

## THE RELATIONSHIP BETWEEN EXECUTIVE FUNCTIONS AND ACHIEVEMENT GOALS WITH ACADEMIC SELF-EFFICACY IN STUDENTS

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**Abstract.** The purpose of this research was to specify the relationship between executive functions and achievement goals and academic self-efficacy in students. The sample studied in the research consisted of 147 female studying in high schools in Tehran using the random method. For data analysis, Pearson's correlation method and simultaneous multiple regression method were used in SPSS statistic software along with methods of descriptive statistics. The results of the research demonstrated that the number of stages component is positively correlated with academic self-efficacy, and the preservative error and specific error are negatively and significantly correlated with it. Furthermore, the regression analysis results demonstrated that the number of stages ( $\beta=0.385$ ) and the mastery style of achievement goals ( $\beta=0.371$ ) positively predict academic self-efficacy.

**Keywords:** academic self-efficacy, achievement goals, executive functions

### 1 Introduction

One of the variables effective on academic achievement is self-efficacy beliefs. Research results demonstrate that there is a significant positive relationship between self-efficacy beliefs and academic achievement, and students with high self-efficacy have had high scores in tasks and tests concerning writing (Sommerfield and Watson, 2000); actually, academic self-efficacy beliefs denotes students' perception and belief of their ability to comprehend and learn, solve school problems, and obtain academic success, which affects many aspects of life, such as goal selection, decision making, amount of effort, perseverance and persistence level, and confrontation of challenging issues (Bandura, 2006). Altunsoy and colleagues (2010) regard academic self-efficacy as a concept related to self-efficacy concerning the student's belief about the ability to achieve a specific task level.

An important variable that may be related to academic self-efficacy realized in academic achievement is executive functions; executive functions is a collection of interrelated control processes involved in selection, initiation, implementation, and supervision of the cognitive function as well as aspects of the sensory and motor function (Roth, 2005). Abilities examined as executive functions in most research include inhibition, planning, sustained attention, working memory, and abstract thinking (Wolf, 2004). Executive functions include a wide range of cognitive processes, such as reasoning, problem solving, planning, organization, active memory, discipline, sustained attention capability, confrontation with interference, utilization of feedbacks, multitasking, and behavioral abilities (Loftiz, 2014).

Barkly (2001) used the behavioral-neurological model to explain executive functions, and regarded inhibited response as a necessary condition for the effective role of self-regulation in social life and academic performance complexities based on the same model. Barkly holds that executive functions and behavioral inhibition make self-regulation possible, and enable the individual to control his behavior and predict and manage events. He also holds that behavioral inhibition causes the response to an event to be presented with delay and provide the conditions for application of other executive functions (Barkly, 2006).

Another important variable that may be related to academic self-efficacy is achievement goals; achievement goal theory is a framework for perception of motivation for achievement, motivation in academic and mastery fields in particular. The

theory, presented by Dweck (1986) and Nicholls and colleagues (1984) has been suggested in resources concerning motivation for achievement as a justifier of people's behavior, cognition, and emotions in environments related to education and mastery (Elliot and colleagues, 1999), which has mainly appeared for specific explanation of behavior. Therefore, they are the most practical target theories for perception and improvement of learning and teaching (Pitirinch and colleagues, 2003).

It is goal orientations, goals, and meanings that the individual takes into account for his achievement behavior (Rayan and Pitirinch, 1997). In separation of achievement goals, researchers first used to focus only on the two mastery and functional orientations (Dweck, 2000), but more recent evidences and theories suggest three goal orientations (Midgley and colleagues, 1998) or even four: mastery-function, mastery-avoidance, function-approach, and function-avoidance (Elliot, Fonseca, and Moller, 2006). People with mastery orientation try to obtain mastery over tasks, overcoming challenges or increasing competency levels, and people with functional orientation try to obtain good grades or satisfying others (the teacher, parents, or others) (Pitirinch, 1999). The approach or avoidance feature of orientations also concerns the individual's willingness to get away from or close to tasks to achieve goals. Therefore, achievement goals can be considered as a cognitive-social mental framework, guiding the individual in interpreting conditions, processing information, facing tasks, and confronting challenges (Kaplan and Flum, 2010). Achievement goal theory explains the approaches students have in different achievement conditions, and assumes that goals specify and guide the direction of students' behavior, cognition, and motivation, so that they get involved in academic tasks (Ames, 1992; Lee and colleagues, 2010).

Several studies have demonstrated that functional-normative goals have a stronger relationship than mastery goals with academic self-efficacy (Hulleman and colleagues, 2010). These findings as well as the advantages of functional goals in making some students interested have made some theoreticians develop a multi-goal approach that emphasizes the positive consequences of both approaches. However, there are still criticisms focused on the validity of the advantages of normative goals, particularly in regard to the relationship between normative goals and academic achievement (Senko, Hulleman, and Harackiewicz, 2011).

The findings of Calero and colleagues' (2007) study, conducted for comparison between gifted and ordinary children's characteristics, demonstrated that gifted children obtained higher scores than ordinary groups not only at intellectual level but also in the values of self-regulation and self-motivation (achievement goals has been identified as a basic motivation component in academic achievement).

Dixon, Cross, and Adams (2001) regard characteristics such as creativity, flexibility, intrinsic motivation, and self-regulation as some specific psychological aspects of people with high academic self-efficacy. Chang (1989) found that gifted students enjoy learning a subject more than ordinary students. Based on Dweck (1986, 1990), the achievement goals of children who hold that intelligence is a fixed characteristic are mostly functional, whereas the achievement goals of children who hold that intelligence is a flexible characteristic are of the mastery (learning) type. The result of her research demonstrated that task selection and process follow-up are done based on abilities in children with functional goal orientation, whereas task selection and process follow-up are focused on achievement and mastery based on efforts in children with mastery (learning) goal orientation. Schommer and Dunnell (1997) state that students with little effort hold that ability is a fixed characteristic, whereas superior students more likely hold that the learning ability can be improved. Furthermore, Dweck and Leggett

(1988) hold that students with mastery goal orientation enjoy higher feeling of competency, and do their tasks successfully. On the other hand, a number of studies have clearly demonstrated that students with mastery goal orientation demonstrate high levels of learning self-regulation skills (Schunk, 1994).

In light of what was mentioned above, this research was seeking to answer the question of whether executive functions and achievement goals are related to academic self-efficacy in students and whether executive functions and achievement goals are able to predict students' academic self-efficacy.

## 2 Method

This study was of the correlation research type. The population of the present research included all female students in the second grade of high school in the field of natural science in ordinary (state) schools in Tehran studying in the 2015-2016 academic year. Cochran's formula was used for specification of the sample size; based on the results obtained from the formula, 150 people was determined for the research. Cluster sampling method was used for sample selection. Wisconsin Card Sorting Test, Midgley and colleagues' (1998) goal orientation questionnaire, and Patrick and colleagues' (1997) academic self-efficacy scale were used for data collection.

### 1. Wisconsin Card Sorting Test<sup>1</sup>

The Wisconsin Card Sorting Test (WCST) is a neuropsychological test of "set-shifting", i.e. the ability to display flexibility in the face of changing schedules of reinforcement (Monchi, et al., 2001). The Professional Manual for the WCST was written by Robert K. Heaton, Gordon J. Chelune, Jack L. Talley, Gary G. Kay, and Glenn Curtiss. The WCST test may be used to help measure an individual's competence in abstract reasoning, and the ability to change problem-solving strategies when needed (Biederam J, et al., 2000). In this test, a number of cards are presented to the participants. The WCST consists of 4 cards with different forms (crosses, circles, triangles or stars), of various colors (red, blue, yellow or green) and numbers of objects (1, 2, 3 or 4) on them. As the task is usually administered, the 4 stimulus cards with the following characteristics are placed before the subject from left to right: 1 red triangle, 2 green stars, 3 yellow crosses and 4 blue circles. The subject is instructed to sort each response card under one of the stimulus cards, whichever she or he thinks is correct. After each sort, the subject is told whether the sort was right or wrong. No other instructions are given throughout the test. The instructor begins by responding "right" each time the subject matches for color. This continues until 10 consecutive cards have been sorted by color. The examiner then, without forewarning or comment, changes to "form" as the correct response. After 10 consecutive forms responses, the principle changes to "number" and so on. The test continues until the subject has either completed 6 categories or all 128 cards have been used.

In their research, Shahgholian, Azad Fallah, Fathi Ashtiyani, and Khodadadi (2011) designed the computerized version of Wisconsin Card Sorting, and examined its psychometric characteristics, and demonstrated that the reliability of the test using Cronbach's alpha coefficient is 0.73 for the number of stages and 0.74 for the preservative errors.

### 2. Midgley and Colleagues' (1998) Goal Orientation Questionnaire

This questionnaire was provided by Midgley and colleagues (1998). The test contains 18 questions, to be answered based on the 7-point Likert Scale. It includes three subscales: 1- goal-mastery (questions 1 to 6 of the questionnaire), 2- functional-approach (questions 7 to 12 of the questionnaire), and 3-

functional-avoidance (questions 13 to 18 of the questionnaire). In each subscale, the scores of the 6 questions are added, and constitute the individual's score in the subscale.

The reliability of the subtests of the questionnaire have been reported as 0.70 to 0.80. In their research, Kareshki, (2008) reported the reliability of the subtests as 0.87, 0.84, and 0.76, respectively; furthermore, the overall reliability of the questionnaire was reported as 0.087. The validity of the questionnaire has also been verified in Kareshki and colleagues' research using confirmatory and exploratory factor analysis. Furthermore, in Kareshki (2012), Cronbach's alpha coefficient for mastery, functional-approach, and functional-avoidance goals were obtained as 0.92, 0.87, and 0.92, respectively, and the overall reliability of the questionnaire as 0.91.

### 3. Patrick and Colleagues' (1997) Academic Self-efficacy Scale

The scale, made by Patrick, Hicks, and Ryan (1997), contains 7 items, reflecting students' perception of their competency in doing class tasks. The questions are scored between 1 and 5 from *totally agree* to *totally disagree*. Hashemi (2001) has reported the reliability of the scale with the two methods Cronbach's alpha and Spearman-Brown split-half as 0.65 and 0.59, respectively. The construct validity of the scale has been proven in many studies. Middleton and Migley (1997) reported a correlation coefficient of  $R=0.43$  between academic efficacy and mastery goal orientation. In Haji Yakhchali, (2014), Cronbach's alpha coefficient for the academic self-efficacy scale has been obtained as 0.82.

For data analysis, Pearson's correlation coefficient and simultaneous multiple regression method were used in the 21 version of SPSS statistic software.

<sup>1</sup> WCST

### 3 Results

Table 1: Correlation coefficients between executive function components and academic self-efficacy

Variable number in columns	1. Academic self-efficacy	2. Number of stages	3. Preservative error	4. Specific error
1.	1	0.504**	-0.228**	-0.184*
2.		1	-0.430**	-0.431**
3.			1	0.381**
4.				1

\*\* The correlation is significant at 0.01 level. \* The correlation is significant at 0.05 level.

The Table 1 data demonstrate that in the Wisconsin Test results, the number of stages component ( $\text{sig} \leq 0.01$ ;  $R=0.504$ ) is positively and significantly correlated with academic self-

efficacy, but preservative error ( $\text{sig} \leq 0.05$ ;  $R=-0.228$ ) and specific error ( $\text{sig} \leq 0.05$ ;  $R=-0.184$ ) are negatively and significantly correlated with academic self-efficacy.

Table 2: Correlation coefficients between goal achievement components and academic self-efficacy

Variable number in columns	1. Academic self-efficacy	2. Mastery style	3. Approach-function style	4. Approach-avoidance style
1.	1	0.482**	0.152	-0.354**
2.		1	0.484**	-0.184*
3.			1	0.148
4.				1

\*\* The correlation is significant at 0.01 level. \* The correlation is significant at 0.05 level.

The Table 2 data demonstrate that the mastery style ( $\text{sig} \leq 0.01$ ;  $R=0.482$ ) is positively and significantly correlated with academic self-efficacy, but the approach-avoidance style ( $\text{sig} \leq 0.01$ ;  $R=-0.354$ ) is negatively and significantly correlated

with academic self-efficacy. However, the approach-function style ( $\text{sig} \leq 0.066$ ;  $R=0.152$ ) is not significantly correlated with academic self-efficacy.

Table 3: Summary of regression model, variance analysis, and statistical specifications of academic self-efficacy resulting from executive functions and achievement goals

Variable	Model	SS	df	MS	F	P	R	R <sup>2</sup>
Executive functions and achievement goals	Regression	934.775	6	155.796	17.167	0.001	0.651	0.424
	Residual	1270.545	140	9.075				
	Total	2205.320	146					

Based on the data presented in the table, the correlation coefficients between the studied variables ( $R$  equal to 0.651 and  $R^2$  equal to 0.424) have been obtained. In other words, 42.4 percent of the academic self-efficacy variance can be explained in terms of achievement goals and executive functions. In this

model, ANOVA test confirms the efficiency of the utilized model in predicting the dependent variable based on the values  $F=17.167$  and  $\text{sig}=0.001$ , and it can be said that there is significant relationship between the predicting variables inputted into the model and academic self-efficacy.

Table 4: Academic self-efficacy regression based on achievement goal styles and executive function components

Model	(Unstandardized Coefficients)	standard coefficients	T	sig
	B	beta		
(Constant)	620.22	-	393.8	001.0
number of categories	155.1	385.0	869.4	001.0
Preservative error	039.0	036.0	487.0	627.0
Other errors (specific error)	012.0	015.0	203.0	839.0
Mastery goal style	180.0	371.0	617.4	001.0
Approach-function goal style	-030.0	-045.0	-588.0	557.0
Approach-avoidance goal style	-108.0	-196.0	-743.2	007.0

In Table 4, the values of change in the criterion variable (academic self-efficacy) for each unit of change in the predictor variable have been presented based on the values of  $\beta$  (standard regression coefficients); according to the values of  $t$  and its significance levels, it can be concluded that the number of stages in Wisconsin Test and mastery goal style positively predict academic self-efficacy. Based on the standard regression coefficients, it can be stated that the number of stages ( $\beta=0.385$ ) and mastery goal style ( $\beta=0.371$ ) have significant shares of academic self-efficacy prediction.

Furthermore, the approach-avoidance goal style negatively predicts academic self-efficacy. It can be stated based on standard regression coefficients that the approach-avoidance goal style ( $\beta=-0.196$ ) has a significant share of academic self-efficacy prediction.

### 4 Discussion

Based on the findings obtained from this research in female high school students, the number of stages component is positively and significantly correlated with academic self-efficacy. The preservative error and specific error are negatively and significantly correlated with academic self-efficacy; if we regard academic performance as the output of academic self-efficacy, the findings of this research are in accordance with results of research that has investigated and confirmed the relationship between executive functions and academic performance; for instance, Barkly (2001) used the behavioral-neurological model to explain executive functions, and regarded *inhibited response* as a necessary condition for the effective role of self-regulation in social life and academic performance complexities based on the same model. Barkly holds that executive functions and

behavioral inhibition make self-regulation possible, and enable the individual to control his behavior and predict and manage events. He also holds that behavioral inhibition causes the response to an event to be presented with delay and provide the conditions for application of other executive functions (Barkly, 2006).

Furthermore, the findings of the research are in accordance with the results of Wilson and colleagues (2001) due to focus on the relationship between executive functions and academic performance (as the output of academic self-efficacy); they have specified that the decision making-planning function plays a very important role in academic performance, scheduling competency, relative motor strength, and voluntary movements.

In regard to the relationship between achievement goals and academic self-efficacy, the findings obtained from this research demonstrated that the mastery style of achievement goals is positively and significantly correlated with academic self-efficacy, but the approach-avoidance style is negatively and significantly related to academic self-efficacy; if we regard academic achievement as one of the positive outputs of academic self-efficacy, the findings of the research on the relationship between the mastery style of achievement goals and academic self-efficacy are in accordance with the results of Keys and colleagues (2011). They demonstrated in their research that while all the three goal orientation methods were correlated with academic achievement, it was only mastery orientation that predicted students' academic achievement in mathematics in a stable manner. Furthermore, the findings of the research are in accordance with the results of Lee and colleagues (2010) due to focus on the relationship between intrinsic motivation (which is one of the characteristics of people with high self-efficacy) and the mastery style of achievement goals; using structural equation modeling, Lee and colleagues demonstrated that future goals with intrinsic motivation (job, social, and family orientations) have a stronger relationship with the approach-mastery orientation than with the approach-functional one, whereas future goals with extrinsic motivation (fame and wealth orientations) have a stronger relationship with the approach-functional orientation than with the approach-mastery one. Researchers suggest that teachers should encourage students to match goal orientation to intrinsic motivation and future goals to increase students' academic motivation.

Furthermore, the results of this research are in accordance with Rastegar and colleagues' (2009) findings due to focus on the relationship between intelligence beliefs and academic achievement (self-efficacy) in light of the mediating role of achievement goals. They demonstrated that the relationship between intelligence beliefs and academic achievement is affected by achievement goals and academic engagement aspects: *inherent intelligence belief* indirectly and negatively affects academic achievement through approach-function goals, avoidance-function goals, cognitive strategies, and task value, and *incremental intelligence belief* (the role of self-efficacy) indirectly and positively affects academic achievement through *mastery goals*, effort, metacognitive strategies, and task value.

Furthermore, the findings of this research are in accordance with the results of Davari, (2012); they investigated in their research the relationship between academic self-efficacy and achievement goals, and demonstrated that academic self-efficacy was positively related to approach-mastery goals, and had a significant share in predicting it, and was negatively related to avoidance-functional goals, and had a significant share in predicting this aspect of achievement goals.

In regard to the predictor role of executive functions and achievement goals in predicting academic self-efficacy, the findings obtained from this research demonstrated that executive functions (number of stages) ( $\beta=0.385$ ) and the mastery style of achievement goals ( $\beta=0.371$ ) positively predict academic self-efficacy. On the other hand, the approach-avoidance style of achievement goals ( $\beta=-0.196$ ) negatively predicts academic self-efficacy.

As mentioned above on the relationship between executive functions and academic self-efficacy, based on Barkly's (2001, 2006) theory, executive function components, such as inhibited response, play a

very significant role in self-regulation in the complexities of social life and academic performance, which is in accordance with the findings obtained from this research concerning the prediction of academic self-efficacy based on executive functions; Barkly holds that behavioral inhibition delays the response to an event, which provides the conditions for application of other executive functions (Barkly, 2006). Along the same lines, the results of this research are in accordance with those of Wilson and colleagues (2001); they specified that the decision making-planning function (executive function component) plays a very important role in academic performance, scheduling competency, relative motor strength, and voluntary movements (academic self-efficacy components).

The findings obtained from this research can also be explained in terms of the results of Malekpur (2013). They argued in their research that teaching executive functions (response inhibition) reduces attention deficit and improves academic performance, which is in line with the results of this research due to focus on the relationship between executive functions and academic self-efficacy.

Furthermore, in regard to explanation of the significant share the mastery style of achievement goals has in predicting academic self-efficacy, the findings of this research are in accordance with the results of Keys et al., (2011); they demonstrated in their research that mastery orientation predicts students' academic achievement in mathematics (academic self-efficacy) in a stable manner. Furthermore, the findings of the research are in accordance with the results of Lee and colleagues (2010) due to focus on the relationship between intrinsic motivation (which is one of the characteristics of people with high self-efficacy) and the mastery style of achievement goals; using structural equation modeling, Lee and colleagues demonstrated that future goals with intrinsic motivation (job, social, and family orientations) have a stronger relationship with the approach-mastery orientation than with the approach-functional one, whereas future goals with extrinsic motivation (fame and wealth orientations) have a stronger relationship with the approach-functional orientation than with the approach-mastery one. Researchers suggest that teachers should encourage students to match goal orientation to intrinsic motivation and future goals to increase students' academic motivation. Along the same lines, the findings obtained from this research are in accordance with Rastegar and colleagues' (2009) due to focus on the relationship between intelligence beliefs and academic achievement (self-efficacy) in light of the mediating role of achievement goals. Researchers hold that the relationship between intelligence beliefs and academic achievement is affected by achievement goals: *inherent intelligence belief* indirectly and negatively affects academic achievement through approach-function goals, avoidance-function goals, cognitive strategies, and task value, and *incremental intelligence belief* (the role of self-efficacy) indirectly and positively affects academic achievement through *mastery goals*, effort, metacognitive strategies, and task value.

Furthermore, the findings of this research are in accordance with the results of Davari, (2012). They demonstrated in their research that academic self-efficacy is positively related to approach-mastery goals, and has a significant share in predicting it; furthermore, the results of Lavasani and Ezhei demonstrated that academic self-efficacy was negatively related to avoidance-functional goals, and played a significant role in predicting this aspect of achievement goals, with which the results obtained from this research are in accordance. Doubtlessly, these findings will have important implicit consequences in regard to planning for improvement of academic self-efficacy as an important factor in enhancement of the academic achievement of the next generation of the country.

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