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Effect of Executive Functioning on Classroom Adjustment in Children with ASD

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Abstract

Any intervention for Classroom integration requires us to focus on the nature of the disorder children have. Executive function skills predict learning in general rather than learning in one specific domain. (Bull, Espy,*et al*., 2008). Research suggests a significant difference in executive functioning in children who have ASD as compared with the neuro-typical peers (F.Pooragha, S.M.Kafi, *et al*., 2013). Furthermore, successful classroom adjustment is based in social as well as cognitive skills. Underlying these social and cognitive skills are executive functions: both action based executive functions (such as response inhibition, emotional control, sustained attention, task initiation, goal-directed persistence, flexibility) and thinking based executive functions (such as working memory, planning/prioritization, organization, time-management, meta-cognition) apart from academic conceptual understanding.

The present pilot study looks at the effect of training in 'Executive Function' for school going children, diagnosed with ASD, on class adjustment. The sample included 26 children, ranging between 4-11 years, diagnosed with ASD. Intervention group comprised of 13 children who received 'executive functions development' training embedded in interventions for social communication skills and special education. The control group comprised of 13, age matched children receiving typical 'concept based' special education. Checklists to measure Executive Skills and Classroom performance were administered to determine whether a difference existed in the two groups. Our results indicate that Classroom adjustment is better in children who are receiving executive function development training embedded in both social skills and special education intervention as compared to the control group.

It is concluded that Executive Functions Development training should be included in any intervention program targeting classroom integration.

Keywords: ASD, Executive functions development, classroom integration

Introduction

Executive functions (EF) refers to an array of sub-processes required to function in our daily life including skills that help us learn new information, remember and retrieve information to solve problems. Execution of a simple daily life routine task requires a set of cognitive functions in order to plan, initiate and sequence the course of actions along with filtering non-required information. These co-constructs work together in cohesive manner to produce and organize a meaningful response.

EF includes interrelated, vital functions such as planning, working- memory, impulse control, inhibition and shifting set, as well as the initiation and monitoring of action (Roberts, Robbins, and Weiskrantz, 1998; Stuss and Knight, 2002) required by the humans to execute or perform a task (Dawson and Guare, 2009).

Scientists have frequently highlighted three dimensions of EF to be of prime importance in the subset of these cognitive functions i.e., Working memory, Inhibitory control, and cognitive/mental flexibility. Barkley proposed that EF skill development is sequential and begins during infancy, with five essential elements: Behavioural inhibition, working memory (non verbal), internalization of speech (verbal working memory); self regulation of affect /motivation/arousal and reconstitution. Behavioural inhibition begins to emerge in the 4-12 month age range followed by nonverbal working memory (5-24 months). The developing ability to hold information in mind (moving beyond here and now) along with ability to have hindsight, foresight, mentally manipulate events and imitate complex behaviours enhances decision making skills. These complex set of skills including emotional modulation, problem solving, planning and organizing keeps on developing till thirty two years of age. This sequential developmental progression is essential for overall adaptive functioning.Approaches to EF delineates eleven sub-processes of EF and divides them into cognitive and behavioural dimension. This array includes thinking based EFs (Working Memory, Planning & Prioritization, Organization, Time Management, Metacognition) and those involving behavior (Response Inhibition, Sustained attention, Emotional Control, Task Initiation, Goal-directed persistence, Flexibility) (Dawson and Guare, 2009) The EF system requires the functions to utilize elements of the each other; For instance, it takes working memory to hold two rules in mind and inhibitory control to ignore one of the rules in order to flexibly switch between changing. EF skills are crucial building blocks for early development of cognitive and social capacities; guide current learning and use that as bases for future references. Any difficulty in these skills directly impacts learning experience. Over the years, EF has been linked to many developmental conditions such as Learning disability, Attention Deficit Hyperactivity Disorder, Autism Spectrum Disorder (ASD) (Russell (1997)). EF is not a primary causal factor in ASD however; it can play a substantial role in their development, including social competence, adaptive behaviour and their success in school (Pennigton, 2012). Executive Functions and Autism Spectrum Disorder (ASD)ASD is a lifelong neurological disorder with marked and persistent difficulties in communication and social skills. Many children with autism have difficulties with executive function (Hill, 2004) which accounts for children having a need for sameness, a strong liking for repetitive behaviors, lack of impulse control, difficulty initiating new non-routine actions and difficulty switching between tasks (Ozonoff, Pennington, and Rogers, 1991; Rajendran & Mitchell, 2007). Individuals with ASD exhibit significant impairment in self regulation (behavioral, thermal, and sensory) hence difficulty in inhibiting non-required stimulus and focusing on the important information. The degree of difficulties in EF could play a substantial

role in autistic children's developmental outcomes— including their social competence, "theory of mind," and their success in school. Several theorists have further proposed a *direct*, functional link between EF and Theory of Mind.

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competence, "theory of mind," and their success in school. Several theorists have further proposed a *direct*, functional link between EF and Theory of Mind.

Executive Functions, Theory of Mind (TOM) and ASD

Cohen describes Theory of mind as essential for an individual to take other's perspective thus is crucial for understanding and engaging in any social interaction seen as a major deficit area in ASD. Research findings have repeatedly shown that early EF skills are predictive of later ToM and is critical to developmental changes in ToM. This connection appears as early as 3 years of age and has predictive relation longitudinally (Carlson et.al, 2004). It is difficult for individuals with ASD to access their own mental states, and they demonstrate signiûcant changes over time in ToM.

Astington and Pelletier (2005) suggest a connection between a child's ToM and his ability to learn based on imitation and previous knowledge, hence affecting the learning process. Studies have suggested that TOM mediates the relation between EF and school readiness skills at the end of preschool as a child's thinking about his own mind may allow him to understand learning in a classroom-appropriate manner. Learning may occur when a child recognizes a gap in his knowledge and, through imitation and repetition, learns from a teacher (Raver & Knitzer, 2002).

School achievement in relation with Executive functions and Self regulation

EF has repeatedly been found to serve as powerful predictor of school readiness (e.g., Blair and Razza 2007), and of school achievement (e.g., Duncan *et al*., 2007). Research has also emphasized that early EF is also predictive of typical preschoolers' later school readiness (Blair and Raza, 2007) and cognitive and socio-emotional gains (Bierman *et al*., 2008). There is also evidence that young children's attention, working memory, and inhibitory control are each important for school performance and adaptation (Blair, 2002; Bull and Scerif, 2001; McClelland *et al.*, 2006; NICHD, 2003).

EF and self regulation play an important role in the acquisition of knowledge; the better children are at focusing and refocusing their attention, holding information in mind and manipulating it and resisting distraction, the better placed children should be to acquire knowledge and skills in the classroom. Also, during the preschool years, growth in inhibitory control skills promotes the capacity to follow classroom rules, sit still, and learn on demand through listening and watching (McClelland *et al*., 2006). Increase in goal-oriented motivation fosters learning initiative and sustained, independent attempts at problem solving and skill mastery (Normandeau and Guay, 1998). Blair and Diamond (2008) suggest that even to learn academic content (mainly reading and math), children need to be able to control distracting behavioural impulses and shift and focus their attention selectively on key pieces of information.

Duckworth and Seligman, 2005 found that aspects of learning-related skills: self-discipline, were stronger predictors of academic performance than intelligence test scores in adolescents providing evidence for EF and self regulation skills to be more important contributors to school success than even cognitive abilities; Lewit and Baker (1995) finding self regulation being more vital to school readiness than academic skills.

Another important dimension of school achievement is Social skills. Walker (1983) defines social skills as "a set of competencies that a) allow an individual to initiate and maintain positive social relationships, b) contribute to peer acceptance and to a satisfactory school adjustment, and c) allow an individual to cope effectively with the larger social environment" Successful learning requires students to interact closely with teachers and peers. Social skills have a big impact on a child's ability to succeed in an academic setting.

For successful school integration, any intervention must keep these factors in mind as ultimate goal is to assist the child to be independent along with continuous motivation to learn and explore new things. With all the above discussed interlinks, it may be believed that interventions can be effective if they provide effective and well-planned EF training based in developmental sequence discussed above.

Materials and Methods

Rationale of Study

As clinicians, one of the most frequent questions asked by parents is with regard to schooling - child's eligibility, ability, skill level, readiness to attend/ benefit from a mainstream school, or how to improve the child's school adjustment and performance.

Despite possessing cognitive skills, for many kids with ASD, classroom adjustment becomes a concern. Their difficulties in social interaction further make adjustment complicated, effortful.

Some commonly used approaches include providing accommodations, environmental structuring, task structuring or a 1:1 aid for the child. In our view, they are not a complete long term solution. Skill based learning needs to be a key component for intervention.

The present study is an attempt to highlight EF skills related to classroom adjustment and effect of EF intervention, embedded in social communication skills and classroom skills, on Class room Adjustment.

Hypothesis

- Children on Autism Spectrum, getting Executive functions training as part

of the intervention program, show better classroom adjustment than children whose intervention program do not focus on executive functions training.

- Training in Executive functions is associated with improved classroom performance.

Participants

A sample of 26 children, in the age range of 4-11 years, diagnosed with ASD by a reputed Mental Health Professional, attending typical mainstream school and following the class curriculum participated in the study. All these children were going to various public schools in Delhi and NCR. In the absence of measure of cognitive functioning, children's following mainstream curriculum and school were taken as a crude measure of comparable cognitive functioning.

Only those children, receiving academic concepts based training from a trained special educator / centre outside school were included in the control group. Children receiving EF training embedded in Social Communication and Study Skill / Educational training contexts at Potentials Therapy Centre were included in the Intervention group.

Measures

Information was collected on demographic profile which enabled us to ensure matched groups for the study. Executive Skills Questionnaire (ESQ) and Classroom Performance Assessment (CPA) were used in the study.

1. Executive Skills Questionnaire (ESQ) – is a brief parent rating scale developed by *Peg Dawson & Richard Gaure* providing information regarding child's executive skills, strengths and weaknesses. These are not norm-referenced instruments. However, they are useful because (i) they are aligned with developmental tasks and specific to the EF skills looked at. (ii) Whereas most behavior rating scales focus on areas of weakness, the ESQ helps to identify both areas of strength and weaknesses.

   Three versions of Executive skills Questionnaire for children (pre-school/ kindergarten, lower elementary, upper elementary) have been used to gather data.

2. The Classroom Performance Assessment (CPA): was developed by *Elisabeth H. Wiig & Wayne A. Secord*, to help clinicians and educators describe, address a student's classroom learning needs through a solution-focused process. The CPA keeps student in the centre and looks at the 4 key areas of classroom adjustment, hence aligns it well to relate to Executive Skill perspective.Similar to EFQ, CPA uses a three point rating scale from 0 (No concern) to 2 (Huge concerns)

Procedure

Ex-post facto research design was used for the study primarily because of the difficulties with random sampling for intervention and control groups (non EF intervention). From the identified children matching participant criterion, 13 children were randomly selected and consent from family sought. Thereafter control group population was identified. From these, students were matched with the intervention group and family consent sought. The groups were specifically matched on age, grade and verbal abilities. The school and therapy centre the children were visiting helped match them overall for socio-economic status and class and curriculum followed helped match on cognitive abilities.

The data collection involved the following:

(i) Observation of children during their participation in the therapeutic intervention and during free/waiting time was done to get an understanding of each child.

(ii) Completion of both, EFQ and CPA rating scales by parents and the interviewer together.

(iii) Formal Interviews (incorporating open ended questions) were conducted with the parents to understand their view of their child. Within the rating scales, the interview with the parents was around the following domains:

Executive skills Questionnaire: Executive Skills involving *cognition* (Working Memory, Planning & Prioritization, Organization, Time Management, Metacognition) and those involving *behavior* (Response Inhibition, Sustained attention, Emotional Control, Task Initiation, Goal-directed persistence, Flexibility)

Care was taken that the interviewer was not personally involved with the active intervention for any of the children in the study so that subjective bias could be minimized.

Classroom Performance Assessment Checklist: included Listening, Speaking, Classroom considerations & Thinking skills. (Keeping in mind various Occupational Therapy related concerns many children in this population face, 'reading' & 'writing' domains were not included in the data as it could have been a source of variance not necessarily accounted for by EF alone).

Because of practical reasons (parent's apprehensions, diagnosis non disclosure in school) school based observations could not be established.

Intervention

During the planning of the intervention model, the researchers took into account (i) the lack of generalization skills that form the repertoire of learning style of many individuals with ASD (ii) Difficulties with social interaction skills seen in this population (iii) specific executive functions that are usually missing/ less

developed in ASD population (iv) the contexts within the school that children would be required to exercise the EFs in.

Research suggests that children with ASD learn to carry out the learnt social – emotional skills in school better if they are imparted the same in school itself. This is due to the difficulty in 'generalization of skills i.e. understanding when and where they should apply a certain learnt skill'. Hence, teaching them in an environment where they were likely to apply the skills, is imperative. Since, conducting the training in school environments was not possible, the next best solution was to create a similar set-up within which to train the children.

The set-up did not primarily mimic the structural settings, rather the engagement settings in which the skill would be required. Any school based performance requires both engagements in cognitive tasks as well as interactional contexts; hence the EF training was in

(i) Structured set-up through study groups which helped the child learn the classroom rules and executive skills application in a classroom based cognitive task appropriate to their grade. Hence, some of the goals for structured sessions included: (a)Environmental cues (like table and chair) to help child understand the sitting behaviour expected of him/her (b)On seat behavior and (c)on task behaviour (d)Initiation of work, sustaining in it and ending it appropriately with reporting completion (f)Group Instruction following (g)Memory (working, short term).

(ii) Children are also required to be mindful of their social behaviour in semi-structured environments in school. For this purpose a semi-structured environment was created as part of the intervention. Since at the base, many social skills involve the executive functioning skills, the sessions involved goals such as (a) Initiation, joining in, sustenance in a play activity (b) Appropriate exit and clearing off the play material (c) Following activities in a sequence- (practicing working memory, sequencing and short term memory. (d)Turn taking and waiting (e) following rules.

Results and Discussion

The study was conducted in order to understand skill-set essential for classroom adjustment. Another aspect to the study was studying the Gaps in understanding of *'traditional intervention models'* and its impact on school performance.

To determine difference between intervention and control groups (with respect to EF skills and Class performance), *Effect size* was compared as per the small sample size. Spearman's Rank Order correlation with coefficient of determination and linear regression were used to confirm the relationship and to ascertain magnitude and direction of relationship between EF and Classroom Performance (CPC)

The Effect Size of EF skill is 0.747 and Effect size of CPC is 0.648, which is significant at 0.005 level of significance, for the intervention group as compared to control group with a confidence interval of -3.229 and 4.595. (The wide confidence interval range could be due to the small sample size) Hence, scores indicate substantial difference in the EF skills of both the groups, and lower classroom concerns in favour of intervention group. Moreover, since the groups were matched on many sources of variance, with intervention in EF being a key difference, it may be said that the higher EF functioning of the intervention group as a whole is a result of the intervention they received. Therefore, the classroom concerns are lower in intervention group as compared to the control group.

Spill over effect has been substantiated by observations from parents. Some of the Samples of Parents' anecdotal data:

- In one instance of direct interaction with school head and teachers, teachers reported "Earlier we did not know how to get through to him, he was like a wall. Now, *I CAN teach him, he listens and does what others are doing"*.
- "Earlier he would just keep fidgeting with stuff or remain in a world of his own," "Has now started to follow what he is told, though may not be able to follow long instructions, but is able to follow one-two step instructions,"
- "She has started waiting with me while papa gets food for her, in a restaurant," "She has started initiating and responding to greetings of neighbours while walking down the stairs or in the lift,"

Ursache, A (2011) has mentioned that 'working memory'; 'inhibition control' and 'cognitive/mental flexibility' are cognitive skills of prime importance. In real life situations, most of these executive functions work in an integrated fashion. The behaviours which are noted may be, manifestations of the deficits in the above mentioned executive functions causing a concern in the classroom environment. In a comparison of the Classroom Concerns Checklist and EF checklist showed that (a)children who have scored low on concerns in the items like, "Pays attention in class", "Follows oral directions" , "Remembers things" etc have scored higher on the "Working Memory" skill. (b)Similarly, Children who have scored low on items like "Responds appropriately", "Acts impulsively", "Maintains self control or awareness" etc. have scored high on the "Response Inhibition" skill. (c)children who have scored low on items like, " Uses effective problem solving", "Makes predictions", etc (in classroom concerns checklist), have scored high on the "Flexibility" dimension in the "EF" checklist; respectively.

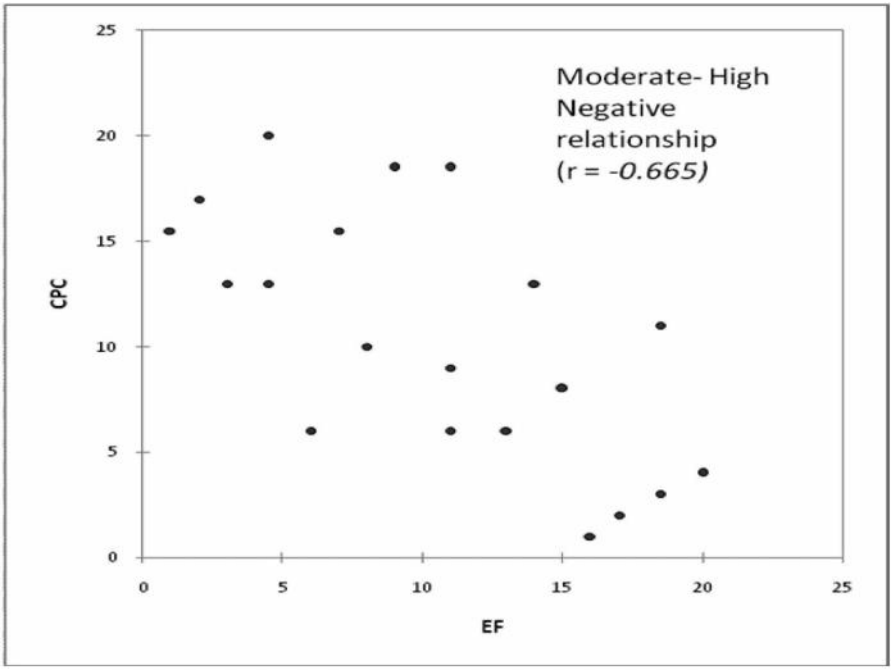
Hence, EF is *trainable* and this is supported by Hoffmann *et.al* (2012) in his research. With the right kind of EF focussed intervention received, a child can be trained in better EF skills. Furthermore, improvements may *translate* to better *behavioral self-regulation*. Research also suggests that EF skills which may be a

cause for the *inability of independent functioning* of many people with ASD could be due to the persistent difficulties in regulating behaviour and adapting flexibly to change. (Howlin, Mawhood, *et al*, 2000).

Spearman's rho correlation between EF and Classroom concerns is -0.664 which indicates moderate to high magnitude of correlation suggesting that there exists a correlation between both these variables. Negative direction of correlation between EF and Classroom concerns signifies that as the independent variable (Executive function skills) increases, the dependent variable (Classroom Concerns) decreases.

Drawing an imaginary line of best, in the middle of the scatter diagram, it is clearly visible that most of the scores are hugging the line indicating a linear relationship between the scores. As is visible and also indicative from the Spearman's rank order correlation (r), there does exists a negative moderate to high relationship between the classroom concerns and executive functioning.

The Coefficient of Determination $(r)^2$ was calculated as 0.44, which implies that 44% of the lowering of the 'Classroom concerns' is a result of the effect of the independent variable that is 'Executive Functioning'. This signifies that 44% of the scores in class adjustment of the sample are a result of the executive functions skills, which have been imparted through the executive functions training. Researchers have quoted that if $(r)^2$ is measured as a measure of percentage of a



F: Executive Functions CPC: Actual Classroom Concern Scores
Graph 1: Relationship between CPC and EF

properly standardized series then $(r)^2$ of 25 % may hold significant importance. Therefore, the current study holds significant importance.

Fig 1 shows that more than 50 % of the *actual classroom concern scores are close to their corresponding PCC scores*. This implies that they are functioning at a level which is expected/ predicted keeping in view their corresponding EF scores and correlation between them. This validates the classroom concern scores of the current study. Out of the remaining, some of the *CPC scores are higher than their PCC scores indicating that their classroom adjustment is low.*

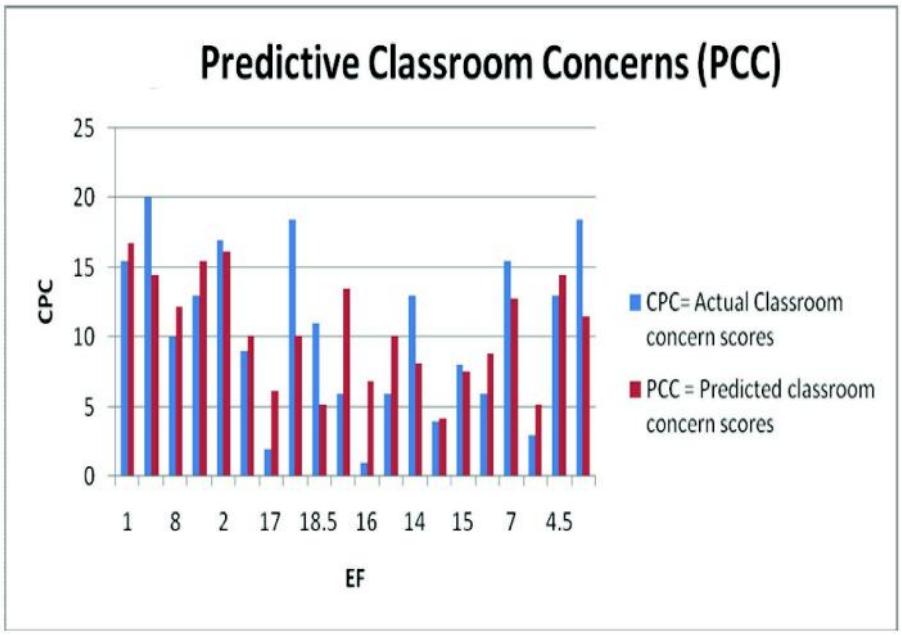


Fig. 1: Predicted Classroom concerns vs Actual classroom concerns

There are still other scores where the CPC scores are lower than their PCC scores indicating that their classroom adjustment is better This discrepancy, that is the PCC scores being lower than the CPC scores, could be due to the study's limitation of the classroom performance information being taken from parents i.e., level at which the parents think that there child is performing. Moreover, autism is a spectrum disorder with children having varying degrees of difficulties with social interaction and routines/flexibility. Hence, if the school is not providing them with a defined structure, as is expected of a school environment, their performance could have been adversely affected.

Results conclude that increase in EF and thereby reduction in the classroom concerns was partly due to the EF embedded intervention.

Limitations and Future Implications

The intervention model needs to be put through rigorous empirically validated data testing. The current data and results are indicative for future research and cannot be generalized due to small sample size and maybe skewed due to demographic factors. Standardized measures can be used to strengthen the study empirically. Further, the study needs to be replicated with different age groups, with children from different language and cultural backgrounds with varying school systems and expectations; i.e. beyond English medium, public school from NCR.

Nevertheless, the effect and relevance of EF training on school adjustment highlights the need for EF based interventions to be an integral part of any therapy program it can help specialists in clinical and educational setups to form strong foundations for Early Intervention programs and School Readiness programs. Results from similar and other larger scale research in the area can be used to sensitize teachers to focus on other important factors impacting classroom adjustment of children beyond course material.

It can also be used as a tool to guide parents about their child's school readiness skills. The study strengthens that executive functions form basis of various other skills like theory of mind, social skills, overall social competence which will later impact perspective taking and other higher order skills.

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