Original Article

Prediction of emotional intelligence on the basis of executive function and metacognitive awareness among female

Zahra Sarvarian[1], Hanifeh Mirzaei[2*], Zohreh Ghaffari Jahed[3]

1. MA of General Psychology, Payame Noor ,Tehran, Iran.
2. MA of General Psychology, Islamic Azad University, Kerman Branch, Tehran, Iran.
3. MA of Clinical Psychology, Department of Psychology, Islamic Azad University, Garmsar Branch, Garmsar. Iran.
**(Corresponding Author: Hanifeh Mirzaei , MA of General Psychology, Islamic Azad University, Kerman Branch, Email: hanifeh.mirzaei@yahoo.com)*

(Received: 13 Nov 2016; Revised: 23 Nov 2016; Accepted: 26 Dec 2016)

Abstract

Introduction: Emotional intelligence is a set of interrelated skills, including the abilities to accurately perceive, assess and express emotions, access or create emotions to facilitate thinking or thoughts, perceive emotions and emotional knowledge and regulate emotions for emotional and intellectual development.

Methods: The study sample consisted of 182 secondary school female students at District 2, Tehran, Iran, who were selected using multi-stage random sampling method. The Wisconsin Card Sorting Test (WCST), Schutte Self-Report Emotional Intelligence Test (SSEIT) and Metacognitive Awareness Listening Questionnaire (MALQ) (2006) were used to collect data. In order to analyze the data, in addition to descriptive statistics methods, simultaneous multiple regression analysis was implemented using the SPSS statistical software.

Results: The results showed that 39.9% of the variance in emotional intelligence can be accounted for based on linear combination of variables from executive functions, including number of classes, preservation error and other errors, and variables from metacognitive awareness, including planning/assessment and personal knowledge.

Conclusion: It can be argued that executive functions and metacognitive awareness components, especially planning and evaluation, play a vital role in one of the most important foundations of emotional intelligence.

Declaration of Interest: None.

Key words: Emotional intelligence, Executive functions, Metacognitive awareness.

Introduction

In recent years, extensive research has been conducted on emotional intelligence disorder and its impact on quality of life, career and academic success, resistance to stress, health and quality of social relationships and marriages. These studies have reported the positive impact of emotional intelligence on success and happiness in life (1). Moreover, extensive research has also approved emotional intelligence to be positively correlated with mental health variables (2,3) and negatively correlated with psychopathology(4). Meanwhile, emotional intelligence is an important mediator in response to stress (5).

Executive functions are a set of interrelated inhibitory processes, which are involved in the selection, initiation, implementation, and monitoring of cognitive function and also, in some aspects of sensory and motor function (6). Executive functions encompasses a wide range of cognitive processes such as reasoning, problem solving, planning, organizing, working memory, ordering, sustained attention ability, dealing with conflict, benefiting from feedback, multitasking and behavioral capabilities (7). The executive function has complicated arrangement, which includes

self-regulatory skills, planning, organizing and problem solving. The action is developed from childhood to adolescence, and even to early adulthood. The executive function is the control center for cognitive process and working memory (8) . Inhibition, planning, sustained attention, working memory, and abstract thinking are among the abilities evaluated as executive functions in most studies (9). Barkly (10) used a behavioral-neurological model to explain executive functions and accordingly, regarded response inhibition as a prerequisite for the effective role of self-regulation in the complexity of social life and academic performance. Barkly believes that executive functions and behavioral inhibition provide self-regulation ability and enables one to control their behavior and predict and manage events. He also believes that behavioral inhibition leads to provide a delayed response to an event and provides conditions to apply other executive functions (11).

One of the concepts that appear to have significant role in predicting emotional intelligence is metacognitive awareness. Metacognition is a multifaceted concept. This concept contains knowledge, processes and strategies that assess, monitor, or control cognition (12 &13). Most theorists have differentiated between the two aspects of metacognition, namely metacognitive beliefs and metacognitive monitoring (13,14,15) . Metacognitive knowledge refers to information that one has regarding self-cognition and learning strategies, and metacognitive monitoring refers to a range of executive functions such as attention, control, planning and detecting errors in performance(16). In fact, metacognitive knowledge refers to interaction of beliefs and knowledge stored in the personal memory function, performance of tasks and selection of strategies (Flavell, Miller and Miller, 1993; cited in Rosenzweig, Krawec and Montague) (17). Metacognition, as a result of the influence of knowledge and metacognitive strategies on the change of beliefs as well as interpretation of particular signs such as intrusive thoughts, affects emotional processing and its disorder-related reactions. The main idea in this approach is that beliefs in psycho-cognitive disorders are composed of metacognitive components that affect thinking functioning and coping style and also, are affected by them (18).

In recent years, metacognition has received attention as a basis for many psycho-cognitive disorders(19) . The results of studies indicate that metacognition is positively correlated with problem-solving ability (20) and efficacy (21). Metacognition is a construction that, in addition to being associated with cognitive abilities, can underlie psycho-cognitive disorders (22).

In recent years, an extensive deal of research has been done on emotional intelligence (EI) and its effects on quality of life, occupational and educational success, stress resistance, health, and quality of social relationships and marriage. These studies indicate the influence of EI on success and happiness in the life. (١). Furthermore, numerous research works have confirmed the positive relationship between EI characteristics and psychological health-related variables (2,3) and the negative relationship between EI and psychopathology(٤) . In addition, this attribute serves as a significant mediator in addressing stresses (5).

Considering the above-mentioned facts, the present research aims at specifying the contributions from the components of metacognitive awareness and executive functions into EI prediction. According to what was mentioned above, in this study, the researchers attempt to examine the impact of executive functions and metacognitive awareness in prediction of female students' emotional intelligence.

Methods

The research benefited a correlational design since it aimed to predict emotional intelligence based on metacognitive awareness and executive functions. The study population consisted of all secondary school (eighth grade) female students at District 2, Tehran, Iran, during the academic year 2015-2016, who were randomly selected using the multi-stage random sampling method. Accordingly, first, three schools were randomly selected from among the female schools at the district and then, about 65 students were randomly selected from each school. Once the objectives of this study were explained to the students by the researcher, all of those students who admitted to participate in the research were evaluated. After excluding flawed questionnaires, the data on 182 female students were used in the final analysis. A sample of 50 students was selected for each variable (a total of 150 students with overestimation of 200 students). The following questionnaires were used to collect the required data:

The Wisconsin Card Sorting Test (WCST)

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 (23). The professional manual for the WCST was written by Heaton et al.,(24) . 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 (25). Heaton et al.'s guide (٢٤) reported sufficient internal reliability coefficients (range of 37%-72%) for children and adults, which was based on the generalization theory (i.e., how well the test reflects one's true score). Test-retest reliability coefficients (with an interval of 1-71 in the test) from 34% (correct responses) to 83% (preservation responses) for 11 scales of the WCST in a group of untreated patients with sleep attacks. Shahgholian, Azad Fallah, Fathi Ashtiani and Khodadadi (26) in their study, designed the software version of the WCST and investigated its psychometric properties. They showed that the reliability of the test, using Cronbach's alpha coefficient, is 0.73 for the number of classes and 0.74 for preservation errors.

Metacognitive Awareness Listening Questionnaire (MALQ)

MALQ was designed and developed by Vandergrift, Goh, Mareschal & Tafaghodtar (27) to assess metacognitive awareness of individuals. The MALQ is a 21-item self-report inventory with five subscales including planning-assessment, direct attention, personal knowledge, mental translation and problem solving. Accordingly, participants must express their rejection or acceptance of any item in the inventory in a 6-point Likert scale. Internal consistency of the subscales in the MALQ resulted from the Cronbach's alpha coefficient has been reported as follows: planning-assessment (0.75), direct attention (0.68), personal knowledge (0.74), mental translation (0.78), and problem solving (0.74). With regard to the validity, the results of confirmatory factor analysis confirm the existence of five subscales

Schutte Self-Report Emotional Intelligence Test (SSEIT)

This scale was developed by Schutte et al. (28) based on Mayer and Salovey's emotional intelligence models (29) . Besharat (30) translated the questionnaire and administered it among 234 male and female secondary school students in Tehran in order to standardize it. The reported reliability value based on internal alpha was 0.81 and the factor analysis using principal components analysis specified three factors: emotional regulation (alpha= 0.81), emotion expression (alpha= 0.67) and emotion exploitation (alpha= 0.50). In addition, general emotional intelligence with three correlation subscale values 0.80, 0.74, and 0.69 for each factor, respectively, showed that all factors were statistically meaningful at 0.01. The results of his study also revealed a significant and negative

correlation between emotional intelligence and variables such as depression and anxiety and this reflected the criterion validity of the questionnaire.

To analyze the data, descriptive statistical methods as well as multivariate regression model were used in the IBM SPSS software version 21.

Results

Table 1. Summary of regression model, analysis of variance and statistical regression

Variable	Model index	SS	df	MS	F	P	R	R^2
executive functions and metacognitive awareness components	regression	14260.087	8	1782.511	14.467	0.001	0.632	0.399
	residual	21438.766	174	123.211				
	total	35698.852	182					

According to Table 1, the multiple correlation coefficients for the study variables are R=.632 and R^2=.399. In other words, 39.9 percent of the emotional intelligence variance can be explained by linear combination of the variables number of classes, preservation error and other errors in the WCST as well as the variables planning / evaluation, direct attention, personal knowledge, mental translation and problem solving as metacognitive awareness components. The ANOVA test results (F=14.467 and sig=0.001) confirm the effectiveness of the model in predicting the dependent variable. Hence, it can be mentioned that there is a significant relationship between the linear combination of predictor variables in the model and emotional intelligence.

Table 2. Emotional intelligence regression based on Predictive variables

	(Non-standard coefficients)	Beta (standardized coefficients)	T	sig	tolerance coefficient	variance inflation index
Intercept	115.395		10.981	.000		
Number of classes	0.528	0.217	2.433	0.016	0.435	2.298
Preservation error	-1.833	-0.250	-2.145	0.033	0.253	3.950
Other Errors	-0.721	-0.243	-2.699	0.008	0.426	2.347
Planning and evaluation	1.067	0.317	3.695	0.000	0.469	2.131
Direct attention	0.604	0.117	1.418	0.158	0.502	1.990
Individual knowledge	1.107	0.262	4.205	0.000	0.888	1.126
Mental translation	0.022	0.005	0.076	0.939	0.804	1.244
Problem solving	0.461	0.147	1.511	0.133	0.363	2.754

Table 2 presents the variation of the basic variable (emotional intelligence) based on the β values (standardized regression coefficients) in exchange for a unit variation in the predictor variables for each variable. Since the values of the tolerance factor range between zero and one and variance inflation index is less than 10, it can be said that there is no multicollinearity among predictor variables. Considering the t-values and level of significance, it can be concluded that the executive functions components including the number of classes as well as preservation error and other errors can positively and negatively predict emotional intelligence, respectively. Standardized regression coefficients show that the number of classes (β=0.22),

preservation error (β=-0.25), and other errors (β=-0.243) have a significant role in predicting emotional intelligence.

Furthermore, the components metacognitive awareness, planning and evaluation, and individual knowledge positively predict emotional intelligence. In this regard, the standardized regression coefficients indicate that planning and evaluation (β=0.317) and individual knowledge (β=0.262) can significantly predict emotional intelligence.

Discussion

The results showed that 39.9 percent of the emotional intelligence variance can be explained based on linear combination of some variables including the number of classes, preservation error and other errors in the WCST and the metacognitive awareness components including the variables planning / evaluation, direct attention, personal knowledge, mental translation and problem solving. According to the standardized regression coefficients, the number of classes, preservation error and other errors (the executive functions components) and planning and evaluation and individual knowledge (the components of metacognitive awareness) only play a significant role in predicting emotional intelligence.

The results of this study is consistent with the findings of other studies investigating the relationship between emotional management and executive functions; Gyurak et al (31 argued that verbal fluency performance better shows complex sequences of controlled planning, activation and monitoring, which are of essence for emotional regulation. On the one hand, the findings of this study can be explained with regard to the fact that researchers believe the development of executive functions and intelligence is important since the processes associated with these structures often influence how to successfully perform complex tasks and consequently the academic achievement as well as life achievements(32). In a similar, Brydges, Reed, Fox and Anderson (33) fund out the same results; They examined the role of executive functions in predicting intelligence and showed that working memory could predict executive function of fluid and crystallized intelligence among sample.

Considering the impact of executive functions on writing skills (34), the weakness of executive functions among students with dysgraphia disorder in comparison with normal students (35), the role of executive functions in the development of students' writing skills and written errors (36 &٣٤) and the weakness of executive functions among students with ADHD (37), it can be argued that executive functions play a vital role in one of the most important foundations of emotional intelligence (Basic Skills Education). This is consistent with the results of the present research.

According to studies indicating that executive functions and meta-cognitive knowledge predict resiliency among individuals and since the resiliency plays a critical role in social adjustment (38) , the results can be used in order to explain the results of the current study implying that the executive functions can predict emotional intelligence. Zust (٣٨) argues that executive functions help resilient individuals to benefit from cognitive knowledge in analyzing situations.

Considering the results of this study, which confirms a relationship between executive functions and emotional intelligence components, it can be argued that executive functions as an umbrella term for other skills play a key role in basic skills necessary for adjustment and psychological health. These results can be implicitly employed in planning in order to prevent the negative consequences of problems caused by weakness in executive functions. On the other hand, regarding the significant contribution of planning and evaluation and individual knowledge as the components of metacognitive awareness in prediction of emotional intelligence, if emotional

intelligence is considered as an important and influential factor in social, family and interpersonal relationships, the results of this study confirms the finding of psychological studies indicating that metacognition is a key factor in determining health and having a successful performance in social interaction (٣٢) and metacognition disorder is associated with endocrine (including depression, anxiety, and social isolation) and exocrine disorders (such as delinquency and aggressive behavior) (39). In this regard, the researchers also claim that metacognition-related problems are the foundation of many psychological disorders (١٦).

Besharat and Abbaspour's (40) similarly found that cognitive knowledge is related to emotional intelligence and can predict emotional intelligence. Furthermore, Spada et al.(41) concluded that individuals with high emotional intelligence level benefit from a high level of abstract thinking and metacognitive ability. The results confirm the findings in this study.

Our study had some limitations. Of the limitations of this research was that all subjects in current study were female. Even though executive functions and metacognitive abilities are known to be closely correlated to general intelligence; the present research has not studied the effect of intelligence on the subjects' responses. In this area, longitudinal studies to characterize the evolutionary trends of executive functions and metacognitive awareness and their effects on adaptability of juvenile and young population shall be supported by researches, research centers, universities, and non-governmental organizations (NGOs).

Considering the results of this study and other studies mentioned above, it can be stated that metacognitive awareness components, especially planning and evaluation, as an effective variable in interpersonal and social relationship and psychological health, in general, can be employed in planning in order to identify and strengthen the necessary foundations to improve interpersonal relationships and help individuals coping with personal and social stressful conditions.

References

1. Nelis D, Quoidbach J, Mikolajczak M & Hansenne M. (2009). Increasing emotional intelligence: (How) is it possible? Journal of personality and Individual differences 47, 36-41.
2. Petrides KV, Pita R, & Kokkinaki F. (2007). The location of trait emotional intelligence in personality factor space. British journal of psychology, 98, 273-289.
3. Schutte NS, Malouff JM, Simunek M, McKenley J & Hollander S (2002). Characteristic emotional intelligence and emotional well-being. Cognition and Emotion, 16, 769-785.
4. Malterer M.B, Glass SJ & Newman JP (2008). Psychopathy and trait emotional intelligence. Personality and Individual Differences, 44(3), 735-745.
5. Mikolajczak M & Luminet O (2008). Trait emotional intelligence and the cognitive appraisal of stressful events: An exploratory study. Personality and individual differences, 44(7), 1445-1453..
6. Roth RM, Isquith PK, Gioia GA (2005). Assessment & intervention for executive dysfunction In: Kocher, GP; Norcross, JC, Hill IIISS, editors. Psychologists desk refrence.2nd ed. Oxford :oxford university press,Inc,.P.38-40..
7. Loftiz WC.(2014). An ecological validity study of executive function measures in children with & without attention deficit hyperactivity disorder, Dissertation for PhD. University of Florida.
8. Stein SM & Chowdburg M (2006). Disorgnaized children: A guide for parents & professionals. London: Jessica Kinsley publisher.
9. Wolfe ME.(2004). Executive function processes : inhibition ,working memory ,planning & attention in children & youth with attention deficit

hyperactivity disorder.[doctoral disseratation].Texas:TAMUuniversity.
10. Barkly RA.(2001). The executive functions & self-regulation: An evolutionary neuropsychological perspective. Nurophysiology Review , 11(1):1-29 .
11. Barkly RA.(2006).Attention-deficit disorder: A hand book for diagnosis &treatment(3rd ed). Newyork. Guilford press.
12. Wells A. (2000). Emotional disorders and metacognition: Innovative cognitive therapy. Jhon Wiley & Sons. LTD.
13. Wells A. (2009). Metacognitive therapy for anxiety and depression. New York, The Guilford Press.
14. Flavell JH. (1976). Metacognitive aspects of problem solving, INL,Resnick (Ed.), the nature of intelligence. Hillsdale, NJ: Erlbaum. 231-235.
15. Flavell JH & Flavell RF. (2004). Development of children intuitions about thought ñ action relations. Journal of cognition and development, 5 (4): 451-460.
16. Wells A. (2010). Metacognitive Therapy for anxiety and depression, Cognitive behavioral therapy book reviews, 6 (1): 1-4.
17. Rosenzweig C, Krawec J & Montague M. (2011). Meta-cognitive strategy use of eighth-grade students with and without learning disabilities during mathematical problem solving: a think-aloud analysis. Journal of learning Dasabilities, 44 (6), 508-520
18. Davey CL, Wells A .(2006). Worry and its psychological disorder ,theory, assessment and treatment. New York: Johon Willy and sons.
19. Wells A. (2009). Metacognitive therapy for anxiety and depression. New York, The Guilford Press.
20. Wang Y & Chiew V. (2008). On The Cognitive Process of Human Problem Solving. Cognitive systems research, 11, 1, 81-92
21. Mih C & Mih V. (2010). Components of self-regulated learning Implications for school performance. Acta Didactica Napocensia, 3 (1), 39-48.
22. Salarifar MH, Pouretemad HR, Heidari M & Farid AA. (2011). Beliefs and metacognitive Status: Hindering or facilitating. Journal of Counseling and Psychotherapy Culture, 2 (5), 77-93(in Persian)
23. Monchi O, Petrides M, Petre V, Worsley K & Dagher A. (2001). Wisconsin Card Sorting revisited: Distinct neural circuits participating in different stages of the task identified by event-related functional magnetic resonance imaging. The Journal of Neuroscience, 21, 7733–7741
24. Heaton RK, Chelune GJ, Talley JL, Kay GG & Curtis G. (1993). Wisconsin Card Sorting Test (WCST) manual revised and expanded. Odessa, FL: Psychological Assessment Resources.
25. Biederam J, Faraone S, Monutaeux M, et al. (2000). "Neuropsychological functioning in nonreferred siblings of children with attention deficit/hyperactivity disorder". Journal of Abnormal Psychology. 109 (2): 252–65. doi:10.1037/0021-843X.109.2.252
26. Shahgholian M, Azad Falah P, Fathi Ashtiani A & Khodadadi M. (2011). Designing Hobby Wisconsin Card Sorting Test Software: Theoretical Foundations, Creation and Psychological features. Journal of Clinical Psychology Studies, 4 (1), 133-11. (in Persian)
27. Vandergrift L, Goh CC, Mareschal CJ & Tafaghodtari MH. (2006). The Metacognitive Awareness Listening Questionnaire: Development and Validation. Language Learning, 53,431–462.
28. Schutte NS, Malouff JM, Thorsteinsson EB, Bhullar N, Rooke SE.(2007). A meta-analytic investigation of the relationship between emotional

intelligence and health. Pers Individ Dif; 42: 921-33.
29. Salovey P & Mayer JD. (1990). Emotional intelligence. Imagination,Cognition and Personality, 9, 185–211
30. Besharat MA. (2005). Schutte Emotional Intelligence Scale Validation. The journal of Psychological Science; 4 (16), 22-35(in Persian).
31. Gyurak A, Goodkind MS, Kramer JH, Miller BL, Levenson RW.(2012). Executive functions and the down-regulation and up-regulation of emotion. Cogn Emot.;26(1):103-18..
32. St Clair-Thompson HL, Gathercole SE.(2006). Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. Q J Exp Psychol (Hove). 59(4):745-59.
33. Brydges CR, Reid CL, Fox AM & Anderson M. (2012). A unitary executive function predicts intelligence in children. Intelligence, 40, 458–469. http://dx.doi.org/10.1016/j.intell.2012.05.006.
34. Meltzer L.(2007). Executive function in education (from theory to practice). Newyork: Guilford press; .
35. Aghababaei S, Malakpour M, Abedi A. (2011). Comparing executive functions in children with and without dysgraphia: Neuropsychological test performance NEPSY, Journal of Clinical Psychology, 3 (4), 40-35(in Persian)..
36. Hooper SR, Swartz CW, Wakely, MB, DE Kruif RE, Montgomery JW(2002). Executive function in elementary school children with and without problems in written expression. J Learn Disable .(16):233-253.
37. Tehranidoost M, Goudarzi R, Sepasi M, Alaghbandrad J. (2003). Executive function disorder in children with attention deficit hyperactivity. New Cognitive Sciences, 5 (1), 9-1(in Persian)
38. Zust JCH (2010). A cognitive path through resiliency. New York: Hyperion.
39. Eisenberg N.(2010). Self-Regulation and School Readiness. Early Education and Development, 21(5), 681-698..
40. Besharat MA. & Abbaspour DT. (2011). On the relationship between metacognitive strategies and creativity with resilience among students. Social psychology (New Findings in Psychology); 5 (14), 124-111. (in Persian)
41. Spada MM, Nikcevic AV, Moneta GB, Wells A. (2008). Metacognition, perceived stress, and negative emotion. Pers Indiv Diff; 44(5): 1172-81.