

## The Relationship Between Executive Functions And Anger Among A Sample Of Students Aged 13-17 Years Old And Its Relationship To Some Demographic Variables

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### Article Info

#### Article History

Received:  
June 28, 2020

Accepted:  
August 21, 2020

#### Keywords

Executive functions,  
Ager, age 13-17

#### DOI:

10.5281/zenodo.3994685

### Abstract

*The present study examines the relationship between executive functions and anger among a sample of students 13-17 years old. The sample consisted of 101 males and 105 females students. The state-trait anger scale and Behavior Rating Inventory of Executive Function 2nd were used.*

*The results showed that executive functions and anger detected on the average among the sample, and showed no significant differences in executive functions related to area of study. The results showed also that girls have better executive functions compared to boys and no sex differences in anger trait nor in anger trait and area of study. The correlational results showed that less anger is associated with better executive functions and that parents' education was not correlated with executive functions.*

### 1. Introduction

The executive functions are the set of processes that all have to do with managing oneself and one's resources in order to achieve a goal (Hofmann, Schmeichel & Baddeley, 2012). It is the term that is usually used when there is an involvement of mental controls, self-regulation or in more technical terms it is used on neurologically-based skills (Bader & Wagner, 2007). There is a range of executive functions that can be considered important for playing a role in human life while for comprising the fact, we have targeted the children (students) to understand the relationship of their behaviour and the executive functions (El Haj et al. 2013).

Executive functions (EFs) play an important role in the life of children in many different ways. It is the main part of the process in which a child develops the cognitive approach as well as effects on the behavioural development of the children. Children are not born with the skills of sorting things in the mind, while it is the executive functions that bring the potential in the children to develop the emotions as well as control them. The process of enhancing the abilities continues along with the growing ages of an individual whereas it gets completed in adulthood. It is important to ensure that the capacities of the children are being increased from the initial levels since it helps them to understand the way of interaction within the society as well as helps to build up an individual personality to play their part as a member of the society. The importance of the executive function is much significant, that is why it is being studied on a large scale for a sufficient period of time. However, there is a lack of studies that examined the effect of deficits in EFs on the development of anger, particularly in middle childhood, taking into account different forms and functions of anger (Hillman et al. 2004). The present study extends previous research by examining the links between EFs and behaviour of the students in terms of anger. Since there is already a number of researches present on the particular field, this study exclusively extends the knowledge of the different factors that are somehow correlated to the children's mental growth along with their behavioural development (Cock, Matute & Jurado, 2008). The study further explores the EFs and its relation with the age while focuses on other variables like gender, father, and mother's education.

The study further aims to investigate the relationship between executive functions and anger among a sample of students aged 13-17 years old. The other aim is to see whether this is a relationship between anger, EFs, and age, sex, area of study, and parents' level of education.

The rationale behind this is that the brain of this age group is still developing so as the EFs, so one would expect that this age group will have problems controlling anger. We will be finding different factors that affect the emotions of the students along with the importance of EFs in the growing ages. Also, some studies showed that EFs contribute to emotional control of anger (Gotlib & Joormann, 2010). Relatedly, it has been found that people with low or high trait anger demonstrate more cognitive control if faced with hostile stimuli (Wilkowski et al., 2010). For understanding these factors and effects of executive function in growing ages, it is important to understand the facts and its basic working criteria and how it affects anger, a defining of the basic concepts of the important factors of this study and their relationship with each other will be summarized. So the study will try answering the following questions:

**Study questions:**

Q1 — what are the levels of executive functions and anger scores among the study sample?

Q2- Are there significant differences between executive function scores and sex and area of study?

Q3- Are there significant differences between anger scores, sex, and area of study?

Q4- Is there a correlation between executive functions, anger, age, and years of education for mother and father?

**What is the Executive function?**

The skills that help the individual to complete the tasks by utilizing the brain abilities are known as executive functions (Moll et al. 2006). Since the brain is the main part to control all these capabilities, there are different studies of the brain that also cover the study of executive functions (Tarek Bellah et al. 2016). The main points that executive function covers in humans' behaviour include the time management, concentration level of an individual, switching the focus, organizing things, remembering the details, the sense of avoiding mistakes, utilizing the experience and multitasking (Rosenthal et al. 2013). Perhaps, these are the major factors that are directly related to the executive function, there are some other important influences of these functions on human behavior (Otero & Barker, 2014). An individual from a very little age can find it difficult to control the behaviour and emotions if they are not trained properly (Zelazo & Carlson, 2012). It is important in several ways because it helps the children to learn how to do their daily tasks, how to deal with the different circumstances, and how to behave in different kinds of occasions.

Covering these different factors, executive functions are divided into two different categories. One is Organization in which the skills of structuring and gathering information are supposed to be polished whereas the second category is Regulation which primarily deals with the behaviour according to the requirement of time and circumstances (Swanson & Alloway, 2012). This study deal with the second category of the executive functions since it depends upon the factor of behaviour i.e. anger and its relationship with executive function (Carriedo et al. 2016). There are a lot of examples that can elaborate on the role of executive functions even better (Banich, 2009; Jacobs, Harvey, & Anderson, 2007). For instance, there are some general circumstances where an individual is supposed to react with aggression and anger, while when the mind decides to control that anger and behave accordingly, it is the executive functions dealing with the brain abilities by analyzing different consequences at the same time (Kuhl et al. 1992; Ylvisaker, 1998). There is another area that is important to understand called executive function disorder (Dias & Seabra, 2017). This is not considered to be the true medical condition however; it is certainly the weakness of the brain which eventually causes the management and control issues in an individual. The student that suffers from this disorder tends to have trouble paying attention to the things, memorizing, and reacting appropriately (Pellis et al. 2010). Executive functions can be weak by the birth of the child while some people suffer from this disorder due to some other disabilities, i.e. autism and ADHD.

The fact describes the importance of these functions briefly, and that is the reason, numbers of studies are taking place on executive function.

The EFs development such as self-regulation of emotions and behaviour begins in the infant and continues during preschool, adolescence, and early adulthood (Zelazo et al., 2007; Hughes et al., 2011). The development of EFs is closely related and subject to neurobiological and environmental elements. In fact, the neurological substrate of the EFs is found in the prefrontal cortex and the cingulate cortex in connection with cortical and subcortical areas (Heyder et al., 2004).

**Anger**

Anger is one of the emotions that humans deal with from the very little age. It is through a natural part of human nature, it often is caused by different psychiatric disorders (Davidson et al. 2006). The emotion eventually leads to different adverse effects on human health and that is why they are taught to control it from the initial stages (Jiang, Capistrano & Palm, 2014). There are other complications in human emotions that may occur with the occurrence of anger, it is still considered to be a normal emotional state with the physiological, behavioural, and cognitive aspects. Anger has previously been referred to as "the misunderstood emotion" and it is a relatively neglected topic in the clinical literature (Nagy, Westerberg & Klingberg, 2004). There are a number of theories that are present on the anger while some of the traditional views relate it with the depression as well (Zelazo & Carlson, 2012). Some theories (Ardila & Rosselli, 1994; Alex & Benson & Stuff, 1989) proposed that the function of anger appears to be that of opposing and attacking destructiveness. However, mature, positive anger may be an active response to deal with a threatening situation (Fitzpatrick, Gilbert & Serpell, 2013). Parental anger may attempt to curb a child's destructive urges. Similarly, anger demonstrated by social groups may be functional within society (Hofmann, Schmeichel & Baddeley, 2012). Anger in its pathological form does not represent a destructive source but its' failure to function positively due to complications. One type, primitive anger, spills easily into violence; objects are all good or all bad and control is not yet exerted (Debbie et al. 2016). These facts make it important to train the children for controlling this emotion while there are some natural facts that cannot be controlled. Moreover, a part of the internal reason, some external factors also affect this emotion, its growth, and the controlling ability of the child. This study is based on these external factors to know what affects the cognitive approach of students at schools.

### **Relationship between EFs and Anger**

There are certain parts of the brain that play an essential role in controlling different types of emotions in the human brain (Bellaj et al. 2016). Executive functions deal with the same part of the brain that is supposed to deal with emotions among the other functions (Barkley & Fischer, 2011). When this system does not function properly people appear to lose their intention and other purposeful activity gets disturbed (Allan et al. 2014). There are clinical cases in which patients are tested for their novel responses while keeping the executive function in consideration (Ernst et al. 2003). For instance, one function would be to ensure the individual does not pay attention to irrelevant external stimuli or respond in impulses for immediate gratification which may abort the complex behaviour before it is completed (Garner & Waajid, 2012). The researchers (Xu et al., 2013) provide a definition that executive functions denote higher-order cognitive and behavioural capacities. These functions exist at the most superordinate level of human cognition, they are difficult to quantify and are closely linked to personality and consciousness. That is why executive functions are considered to be significantly important with the matter of dealing with emotion. It is more important in the growing ages since the brain develops different kinds of skill sets at that time and if an individual fails to build the skills of controlling the emotions and some other brain activities, it can be disadvantageous on long-terms. Ogilvie et al., (2011) concluded that EFs is negatively associated with antisocial behaviours and the occurrence of comorbid problems.

Finally, anger is related to increased aggression (Bushman et al., 2005), and escalated of negative mood (Rusting et al., 1998) and decreased the capacity for self-control (Denson et al., 2011).

#### **The Method:**

**Sample:** Two hundred and six students participated in this study (13-17 years old). One hundred and one of them were males while 105 were female students. Demographical variables like age, sex, field (area) of study, mother and father education were collected in order to subdivide the participants into two groups according to genders, and two groups according to the area of study including one of the scientific group, the students who study courses like math, physics and the other group was the literary group which includes the students that study the courses like language, history, etc.

**Tools:** Two different tools were used to measure the anger and executive functions of the students include:

#### **-Trait anger Scale (TAS)**

The participants' trait anger level was measured using the 15-item Spielberger Trait Anger Scale, Arabic version (Spielberger et al., 1983). Item responses are rated on a 4-point Likert scale (1 = Almost never, 2 = Sometimes, 3 = Often, 4 = Almost always) that assess the intensity of anger at a particular moment and the frequency of anger experience, expression, and control. Higher scores indicate a greater tendency to experience anger in a wide range of situations. Cronbach's alpha was found to be 0.86 for this study and was 0.81 for the Arabic version (Abdelrahman & Abdel Hameed, 1997). The TAS is a self-reporting tool. Using the means and range of responses, the performance of the sample was calculated (mean) as follow:

Less than 1.34 low, 1.34-2.67 average and more than 2.68 high.

#### **-Behaviour Rating Inventory of Executive Function, Second Edition (BRIEFS 2), self-rating part, Arabic version.**

The Behavior Rating Inventory of Executive Function, Second Edition (Gioia, et al., 2015), is individually administered rating scale of executive function (EFs) for children and youth, aged 5 to 18 years. Primarily used in clinical, psychoeducational, and research settings. The BRIEFS 2 evaluates everyday behaviours associated with EFs in the home and educational environment. Item responses are rated on a 3-point Likert scale (1 = never, 2 = Sometimes, 3 = often).

BRIEFS 2 self-rating part consists of 55 items that contribute to seven factors: Inhibit, Self-Monitor, Shift, Emotional Control, Task Completion, Working Memory, and Plan/Organize. There are also three validity scales (Inconsistency, Negativity, and Infrequency) comprised of items on each version of the measure that evaluate respondents' response patterns. The primary scales combine to form three composite indexes: Behavior Regulation Index (BRI; comprised of the Inhibit and Self-Monitor domains), Emotional Recognition Index (ERI; comprised of the Shift and Emotional Control domains), and Cognitive Regulation Index (CRI; comprised of the Initiate, Working Memory, Plan/Organize, Task-Monitor, and Organization of Materials domains), and a unitary Global Executive Composite (GEC). The BRIEFS 2 have good psychometric characteristics. Test-retest reliability was (0.86) for the total score and for the factors the range of reliability was (0.78-0.85). Cronbach's Alpha was (0.93) (Almomani, 2018). A higher score indicates bad executive functions. Using the means and range of responses, the performance of the sample was calculated (means) as follow:

Less than 1.67 low, 1.67-2.33 average and more than 2.34 high.

#### **Results and Discussion**

The descriptive statistics of all study variables are presented in the Tables below and analyzed using different statistical procedures.

Q1: What are the levels of executive functions and anger scores among the study sample?

**Table (1)**  
**Means and standard deviation (SD) of the sample performance on the study tools**

Variable	Mean	SD	level
<b>Inhibition</b>	1.74	.34	Average
<b>Self -monitor</b>	1.83	.34	Average
<b>Shifting</b>	1.72	.30	Average
<b>Emotional control</b>	1.76	.37	Average
<b>Task completion</b>	1.75	.35	Average
<b>Working memory</b>	1.64	.35	Low
<b>Organize</b>	1.65	.31	Low
<b>Inconsistency</b>	1.74	.30	Average
<b>Negativity</b>	1.74	.35	Average
<b>Infrequency</b>	1.27	.37	Low
<b>BRIEFS 2 (total score)</b>	1.69	.24	Average
<b>Anger</b>	1.46	.43	Average

**Table 1** showed that Anger was detected on the average in the overall descriptive approach of study same as the BRIEFS 2 scores. Whereas some of the factors of BRIEFS 2 including working memory, organization, and infrequency were detected to be low in the particular cohort of the students.

These results can be explained as the frontal lobes are involved in behaviours such as problem-solving, planning, inhibiting responses, strategy development, and working memory all these skills improved as the brain matures during childhood and adolescence. The incomplete development of the frontal lobes in childhood implies that a limited ability to apply effective executive skills may be present (Anderson, Lajoie, & Bell, 1996). The EFs development such as self-regulation of emotions and behaviour begins in the infant and continues during preschool, adolescence, and early adulthood. (Zelazo et al., 2007; Hughes et al., 2011) and continue to develop in conjunction with the prefrontal cortex developing (Blair, 2002) which is relatively immature in early adulthood (Jones et al., 2009).

Since EFs begin to emerge in infancy and show marked improvements across adulthood and the preschool period and continue to improve across the school years with some aspects of EFs continuing to develop throughout adolescence that may explain why some of the subtests of the executive function are within the average and some of it still developing among the sample group.

Furthermore, the results were extracted from the relation of parents' education and the tests of students according to the mother and father years of education (average of mother years of education was 11.04, Average of Father Years of education was 11.24) this may, in some parts, contribute to average EFs among the sample.

Furthermore, the results were identified by the differences in the area of study and EFs scores as well as the role of the sex on the following study results in table 2.1 and 2.2.

**Q2: Are there significant differences between BRIEF 2 scores and area of study (scientific stream vs literary stream\*\*) and sex.**

**First: Brief 2 scores and Area of study**

**Table (2.1) t-test results (t-test for two independent samples)**

Dimension	Area of study	N	Mean	SD	t-test	Df	Sig		
<b>Inhibition</b>	Scientific	102	14.08	2.95	.701	204	.484		
	Literary	104	13.81	2.56					
<b>Self-monitor</b>	Scientific	102	9.20	1.69	.566		204	.572	
	literary	104	9.07	1.74					
<b>Shifting</b>	Scientific	102	13.98	2.36	1.075			204	.284
	literary	104	13.62	2.43					
<b>Emotional control</b>	Scientific	102	10.47	2.33	-1.243	204			.215

	literary	104	10.88	2.39		
<b>Task completion</b>	Scientific	102	33.23	2.11	-.548	.585
	literary	104	33.42	2.93		
<b>Working memory</b>	Scientific	102	13.15	2.92	.068	.946
	literary	104	13.12	2.79		
<b>Organize</b>	Scientific	102	16.44	3.19	-.311	.756
	literary	104	16.58	3.16		
<b>Inconsistency</b>	Scientific	102	25.64	4.45	-1.395	.165
	literary	104	26.54	4.75		
<b>Negativity</b>	Scientific	102	13.95	2.90	.217	.828
	literary	104	13.87	2.69		
<b>Infrequency</b>	Scientific	102	3.80	1.05	-.165-	.869
	literary	104	3.82	1.20		
<b>BRIEF2 total score</b>	Scientific	102	92.86	13.42	-.146	.884
	literary	104	93.13	13.18		

As it can be seen from table 2., t-test results showed no significant differences between EFs and area of study across 104 of literary student and 102 of scientific (high school students). That could be explained by the interest of that student in the high school age group doesn't fully differentiate, so we suggest repeating that study at the university student.

#### Second: BRIEF 2 and Sex

**Table (2.2)** t-test results (t-test for two independent samples)

Dimension	gender	N	Mean	SD	t-test	df	Sig
<b>Inhibition</b>	Male	101	14.67	2.72	3.853	204	.000*
	female	105	13.24	2.61			
<b>Self-monitor</b>	male	101	9.22	1.81	.715	204	.475
	female	105	9.05	1.62			
<b>Shifting</b>	male	101	14.19	2.43	2.325	204	.021*
	female	105	13.42	2.31			
<b>Emotional control</b>	male	101	10.53	1.99	-.847	204	.398
	female	105	10.81	2.68			
<b>Task completion</b>	male	101	33.66	2.81	1.827	204	.069
	female	105	33.01	2.25			

<b>Working memory</b>	male	101	13.73	2.63	3.005		.003*
	female	105	12.56	2.94			
<b>Organize</b>	male	101	16.92	2.85	1.816		.071
	female	105	16.12	3.40			
<b>Inconsistency</b>	male	101	26.85	3.97	2.332		.021*
	female	105	25.37	5.07			
<b>Negativity</b>	male	101	14.31	2.79	2.051		.042*
	female	105	13.52	2.74			
<b>Infrequency</b>	male	101	3.92	1.24	1.421		.157
	female	105	3.70	1.00			
<b>BRIEFS 2 total score</b>	male	101	95.80	12.22	3.033		.003*
	female	105	90.30	13.73			

The results showed significant differences between males and females on EFs total score, the means of males were higher, this suggests that EFs are better for females than Male. There were also significant differences between males and females on inhibition, shifting ability, working memory, inconsistency and negativity with the male's scores were higher which suggest better performance for females at BRIEF 2.

This results is consistent with previous study which showed the presence differences in the total score of BRIEF 2. (Almomani, 2018)

Although there is little support for sex differences in EFs (Grissom and Reyes, 2019) the current results could be explain, heuristically, by there are more females going to education than males. In addition to the fact that, culturally, patents stress for more good behaviours among girls than among boys.

### **Q3: Are there significant differences in anger and area of study and sex?**

#### **First: Anger and Area of study**

**Table (3.1)** t-test results (t-test for two independent samples)

<b>Variable</b>	<b>Area of study</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>t-test</b>	<b>df</b>	<b>Sig</b>
<b>Anger</b>	Scientific	102	21.3357	6.84463	-1.283	204	.201
	literary	104	22.5058	6.23629			

#### **Second: Anger and Sex**

As it can be seen on table 3.1 there are no significant differences in anger and area of study among the sample

#### **Second: Anger and Sex**

**Table (3.2)** t-test results (t-test for two independent samples)

<b>Variable</b>	<b>gender</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>t-test</b>	<b>df</b>	<b>Sig</b>
<b>Anger</b>	Male	102	21.33	6.84	-.240	204	.810
	Female	104	22.50	6.24			

As it can be seen on 3.2 there are no significant differences in anger and sex among the sample. Girls and boys do not differ in their experience of anger but there are beliefs that girls are more likely to positively express (behavioural) their anger than boys (Boman, 2003).

This finding is in line with a meta-analysis on gender differences in aggressive behaviour (Card et al., 2008). However, the multi-group analyses revealed that the predictive paths from EFs to aggression and from EFs to habitual anger as well as the indirect paths from EFs over anger to aggression did not vary by gender, which confirms and extends previous cross-sectional research (White et al., 2013). Consequently, the processes and mechanisms that lead from EFs to aggressive behaviour seem to be equivalent in girls and boys in middle childhood.

**Q4: Is there a correlation between executive functions, anger, age and years of education for mother and father**

**Table (4) Pearson Correlation Matrix.**

Dimension	Anger	Age	Father education	mother education
Inhibition	.302**	.011	.089	-.030
Self-monitor	.221**	.042	.128	.029
Shifting	.122	-.058	-.005	-.139*
Emotional control	.312**	.036	.230**	.155*
Task completion	.147*	.091	.037	-.088
Working memory	.130	.103	.122	-.037
Organize	.315**	-.035-	.089	-.056
Inconsistency	.354**	.149*	.149*	.037
Negativity	.230**	-.009-	.041	-.124-
Infrequency	-.013	.155*	-.008-	.005
BRIEFS 2	.320**	.053	.130	-.037

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

The results showed a positive significant correlation between executive functions and anger and for the factors of the executive function anger was positively correlated with inhibition, self-monitor, emotional control, task completion and organizing, whereas the result showed no significant correlation between anger and shifting ability and working memory. Also, the results showed no significant correlation between anger scores and mother and father education.

The results showed no significant correlation between age and EFs across the sample, and no significant correlation between father and mother education and EFs except a positive significant correlation between emotional control ability and mother and father education, and shifting ability was significantly correlated with the mother education only.

These results showed a significant positive correlation between the scores of (TAS) and Behavior Rating Inventory of Executive Function, (BRIEFS 2), (notice that the higher the score for both tools means higher anger and bad executive function), so this significant correlation means the less EFs students have the more anger they show. Relatedly, since EFs are negatively associated with antisocial behaviours and the occurrence of comorbid problems (Ogilvie et al., (2011). So, one would expect such results.

It is also found that there is a significant correlation between age and performance on executive function tests for both boys and girls. (Ardila et al., 2000).

Consistent with the findings from this study, different aspects of EFs have been reported to show distinct trajectories across the adolescent years. For example, in a study of Australian 11- to 17-year olds that included a variety of EFs tasks, Anderson, Anderson, Northam, Jacobs, and Catroppa (2001) found clear linear age-related improvements on tests of selective attention, working memory, and problem-solving, but no age-related difference in planning performance. Also, accumulated findings from studies of younger samples is an emerging theme from the adolescent literature regarding the need to consider individual differences in both the maturity of adolescents' EFs functions and the extent to which they avoid risk and respond to reward/peer influence (adolescents are less risk-averse, more driven by reward, and more easily influenced by peers).

The results showed no significant correlation between EFs and mother and father education, contrary to previous studies which found a positive correlation between EFs and parents education. Parents with a higher education create a more intellectually stimulating environment for their children. College-educated mothers talk more, use a richer vocabulary, and read more to their children than those mothers limited to high school education (Hoff-Ginsberg, 1991).

Although parents education plays a role in developing the executive function in the literature, the current study found no significant correlation between parents years of education and executive function and that may be related to the intervening of the media; social media, peers, televisions and the openness to the world which recently played a role on limiting the parents' role on affecting their children. For example, mothers tend to spend less time of reading to their children and social media gives space for many people to influence the children's value system and problem-solving approaches

### Conclusion

This study extends the existing research on the relationship between Executive Functions and anger of the children in the middle childhood by taking the measurements and the surveys in the five different schools. Students actively participated in the research and the findings show the tendency to experience anger as a potential mediator into account, by considering different forms and variables such as education of parents, gender and the field of study. The study found that EFs has significant importance and the link between EFs and anger was partly detected along with the change in variables. The difference of gender also has an important role in impacting the cognitive growth of the students while there are factors like parents' education and area of the study of the students that were taken under the concentration for conducting the research. Further studies can extend this research by correlating other variables while identifying characteristics that affect the emotional growth of the human in the growing age.

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