six and fourteen, the tests were well standardized. In 1924 a guide book was issued by the writer containing two adult mazes and a guide book was issued by the writer containing two adult Mazes and modifies scoring system. The form of the test now in use was published in 1941 the writer pointed out how essential planning and pre-rehearsal are to every intelligent act. Until the activity becomes automatic through repetition this pre-rehearsal and choice of alternatives is chrematistics of speech, literary composition, painting, solution of mathematical problems, engineering, social adjustments, mechanical operations, and so on through the whole list of humanly adjusted conduct. All mental tests therefore require planning, but the Maze is the most specific test of planfulness, especially at the level of social sufficiency.

In this test, the first 5 Mazes with increasing difficulty were selected. It was prepared with pieces of woods and the Maze path was prepared according to the manual. There were two openings in the maze so that two paths can be found out. Arrangements were so made by a piece of wood so that one way can be easily blocked when required. The participants need to change the mental set to shift to the next path to reach the goal. The maze design can be as follows:-
(d) **Color shape sorter:** Color shape sorter was used for intervention. It consisted of numerous different colored shapes of many types, viz. circle, triangle, square etc. This type of tool was usually very common for teaching children color and shapes.

It consists of two sets.

**I\(^{st}\) SET:** It consists of 6 shapes; each shapes having different 6 colors. (Viz. squares, rectangles, diamond, equilateral triangles, isosceles triangles and plus, while each of the shapes us in the following colors- red, blue, black, green, yellow and pink). There was a tray containing 6 rows and 6 columns making 6 cells. However for the present study, four of each shape with each colour yellow, red and blue is taken. Thus, 72 objects of this kind were taken.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Squares</th>
<th>Rectangles</th>
<th>Diamonds</th>
<th>Equilateral triangles</th>
<th>Isosceles triangles</th>
<th>pluses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Red</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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</tr>
<tr>
<td>Blue</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td>4</td>
</tr>
</tbody>
</table>

![Fig.2 MAZE 1(Similar to Porteus Maze)](image.png)
2nd SET- It consists of hexagon, trapezoid, octagon, and triangle, oval shapes of colors red green and blue yellow. These were to be arranged in a tray having five horizontal parts.

Pictures of the tools are provided in appendices.

**Procedure**

The participants were selected from some institutes in Kolkata where special education and training was provided to persons with differently abled. Beforehand, permission was taken from the institutes and special educators and the purpose of the research was conveyed. Consent was also taken from the participant’s parents/guardians, because of the subject’s inability to provide the consent properly.

Rapport was established with those participants in initial sessions. Either the data were collected in the institute itself in clinical setting or in home where formal setting is made prior to data collection. Detailed case history was taken from the institute case record and in some cases from the parents. The data were collected in one to one interaction between the researcher and the participant.

The study consisted of pre-training; training and post training sessions.

**Pre-training session:-**

- CPM was conducted to measure intellectual ability of the participants by performance box of colored progressive matrices.
- Tower of London (TOL) was administered for a comprehensive evaluation of executive functioning of both the groups. The task was to move and fix the beads strategically on
the pegs in order to accomplish a pre-arranged goal state. The TOL literature has consistently linked a wide array of executive functions such as response inhibition, working memory, and shifting. (Miyake et. al., 2000, Bugg et. al., 2006).

- For mental set shifting task, Trail Making Test (part B) was administered to elicit the mental shifting ability of the participants. The participants connects the numbers(1 to 13) with a pencil in ascending order with the added task of altering between numbers and letter( A to L) without lifting the pencil from the paper.

- Visuospatial Working Memory test i.e. Block Span test was the administered where the examiner pointed to four blocks and the subjects have to point to the block in the same sequence the examiner did.

**The training session**

Training sessions were conducted in one to one interaction and each task was preceded by practice trials to ensure participants comprehension of task instruction. Intervention of executive functioning focuses on improving the executive functioning of the individual (Dawson & Guare, 2004). Here in the present study the training sessions were conducted in fixed trials (refer the Table A) to complete each of the task given related to the variables of EF selected in the present study.

**Training of Working Memory:** Working memory was exercised through practicing object span and picture span. 3 objects and 3 pictures were selected to start with. The participants were shown 3 of them one by one at a time in a particular sequence. Next the participants were instructed to reproduce the same sequence and arrange the picture cards and objects. Fruits, vegetables and animals were selected in both object span and picture span. The trials were
continued till the successful completion of the task but discontinued when the optimum trial number is reached even if the given task was not completed till then. Once the sequence was successfully reproduced the next sequence was introduced increasing the number of object and picture by one.

Three series of object span and three series picture span were selected with one increasing number of object and picture respectively.

Series a

Series b

Series c

For each series, 10 trials were fixed. In a single session all the three series were exercised. The sessions were repeated for the twice or thrice a week. The total number of sessions that were given to them varied from participant to participant on the basis of successful completion of the task. Approximately, each participant was given 10 to 12 sessions for object span and picture span task.

Training of mental set shifting:

- 5 mazes with increasing level of difficulty were given to them one after another. In each maze, on one opening a chocolate or potato chips were kept. The mazes (similar to those of Porteus maze) contain two alternative paths to reach a goal point. The subject was asked to reach the goal point (the chocolate/ chips) by index finger by a particular path. After this phase, the path by which s/he reached was blocked by a piece of wood. The participant needed to shift the path and reach the goal point keeping in mind that they
cannot jump the obstacle. Many of them can shift to the other path to reach the goal with minimum effort while many of them cannot shift the path and even after much persuasion. This gives the idea of flexibility i.e. shifting ability which is a component of executive functioning. Trials were taken until the alternative path was being shifted; in many a cases the participants were shown the alternative paths. The problem for which the subject faced difficulty i.e. made errors (jumping the obstacle, cannot able to shift the path) was taken as trainable problem. The number of training session were ‘up to the criterion level’ for each problem but not more than 10 to maintain the time limit of the study as well as to overcome boredom both on the part of the trainee and trainer. There were total 5 mazes and 10 trials were fixed for each of the mazes. In a single session all the mazes were provided to them. The sessions were repeated thrice a week. The total number of sessions given to them varied from participants to participants. Here, they required more sessions than the other intervention.

- Colour shape sorter was used for sorting the shape wise pattern and then the colour wise pattern. A particular pattern, shape wise was shown where the participant needed to sort the shape in the given the pattern. In next set the pattern was altered into colour wise pattern and the participants were instructed to alter the pattern. In most cases the participants failed to shift the set and were shown to do so.

There were 4 sets of patterns; 2 colour wise pattern and 2 shape wise pattern. Trials were fixed for each pattern, 10 trials each set. The sessions were repeated thrice a week. The total number of sessions given to them varied from participants to participants. Approximately, each participant was given 10 sessions for this task.
The training sessions were continued for 45 days to 60 days intermittently for each of the participants. After a month gap (30 days gap) post training measures were taken considering the dependent measures.

**Post training session**

The post measures taken were the repetitive measure of those taken in pre-training sessions by re-administration of the tests after the termination of training session. TOL, TMT (Part B), and Visuospatial Working Memory Test were re-administered to each participant a time gap of minimum 2 and half months to 3 months(approx.) between pre and post measure.
### TABLE A

Tests and tools; trials and re-administration

<table>
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<tr>
<th>STANDARDISED TESTS</th>
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<th>RE-ADMINISTRATION</th>
<th>SESSIONS</th>
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<tr>
<td>CPM</td>
<td>Intelligence Level</td>
<td>-</td>
<td>Single session</td>
</tr>
<tr>
<td>TOL</td>
<td>Composite measure of Executive Function</td>
<td>After 1 month of the termination of training</td>
<td>2 sessions(pre-post)</td>
</tr>
<tr>
<td>TMT(Part B)</td>
<td>Mental set shifting</td>
<td>After 1 month of the termination of training</td>
<td>2 sessions(pre-post)</td>
</tr>
<tr>
<td>Block Span(NIMHANS)</td>
<td>Visuospatial Working Memory</td>
<td>After 1 month of the termination of training</td>
<td>2 sessions(pre-post)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOOLS</th>
<th>USED FOR TRAINING</th>
<th>FIXED TRIALS PER SESSION</th>
<th>SESSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object span</td>
<td>series a</td>
<td>Working memory</td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>series b</td>
<td></td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>series c</td>
<td></td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>series a</td>
<td>Working memory</td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>series b</td>
<td></td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>series c</td>
<td></td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td>Mazes</td>
<td>Maze I</td>
<td>Set shifting</td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>Maze II</td>
<td></td>
<td>10 trials in a single session</td>
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<tr>
<td></td>
<td>Maze III</td>
<td></td>
<td>10 trials in a single session</td>
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<tr>
<td></td>
<td>Maze IV</td>
<td></td>
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<tr>
<td></td>
<td>Maze V</td>
<td></td>
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<tr>
<td>Colour shape sorter</td>
<td>Set 1</td>
<td>Set shifting</td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>Set 2</td>
<td></td>
<td>10 trials in a single session</td>
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<tr>
<td></td>
<td>Set 3</td>
<td></td>
<td>10 trials in a single session</td>
</tr>
<tr>
<td></td>
<td>Set 4</td>
<td></td>
<td>10 trials in a single session</td>
</tr>
</tbody>
</table>
Data Analysis

The study comprises of pre-training and post training data sets of the participants. The data obtained were treated in 4 forms.

Firstly, an attempt has been made in TOL profiling of the participants where the pre-training data of TOL are considered for statistical treatment. This is done to reflect the extent to which the participants with autism and those with borderline intellectual functioning (BII) are deviant in TOL performance from the given norm. For this, Table 4.2(TOL$^{DX}$) has been referred and further the individual scores of the participants are shown in bar graphs in respect to their respective norm at per their age. This gives an idea about their baseline measurement of executive function in TOL and their deviations from norm in a glimpse.

Similarly, the baseline measure of their performance in TMT test and NIMHANS block span test were also displayed in bar graphs relating to the respective norms of the test.

Next, a direct comparison is quantified between the two group’s baseline pre-training performances. For this, Mann Whitney U test is applied to TOL measures, TMT measures and Block span measures obtained in pre-training session.

In the next step, the pre-post measures of the autism group and the BII group are treated with Wilcoxon Signed Rank Test to elicit if there is any significance of the training in between pre and post measures of the individual groups.

Finally, Ipsative assessment is made between the scores of the pre and post measures obtained in all the three tests. For this the ipsative or the difference value between the pre and post measures of the two groups are evaluated to elicit the gain or the increase in their EF skills from the training given to them. Further Mann Whitney U test is applied between the two group’s Ipsative values to study the difference in their procurement or obtainment from the training.