CHAPTER 14

A CHECKLIST FOR EVALUATING EXECUTIVE FUNCTIONING IN CHILDREN WITH DEVELOPMENTAL DISABILITIES

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INTRODUCTION

Over the years, the assessment of neuropsychological constructs, specifically executive behaviour checklists, have contributed greatly to understanding, and evaluating the various executive functions (EF). However, most assessment tools focus on some specific areas of executive functions instead of an overall assessment for each sub-specific area, identifying a major gap in the assessments available for executive functioning. Moreover, when it comes to testing the Indian population for this construct, firstly, the population the paper focuses on is specific, i.e. children with developmental disabilities between the ages of eight to fifteen years; secondly, a test specifically developed to assess executive functioning for Indians. Hence, to further this purpose, this study explains the development process of a new checklist for executive functioning.

Executive functions are a set of cognitive skills that are used to learn, work and manage everyday life, which, when it comes to children with developmental disabilities, are observed to be dysfunctional. Executive functioning involves a set of top-down mental skills which helps in memory, thinking, and control. Some people describe executive functioning as "the management system of the brain" as they help set goals, plans and get and things done. According to experts, all the skills can majorly be classified under three important domains of executive functioning called inhibitory control, working memory, and flexible thinking.

Some warning signs that a child may have problems with executive function include problems with:

- Planning projects
- Estimating how much time a project will take to complete
- Telling stories (verbally or in writing)
- Memorizing
- Starting activities or tasks
- Shifting plans when situations change

- Focusing only on one task
- Shutting down when parents or peers don't act as expected

Professionals and scholars alike have been interested in early identification and interventions for EF deficits for many years, because impairments in EF are seen as characteristic of individuals with Autism Spectrum Disorder (ASD), highlighting that individuals with Intellectual Disability, Autism Spectrum Disorder, Attention-Deficit/Hyperactivity Disorder commonly experience executive functioning deficits (Benallie et al., 2021; Robinson et al., 2009; Panerai et al., 2014).

Poor EF is a significant clinical health issue not only due to its prevalence in neurological injury and disorder, but also due to the influence of poor EF on academic outcomes such as memory problems, educational failure (Barkley, 2012) and learning disabilities (Jerman, Reynolds, & Swanson, 2012). EF delays, as well as disorders characterized by poor EF, are commonly associated with academic underachievement, learning deficits, and related problems with learning and memory (Barkley, 2012).

Many researches have drawn a parallel between a deficiency in executive functions and developmental disabilities i.e. autism spectrum disorder, learning disability, intellectual disability, attention deficit hyperactivity disorder, downs syndrome, stating that a deficiency of executive functioning in individuals with developmental disabilities can be targeted for intervention and treatment plans.

Assessment of executive functioning using checklists

One of the first questionnaire-based measures of EF was the Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia et al., 2000), recently revised as the BRIEF-2 (Gioia, Isquith, Guy, & Kenworthy, 2016). The BRIEF and BRIEF-2 forms are parent-, teacher-, and self-report behavior checklists for children and adolescents. BRIEF-2 EF subscales assess areas including inhibition, self-monitoring, shifting, emotional control, initiation, task completion, working memory, planning/organizing, task monitoring, and organization of materials. In addition to the BRIEF, other checklist measures of EF exist, including the Comprehensive Executive Function Inventory (CEFI, for children aged 5 – 18 years; Naglieri & Goldstein, 2013) and the Barkley Deficits in Executive Functioning Scale (BDEFS for adults; Barkley, 2011b; BDEFS-CA for children and adolescents; Barkley, 2011a). The CEFI measures EF domains such as attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory. The BDEFS measures EF in daily life activities such as time management, organization and problem solving, self-restraint, self-motivation, and self-regulation of emotions.

Assessment of executive functioning in India

There is no tool that separately or comprehensively assesses global executive function for the Indian population, as has been established above, however, there are Indian adaptations of the same available for different age groups.

A Hindi version of Behaviour Rating Inventory of Executive Function-Adult Form (BRIEF-A) was translated by Yadav & Singh (2021) for adults ages 40 to 60 years, hence, establishing that BRIEF can be used with the Indian adult population.

Another relevant study was carried out by Selvam et al (2018) in which they developed norms for children aged 2 to 5 years old using the Behavior Rating Inventory of Executive Function – Preschool Version (BRIEF-P) for use with Indian preschool population.

To test the executive functioning and social skills in children with autism in India, the study conducted by Ghosh et al (2020) used a variety of different tests to assess different components of EF i.e., Color Trail Test, Animal Cancellation Test, Design Fluency Test and Maze Test.

The above studies further our purpose in developing a standardized tool developed for the Indian population, specifically for children aged 8 to 15 years. None of the above norms of BRIEF could be used for the population of this study and hence, developing a global executive functioning assessment is an essential component in this field's assessment and intervention plans.

A new checklist to assess executive functioning: The Executive Functions Assessment Checklist for Children with Developmental Disabilities (EFAC-CDD)

The executive Functions assessment checklist for children with developmental disabilities (EFAC-CDD) is developed to assess the executive functioning level of children with developmental disabilities across different domains of executive functions. For assessment of executive functions, domains; Sub-domains and set of skills have been developed. The set of skills could be used for program planning and providing intervention in different Domains and sub-domains of executive functions. In view of non-availability of checklist or any assessment tools with an Indian standardization, for the purpose of assessing the level of executive functioning of children with developmental disabilities; the EFAC-CDD can be used by special educators, occupational therapists, psychologists, behavioral therapist and other allied professionals working for children with developmental disabilities. The checklist will be able to guide them to assess and to plan for intervention of children with developmental disabilities.

The dimensions of the checklist that are assessed by the EFAC-CDD are as follows:

- Working Memory – It involves processes holding/retaining small amounts of or temporary information that helps us is accomplishing tasks. Doing mathematical operations, translating instructions, and working with language, all require the use of working memory.
- Impulse Control – It involves the ability to control one's attention, behavior, thoughts, and/or emotions to override a strong internal predisposition (an impulse) and instead do what's more appropriate or needed. This is commonly known as "thinking before acting".
- Planning – It involves the ability to create a plan or a roadmap to reach a goal. Completing tasks requires the ability to have a mental plan in place so that things get done.
- Mental Flexibility – It involves the ability to change perspectives and be flexible enough to adapt according to the situation or circumstance demands.
- Attention – It helps us to focus on tasks, ignore distractions, and resist impulsive behavior.
- Action Monitoring – It is the ability to monitor one's own behaviour involving controlling impulses and emotions, staying on task, keeping belongings organized.
- Problem Solving – It involves the capacity to identify, describe a problem, and generate ideas to overcome or fix it.
- Emotional Control – It involves how we manage and respond to emotional experiences in the environment, particularly stressful ones.
- Time Management – It is the ability to plan and organize one's time in an efficient manner which helps in achieving goals and maximizing productivity.

The present paper describes the development of the EFAC-CDD as a checklist measure of EF that helps to assess an extremely broad set of EF components, and its pilot study tested on a sample, the first assessment on EF developed in India.

METHODOLOGY

Scale/Item Development

The baseline of the checklist was based on the various domains present in the BRIEF, intelligence tools and cognitive functioning questionnaires. A team of advisers, experts from the subject area of executive functioning as well as developmental disabilities provided their feedback, which was henceforth incorporated in improving the efficacy, reliability and validity of the tool.

Executive functioning is an immensely broad concept; hence, specific domains were selected to be tested for a child with a developmental disability. The specific domains of concern are specifically listed in TABLE 1.1 below.

The sub-domains under each domain were the skills on which a child would be tested were taken from a variety of intelligence tests, performance test and functioning tests under specific executive functioning domain for a broad, well-designed spectrum of relevant items or skills for a child's functionality to be assessed in an appropriate manner. The tests that were used as reference include:

- Stroop Color Word Task – Measures the ability to inhibit, responses, resolve interference and behavioral conflict.
- Go – No Go Task – measures an individual's attention, flexibility of responding and ability to withhold a response.
- Stop-Signal Task – measures an individual's ability to stop a response that is already underway.
- Wisconsin Card Sorting Test – assesses an individual's ability to test hypothesis and flexibility through color matching, shape matching and number matching.
- Tower of Hanoi – measures an individual's ability to plan ahead.
- California Verbal Learning Test – assesses an individual's working verbal memory.
- Children's Memory Scale – measures learning in a variety of dimensions including attention and working memory.
- Color Trails Test – assesses sustained attention.
- Lumosity – includes five types of game categories based on flexibility, speed, memory, attention and problem solving.
- Wechsler Intelligence Scale for Children – measures a child's intellectual abilities via verbal comprehension, perceptual organization, freedom from distractibility and processing speed.
- Universal Nonverbal Intelligence Test – measures a broad range of complex memory and reasoning ability, both symbolic and non-symbolic.
- Malin's Intelligence Scale for Indian Children – the Indian adaptation of WISC tests the same dimensions i.e., verbal and performance functioning.

In a sub-domain, the skill that is being tested was designed such that each skill would have 8 items that increase in level of complexity, in order to establishing the functionality level through a percentage calculation. Each particular item has 3 trials, that is observed to be essential when it comes to testing a child with developmental disability.

Specific information for development of each domain and sub-domain is as follows:

I. WORKING MEMORY

The working memory domain assesses short-term recall (auditory digit spell, letter spell), visuospatial memory (odd one out,), symbolic memory (card matching game) as well as delayed recall and recognition (find the pair, summarizing the story and add-on words to category). Herein these specific items give an accurate

representation of whether the child is able to perform said task or needs assistance in further development of the skill. Below is an example of auditory letter spell, find the pair and odd one out items.

Figure 1.1 Auditory Letter Spell, 2 items with 3 trials each.

Sub-domain	Items
Up to 3 Letters	(H,W,T) (G,K,L) (Y,U,O)
Up to 4 letters	(T,L,K,W) (G,O,P,A) (Y,E,Z,X)

Figure 1.2 Odd One Out, 1 item with 3 trials.

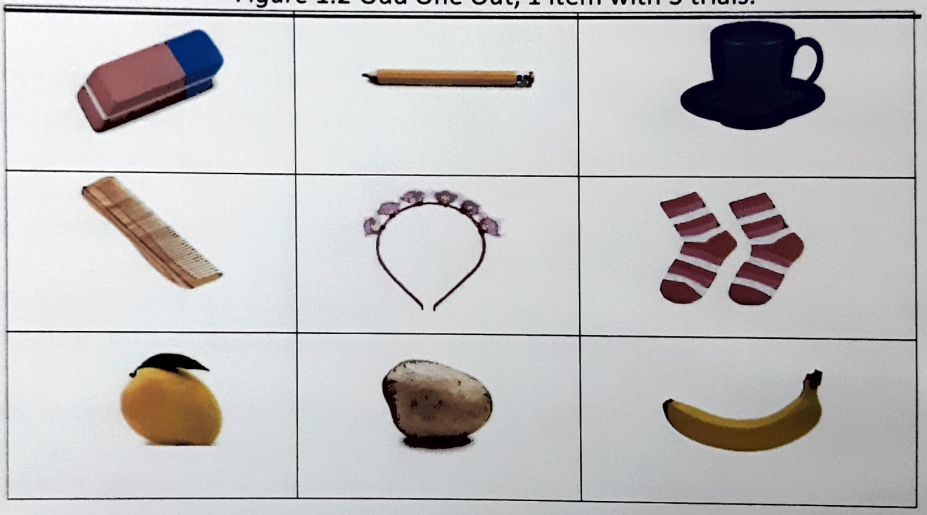
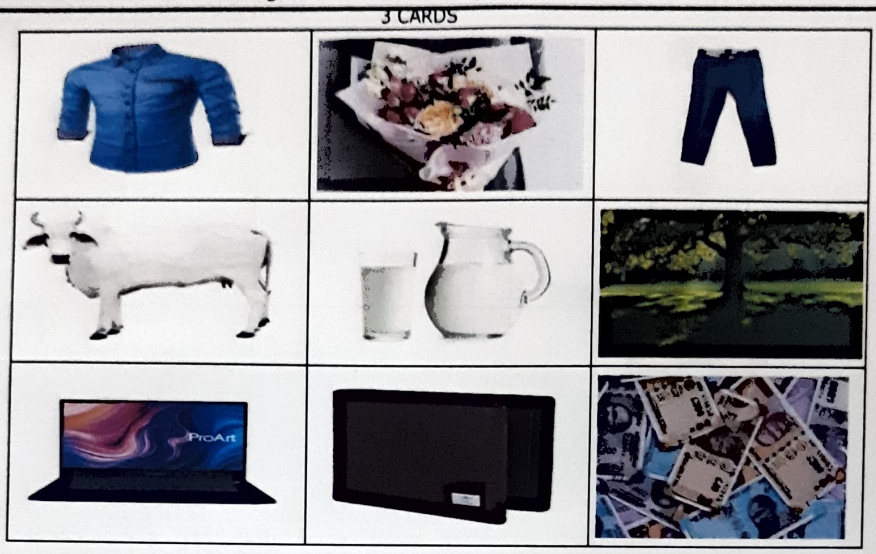


Figure 1.3 Find the pair, 1 item with 3 trials.



IMPULSE CONTROL

The Impulse Control domain measures the child's ability to control an impulse, interference control and inhibition through a folk game called "Chidiya ud", also known as "Does it fly?", jump in jump out game, and random letter cancellation which increase in level of complexity with each item, a sample of the same is given in the figure below.

Figure 1.4 Chidiya ud game, item number 2, with 3 trials.

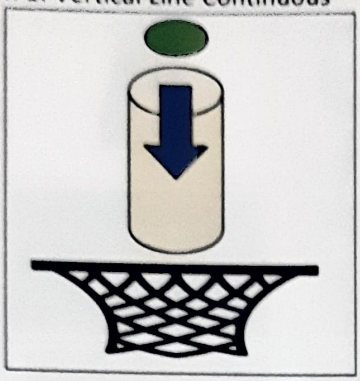
Duck fly	**Tiger fly**	**Balloon fly**	**Owl fly**
Peacock fly	**Butterfly fly**	**Helicopter fly**	**Monkey fly**
Dettol fly	**Woodpecker fly**	**Ladybug fly**	**Crow fly**

II. PLANNING SKILLS

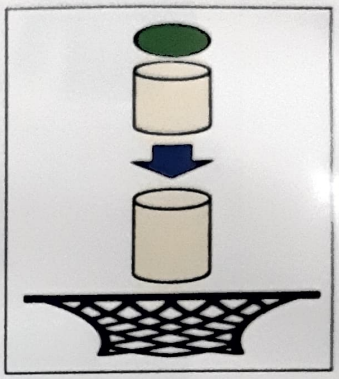
The Planning skills domain assess concentration, perception, memory, reasoning and coordination through Jenga, find the key, block building and net the ball, a sample of the same is given in the figure below.

Figure 1.4 Net the Ball item number 1 and 2

Item 1: Vertical Line Continuous



Item 2:Vertical Line Discrete



III. MENTAL FLEXIBILTY

The Mental Flexibility domain assesses attention, detection, inhibition, working memory and switch process through read and clap, follow and underline the pattern, and watch the color and tap, a sample of the same is given below.

Figure 1.5 Read and clap item number 1, 2, 3

READ AND CLAP

H	C	O	K	E	R	L	M	P	H	D	J
S	W	Y	V	J	B	X	Z	U	W	V	M
N	I	B	M	O	S	C	N	K	P	G	R
U	T	Q	F	A	W	Y	A	B	Y	Q	T
D	X	Z	R	F	E	D	I	Y	E	V	S
P	G	L	A	T	C	W	E	H	L	F	U

CLAP WHEN YOU READ O

T-1 (A)	T-2	T-3	Remarks	Total Score

CLAP WHEN YOU READ A & F

T-1 (A)	T-2	T-3	Remarks	Total Score

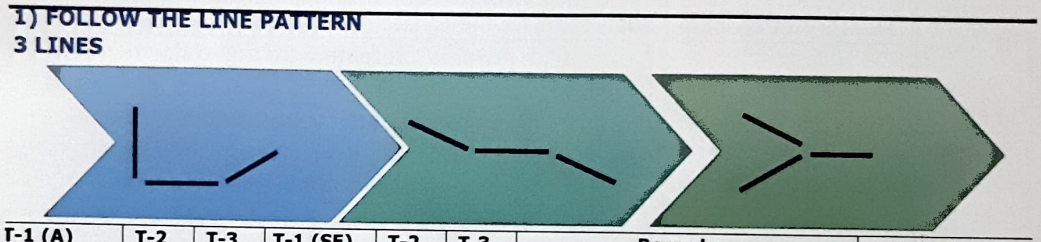
CLAP WHEN YOU READ T, R & B

T-1 (A)	T-2	T-3	Remarks	Total Score

IV. ATTENTION

The Attention domain assesses executive, selective, divided and sustained attention through follow the line pattern, imitate physical action, pattern walking, track the ball below the cups, and coloring game, a sample of the same is given below.

Figure 1.6 Follow the line pattern item 1, 2 with 3 trials each



T-1 (A)	T-2	T-3	T-1 (SE)	T-2	T-3	Remarks	Total Score

ACTION MONITORING

The Action Monitoring domain assesses self-monitoring through find the difference, sort the items, and color coding sub-domains, a sample of the same is given below.

V. PROBLEM SOLVING

The Problem-Solving domain assesses the ability to identify a problem and come up with ways to solve it, through the tasks mazes, crossword puzzles, tangrams, finding a solution to a narrated problem, a sample of the same is given below.

VI. EMOTIONAL CONTROL

The Emotional Control domain assesses the ability to recognize, understand and manage emotions in our environment through knowing one's emotions, and knowing others' emotions, a sample of the same is given below.

VII. TIME MANAGEMENT

The Time Management domain assesses understanding, performing tasks while prioritizing and postponing specific tasks according to importance, setting a routine through identification of priority of task, a sample of the same is given below.

Table 1.1 – Domain details and item description

Domain	Sub-domain	Item Description
Working Memory	Auditory digit spell	A set of orally presented number sequences which the individual repeats in verbatim for digits forwards. The complexity of the digits forwards increases at each level but is same for the consecutive 3 trials.
	Auditory letter spell	A set of orally presented letters sequences which the individual repeats in verbatim for letters forwards. The complexity of the letters forwards increases at each level but is same for the consecutive 3 trials.
	Odd one out	A series of pictures presented to the child in paired images in each set where the child has search for the odd one out. The complexity of the paired images increases at each level with the increased number of paired images to choose from but is same for the consecutive 3 trials.
	Card matching games	A series of images are presented to the child where they need to search for the image which is similar to the image presented from the set at each level. The complexity of the similar images increases at each level with the increased number of images to choose from but is same for the consecutive 3 trials.
	Find the pair	A Series of pictures presented to the child for them to find the paired images in each set. The complexity of the paired images increases at each level with the increased number of images to choose from but is same for the consecutive 3 trials.
	Summarize the story	At each level the child is presented with a story within the paradigm of a fixed number of sentences. In each set of stories there is a set of keywords which demarcated the standard for summarizing the story as verbatim is not a mandate for this section. The complexity of the stories increases at each level with the increased number of sentences as well as demarcated keywords but is same for the consecutive 3 trials.
	Add on words to category	The child is presented with a set of words in a specific category to which the child has to add another word from the similar category to accomplish the task. The complexity of the number of words increases at each level but is same for the consecutive 3 trials.
Impulse Control	Chidiya ud game	In this game the examiner as well as the child both place their index finger of one hand against the flat surface i.e., table, floor etc. As the examiner read out the names from the category for 3 trails at different levels, they raise the finger for every item/ component that can fly. If they raise their finger for an item that cannot fly its an

		incorrect response and vice a versa. The complexity of the item's increases at each level but is same for the consecutive 3 trials.
	Jump in and jump out game	In the beginning of each trial the child has to stand inside the circle post it the examiner can give the instructions for each level. Each time the child does the action opposite to what the examiner instructs to do would be scored as incorrect and vice versa. The complexity increases as the number of instructions are increased at each level but is same for the consecutive 3 trials.
	Random letter cancellation	At each level for the 3 trials the child is instructed to cancel the letters from the paragraphs presented to them. After completion of each paragraph the examiner checks if all the instructed letters are cancelled if not then the attempt at that specific trail is recorded as incorrect and vice a versa. The complexity increases as the number of letters to be cancelled increases at each level but is same for the consecutive 3 trials.
Planning Skills	Jenga	For each level the examiner instructs the child to remove the number of specific Jenga blocks as part of each trial. If during any of the trials the Jenga tower falls apart it would be incorrect attempt and vice a versa. The complexity increases as the number of blocks to be removed increases at each level but is same for the consecutive 3 trials.
	Find the key	At each level a different set of lock and key is presented to the child in which the child needs to follow the instructions to match the lock with the keys for each trial. The complexity increases as the number of keys to match increases at each level but is same for the consecutive 3 trials.
	Block building	The child is given blocks post which they are supposed to build the blocks as described in the EF booklet and instructions from the examiner. The complexity increases as the number of blocks, floor and color increases at each level but is same for the consecutive 3 trials.
	Net the ball	In this section the child is given a ball which they are supposed to pass through all the phases as instructed. Any attempt to do so till the end of the activity will be accounted as an incorrect response and vise a versa. The complexity increases as the number of blocks to be removed increases at each level but is same for the consecutive 3 trials.
Mental Flexibility	Read and clap	The child is presented with a list of alphabets then they are instructed to read then clap after each attempt of reading the letter out loud. If the child missed to clap

		after reading each letter out loud it would be an incorrect response and vice a versa. The complexity increases as the number of letters to read and clap increases at each level but is same for the consecutive 3 trials.
	Follow and underline the pattern	There are some patterns/ figures that are presented to the child post which they underline the pattern. If they are unable to underline the pattern/ figures it would be counted as an incorrect response and vice a versa. The complexity increases as the number of patterns to underline increases at each level but is same for the consecutive 3 trials.
	Watch the color and tap	At each trial the child is instructed to read the alphabets then tap on the color mentioned at each level. If the child taps on the wrong color after reading the alphabets it is an incorrect response. The complexity increases as the number of colors to read then tap increases at each level but is same for the consecutive 3 trials.
Attention	Follow the line pattern	The child is presented with a pattern of line at each level for all the trials. If the pattern cannot be copied as presented in the pattern it would be counted as an incorrect response and vice a versa. The complexity increases as the number of line-based patterns to be follow increases at each level but is same for the consecutive 3 trials.
	Imitate physical action	In this section the child is instructed to follow a series of physical action for each trial. If any of the steps of physical imitated is not done as instructed it is considered as an incorrect response and vice a versa. The complexity increases as the number of actions to imitate increases at each level but is same for the consecutive 3 trials.
	Pattern walking	The child is instructed to walk in a pattern for each trial at all level. If the pattern walking is not done as instructed it would be counted as an incorrect response and vise a versa. The complexity increases as the patterns to walk increases at each level but is same for the consecutive 3 trials.
	Track the ball below the cups	The ball is hidden under one of the cups then rotated or swapped at each trail for each level. If the child in unable to tell under which cup the ball is hidden after the rotation/ swapping its counted as a incorrect response and vice a versa. The complexity increases as the number of cups increases at each level but is same for the consecutive 3 trials.
	Coloring game	In each of the trial the child is presented an image then instructed to color the image without any episode of the coloring being done outside the figure. If the child colors

		outside the lines of the image it would be considered as an incorrect response and vice a versa. The complexity increases as the lines inside the image to color increases at each level but is same for the consecutive 3 trials.
Action Monitoring	Find the differences	The child is presented with two similar images at each level where they have to spot the differences in the similar images at each trial. If the child is unable to spot all the differences in each trail it is considered as an incorrect response and vice a versa. The complexity increases as the number of differences to be find in the similar images increases at each level but is same for the consecutive 3 trials.
	Sort the item	At each level the child is given a mix of items mentioned in the EF booklet post which they are instructed to sort the item and keep separately. If the child is not able to sort each item separately it would be considered as an incorrect response and vice a versa. The complexity increases as the number of items to be sorted increases at each level but is same for the consecutive 3 trials.
	Color coding	In each of the trial the child is instructed to find out the color code i.e., the spelling of the color has to be same as the color itself. If the child is able to detect the wrong color coding in contrast to correct color coding it would be a correct response and vice a versa. The complexity increases as the number of colors with correct / incorrect color code increases at each level but is same for the consecutive 3 trials.
Problem Solving	Mazes	When the child is presented with a maze for each trail, they are instructed to enter the maze from the entry point then find their way through the maze to the exit point. If the child is unable to make their way from the maze it would be an incorrect response and vice a versa. The complexity increases as the complexity of the mazes increases at each level but is same for the consecutive 3 trials.
	Crossword puzzles	At each level the child is presented with a list of alphabets from which they are instructed to find the words mentioned below, if the child is unable to find all the words it's an incorrect response and vice a versa. The complexity increases as the numbers of letters in the words increases at each level but is same for the consecutive 3 trials.
	Tangrams	The child is presented with a tangram at each level which they are instructed to make if the child is unable to make the tangram presented to them it would be considered as an incorrect response and vice a versa. The complexity

		increases as the complexity of the tangram increases at each level but is same for the consecutive 3 trials.
	Finding a solution to a narrated situation	The situation is narrated to the child after which they have to select the correct solution from the options given below, if they select the correct solution, it's a correct response and vice a versa. The complexity increases as the complexity of the situation increases at each level but is same for the consecutive 3 trials.
Emotional Control	Knowing one's emotions	The child is narrated a situation after which they have to tell what is the emotion they feel after hearing the situation, if the correct response is selected from the options given below it is a correct response and vice a versa. The complexity increases as the complexity of the situation's given to solve increases at each level with the level of self-conceptualization, awareness and understanding but is same for the consecutive 3 trials
	Knowing other's emotions	The child is narrated a situation after which they have to tell what is the emotion the other person will feel after hearing the situation, if the correct response is selected from the options given below it is a correct response and vice a versa. The complexity increases as the complexity of the situation's given to solve increases at each level with the level of conceptualization, awareness and understanding of other's emotions but is same for the consecutive 3 trials.
Time Management	Identification of priority of the task	At this level the child is presented with a situation and the tasks associated to the situation post which he has they have to select the task that is most important to do or prioritize. If the child is unable to select the task that the most important to do in this situation it's an incorrect response and vice a versa. The complexity increases as the complexity of the situation increases with the ability of the child to prioritize the task at each level but is same for the consecutive 3 trials.

Pilot Study

Sampling process

The sampling design was purposive as for the purpose of this study only children with developmental disabilities were chosen. The inclusion criteria included children who had a disability certificate issued by the Rehabilitation Council of India (RCI) for intellectual disability, and autism spectrum disorder, establishing not only their diagnosis but also their impaired social, intellectual, executive functioning as the RCI uses a variety of tests before issuing a disability certificate in their due process.

Participants

The participants of the study were children with Intellectual Disability and Autism Spectrum Disorder from the Learning Ladder Therapy Centre, New Delhi, between the ages of 8 and 15 years. Learning Ladder is a centre for differently abled children and adults concerned with their diagnosis, testing and rehabilitation. Purposive sampling was used to collect the sample, hence, only children falling under ID and ASD between the age of 8 and 15 years were chosen.

For the purpose of pilot testing, a sample of 25 children were taken, of which 14 children were diagnosed with Autism Spectrum Disability and 11 were diagnosed with Intellectual Disability {(N=14 ASD + N=11 ID) N=25}. These children are Indian citizens who attend special schools, integrated schools that follow English language as the medium of teaching hence, the verbal components and instructions for the tool were administered to them in English.

Administration of the test

In order to test the administration of the tool, this pilot study was conducted on 25 children. Herein, the administrator of the test gave instructions for the test's items in English to the child making sure the environment was quiet and comfortable for the child. In case of any confusion, the item was clarified or repeated in the local language, however, this did not occur frequently.

The administrator starts by collecting demographic information of the child i.e., their name, age, gender, diagnosis, followed by a small introduction and basic instructions for the test that is given on top of each booklet. This is not a timed test; hence, an assessment of time duration is not necessary, however, approximately an hour was observed to be the time duration for administering the complete test.

As the administrator proceeds through the checklist, it is important to note that:

- Each item has 3 trials
- In case of 2 consecutive scores of non-functionality (score of 0), you may directly proceed to the next sub-domain.
- In case of any score of 0 in even a single trial, it will result in a score of 0 for that item.
- Hence, an item will only be scored as 1, if all 3 trials are successful, in order to establish functionality.
- The space to write a score of 1 or 0 is given next to or below each item.
- The scoring for each domain must be calculated in the space provided and then at the end of the checklist, the grand total will be calculated.

- After completing the test, the scores will be transferred to the scoring summary table, where the percentage of each domain will be calculated as per the formula provided below. The percentage establishes the functionality of that particular skill.
- A score for an individual sub-domain may be calculated if required on a case basis, however, individual sub-domain calculation for percentage was not deemed necessary.

Scoring Process

The EFAC-CDD is a checklist developed to assess the level of executive functioning among children with developmental disabilities across 9 domains i.e., Working Memory with 7 sub-domains; Impulse Control with 4 sub-domains; Planning Skills with 4 sub-domains; Mental Flexibility with 3 sub-domains; Attention with 5 sub-domains; Action Monitoring with 3 sub-domains; Problem Solving with 4 sub-domains; Emotional Control with 2 sub-domains; and Time Management with 1 sub-domain (Table 1.1). Each sub-domain consists of 8 skills that will be assessed, hereby resulting in a total of 256 items.

A child will be scored on each skill item on a score of 0 – 1. The child will be given 3 attempts to perform the given skill, which is termed as a trial, and each successful attempt will receive a score of 1, and every unsuccessful attempt will receive a score of 0 subsequently. As the administrator proceeds through the trials, if a child receives two consecutive unsuccessful attempts (or two consecutive scores of 0), the administrator will not assess it further and move on to next sub-domain.

The raw score of each sub-domain will be calculated by summing the 8 constituent skill items, i.e., the raw score for each sub-domain is the total of all the successful or functional scores ranging from 0-8. The raw score for each domain is the summation of all sub-domain scores, the range for each specific domain varies and is given as follows.

The maximum score for each domain is as follows:

Working Memory = 56
Impulse Control = 24
Planning Skills = 32
Mental Flexibility = 24
Attention = 40
Action Monitoring = 24
Problem Solving = 32
Emotional Control = 16
Time Management = 8
Individual domain percentage calculation:

$$Domain\ \% = \frac{\text{Raw score}}{Max\ Score} \times 100$$

Grand total percentage calculation:

$$Total\ \% = \frac{\text{Raw score}}{Max\ Score\ (256)} \times 100$$

RESULTS

The following results were found through analysis of data collected:

Table 1.2 - Sample Demographic Details

Diagnosis	Male	Female	Total	Age range
ID	4	7	11	9-15 (M=13.27, SD=1.90)
ASD	10	4	14	8-15 (M=11.85, SD=2.62)
Total	14	11	25	8-15 (M=12.48, SD=2.4)

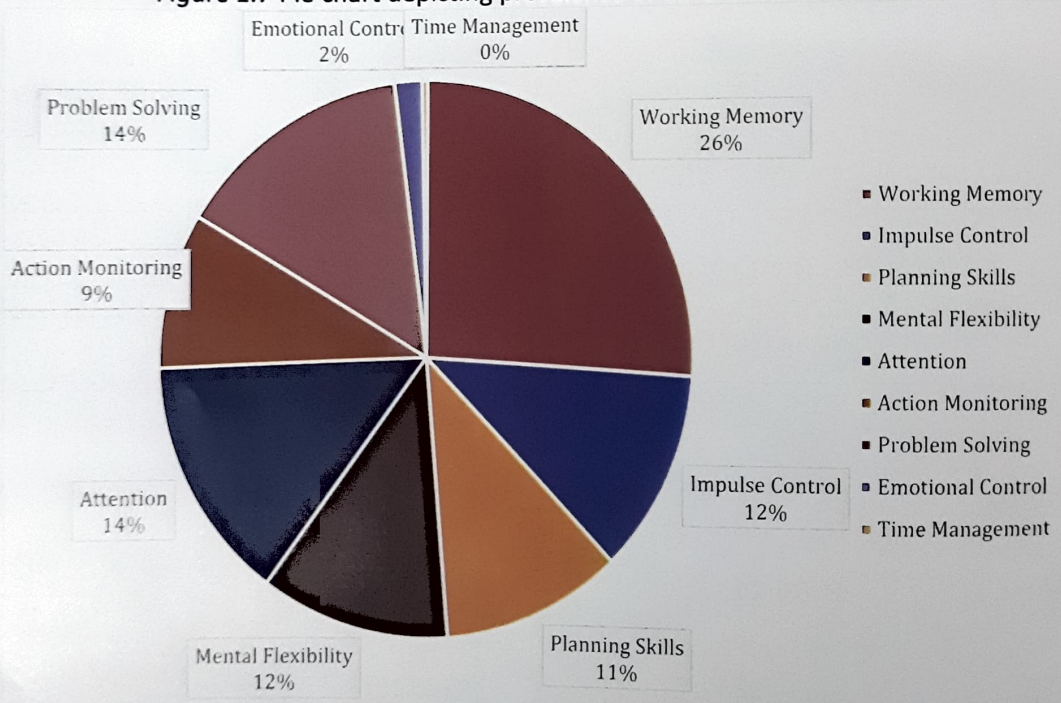
Table 1.3 - Score and percentage EF results as per different correlates

Sample	EF score Mean (SD)	EF % functionality Mean (SD)
Male	53.64 (29.69)	20.95% (0.11)
Female	62.09 (21.06)	24% (0.08)
ID	61.63 (24.11)	24.07% (0.09)
ASD	54 (27.96)	21% (0.10)
Total	57.36 (26.09)	22% (10%)

Table 1.4 - Prevalence of different domains of EF

Domain	Mean	SD
Working Memory	14.88	6.45
Impulse Control	6.72	2.70
Planning Skills	6.28	3.79
Mental Flexibility	6.6	3.81
Attention	8.24	4.54
Action Monitoring	5.2	3.94
Problem Solving	8.28	4.45
Emotional Control	0.96	1.71
Time Management	0.2	1
Total Executive Functioning	57.36	26.09

Figure 1.7 Pie chart depicting prevalence of different EF domains



According to the results, the total executive functioning was found to be 57.36(26.09) and the percentage of EF was 22%(10%) with the lowest functioning in the time management domain as 0.2(1) and highest in the working memory domain as 14.88(6.45).

DISCUSSION

The aim of this study was to develop a new tool for assessing executive functioning for children with developmental disabilities, which is titled "Executive Functioning Assessment Checklist for Children with Developmental Disabilities (EFAC-CDD). For the purpose of this study, the development of the checklist has been documented as well as pilot tested on a sample of children with developmental disabilities (N=25) to establish functionality of the test and pave the way for further standardization of the same.

Through the pilot study it was established that in a sample of 25 children from the age range of 8 to 15 years (M=12.48, SD=2.4), of which N=11 were children with Intellectual Disability and N=14 were children with Autism Spectrum Disorder, the overall total Executive Functioning Score was Mean=57.36 with SD=26.09, and executive functioning percentage was M=22% with SD=10%. Specifically, in children with ID the executive functioning score was M=61.63 with SD=24.11, and executive functioning percentage was M=24.07% with SD=0.09; and in children with ASD the executive functioning score was M=54 with SD=27.96, and executive functioning percentage was M=21% with SD=0.1.

As executive functioning is regarded as an extremely broad concept, it was decided to assess the performance of the sample in each domain for convenient and easier understanding of specific domains of EF. The findings also highlight the prevalence of these domains in children with executive functioning (8-15 years) in India. As per the results, in the domain Working Memory the score was Mean=14.88 with SD=6.45, which is the highest average score in comparison to all other domains. The domain Impulse Control yielded a score of M=6.72 with SD=2.7; Planning Skills gave a score of M=6.28 with SD=3.79; Mental Flexibility yielded a score of M=6.6 with SD=3.81; the score for Attention was M=8.24 with SD=4.54; the score for Action Monitoring was M=5.2 with SD=3.94; the score for Problem Solving was M=8.28 with SD=4.45; Emotional Control yielded a score of M=0.96 with SD=1.71; and lastly, Time Management domain yielded a score of M=0.2 with SD=1, which is the lowest average functionality score in comparison to other domains.

Hence, children with ID and ASD are observed to have the highest functionality in working memory to begin with, as a pre-assessment, and the lowest functionality in time management, albeit that even their highest functionality domain in itself remains to be below average, wherein 0 is having no functionality of that skill and 100 is having full functionality of that skill. Emotional Control is the observed to be the second lowest functionality score with other domains scoring higher than emotional control but none higher than working memory.

Hence, it is assumed that children with developmental disabilities have the lowest functionality in Time Management and Emotional Control, followed by Action Monitoring, Planning Skills, Mental Flexibility, Impulse Control, Problem Solving, Attention, and finally

the highest in Working Memory. Therefore, the amount of intervention, complexity and attention to be given for each domain may be calculated, planned and thereafter be utilized to increase the functionality of a child in the particular skills of executive functioning.

CONCLUSION

The current study aimed to develop a new checklist for testing executive functioning in children with developmental disabilities in India. The development and pilot study were undertaken with children with Intellectual Disability and Autism Spectrum Disorder, and when tested on a broad range of executive functioning components, it was found that their executive functioning is poor, as is already characteristic in this population (Benallie et al., 2021; Robinson et al., 2009; Panerai et al., 2014). Hence, the tool is a suitable checklist for assessing executive functioning.

The study has a few limitations due to time constraints, the sample could not be compared with the average counterpart i.e., school going children without developmental disabilities, to validate the executive functioning assessing component further.

For future studies, the pre and post analysis on a case basis with a intervention plan will be tested using this checklist to help establish an effective assessment and intervention tool in working with children with developmental disabilities, with a larger sample size. Secondly, a validation and reliability study will also be undertaken for standardization of the newly developed checklist.

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