Chapter 1

Introduction
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Neurodevelopmental Disorder

The neurodevelopmental disorders as introduced by DSM V described a group of conditions with the onset at the developmental years. The range of developmental disorders varies from very specific limitations of learning or control of executive functions to global impairments of intelligence. The developmental disorders may emerge often before the child enters preschool, and impairments are prominent in personal, social, academic, or occupational functioning. DSM V describes neurodevelopmental disorder in seven conditions viz.

- Intellectual Disabilities
- Communication Disorders
- Autism Spectrum Disorder
- Attention Deficit Hyperactive Disorder
- Specific Learning Disorder
- Motor Disorders
- Other Neurodevelopmental Disorders

The present study considers the autism spectrum disorder and borderline intellectual functioning group.

*Intellectual Disability*

Intellectual disability or impairment (intellectual developmental disorder) is characterized by deficits in general mental abilities, such as reasoning, problem solving, planning, abstract
thinking, judgment, academic learning, and learning from experience. The deficits result in impairments of adaptive functioning. The individual fails to accomplish personal care and social responsibility in one or more aspects of daily life. The skill of communication, active social participation, appropriate academic or occupational functioning, and personal independence at home or in community settings are either delayed or inadequate or absent in them.

In 2010, Rosa’s Law replaced the term mental retardation with intellectual disability as a matter of U.S. federal law. In keeping with this change, DSM-5 has also replaced the diagnosis mental retardation with intellectual disability. The term mental retardation has been widely considered stigmatizing and categorizing them markedly, eliminating them as a separate group of individuals with poor intelligence. This amendment helps in awareness and understanding this developmental condition as responsive to intervention and rehabilitation. Also the elimination of the multiaxial diagnostic system in DSM-5 will also serve to lessen stigmatization.

The definitions of intellectual disability (ID) and have gradually evolved over time to include the legal and social gains, inclusive practices made by individuals with such a disability and their families. A Communication Bill of Rights—originally developed by the National Joint Committee for the Communication Needs of Persons with Severe Disabilities (NJC) in 1992 and updated in 2016—recognizes the right of all people to effective communication (NJC, 1992; Brady et al., 2016).

- Limitations in intellectual functioning
- Limitations in adaptive behaviour (Schalock, Luckasson, & Shorgren, 2007). (i.e., conceptual, social, and practical skills in everyday life); and
- Onset in childhood (before the age of 18 years; American Association on Intellectual and Developmental Disabilities [AAIDD, 2013]).

In DSM-5, intellectual disability is considered to be approximately two standard deviations or more below the population, which equals an IQ score of about 70 or below. DSM-5 provides a table and examples of deficits listed in three domains of adaptive functioning: conceptual (academic), social, and practical. The diagnosis is on the impact of the deficit in general mental abilities on functioning needed for everyday life.

**Borderline Intellectual Impairment (BII)**

The term borderline intellectual functioning describes a group of people who functions on the border between normal intellectual functioning and intellectual disabilities, (DSM V) between 1 and 2 standard deviations below the mean on the normal curve of the distribution of intelligence and scores an estimated intelligence quotient within the 70 to 85 range on an intelligence test. According to the normal curve, as much as 13.6% of the population falls into this category. (Wieland & Zitman, 2015).

Borderline intellectual functioning has always been a difficult concept. It had different names, different boundaries its own different adjustments and adaptations. It is a midway between a normal functioning and deviant functioning. According to DSM and ICD, borderline intellectual functioning is not a disorder. But people with borderline intellectual functioning, or an IQ between 70 and 85 comprise a vulnerable group. The etymology can be attributed to genetic liability, biological causes such as perinatal difficulties, and epigenetic factors such as socioeconomic status, maternal stress etc. (Baglio et.al., 2014)
The limitations that are faced by borderline intellectual functioning individuals are somewhat similar to those of faced by intellectual disability group i.e. they have difficulty in adaptive behaviours and cognitive functions. Since they are in the advantage of a better IQ than the intellectual disability (ID) group their coping and adaptive functions are also at much ease than the ID group.

The limitations and obstruction are also often individual specific. It is difficult to generalise them. Literature suggests -

- They face difficulties in all spheres of ordinary life and daily living. (Fujiura 2013, Peltopuro, et. al., 2014 & Hassiotis, et. al., 2008).
- They are also at increased risk of experiencing physical problems (Snell, et. al., 2009).
- They have limited social support (Hassiotis, et. al., 2008b & Gigi, et. al., 2014).
- They have no access to specialised services (Emerson, 2011).
- They often live messy and a problem life, functioning under high strain but unnoticed by the rest of society (Emerson, 2011).

The present study considers borderline Intellectual functioning individuals and individuals having autism along with borderline functioning.

**Autism Spectrum Disorder**

The term ‘Autism’ was originated by Leo Kanner in 1940’s. In “Autistic Disturbances of effective Contact” (1943), he described a group of children; he viewed them more much more similar to one another than to the schizophrenics, with whom they generally had been associated. Until that time, the classical definition for autism (still seen in some dictionaries) was “a form of
childhood schizophrenia characterized by action out and withdrawal from reality”. Kanner believed that children with autism represent an entirely different disorder. He noted four main symptoms associated with the deficit. Social withdrawal of “extreme autistic aloneness”; either muteness or failure to use spoken language “to convey meaning to others”; “obsessive desire for maintenance of sameness”; and preoccupation with rightly repetitive play habits, producing “severe limitation of spontaneous activity”. Kanner also noted that autism unlike other types of childhood disorder began in or near infancy.

Children with autistic disorder show **Triad impairment** that characterize autism are:

- difficulties with social interaction,
- problems with verbal and nonverbal communication,
- Repetitive behaviors or problem in flexibility.
➢ **Social Interaction**

The hallmark feature of autism is impaired social interaction. It is often said that a child with autism “is the beautiful child in a glass cell”. A child with autism may appear to develop normally and then withdraw and become indifferent to social engagement. They fail to respond to their names, avoid eye contact, fail to imitate others.

The intrinsic motivation to social engagement is absent in them. They don’t understand their socially desirable act. The deficit seems to be in their ability to understand and respond to social information.

➢ **Communication**

Children with autism display serious difficulties in communication and language that appear early in life and persist over time. Children with autism are inconsistent in using early preverbal communication. They may use instrumental gestures to get someone else to do something for them immediately and they fail to use expressive gestures to convey feelings. Echolalia or parrot like repletion of word immediately heard, unconventional verbal behavior, and preservative speech, incessant questioning, may serve a variety of communicative and developmental functions for children with autism.

Again the problem lies in encoding the meaning of the word communicated and decoding them in socially acceptable language.

➢ **Flexibility**

Another significant feature of autism is inflexibility. They are resistant to change. It is pervasive for all sense organs. So, mostly sensory dysfunction (i.e. hypersensitivity and hyposensitivity) is
common in them. Because of stimulus over selectivity (Lovaas et.al, 1979) they cannot filter the desirable sensation and so due to habituation in sensory adaptation it is difficult for them to change.

Other significant characteristics of Autism:-

- Cognitive deficits
  Difficulties in executive functioning,

- Sensory and Perceptual Impairment,

- Preoccupations and Perseverations.

Scientists aren’t certain what cause autism, but it’s likely that both genetics and environment play a role. Researchers have identified a number of genes associated with the disorder. Autism could result from the disruption of normal brain development early in fetal development caused by defects in genes that control brain growth and that regulate how neurons communicate with each other. While these findings are intriguing, they are preliminary and require further study.

There is no cure for autism. Therapies and behavioral interventions are designed to remedy specific symptoms and can bring about substantial improvement.

Executive Function (EF)

“Being able to focus, hold, and work with information in mind, filter distractions, and switch gears is like having an air traffic control system at a busy airport to manage the arrivals and departures of dozens of planes on multiple runways. In the brain, this air traffic control mechanism is called executive function” (Shonkoff, et.al., 2011). It provides a workspace for
the individual to process current information, plans, and needs, along with prior knowledge about the world. Executive functions are not the same as cognitive skills and abilities, such as language and perceptual abilities. Rather, it enables an individual to successfully coordinate and apply their cognitive abilities, skills and knowledge in pursuit of a goal. It would have been a cacophony of music if there is no director to coordinate a band of musicians in a symphony orchestra. (Goldberg, 2001). The musicians in the orchestra can be compared to the various cognitive abilities an individual possess; while the director represents the way the executive functions coordinate and organize the various components to produce a desired outcome.

The executive skills that enable to make plans, shift, stay focused, inhibit impulses and recall immediately are not present from birth. These are the potentials that are predisposed and whether to develop these capacities or not depends on experiences during early years of life in childhood, and into adolescence (Shonkoff et.al., 2011). EF skills grows over time, starting its journey as early as the first year of life which are prominent and further it matures by the developmental years, gradually with experiences, travelling through childhood and into adolescents. (Best & Miller 2010; Diamond 1991a, 1991b, 2002, 2006)

EFs are the control functions of the brain. Evidence exists from neuroanatomical and developmental psychology as reviewed by (Huges, 1998) that pre-frontal and executives functioning emerge during early infancy and continues to develop well into adolescence. This development parallels the developmental of the pre-frontal cortex; a part of the brain that contributes to EF by in adequate self-care. The dorsolateral prefrontal circuit mediates EF.

Thus the concept of ‘executive function’ refers to the higher order control processes necessary to guide behavior in a constantly changing environment (Jurado & Rosselli, 2007). The concept
includes abilities such as planning & problem solving, working memory, mental flexibility, response initiation, response inhibition, impulse control and monitoring of action, categorization and abstraction (Roberts, Robbins, & Weiskrantz, 1998; Stuss & Knight, 2002).

Three most important dimensions or components of executive functioning that are highlighted in recent studies are working memory, planning and cognitive flexibility (Diamond & Taylor 1996; Greenberg, Riggs, & Blair, 2007; Rothbart, Posner, & Kieras, 2006).

**Cognitive flexibility** is the capacity to promptly switch gears and adjust to changed demands, priorities, or perspectives in the environment. Impairment in such set shifting ability is a prominent feature of executive dysfunction; where the shifting ability is demanded on changing goals or tasks and environment. **Mental set shifting** requires cognitive flexibility which is a readiness to freely shift cognition and behaviour according to particular demands and content of a situation (Eslinges & Gratton, 1993).

**Working memory** helps in maintenance of task relevant information and guides the process of task completion. Working memory is the capacity to hold and manipulate information over short periods of time. It provides a mental surface on which one can place important information so that it is ready to use in the course of everyday lives. It enables to remember a phone number long enough to dial it. It enables children to remember and connect information from one paragraph to the next, to perform arithmetic problem with several steps, to keep track of the moves and make a logical next step in a game of checkers and to follow multiple-step instructions without reminders. It also helps children with social interactions, such as planning and acting out a skit, taking turns in group activities or easily re-joining a game after stepping away to get a drink of water.
Further research has shown that individuals having high capacity of working memory tend to be more strategic which relates to strategic behaviour during planning.

**Planning** is a complex goal directed activity, where several alternative moves or actions are required to be executed either by trial and error or by sequential strategies. Thus, working memory, cognitive flexibility and planning are not entirely distinct, rather, they work together to produce competent executive functioning.

In daily life activities, executive functions underlie a large number of life skills and behaviours. Starting from as simple abilities as, following one step instruction, following rules, remembering simple rules, seeking alternative method to retrieve a object, till as complex abilities as, following multiple instructions, abiding to situational appropriate rules, remembering strategies and ability to construct a plan, is the range of executive functions. Children uses executive function skills to complete tasks that involve following two or more rules showing that they can alter their attention to make deliberate choices (cognitive flexibility), hold rules mentally as they figure things out (working memory) the strategy to complete the task(planning).

**Executive function in autism and borderline intellectual impairment**

In several studies it is evident that Executive Functions are related to performance on tasks closely associated with intelligence (e.g. Carpenter, Just, & Shell, 1990; Miyake, Friedman, Rettinger, Shah, & Hegarty, 2001; Salthouse, Fristoe, McGuthry, & Hambrick, 1998). Studies have also suggested that impaired executive functions are present in a number of neurodevelopmental disorders like in autism (Pennington & Ozonoff, 1996; Hughes, 2002; Skoff, 1988). About 70% to 80% individuals with autism achieve I.Q scores on standardized
tests in the intellectually challenged range, with the major proportion scoring in the moderate to severe ranges of intellectual impairment. (De Myer, et.al., 1974; Wing & Gould, 1979). Thus, a significant percentage of the population of persons with autism can be associated with restricted intellectual ability. It can be said that the typical autism symptoms makes it difficult for them to exhibit or reveal their actual intelligence level and at the same time high intelligence is a good predictor of cognitive ability which is not always extracted overriding the symptoms of autism (Rommelse et. al., 2015). So, their cognitive ability may differ depending on their intelligence or on other origins also.

At an empirical level, the individuals with autism are severely impaired on tests involving executive functioning tasks. As earlier as in 1978, Damasio & Maurer study reveals that deficiency in executive control is a cause of the rigid and repetitive behaviour patterns that characterizing autism. Children with these disorders are especially likely to display the kinds of problems regarding the components of executive functioning e.g. they may know rules and be able to repeat them, but nonetheless have considerable difficulty putting them into practice (Zelazo, 2004). Individuals with autism also performs significantly poor on measures of temporal order memory, source memory, working memory (Benetto, 1996) and also shows difficulties in attention. Deficits are also generally found on planning as indexed by Tower of Hanoi (Ozonoff et. al., 1991).

In general, cognitive and social capacities in early developmental years are constructed upon the building blocks of EF skills. Executive functioning is considered to be a common denominator for developmental outcomes both in social competence and the adaptive behavior of children with autism. (Pellicano, 2010). The rigidity and the variation in autistic typicality could also be explained by impairment in executive control (Hughes & Russell 1993; Ozonoff, Pennington &
More specifically the prevalence of autistic symptom i.e. perseveration and the troublesome in cognitive flexibility between response sets itself explains the most important construct of executive functioning. Deficits are found in their cognitive flexibility (Gioia et al., 2002, Goldstein et al., 2001). Often assessed with WCST- individuals with autism show deficits when necessary to shift response set i.e. they perseverate (Prior & Hoffman, 1990). Executive functions attracted interest of many researcher especially dealing with autism probably because besides intelligence and cognitive abilities, EF are the most important area to be explored explaining the autistic symptomatology. Also EF uses and synchronizes the general mental and cognitive abilities and how far it works, if at all or is a deficit is surprising and interesting concern in autism. Several other such studies are cited in literature review section.

From the literature of EF tasks on intellectual impairment, it is evident that such individuals may perform executive function tasks at their mental age (MA) level (Van der Molen, Van Luit, Jongmans, & Van der Molen 2007). Similarly, in a study on the problem solving task, adults with Intellectual challenged performed Tower of Hanoi task (Numminen, Lehto, Ruoppila, 2001). The intellectually challenged individuals had been able to perform on working memory task for both adults (Numminen, Service, & Ruoppila, 2002) and children (Brown, 1974; Henry & MacLean, 2002; Henry & Winfield, 2010; Maehler & Schuchardt, 2009). There are further more studies to be referred in the literature review column.

From the above literature, it can be said that though there are studies on executive functioning on autism but most of the studies reported executive function as a global capacity without considering its sub-components some of which are very important to explore the core problem of autism to procure the ability of executive function. Also, there are relatively few studies in comparing Executive Functions of individuals with autism and with that of individuals with
Intellectual Impairment. Moreover, in the current context there is very little literature in India exploring the sub components of EF of both the groups. Last but not the least, there is a dearth of studies on training of EF for the persons with Autism and Intellectual Impairment. EF deficit in autism and borderline intellectual impairment (BII) though can be supplemented with several research studies but the question of trainability of EF in such neurodevelopmental disorder cannot be overruled. There are several methods and intervention program of autism and BII. But EF training can at all be included in such intervention or not is still a quest to know. Thus the present study purports to compare the executive functioning that are specific to the syndrome of autism with intellectual impairment in comparison with that of individuals with intellectual impairment without autism, the most important part being the EF training and the effect of training in the aforesaid groups.