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Relationship between sensory processing styles and deficit in executive functions: The moderating role of personality traits

Milad Shirkhani¹; Mohammadreza Mazloomzadeh¹;
*Shahrbanoo Aali²

¹M.A. student in clinical Psychology, Ferdowsi University of Mashhad, Mashhad, Iran.

²Assistant Professor of Psychology, Department of Psychology, Ferdowsi University of Mashhad, Mashhad, Iran.

Abstract

Introduction: This study aimed to investigate the relationship between sensory processing styles based on the Dunn model, the deficit in executive functions, and the moderating role of personality traits.

Materials and Methods: The statistical population of this descriptive-correlation study included all students of Ferdowsi University of Mashhad in the academic year 2019-20. Among them, 426 students from different fields were selected by convenient sampling method. Data were collected using the Neo-Form Short Personality Questionnaire (NEO-FFI), Adolescent and Adult Sensory Processing Profile (AASP), and the Barkley Deficits in Executive Functioning Scale (BDEFS). Data analyzed using Pearson correlation and hierarchical regression.

Results: The findings showed that sensory processing styles, low recording ($P < 0.001$), and sensory sensitivity ($P < 0.01$) predict positive and significant performance deficit. Among the personality traits, neuroticism ($P < 0.01$) and extraversion ($P < 0.01$) predict deficit in executive functions significantly. The feature of extraversion modulates the relationship between low sensory recording and deficit in executive functions. It should be noted that low recording sensory processing style with extraversion personality trait predict 48% of the variance of deficit in executive actions.

Conclusion: Based on the findings of this study, deficit in executive functions can be predicted based on the Dunn modeling sensory processing styles of the model, and personality traits, especially the factor of extraversion, play a decisive role in strengthening this relationship.

Keywords: Executive functions, Personality traits, Sensory processing.

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*Corresponding Author:

Faculty of Educational Sciences and Psychology, Ferdowsi University of Mashhad, Mashhad, Iran.
aali@um.ac.ir

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Introduction

Executive functions include a set of management processes of cognitive processing and behavioral abilities that promote facilitative behaviors, achieve goals, respond to environmental stimuli, and self-regulate thoughts and behaviors (1-4). These functions are considered indicators of when and how to perform everyday behavioral actions (5,6) and include inhibition, problem-solving, attention, organizing, planning, working memory, and performing tasks (2,3). Executive functions provide more cognitive resources for individuals' assessments, allowing them to break habits, assess risks, plan for the future, prioritize, make decisions, and cope with new situations (6,7). These capabilities, in turn, affect academic, occupational, interpersonal functions, and most importantly, physical and mental health. They lead to innovation and construction (8,9). Among the positive effects of these executive abilities, we can mention their influential role in reasoning, comprehension, and successful learning (10), good academic preparation and progress (11), and even the success of football players (12).

The deficit in executive functions are often associated with internalizing behavioral problems such as anxiety, depression, and emotional problems (13) and externalizing behaviors such as violence, conflict, and impulsive behaviors (14,15). They play role in the etiology of many neurodevelopmental psychiatric disorders such as autism spectrum disorder (16,17), attention-deficit / hyperactivity disorder (18,19) and learning disabilities (20). Therefore, improving these capabilities and improving their related deficiencies is always an important research and treatment topic.

Research evidence shows that among the components that are near related to executive functions are personality traits (2,21,22). According to Hosseini, Ashuri, and Zarandi research, the desired level of executive functions negatively correlates with the neuroticism personality component. While executive functions have a positive and significant correlation with extraversion components, openness to experience, agreeableness, and conscientiousness (21). The results of Buchanan's research, and Bell, Hill, and Stavrinou research showed that high scores in the neuroticism component and low scores in the conscientiousness component

were significantly associated with a deficit in executive function (23,24). Crowe's research results also showed that neuroticism and high stress in people in various activities would lead to a deficit in executive functions and deficiencies in performing that activity (25). In Vaughan and Edwards's research, the results showed that the desired functional level of executive actions has a positive correlation with the components of openness to experiences, conscientiousness, while it has a negative correlation with the neuroticism component. Also, it has no correlation with the component of agreeableness. However, the results on the extraversion component are contradictory (22), and in various studies, the results of non-correlation (22), positive correlation (26) and negative correlation (27) have been reported.

The most significant contribution to the explanation of executive function in previous research through the components of neuroticism is openness to experience and conscientiousness. This means that high scores in the neuroticism component and low scores in the components of openness to experiences and conscientiousness are associated with inadequacies in executive functions (2,23). Therefore, according to the results of previous research, personality traits can significantly predict executive functions. The researchers always examine the factors that are related to personality traits. Among these factors, we can mention the sensory processing style of individuals (28,29).

According to studies by Sadoughi et al., and Devlin et al. sensory processing is an essential component of personality that can be considered the most fundamental psychological element that deals with understanding and perceiving the environment and how people react to the environment (30,31). The human nervous system uses this structure to receive, organize, and perceive sensory input (31,32). Dunn believes that each person has their unique way of processing sensory input (33) and states that in terms of receiving sensory information, each person takes place at the high neurological threshold too low neurological threshold and in how to respond to this information, take place at the active to passive respond continuum, and based on the combination of this two continuum, four sensory processing styles are

introduced that individuals adjust their inputs based on these styles (34).

1- Low registration: In this pattern, the neural threshold is high, but the individual has a passive response strategy. These people are less aware of sensory stimuli, are inattentive to the environment, or may even be delayed in responding to stimuli. 2- Sensation seeking: In this pattern, the neural threshold is high, and the response strategy is active. These people are aroused to get more stimulation. They seek to generate additional sensory input, and they enjoy it a lot. 3- Sensory sensitivity: In this pattern, in addition to the low neural threshold, the response strategy is also passive. These people have more sensory input than others. They tend to quickly pay attention to any stimulus, but they may be delayed in responding to stimuli. 4- Sensation avoiding: In this pattern, the neural threshold is low, but the individual's response strategy is active. In these people, sensory input is high, but they have active strategies to avoid these inputs, and often reduce environmental stimuli (34).

In this regard, several studies have examined the relationship between sensory processing and personality traits. In Ben-Avi et al. research the components of sensory sensitivity and sensory avoidance have a significant relationship with neuroticism (35). According to the results of Grimes and Diseth's research, the components of sensory processing are related to the dimension of openness to experiences and neuroticism in children (36). In study by Lionetti et al., the results indicate that sensory processing is correlated with the components of openness to experience and neuroticism, but no relationship was found with the components of extraversion, agreeableness, and conscientiousness (37).

Also, minimal research has been done on the relationship between sensory processing styles, and executive functions in a study by Adams et al. on preschool children. The results showed that the highest correlation between sensory processing styles and components of executive functions is related to the components of inhibition and working memory, but this relationship is not significant (38). The results of Hebert's research showed that the low registration component has a significant correlation with the defect in the executive function of inhibition (39). In a study by Soler et al. on children with tic disorders, the results showed that defects in

sensory processing and deficit in executive functions are associated with each other (40). Negative affect is one of the most critical components in predicting the deficit of executive functions (41). In Engel-Yeger and Dunn study, the results showed that negative affect was significantly correlated with the low registration components, sensory sensitivity, and sensory avoidance (42). Therefore, the three mentioned sensory processing styles could also be a predictor of deficit in executive functions. Therefore, each of the variables of sensory processing styles and personality traits plays a decisive role in the deficit of executive functions. However, the interactive effect of sensory processing styles and personality traits on the deficit of executive functions in domestic and foreign research has not been investigated. Therefore, in the present study, these two variables are placed next to each other. We aimed to assess their interactive effect on the deficit of executive functions. The results can be useful in planning to improve sensory processing styles, and personality traits that improve executive functions.

Materials and Methods

The statistical population of this descriptive-correlational study which approved by Ferdowsi University of Mashhad consist all students of the Ferdowsi University of Mashhad city. The sample size calculated 426 cases based on the type of statistical method, calculating 25% drop, effect size of 0.15, and G-power test (0.95). The participants were selected through easy and convenient sampling methods. Because this study was conducted during the Corona outbreak and lack of face-to-face access to individuals, sampling was done through an online questionnaire.

Research instrument

A) *Demographic checklist*: This checklist included gender, age, level of education, the field of study, marital status, history of physical and psychological problems, and ways of reconnecting to send research findings.

B) *NEO Five-Factor Inventory (NEO-FFI)*: The NEO questionnaire is one of the most valid questionnaires related to personality structure based on factor analysis (43). This test was first developed in 1985 by Costa and McCray, and revised in 1992. This

questionnaire has two forms: long (240 questions), and short (60 questions). The short form of this questionnaire is widely used to assess the five main personality factors, namely Neuroticism (N), Extraversion (E), Openness to experience (O), Agreeableness (A), and Conscientiousness (C). In each question, the subject scores between zero and four on a five-point Likert scale. Of course, scoring is not the same in all materials, and some items in this form are scored reversely. Each factor has 12 questions. Costa and McCrae reported the Cronbach's alpha coefficient of this questionnaire form 0.68 for the agreeableness component to 0.86 for the neuroticism component (44). Holden also reported the alpha coefficient of these five factors from 0.76 for the component of openness to experience to 0.87 for neuroticism (45). In a study conducted by Mooradian and Nezlek, Cronbach's alpha was obtained from 0.74 for the component of openness to experience to 0.84 for neuroticism (46). Garousi Farshi has standardized the NEO-FFI questionnaire in Iran. This questionnaire's validity was obtained using the test-retest method for 208 students with an interval of 3 months, from 0.75 for the extraversion component to 0.83 for the neuroticism component (47). In Atashafrouz's study, with the use of the internal consistency method, Cronbach's alpha coefficient was obtained from 0.38 for the agreeableness component to 0.77 for the conscientiousness component (48). Also, Costa and McCrae stated that this questionnaire corresponds precisely to its complete form (NEO-PI) as the components of the short form (NEO-FFI) have a higher correlation than 0.68 with the components of the full form (49).

C) Adolescent/Adult Sensory Profile (AASP): This questionnaire is a self-assessment tool of behavioral responses given to everyday sensory experiences. Moreover, it provides a standard method for individual and specialized evaluations and categorizes the effect of sensory processing styles on performance (34). The adolescent-adult sensory processing profile is suitable for groups of 11 to 65 years of age and designed based on children's sensory profile (50) previously developed for children 3 to 10 years of age. Each person answers questions according to how they often react to their sensory perceptions (and not in a particular situation). This feature enables the

tool to identify a person's preferences for continuous and sustained sensory processing. The scores obtained from the adolescent-adult sensory processing profile will indicate the individual's sensory processing style. This questionnaire's answer is a five-point Likert scale, and all items are scored directly from "almost never" = 1 to "almost always" = 5. This questionnaire contains 60 questions and measures four subscales of sensation seeking, low registration, sensory sensitivity, and sensory avoidance. Each of these subscales has 15 questions: 1- Sensation seeking (questions 2, 4, 8, 10, 14, 17, 19, 28, 30, 32, 40, 42, 47, 50, and 58), 2- Low registration (questions 3, 6, 12, 15, 21, 23, 36, 37, 39, 41, 44, 45, 52, 55 and 59), 3- Sensory sensitivity (questions 7, 9, 13, 16, 20, 22, 25, 27, 31, 33, 34, 48, 51, 54 and 60), and 4- Sensory avoidance (questions 1, 5, 11, 18, 24, 26, 29, 35, 38, 43, 46, 49, 53, 56 and 57). To determine the dominant style of sensory processing of each person, the style with the highest score is selected as the dominant style of sensory processing. In Brown and Don's study, its internal consistency coefficients ranged from 0.66 for the sensory avoidance component to 0.82 for the low registering component (34). In another study, Cronbach's alpha coefficient of this questionnaire ranged from 0.63 for the sensory seeking component to 0.69 for the sensory avoidance component (51). This indicates a perfect internal consistency for this questionnaire. Construct reliability of this scale was obtained through correlation with the scales of social extraversion, emotional regulation, light sensitivity, and alcohol, respectively 0.45, 0.65, 0.32, and 0.39 (52). In research that has been done in our country, Cronbach's alpha obtained and confirmed 0.85 in Sadoughi et al. and 0.74 in Adlparvar et al. studies (30,53).

D) Barkley Deficits in Executive Functioning Scale (BDEFS): Barkley designed the scale in 2011 to represent executive function deficits in clinical and non-clinical populations (54). This scale contains 89 questions and is applicable for the age range of 18 to 81 years. This questionnaire's answer is scored in the form of a four-choice Likert scale from "never or rarely" = 1 to "almost always" = 4. This questionnaire contains five subscales: 1- Self-management to time (questions 1 to 21), 2- Self-organization / problem solving (questions 22 to 45), 3- Self-resistance / inhibition

(questions 46 to 64), 4- Self-motivation: (questions 65 Up to 76) and 5- Self-regulation of emotion (questions 77 to 89). Each subject receives an overall score in addition to the score they earn on each subscale. In general, high scores on each subscale indicate a further deficit in that executive function.

Cronbach's alpha coefficient for the whole questionnaire is 0.918 and for subscales from 0.914 for the self-motivation component to 0.958 for the self-organization/problem-solving component. The test-retest validity coefficient for the whole scale was 0.84 and for the subscales from 0.62 for self-motivation to 0.90 for self-organization/problem solving (55,56). In our country, in the research of Mashhadi et al., the obtained alpha coefficient for the whole scale is 0.96 and for the subscales from 0.80 for the self-motivation component to 0.92 for the self-organization/problem solving. Therefore the questionnaire contains desirable coefficients in terms of psychometrics and the subscales have good internal consistency (57).

Data were collected from students who were interested and volunteered to participate through an online questionnaire (Google form between March and May 2020). Inclusion criteria included employment at Ferdowsi University of Mashhad during the implementation of the project (third semester of 2019, 2020), no acute medical and psychiatric problems and willingness to participate in the study, and exclusion criteria included no Satisfaction and willingness to cooperate and Incompleteness of questionnaires. Therefore, among the students of each faculty, the necessary explanations were provided regarding the aims of the research. Then, the research link was provided to the people who expressed their desire and also had the necessary criteria to participate in the research to complete the questionnaire whenever he had the opportunity. The questionnaire took an average of 15 to 20 minutes to be answered by participants.

The collected data were then entered into statistical software, and descriptive statistical methods including mean, frequency, standard deviation, lowest and highest score, and Pearson correlation were used to analyze the research data. Hierarchical regression was used to analyze the research hypotheses. Data were analyzed using SPSS software version 26. To maintain the principle of

confidentiality, the information obtained from the questionnaires was collected without the names and addresses of the subjects so that the identities of the subjects were preserved and only at the disposal of those involved in this research. Also, gaining the subjects' trust and confidence to participate in the research and being free to answer the questionnaires were among the other considerations that were tried to be observed in this study.

Results

Of the 426 samples, 82 were male (19.2%), and 344 were female (80.8%). The age of individuals is in the range of 18 to 45 years, with averages and standard deviations of 22.46 and 4.25, respectively. Among this number of participants, 332 (77.9%) are undergraduate students, 65 (15.3%) are graduate students, and 29 (6.8%) are doctoral students. Among the participants, 367 (86.2%) are single, and 59 are married. The field of study of the volunteers participating in the research is 230 (53.9%) humanities, 130 (30.6%) mathematical and engineering sciences, and 66 (15.5%) basic sciences. Table 1 shows the mean and standard deviation of the research variables and their Pearson correlation coefficient.

As shown in Table 1, there is a positive and significant relationship between the components of low sensory registering, sensory sensitivity, and sensory avoidance with the total score of deficit in executive functions. Among the personality traits, there is a positive and significant relationship between neuroticism personality factor and executive functions deficits and a negative and significant relationship between extraversion factor and deficit in executive functions. In the next step, regression analysis was used to evaluate personality traits' role in adjusting the relationship between sensory processing styles and deficit in executive functions as a criterion variable.

Based on Baron and Kenny model to investigate the effect of moderating variables on the relationship between predictor variables and the criterion variable, hierarchical regression analysis is a suitable statistical method (58). In this analysis, the main effect of predictor and moderator variables and their interactive effect on the criterion variable are investigated (59).

Table 1. Descriptive statistics and correlation matrix of research variables

Research variables	M	SD	1	2	3	4	5	6	7	8	9	10
1. Sensation seeking	49.18	6.30	1									
2. Low registration	32.19	6.24	0.04	1								
3. Sensory sensitivity	40.74	7.49	-0.12*	0.52**	1							
4. Sensation avoiding	38.42	7.57	-0.11*	0.43**	0.64**	1						
5. Neuroticism	25.47	8.37	-0.11*	0.37**	0.46**	0.36**	1					
6. Extraversion	27.49	6.62	0.42**	-0.26**	-0.39**	-0.43**	-0.49**	1				
7. Openness to Experience	27.96	4.73	0.25**	0.06	0.01	-0.03	0.01	0.09*	1			
8. Agreeableness	29.09	5.88	0.02	-0.49**	-0.23**	-0.28**	-0.28**	0.24**	-0.03	1		
9. Conscientiousness	32.16	6.99	0.13**	-0.49**	-0.29**	-0.20**	-0.36**	0.38**	-0.12*	0.14*	1	
10. executive functions	170.53	39.33	-0.09	0.54**	0.42**	0.35**	0.59**	0.39**	0.09	-0.27	0.65	1

*P<0.05 **P<0.01

To use the regression analysis model, it is necessary to test its assumptions. For this purpose, the Durbin- Watson test was performed to check the independence of errors, and the Kolmogrov-Smirnov test was performed to check the normality of the distribution. The Durbin / Watson test's

numerical values 2.13 and the Kolmogrov-Smirnov test were not significant for executive functions and its subscales (P> 0.05), which indicates the independence of error and the normality of the distribution. The results of regression analysis are presented in the table below.

Table 2. Summary of regression prediction of five dimensions of personality and deficit in executive functions based on sensory processing styles

Levels	Predictive variable	Criterion variable	R	R2	B	Beta	t	p
1	Low sensory registration	Executive functions			2.72	0.43	9.11	0.000
	Sensory sensitivity		0.57	0.32	0.82	0.15	2.79	0.005
	Sensation avoiding				0.35	0.06	1.29	0.198
2	Neuroticism	Executive functions			1.89	0.40	9.26	0.000
	Extraversion		0.69	0.47	-0.53	-0.09	-2.09	0.036
3	Low sensory registration × Neuroticism				0.06	0.59	1.58	0.114
	Low sensory registration × Extraversion	Executive functions			0.10	0.60	2.03	0.043
	Sensory sensitivity × Neuroticism		0.70	0.48	0.02	0.34	0.78	0.431
	Sensory sensitivity × Extraversion				0.04	0.30	0.96	0.334

*P<0.05 **P<0.01 ***P<0.001

As shown in Table 2, the results of the first step show that common sensory registration processing styles and sensory sensitivity predict deficits in executive functions and

account for 32% of executive function deficits variance. In the second stage, to evaluate the predictive power of personality traits on the deficit of executive functions, the scores of

neuroticism and extraversion were entered into regression analysis as a moderating variable. This analysis stage showed that 47% of the variance of executive function deficit is explained by neuroticism and extraversion personality traits. Also, to investigate the moderating effect of personality traits in the relationship between sensory processing styles and the deficit in executive functions, the interactive effect of neuroticism and extraversion traits entered the third stage of the regression equation. This stage showed that among the personality traits, the feature of extraversion modulates the relationship between low sensory registration and deficit in executive functions.

Discussion

This study aimed to investigate the moderating role of personality traits in the relationship between sensory processing styles and executive function deficit. Findings showed that low sensory registration and sensory sensitivity could predict a deficit in executive functions. This finding supported the results of the research of Engels and Dan, and Hebert. The descriptive-correlation study by Engels and Dan aimed to investigate the relationship between negative emotions and sensory processing styles on a sample of 213 ordinary people aged 18 to 50 years through the adolescent-adult sensory processing profile questionnaire (AASP) and a positive and negative affect schedule (PANAS).

The results showed that people whose predominant processing styles are low registration, sensory sensitivity or sensory avoidance, experience more negative emotions, and considering the significant correlation between negative emotions and a deficit of executive functions (60), it can be concluded that low registration styles, sensory sensitivity, and sensory avoidance are associated with a deficit in executive functions (42). Hebert's research investigated impulsiveness, the task of measuring inhibition (one of the most critical executive functions) on 226 cases aged 18 to 60 years through the Adolescent-Adult Sensory Processing Profile Questionnaire (AASP), Bart's Impulsiveness Scale (BIS)), and the Go/No-Go task. The results indicated that the component of low sensory registration was significantly associated with deficit to perform the task (39). Explaining this finding, it can be

said that in the components of low sensory registration and sensory sensitivity, the strategy of responding to environmental stimuli is passive, which means that the sensory threshold is very high and requires high arousal to stimulate. They are unconscious individuals in the purposeful activities and are unable to make fair use of executive functions and to adjust their thoughts and actions. Therefore, they do not tend to participate in these activities and need to receive more motivation from the environment to respond and perform (34,39,53). So they fail to adapt to these changes, and have problems and are not able to react to them with the right decision.

The results also showed that neuroticism and extroversion personality traits could significantly predict the deficit in executive functions. In other words, high levels of neuroticism and low levels of extroversion can predict the inadequacy of executive functions. This finding is consonant with the studies conducted by Hosseini, Ashouri and Zarandi, Campbell et al., Buchanan and Bell, and Hill and Stavrinos. In Hosseini, Ashuri, and Zarandi's study, they examined the relationship between executive functions and personality traits and self-concept among 120 male students.

The data were collected through a cognitive abilities questionnaire, a big five-factor personality inventory, and a self-concept questionnaire. In line with the results of the present study, the results showed that high scores in the neuroticism component and low scores in the extraversion component were significantly correlated with the deficit in executive functions (21).

Campbell et al. specifically examined the component of extraversion. A total of 155 students with a mean age of 19 years were selected. The data were collected through the Eysenck personality questionnaire and the Carver and White's BIS/BAS scales. They found that people who received low scores in extraversion component had lower performance levels on inhibition and task updating than those who scored high (26). In the Buchanan study, which was a meta-analysis of three studies, the results of this study, concordant to the present study, showed that high scores in the neuroticism component are associated with a deficit in executive functions (23). Bell, Hill, and Stavrinos's study

investigated the relationship between mood and personality traits on executive functions. Seventy five adults aged over 65 years were divided into two groups of 25 and 50 cases. Data were obtained through the Behavioral Rating Inventory of Executive Function-Adult, Adult Temperament Questionnaire, and Five Major Personality Factors. This study showed that people with high neuroticism characteristics have difficulty in executive functions, and especially in movement (24).

In explaining the obtained results, it can be said that neuroticism refers to the stress expressed in anxious experiences. People who have high scores in the neuroticism component often have an over-emotional response and can hardly return to normal after emotional arousal. They often present with physical symptoms such as headache, back pain, and vague psychological problems such as worry and anxiety (61,62).

The primary function of executive functions is to enable individuals to set their thoughts and actions in purposeful activities to achieve a specific goal. Therefore, to achieve this specific goal, he/she must be able to actively keep information in his/her mind and update it (6); however, during high stress of neuroticism, a person will not be able to do this (22).

Also, people who have low scores on the extraversion component are restrained, silent, withdrawn, passive, and cannot express strong emotions (62), have low dopamine levels (63), and do not have enough arousal to regulate their thoughts and behavior. Therefore, their ability to update information, and adapt to the environment is impaired. They cannot make fair use of executive functions (6,26). Therefore, the decrease in the average number of people in the extraversion factor is associated with increased inadequacies in executive functions.

Another finding of the present study was to investigate the moderating role of personality traits in the relationship between sensory processing styles and executive functions, which, given that low sensory registration and sensory sensitivity in the first stage predicted the deficit variable in executive functions. Their interactive effect with personality traits entered the hierarchical regression model in the third stage. The results showed that a low score on extraversion personality traits moderates the relationship between low

sensory registration and executive function deficits. The reason for this finding can be found in the characteristics of these two components. Traits of people who have low scores in the extraversion component are reluctance, isolation, passivity, and inability to express emotions (62). On the other hand, low registration means that the person is well aware of the changes in their environment; but he/she does not have the ability or desire to respond. Thus, the low registration characteristics and low scores of extraversion can be considered overlapping, and a person with a low sensory processing style, if he/she also has low extraversion in terms of personality traits, will face more deficits in executive functions.

In generalizing the findings of this research, its limitations should always be considered. One of the limitations during the research was the increase in the prevalence of coronavirus in Iran and the absence of university activities, which forced researchers to conduct questionnaires electronically and in absentia, so students who did not have access to cyberspace and the Internet were not included in the study. Another limitation is the use of self-reporting tools, and doubts about honesty and response accuracy.

However, it is worth considering the results of the present study on the significant relationship between Dan's sensory processing styles and executive functions deficit, as well as the overlap between extraversion personality factor and low sensory registration, also the interactive role of these two variables in predicting executive function deficit.

So, future extensive research by using cognitive tests to conclude more accurate findings about the underlying factors of this relationship. The present results can be used for prevention and treatment programs to improve executive functions by improving processing styles and modifying personality traits.

Conclusion

According to the results, among the components of sensory processing style, the components of low registration, sensory sensitivity, and sensory avoidance have a positive and significant relationship with the total score of deficit in executive functions. Among the personality traits, there is a positive and significant relationship between

neuroticism personality factor and executive functions deficits. There is negative and significant relationship between extraversion factor and deficit in executive functions. Also, the feature of extraversion modulates the relationship between low sensory registration and deficit in executive functions among the personality traits.

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