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The Relationship of Critical Thinking According to the Five-Factor Model through Metacognition Mediation: A Path Analysis Model

Mojgan Mohammadimehr* [1], Mohamad Bagher Majidianfard [2]

[1] Department of Laboratory Sciences, Faculty of Paramedical Sciences, Aja University of Medical Sciences, Tehran, Iran.
[2] Educational Development Center, Aja University of Medical Science, Tehran, Iran.

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***Corresponding author:**
Mojgan Mohammadimehr, Department of Laboratory Sciences, Faculty of Paramedical Sciences, Aja University of Medical Sciences. Tehran, Iran.
Email: mojganmehr20@yahoo.com

Abstract

Background & Objective: The development of critical thinking skills, which is hugely affected by personality traits, is always a puzzling educational subject. This study aimed to elaborate the relationship of critical thinking according to the Five-Factor Model (FFM) through metacognition mediation among students of the Aja University of Medical Sciences.

Materials and Methods: The sample population of this descriptive-correlational study was 300 students of AJA University of Medical Sciences during the academic year of 2016-2017. A stratified random sampling model used to select the participants. Data was collected by the Traits Personality Questionnaire 5 (TPQue5) developed by Costa & McCrae, Wells' Metacognitions Questionnaire, and Ricketts' Critical Thinking Disposition Questionnaire. Data analyzed by Amos 24 software.

Results: According to results, there was a significant relationship among four personality traits (p-value=0.001); there was also a positive correlation among metacognition and five personality traits of "openness to new experiences", "conscientiousness", "extraversion", "agreeableness", and "neuroticism" (p-value=0.001). Results indicated a direct and significant relationship between four personality traits and critical thinking (p-value=0.001). However, no direct correlation was observed between agreeableness and critical thinking through metacognition mediation.

Conclusion: This study revealed that personality traits could influence the development of critical thinking in medical sciences students.

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Introduction

Nowadays, the development of critical thinking skills is one of the critical objectives of the educational system. Critical thinking is a cognitive process in which an individual makes decisions based on deduction and analysis. Critical thinking is related to Higher Order Thinking Skills (HOTS), analysis, composition, and evaluation (1).

Critical thinking results in learning motivation, acquiring problem-solving and decision-making skills, creativity, and collaborative learning (2).

De Bie conducted a study on 350 students that suggested the educational environment influence not only the skills but also enhances the development and tendency towards critical thinking (3). The study of Lee reported that one-third of the students did not acquire critical thinking skills even after educational sessions (4). One of the most important developments of the second half of the twentieth century, the emergence of capacities of emphasized metacognition (5, 6). The metacognitive approach pertains to the individual's awareness of thought processes and the capacity to manage cognitive processes. Therefore, metacognition includes knowledge and strategies that evaluate, monitor, or control cognition and has broad, comprehensive, and affective dimensions (7-10). Nadi et al. stated that teaching critical thinking, problem-solving, and metacognition will enhance self-directed learning and its components (self-management, desire to learn, and self-control) (11). In a separate study

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conducted by Kim et al. (12), it has been indicated that critical thinking and cognitive development define and affect an individual's learning style. Personality traits signify the general pattern of an individuals' response. These traits are coordinated between various situations and are consistent through time. One of the main theories of personality is McCrae & Costa's Five-Factor Model (FFM), which includes "openness to new experiences," "conscientiousness," "extraversion," "agreeableness," and "neuroticism" (13). The separate studies of Heidari (14), Siavoshifar (15), and Yanardöner (16) revealed that personality traits define and anticipate practical critical thinking attitudes. The current nature of critical thinking in medical students and the impact of current teaching methods in developing critical thinking is effectual on determining the quality, performance, and inefficiency of the current education system (14-16). Given the significance of the matter and due to the limited number of studies conducted on medical students and the effect of critical thinking and the role of personality traits on its promotion, this study aimed to analyze the relationship of critical thinking according to the FFM through metacognition meditation Aja University of Medical Sciences.

Materials and Methods

The sample population of this descriptive-correlational study was all of the students of Aja University of Medical Sciences in different disciplines during the academic year of 2016-2017. The sampling was performed with a stratified random method in which 300 male-female students from each faculty were selected, according to Morgan's table. Data was collected by the Traits Personality Questionnaire 5 (TPQue5) developed by Costa & McCrae (1983) which include "openness to new experiences", "conscientiousness", "extraversion", "agreeableness", and "neuroticism". The questionnaire was scored by a typical five-level Likert scale, including "Strongly disagree," "Disagree," "Neither agree nor disagree," "Agree," and "Strongly agree" responses. There are a total of 60 items in this questionnaire, every 12 items allocated to one factor of FFM. Kiamehr did the standardization of this questionnaire for the first time in Iran (2002). The Cronbach's alpha coefficients for each of the FFM factors such as neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness were 0.86, 0.73, 0.56, 0.68, and 0.87, respectively. The minimum and maximum scores were 60-300. The content validity and reliability of it were confirmed by Atash Afrooz in 2007. The Critical Thinking Disposition Questionnaire is developed by Ricketts and composed of 33 items ranging from strongly agree to strongly disagree and a minimum and maximum score of 33-165. The content validity and reliability of it were confirmed by Biabangard (2008), Izadifar, and Ashtiani (2010). The Metacognitions Questionnaire was developed by Wells in (1997) and comprised of 30 items, which were scored by a typical five-level Likert scale, including "Strongly disagree," "Disagree," "Neither agree nor disagree," "Agree," and "Strongly agree" responses. The scores are ranged from a minimum of 30 to a maximum of 150 points. The content validity and reliability of it were confirmed by Shirinzadeh et al. with Cronbach's alpha coefficient of 0.91. Data were analyzed by Amos 24 software and with a path analysis model. This study has been approved with the code of IR.AJAUMS.REC.1396.18 by the Research Ethics Committee of the Aja University of Medical Sciences. After obtaining the necessary permits, the research objectives were explained to the participating students; they were free to participate in the research. After obtaining consent, the participants were not asked for their names. They were assured of the confidentiality of their information and moral ethics. Inclusion criteria were academic enrollment for at least one semester.

Results

The proportion of male-female participants from 300 collected questionnaires, were 262 males (87.3%) to 38 females (12.7%). The age range of 300 participants

students was as follows, 99 individuals between 18-20 (33%), 80 individuals between 21-23 (26.7%), 97 individuals between 24-26 (32.3%), and 24 individuals were older than 26 years old (8%). The following standard deviations (SD) results were obtained for the TPQue5: agreeableness (25.20±4.90), extraversion (27.33±3.40), openness to experience (28.49±4.48), neuroticism (22.67±3.35), and conscientiousness (22.67±3.35). Likewise, the SD of critical thinking and metacognition were (49.79±8.18) and (72.34±7.23), respectively.

The factors of FFM are presented in the table.1 Table.2 contains the results of the final model of path analysis of FFM wit critical thinking and through metacognition mediation. Table.3 contains the results of the mediation analysis of FFM with critical thinking and through metacognition mediation.

The path analysis model of five critical thinking personality factors with the role of metacognition mediation is shown in Figure 1.

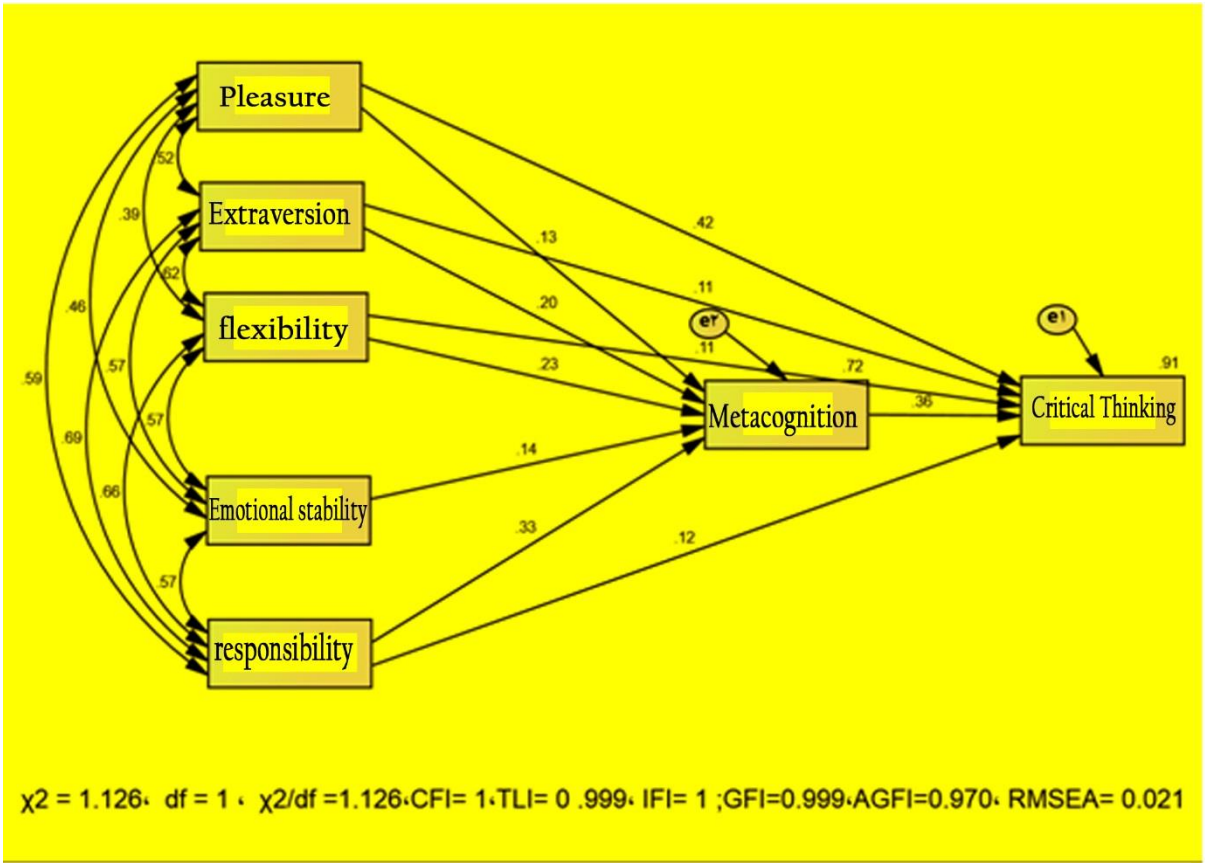

Figure 1: Modified path analysis model of five personality factors

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Table1: Path indicators of five personality factors

Limit	amount	Index Name
Less than3	1/26	X2/df
Less than 0/08	0/021	RAMSE
Larger than 0/8	0/999	GFI
Larger than 0/9	1	CFI
Larger than 0/9	0/999	NFI
Larger than 0/8	0/97	AGFI

The research structure was defined as the 'quality of scientific functions' following the extraction of the determinants of scientific functions and supplementary studies for textual analysis. Afterwards, a quantitative questionnaire with 29 items was developed and implemented on the faculty members of Shiraz University and Shiraz University of Medical Sciences. The factor analysis was applied to assess the weight and impact of each factor in the completed questionnaires (n=265). The characteristics of the candidates are presented in Table 2.

Table 2: Evaluation of the results of the final model of path analysis of five personality factors with critical thinking with the role of metacognition mediation

Sig	Critical ratio	standard error	Citation coefficients are regression	Non-citation regression coefficients	routes
0/001	3/419	0/092	0/134	0/314	**Pleasure → Metacognition**
0/001	4/431	0/074	0/204	0/330	**Extraversion → Metacognition**
0/001	5/071	0/063	0/225	0/323	**Flexibility → Metacognition**
0/001	3/370	0/064	0/137	0/217	**Emotional stability → Metacognition**
0/001	6/537	0/086	0/328	0/561	**Responsibility → Metacognition**
0/001	18/460	0/061	0/423	1/122	**Pleasantness → Critical thinking**
0/001	3/931	0/060	0/122	0/236	**Responsibility → Critical thinking**
0/001	4/069	0/043	0/107	0/173	**Flexibility → Critical thinking**
0/001	4/137	0/050	0/131	0/206	**Extraversion → Critical thinking**

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Table 3: A review of the results of the metacognitive mediation model based on five personality factors

direct impact	Indirect effect	Full effect	routes
۰/561**	--	۰/561**	Responsibility to metacognition
۰/236**	۰/230**	۰/466**	Responsibility to critical thinking
۰/217**	--	۰/217**	Emotional stability to metacognition
---	۰/089	۰/089	Emotional stability to critical thinking
۰/322**	--	۰/322**	Flexibility to metacognition
۰/173**	۰/132**	۰/305**	Flexibility to critical thinking
۰/330**	--	۰/330**	Extraversion to metacognition
۰/206**	۰/135**	۰/342**	Extraversion to metacognition
۰/314**	--	۰/314**	Pleasure to metacognition
0/122**	۰/129**	۰/251**	Pleasure to critical thinking
* P<۰/۰۵	Lack of significance=ns		
** P<۰/۰۱			

Discussion

This study suggests a positive and significant relationship between the FFM factors (extraversion, openness to experience, conscientiousness, agreeableness) and critical thinking through metacognition. However, there is not a direct relation between "neuroticism" factor and critical thinking through metacognition. This relationship can be elaborated as a metatheoretical framework due to the requirement of an executive approach, such as metacognition for the fulfillment of an executive skill such as critical thinking and personality factors. The presence of a trans theoretical relationship between

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metacognition and critical thinking with personality traits is not a simple achievement or aptitude. However, it demands a problem assessment inquiry (17). Critical thinking is one of the necessities that should be learned and promoted by all the students, particularly medical students who are working in clinical environments. Due to a positive and direct correlation among critical thinking and personality traits and metacognition, it is essential to address the latter two components (15). Given the significant role of metacognition mediator on the personality traits and critical thinking, it is required to have specific metacognitive skills such as thought monitoring, progress trackers, and accurate time-management decisions for training individuals with a lower personality trait so that critical thinking will be the outcome of metacognition (16). Ghayed Heidari believes that the Halpern's Four-part Model (14) represent metacognition and critical thinking as a united model; he has also defined metacognition as an ability that applies knowledge for the improvement of thinking skills. The result of this hypothesis is consistent with the findings of this paper. The results of Soleimanifar research revealed a significant relationship for the role of personality traits, learning styles, and metacognition in predicting critical thinking of undergraduate students (17). Siavoshifar (15) also asserted that metacognitive variables are valuable in predicting critical thinking attitude. According to Salehi, there is a significant relationship between metacognitive beliefs and personality traits (18). Arsalan proved the predictive role of metacognition on critical thinking (19).

According to the results of this study, there is a direct and significant relationship (less than 0.05) between the factors of personality (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) and metacognitive factors. It can be inferred from the results that inherited characteristics, and innate personality traits are significant metacognition predictors. Individuals who have a positive personality are fond of social interaction, have a big social circle, and develop their social skills. Hence, personality traits have a significant impact on individuals' metacognitive functions (20). These traits are responsible for the formation of thought, emotion, and distinct behaviors in individuals. Researchers believe that our personality is composed of stable interpersonal processes that distinguish individuals from one another. However, some standard features make these different individuals look alike. Psychologists have emphasized on both dimensions of individual differences and behavioral coherence. The metacognitive process is critical for successful problem-solving. Therefore, individuals with high personality traits are more successful in metacognitive activities than others. Since metacognitive knowledge is the building block of learning transfer, then acquiring knowledge of the rules, strategies, and objectives of the problem helps individuals to employ their cognitive abilities to the new task more efficiently (21). This hypothesis is consistent with the study of Salehi (18), which proved a relationship between metacognitive beliefs and personality traits. Arsalan has indicated a predictive role of metacognition on critical thinking (19). In his study "The relationship between extraversion and neuroticism with cognitive deficits: Assessing the mediating role of metacognition," Shahgholian (22) stated that some components of metacognition including positive beliefs on anxiety, negativity, and cognition and negative beliefs on though control had a meditative role on neuroticism and cognitive disorder (CD). Abidi examined the relationship between personality traits and openness to experience (23), the findings of his study indicated a significant association with critical thinking and personality traits such as extraversion, agreeableness, openness to experience, and conscientiousness. Although "neuroticism" negatively with personality traits. It can be inferred that individuals with a higher score belong to the "extraversion" group; they have more vitality and seem to be more successful in interpersonal relationships. In individuals with high levels of

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extraversion tend to be energetic, talkative, interested in group work, social, and able to express themselves (24). Liao and Chang, quoting by Soleimanifar (17), argued that individuals with higher levels of "openness to experience" not only perform well in group activities but also are skillful critical thinkers and can concentrate while working. A high "conscientiousness" score of students means critical thinking can be reinforced by having solid and predetermined goals and controlling impulses and utilizing plans to pursue and accomplish them. Lee (4) confirmed a relationship among personality traits with critical thinking and the mediating role of moral intelligence. Kelly attested the predictive role of critical thinking based on its performance (25). The study of Soleimanifar proved the predictive role of personality traits, learning styles, and metacognition in critical thinking of undergraduate students (17). Siavoshifar confirmed the significant relationship of metacognitive variables in predicting the attitude toward critical thinking (15).

According to the results of this study, it is advised that academic environments and programs support an extensive spectrum of new experiences, activities, and ideas to improve critical thinking skills by using cognitive-oriented factors. It is also suggested that inform university lecturers and instructors of the significance and consequences of personality traits of students in the development of critical thinking by running workshops or design curriculum that focus on cognitive skills and critical thinking. At the same time, due to the impact of learning styles on thought patterns, it is required to design learning activities that benefit all learning methods. Besides, instructors and professors should concentrate on modern and integrated teaching methods, instead of relying on theoretical ones.

Limitations of the study

The sample size of this study was only limited to the Aja University of Medical Sciences, which is the primary limitation of this paper. Therefore, to obtain a more accurate analysis, it is suggested that future studies contain a broader statistical population from medical universities. It is also recommended to use qualitative methods and using semi-structured interview tools with the community of experts.

Conclusion

Attentive recognition of individuals' mental context and their ability of critical thinking promotes students with a comprehensive view of social, personal, economic, and political dimensions. It acquaints them with the basic principles of democracy. Individual differences and personality traits aid students in the fulfillment of academic and community success and accelerate their growth and development. The recognition of such a context can only be realized by addressing various disciplines that are rooted in high school education and then continued in universities. Eventually, it is possible to cultivate the critical thinking ability and deliver a passive society into an active and dynamic one through accurate recognition of individuals' personality traits, their differences, and their educational backgrounds.

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Conflicts of Interest: The authors declare that there are no conflicts of interest.

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