

Gender Differences in Executive Functions among Secondary School Students

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The aim of this study was to investigate the gender difference in executive functions of secondary school students in Karachi. It was hypothesized that “Male students will score higher on the variable of Executive Functions as compared to female students”. Following a comparative research design a sample of 100 (50 male and 50 female) students with grade level of 7 and 8 were randomly selected from various private English medium schools of Karachi-Pakistan. The age range of participants was from 12 to 14 years (mean age: 12.50; SD = .92). After establishing the rapport and written informed consent, the demographic form was filled in and the Behavior Rating Inventory of Executive Function -BRIEF was administered. Statistical analysis showed that there is a significant difference on the variable of executive functions ($p < .05$) where boys scored higher on global, as well as sub domains of executive functions as compared to girls of secondary school students. Limitations and recommendations are also suggested.

Keywords: Executive function, secondary school students comparative study

The aim of this research is to find out the gender difference in executive functions of secondary school students in Karachi. As we know that “Executive functions” is a relatively new broad terminology used by counselors, teachers and parents to define learning and attention difficulties. Executive functions are set of cognitive functions which comprise of scheduling, cognitive flexibility, abstract thinking, role attainment, beginning suitable actions, constrain inappropriate actions and picking appropriate sensual information. Executive functions progress gradually and slowly. They begin in late infancy, undergo noticeable variations through the ages of 2 over 6, and reach their peak near the age of 25

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years. In the Adolescent stage partial executive functions are out of sync with their developing sense of autonomy, sense of independence, strong emotional state and sexual energy that results in failure to prepare these individuals with the inhibitory and control mechanisms required for proper justified decisions in this tempting period. In this stage they require parents to establish external restrictions and be the substitute for their immature executive functions because teens are not capable to put into action the self-control inhibitory mechanisms (Lynn, 2011).

Current neuroscientific researches on children and adults implicate unsuccessful executive functions, or their absence of commitment, in the matters of performance in school as well as in deregulated emotive conditions experienced by individuals without executive function deficits. Such a status is categorized by a partial capability for thinking and understanding as well as by involuntary, spontaneous responses (Ford, 2010). Miller (2005) pointed the two fundamentals of executive functions that are self-regulation and meta-cognition.

Self-regulation, particularly the capacity to inhibit, is required for efficient problem solving and aim-oriented action to take place. Inhibitory control is vital to the regulation of behavior and cognition (Tamm, Menon, & Reiss, 2002). Inhibition permits a person to stop or delay a first response, interrupt an ongoing but inappropriate behavior, or resist interference by distracting stimuli or thoughts where as Flexibility describes the ability to shift and transition adaptively between activities or thoughts (Gioia, Isquith, Guy & Kenworthy, 2000). Flexibility also can be observed in creative thinking or in planning new behavior patterns. Some children shift from one stimulus or action too quickly or without reflection and are easily distractible which is observed in children within the autism spectrum and attention deficit disorders (Gioia, Isquith, Kenworthy, & Barton, 2002). Moreover, discussing about executive function, it is indicated that Self Regulation was found to be higher in male kindergarden students (Matthews, Cameron, & Morrison, 2009). After administering Child Behavior Rating Scale on teachers, they found that boys score higher than girls in five domains of initial performance, such as problems in applied mathematics, general

knowledge, letter-word identification, vocabulary of expression and comprehensive cognizance.

Meta cognition (Barkley, 2000) includes higher order abilities that are used to self-manage and self-monitor. Metacognition can include simple reflection, planning, and execution of immediate goal-oriented behavioral sequences. The components of metacognition include initiation, planning, working memory and monitoring. Researchers have been interested to find out the gender difference regarding Executive functions and cognitive abilities. It is a known fact that males and females are not the same biologically however, they too vary from each other in cognitive functions (Kimura, 1998). Conventionally, dissimilarities in spatial, verbal and quantitative abilities have been studied. Studies by Crucian and Berenbaum, (1998) confirmed, that male benefit in some spatial abilities and Chipman and Kimura, (1998) revealed that a female advantage in some verbal abilities. Recently Said (2013) revealed that executive functions, self-efficacy and self-reported study strategies did not predict academic performance. According to the process oriented model (Halpern & Wright, 1996) males outperform females in tasks that require maintaining and manipulation of information in short term memory, and females outperform men in tasks that require rapid access and retrieval from long term memory.

Most studies of cognitive sex differences have been conducted using paper-and-pencil tests. The tests often measure primarily one type of ability, thus not corresponding very well the demands of everyday life, which requires many capacities simultaneously. There are male and female advantages in cognitive abilities depending on the content of a problem. One of the largest sex differences may be a male advantage in mental rotation tasks (Kimura, 1999). On average, men also outperform women in perception of line judgment, in mathematical reasoning, and in route-navigating, whereas women usually outperform men in tasks of perceptual speed, finger dexterity, verbal fluency, verbal and item memory (Weiss, Kemmler, Deisenhammer, Fleischhacker & Delazer, 2003.). Spatio-motor targeting abilities, which favor males (Westergaard, Liv, Haynie & Suomi, 2000), demonstrate sex differences in more ecologically valid situation than the paper-and-pencil tasks.

In general, boys and girls perform similarly on tests of executive function (Welsh, Pennington, & Grossier, 1991). Nonetheless, there is some evidence that girls perform slightly better than boys on certain verbal tasks (Levin et al., 1991), and boys perform marginally better than girls on specific spatial tests (Krikorian & Bartok, 1998). Anderson (2001) concluded that most research suggests that gender differences do not affect the development of executive processes as these develop at the same rate in boys and girls. Gender differences may occur on specific tasks or domains, but at present there is an inadequate data to accept that boys and girls would perform differently. Developmental paths during adolescence may differ for males and females as a result of neuroendocrine changes. Researches conducted in the west have opened a pathway to explore this phenomenon in our culture as there are no researches available regarding gender difference in executive functions.

Hence a question arises “whether there is any difference in the executive functions of male and female secondary school students in Pakistani Culture”? The finding of this study will be helpful in opening different new paths through which we can investigate and understand the role of executive functions in male and female in a better way. The basic purpose of this study is to identify the strengths of secondary school students in a different context by which they can strengthen their abilities towards success and will be able to perform as a more positive and productive part of society. As in our culture, students who are not able to achieve certain levels of grades are labeled as failures though they are not. This new area of research will be beneficial in generating further scientific knowledge and ways of understanding mental health. Keeping in view all these western research and above mentioned queries, following hypothesis has been formulated:

- Male students will score higher on the variable of Executive Functions as compared to female students.

Method

Participants

Hundred adolescents (50 male and 50 female students) with grade level of 7 and 8 and the age range of 12-14 years (with the mean age of 12.5; $SD=.92$) were randomly selected from different private English medium schools of Karachi, Pakistan. The probability sampling technique was used so that every student had an equal chance of participation in the study. From every school two classes 7 and 8 were selected and after consultation with their class teacher the numbers of students in whole class were listed out and every 10th student was selected from that list.

Measures

Demographic Information included participant's personal information including age, gender, educational level, socioeconomic status, birth order, number of siblings, marks obtained in previous exams, tuitions given and family system.

Behavior Rating Inventory of Executive Function (BRIEF), developed by Gioia, Isquith, Guy, and Kenworthy (2000) is an assessment of executive function behaviors at home and at school for children and adolescents. It has 89 items. The questionnaire can administer on parent- and teacher- informants and takes 10–15 minutes to be administered, and 15–20 minutes to be scored. Other versions of the BRIEF measuring executive function in preschool children (BRIEF Preschool 3–5 years), school-age children using self-report (BRIEF Self-Report 13–18 years), and adults (BRIEF Adult 18–90 years) are also available. The BRIEF was developed in 2000 to address limitations in available rating scales of executive functions to examine children's qualitative behavioral expression of executive functions competence in real-world settings. BRIEF based on normative data on child ratings from 1,419 (815 girls and 604 boys) parents and 720 teachers from a representative distribution of socioeconomic status. The BRIEF provides a standardized way of

asking multiple raters about executive functions of daily life in a manner that is not disease specific. Since it is not disease specific, the BRIEF may be used to assess executive function behaviors in children and adolescents with an array of difficulties, including learning disabilities, attention difficulties, brain injuries, developmental disorders, psychiatric conditions, and medical issues. It consists of two indexes: Behavior Regulation Index including inhibit, shift and emotional control. The second is Meta-cognition Index that measures working memory, initiate, plan, organization of material and monitor. By adding both indexes Global Executive Composite is obtained. It has two validity scales the negativity scale and inconsistency scale. Convergent and divergent validity with other measures of emotional and behavioral functioning has also been established. Questionnaire was based on Inter-rater reliability correlation and item-total correlations that shows highest probability of being informative. This inventory has highest test-retest reliability and internal consistency. The BRIEF has validated, with high test-retest reliability (r_s - .88 for teachers, .82 for parents), internal consistency (alphas - .80 - .98), and moderate correlations between parent and teacher ratings (r_s - .32 - .34).

For this research the internal consistency of the present data was calculated and the coefficient alpha for all the items of our sample ranging from .405 to .842 ($p < .000$). For the whole sample the values for Inhibit is .619, Shift is .582, Emotional Control is .598, Monitor is .405, Working Memory is .607, Plan/Organize is .842, Org. of Materials is .504 and Task Completion is .582 ($p < .05$) (Hussain & Ali, 2014).

Procedure

Initially the research synopsis was approved at the meeting of the Board of Advanced Studies and Research, University of Karachi in which the ethical principles of research with human participants were thoroughly addressed. After getting approval, the researcher purchased original forms and scale from publisher. Then researcher approached the administration of different English medium schools of Karachi and took written permission after providing the letter of

permission of data collection by the supervisor. The participants were briefed about the purpose of the study and rapport was established. All participants were scattered by seating them randomly in order to control the corresponding and cheating factors. They were given informed consent to be filled in and confidentiality of their identity was assured. In order to ensure their willingness of voluntary participation in the study, they were also given the right to withdraw from the study at any time. Since this study was the part of Researcher's Ph.D. Thesis, after establishing rapport the demographic form and other scales were administered individually on the participants then the BRIEF was administered on them in a group setting. After completion of the data collection, the statistical analysis was done through SPSS.

Operational Definitions of Key Terms

Executive function

It's a Complex cognitive processing requiring the co-ordination of several sub processes to achieve a particular goal (Funahashi, 2001).

Meta-cognition

Metacognition includes higher order abilities used to self-manage and self-monitor (Gioia, Isquith, Guy, & Kenworthy, 2000).

Self-regulation

Self-regulation, particularly the capacity to inhibit, is required for efficient problem solving and aim-oriented action to take place (Gioia, Isquith, Guy, & Kenworthy, 2000).

Results

Table 1

Descriptive Statistics of Demographic Information's of Entire Sample

Variables	n	%
1. Gender		
Male	50	50
Female	50	50
Total	100	100
2. Education		
6th grade	4	4
7th grade	44	44
8th grade	52	52
Total	100	100
3. Family Structure		
Nuclear	72	72
Joint	28	28
Total	100	100
4. Tutions taken	40	40
Tutions not taken	60	60
Total	100	100
5. Birth order		
1st born	39	39
Middle born	16	16
Last born	45	45
Total	100	100

Table 1 shows most of the adolescent are studying in 8th grade (52%) and didn't take tuition (60%). Mostly are last born (45%) and living in a nuclear family system (72%).

Table 2

Mean Scores of Global Executive Composite (Its Domains and Sub-domains) between Male and Female Secondary School Students

Groups	N	M	SD	SEM	t	p
1. Global						
Female	50	115.58	22.77	3.22		
Male	50	128.48	18.00	2.54		
2. Meta-cognition						
Female	50	66.92	14.82	2.09		
Male	50	75.28	11.59	1.63		
3. Behavior Regulation						
Female	50	49.06	8.27	1.16		
Male	50	53.08	7.67	1.08		
4. Inhibit						
Female	50	18.12	3.64	.514		
Male	50	20.06	3.85	.545		
5. Shift						
Female	50	15.52	3.01	.425		
Male	50	16.90	2.71	.384		
6. Plan						
Female	50	18.78	4.34	.614		
Male	50	21.46	3.46	.490		
7. Task Completion						
Female	50	14.0	3.37	.477		
Male	50	15.5	3.15	.446		

* $p < .05$ $df = 98$

Table 2 indicates that there is a significant difference regarding gender on Executive Functions of adolescent students, where male scores are higher than female on global, its two domains Meta Cognition and Behavior Regulation and also on its sub domains i.e inhibit, shift, plan and Task Completion.

Discussion

Findings of the present study showed that male students score significantly higher than female students on Global Executive functions and as well as on its domains (table 2). As we know that Executive functions are set of cognitive functions which comprise of abilities to schedule the task, cognitive flexibility, abstract thinking abilities, role attainment, beginning taking initiation for suitable actions, constrain or inhibit inappropriate actions and picking appropriate sensual information, which need opportunity to execute. Finding clearly indicates than male students are better able to execute these functions. As it can be observed that in our culture, parents are more concerned and worried about their teenage boy's future and education. They want their boys to have a strong career. But for girls the case is opposite. Parents force more check on their sons that in turn enhance their self regulation and metacognitive behaviors. Overall, this check and balance impacts positively on their executive functions. In adolescent stage partial executive functions are out of sync with their developing sense of autonomy, sense of independence, strong emotional state and sexual energy that results in failure to prepare these individuals with the inhibitory and control mechanisms required for proper justified decisions in this tempting period. In this stage they require parents to establish external restrictions and be the substitute for their immature executive functions because teens are not capable to put into action the self-control inhibitory mechanisms. It's easily observed and concluded that continuous use of executive functions is essential for maintaining concentration, purposeful thinking and mental effort during learning years (Lynn, 2011).

There are not much research done in Pakistan, however western literature showed that girls and boys have different trajectories of brain development; males and females are different by their biology (Lenroot et al., 2007) but they also differ from each other in cognitive functions (Kimura, 1999). For instance, considering cognitive abilities, researches indicated that male score higher than female on spatial abilities (Crucian & Berenbaum, 1998) and visual-spatial abilities, (Weiss, Kemmler, Deisenhammer,

Fleischhacker & Delazer, 2003). Previously Collaer and Hines (1995) found another factor that favored males was auditory attention and working memory where as Digit Span task has been considered a sex-neutral task. However, according to process oriented model of cognitive sex differences, males outperform females in tasks that require maintaining and manipulation of information in short term memory (Halpern & Wright, 1996). Males may have used visuo-spatial imagery, which is proved to be a good strategy for a better performance in Digit Span task (Hoshi et al., 2000).

This difference can be explained by Biological Theories for instance, according to Lynn (2011) sex differences in g and in intelligent quotient (IQ) as measured by Wechsler Adult Intelligence Scale (WAIS) or other intelligence tests have been observed there is a male advantage of approximately four IQ points correlation with larger brain size in men. One of the largest sex differences may be a male advantage in mental rotation tasks (Kimura, 1999). Weiss, Kemmler, Deisenhammer, Fleischhacker and Delazer (2003) stated that on average, men also outperform women in perception of line judgment, in mathematical reasoning, and in route-navigating, whereas women usually outperform men in tasks of perceptual speed, finger dexterity, verbal fluency, verbal and item memory. Hence, it is concluded that there is a gender difference regarding executive functions in our culture and boys score high on every domain of executive functions as compared to girls of secondary school students.

Limitations and Recommendations

In this study, we selected private schools were selected and it is recommended that a further study should be done on students from government school and from different economic strata. Further research work is needed to explore the reason of difference in boys and girls executive function on a larger data. Due to the availability of scale in English language the data was collected from English medium school only. Further research should be done with other students after translating or developing the scale in national language.

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