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Investigation the Relationship between Big Five Personality Dimensions and Executive Functions via Structural Equation Model

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ABSTRACT

Objective: The aim of this study was to clarify the link between five factor personality traits and executive functions.

Method: A total of 100 healthy participants, 59 female and 41 male, participated in the study. The data was analyzed performing Pearson moment correlation coefficients and Structural Equation Model (SEM).

Results: Three models were constituted and the first model revealed a significant relationship between personality characteristics and executive functions. The second and the third models indicated that personality-executive functions relations are based on the correlation between openness to experience and shifting executive function measured by Wisconsin Card Sorting Test (WCST). Results indicated that there is a significant positive relationship between openness to experience and WCST perseverative scores. In addition, there was no correlation between openness to experience and fluid intelligence.

Conclusion: According to the results of this study, it can be suggested that high openness may be characterized by high perseverative thinking rather than intellect.

Keywords: WCST, openness to experience, shifting, risk taking, reasoning

ÖZET

Beş Faktörlü Kişilik Boyutlari ile Yürütücü İşlevler Arasındaki İlişkinin Yapısal Eşitlik Modeliyle İncelenmesi

Amaç: Bu çalışmanın amacı**,** beş faktörlü kişilik özellikleri ile yürütücü işlevler arasındaki bağlantıyı açıklamaktır.

Yöntem: Araştırmaya 59 kadın ve 41 erkekten oluşan toplam 100 sağlıklı birey katılmıştır. Verilerin analizinde Pearson momentler çarpımı korelasyon katsayıları ve Yapısal Eşitlik Modeli (YEM) kullanılmıştır.

Bulgular: Bu amaçla, üç model oluşturulmuştur ve ilk model kişilik özellikleri ve yürütücü işlevler arasında anlamlı bir ilişki ortaya koymuştur. İkinci ve üçüncü modeller kişilik ve yürütücü işlevler arasındaki ilişkinin, Wisconsin Kart Eşleme Testi (WKET) ile ölçülen kurulumu değiştirme yürütücü işlevi ve deneyime açıklık arasındaki ilişkiye dayandığını göstermiştir. Sonuçlar deneyime açıklık ile WKET perseverasyon puanları arasında pozitif yönde anlamlı ilişki olduğunu göstermiştir. Ayrıca, deneyime açıklık ile akıcı zeka arasında anlamlı korelasyon bulunmamıştır.

Sonuç: Bu araştırmanın sonucunda, yüksek deneyime açıklığın, yüksek perseveratif düşünce ile karakterize edilebileceği ileri sürülebilir.

Anahtar sözcükler: WKET, deneyime açıklık, kurulumu değiştirme, risk alma, akıl yürütme

INTRODUCTION

Executive functions are a system and can enable to a person to direct attention, organize activities, coordinate and regulate the knowledge and behaviors.[8] These can be further described as cognitive functions that provide to coordinate the mental activities and are necessary for a person to reach goals by changing working of a number of the different mental processes.[24]

Several classifications of executive functions have been proposed in the literature, but Miyake et al.[17] has suggested three basic executive functions: Updating/monitoring, inhibition and shifting. Updating/monitoring is closely related to working memory which is responsible for short-term memory and manipulation of information. Inhibition refers to suppression automatic and dominant reactions and control and maintenance of attention for appropriate response. Shifting is especially measured by Wisconsin Card Sorting Test (WCST) and it is composed of concept formation, switching, perseverative thinking and sorting. It is also used to be synonymous with cognitive flexibility.[17] In the literature, studies investigating the brain areas related to executive functions have generally reported that prefrontal cortex (and particularly dorsolateral prefrontal cortex, orbitofrontal cortex and anterior cingulate) has a crucial role in these functions.[24]

Various findings have indicated that behaviors related to executive functions and personality are not independent. These studies base on the big five personality theory.[18,23,28] However, contradictory results regarding the relationship between five factor personality traits (extraversion, conscientiousness, agreeableness, neuroticism and openness to experience) and executive functions exist in the literature.[29] In particular, on the basis of the significant relationships between neuropsychological tests and personality,[22] it is deduced that personality assessment should be performed in the neuropsychological assessment.

When examining the literature, the openness to experience have been defined in different ways. People having high score in openness are defined as creative, imaginative and intellect while individuals who are high in people in openness to experience are defined as uncreative, realist and ordinary.[14,15] According to the researches which emphasize the association between openness and intellect, there was a positive correlation between openness and fluid intelligence.[6,23] On the other hand, there was no correlation between openness and fluid intelligence in some studies.[26] In general, openness is weakly correlated with fluid intelligence[1] and openness and intellect are different from each other.[5,19] On the one hand, recent studies have showed that a person high score in openness to experience can be characterized as willing to try new activities and it may cause him/her to participate in risk-taking activities. Furthermore, it was found that risk taking behavior was higher in openness and extraversion than other personality traits.[2,16]

Consequently, this study aimed to understand whether the personality differences are related to executive functions. Particularly, openness to experience personality trait was hypothesized to be important for the individual's cognitive processes. The importance of this study was to present three model including shifting, inhibition and updating executive functions and five personality traits. In addition, this study proposed that personality traits (especially openness to experience) are related to shifting rather than inhibition and updating.

METHOD

Participants

The current study was conducted on a sample of 100 healthy university students (59 female and 41 male). The mean age of the participants was 20.42 years (SD = 1.37; age range, 18-23 years). All participants were informed about the study, their consents were obtained and they voluntarily participated in the study. Participants were tested individually and in accordance with standard test instructions. All participants filled out the measures described below, using a counterbalancing scheme. The tests were completed in one session.

Measures

Basic Personality Traits Inventory (BPTI)

BPTI was created by Gencoz and Oncul[7] based on the Big Five (Big-5) model to measure personality traits. This inventory includes 45 items with 5-point likert type scale and 6 personality traits. Internal consistency coefficients were calculated for extraversion, agreeableness, conscientiousness, neuroticism, openness to experience and negative valence with scores of .89, .85, .85, .83, .80, and .71, respectively. Test-retest correlation was ranged from .71-.84. Factor analysis indicated that 6 factors explained 53.25 % of the totalde variance.

Wisconsin Card Sorting Test (WCST)

Wisconsin Card Sorting Test (WCST) were used for this study in order to measure mental set-shifting ("shifting"). The WCST was developed by Berg[4], revised by Heaton[9,10] and adapted into Turkish by Karakas.[12] Thirteen scores are calculated from the WCST. Perseverative Responses, Perseverative Error Response, Percent Perseverative Errors scores were used as indicators of shifting in the present study.

Stroop Test TBAG Form

The original form of the Stroop Test TBAG Version was developed by Stroop[25] and the adaptation of the test for Turkish was completed by Karakas.[12] This test consists of 5 stimuli cards and for these five cards total duration, error number and point of correct number scores are calculated. The test utilized as a measure of "inhibition".

Wechsler Memory Scale-III (WMS-III) Letter-Number Sequencing Subtest

WMS-III Letter-Number Sequencing Subtest[27] was adapted into Turkish by Ant[3] and Ozdemir.[20] This test was used in order to measure "updating/monitoring". Participants are given 1 point for each correct trial.

Raven's Standard Progressive Matrices Test (RSPM)

RSPM was developed by Raven, Raven and Court[21] and adapted into Turkish by Karakas.[12] The RSPM composes of 60 test items and each correct trial 1 point. This test is completed in approximately 35 minutes. The test is used in order to examine fluid intelligence, visuo-spatial perception (K factor), general ability (g factor), problem solving and abstract thinking.[21]

RESULTS

The descriptive statistics for neuropsychological measures and personality traits were presented in Table 1. Pearson correlation coefficients between personality traits and executive functions and fluid intelligence were shown in Table 2. Openness to experience personality trait were significantly associated with WCST perseveration scores. Openness to experience were positively correlated with Perseverative Responses ($r = .23$, $p < .05$), Perseverative Error Response ($r = .21$, $p < .05$) and Percent Perseverative Errors ($r = .20$, $p < .05$). In addition, there were marginally significant correlations between WCST perseveration scores and extraversion and conscientiousness ($p < .10$). Finally, RSPM total score was negatively associated with conscientiousness ($r = -.29$, $p < .01$).

In the present study, three measurement model were obtained by performing SEM analysis. For the first model, executive functions latent dependent variable was constituted by three executive function. Latent independent variable was constituted by five personality

Table 1. Descriptive statistics for all measures

	N	X	SD	Range	Skewness	Kurtosis
Extraversion	100	29.99	6.55	27.00	-.339	-.630
Conscientiousness	100	28.58	6.31	29.00	-.451	.-.080
Agreeableness	100	33.85	3.80	19.00	-.405	.449
Openness to Experience	100	21.63	3.42	19.00	-.268	.600
Neuroticism	100	27.73	7.14	35.00	.541	-.098
WMS-III Letter Number Sequencing Total	100	10.83	2.42	13.00	.905	1.084
Stroop 5nd Part Correct	100	1.02	1.17	5.00	1.075	.539
Stroop 5nd Part Error	100	.19	.63	5.00	1.25	-.950
WCST Perseverative Responses	100	11.30	7.14	33.00	1.24	1.061
WCST Perseverative Error Response	100	10.72	6.45	27.00	1.16	.650
WCST Percent Perseverative Errors	100	10.82	4.80	19.86	.949	.260
RSPM Total Score	100	48.67	5.85	32.00	-.517	-.218

traits (Figure 1). According to this analysis personality traits (ß = 0.30, p < .05) directly predicted executive functions significantly. The fit of the model was acceptable, [X^2 (21, N = 100) = 35.95, p > 0.5; x^2/df = 1.057; root mean square error of approximation (RMSEA) = 0.02; GFI = 0.94; AGFI = 0.90; CFI = 1.00; NFI = 0.93]. For the second model, latent dependent variable was constituted by WCST perseveration scores (Figure 2). Accordingly, personality traits (ß = 0.29, p < .05) directly predicted shifting significantly. This model achieved an acceptable fit, [X^2 (17, N = 100) = 16.71, p > 0.5; x^2/df = .880; RMSEA = 0.00; GFI = 0.96; AGFI = 0.93; CFI = 1.00; NFI = 0.98]. The fit indices of the second measurement model were better than those of the first model. Moreover, for the last model latent independent variable constituted by openness to experience scores. As presented in Figure 3, impact of openness to experience on shifting was significant (ß = 0.29, p < .05). This model also showed that the fit was good enough, [X^2 (19, N = 100) = 43.80, p < 0.5; x^2/df = 1.69; RMSEA = 0.08; GFI = 0.91; AGFI = 0.85; CFI = 0.98; NFI = 0.95].

Table 2. Pearson correlation coefficients among variables

	WMS-III Letter Number Sequencing Total	Stroop 5nd Part Correct	Stroop 5nd Part Error	WCST Perseverative Responses	WCST Perseverative Error Response	WCST Percent Perseverative Errors	RSPM Total Score
Extraversion	-0.02	-0.08	0.01	**0.17**$^{+}$	**0.18**$^{+}$	**0.17**$^{+}$	-0.03
Conscientiousness	-0.16	-0.10	0.11	**0.19**$^{+}$	**0.19**$^{+}$	0.16	**-0.29****
Agreeableness	0.04	0.00	.02	0.12	0.10	0.13	0.02
Openness to Experience	0.10	-0.06	0.12	**0.23***	**0.21***	**0.20***	-0.10
Neuroticism	-0.05	0.14	-0.04	0.07	0.00	-0.01	0.14

*p<.05, **p<.01, $^{+}$p<.10

DISCUSSION

The purpose of the current study was to examine the association between executive functions and personality traits. In line with this aim, personality variable was investigated on the basis of five factor personality model and executive functions were evaluated by using three basic classes: updating, shifting and inhibition.

Primarily, the first model for the current study demonstrated that personality dimensions and executive functions are correlated. This result is consistent with the findings in the literature and it is suggested that executive functions and individual differences cannot be independent of each other.[6,11,13,28] However, in parallel with the second model and correlation analysis, it is showed that this correlation is derived completely from shifting function measured by WCST. In addition, correlation analysis results and the third model suggested that there is a positive correlation between shifting executive function and openness to experience. That is to say, there is a linear relationship between openness to experience and WCST perseveration scores. Perseveration increased with increasing openness to experience score.

In the literature, there is no consensus on the description of openness to experience. Some of studies define openness to experience as intellect.[14] But the current research suggests that there is no relationship between openness to experience and fluid intelligence. This finding is consistent with that found in study conducted by Unsworth et al..[26] Thus, these results indicate that openness and intellect are not same components. On the other hand, according to

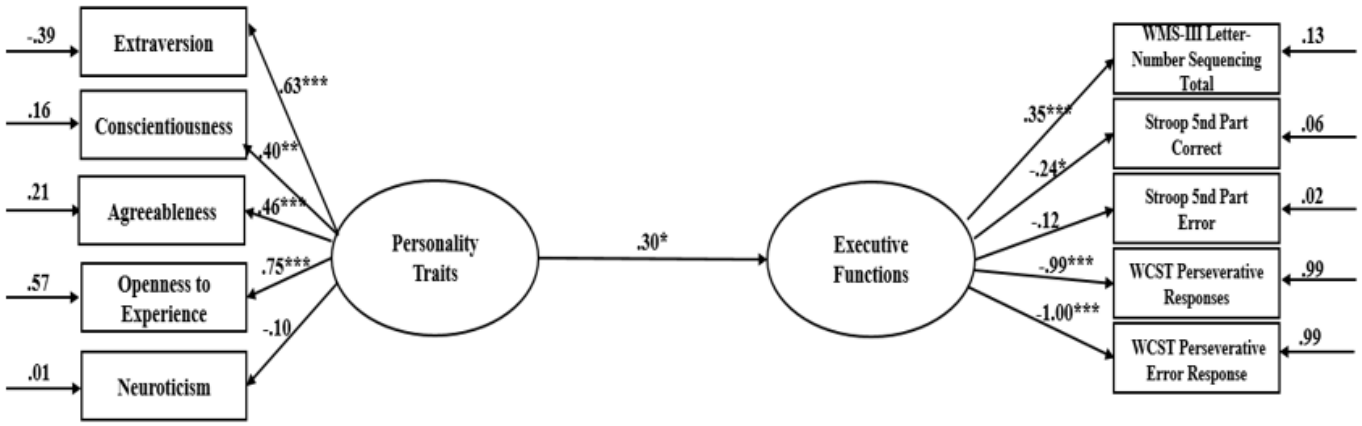

Figure 1. Structural equation model for five personality traits and three executive functions (*p≤.05, **p<.01*p<.001)**

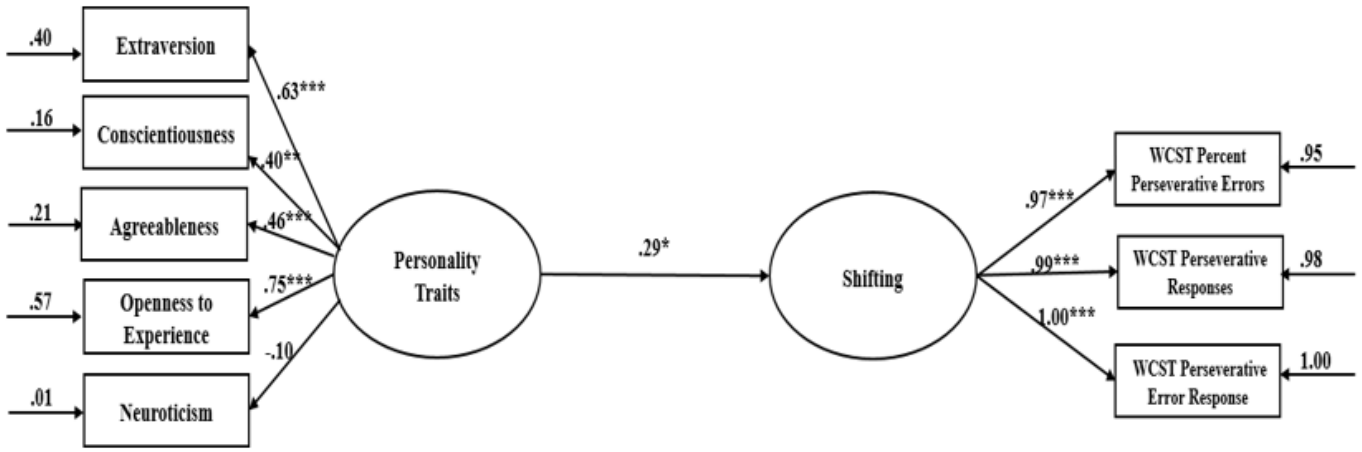

Figure 2. Second structural equation model showing the relationship between five personality traits and shifting executive function (*p≤.05, **p<.01***p<.001)

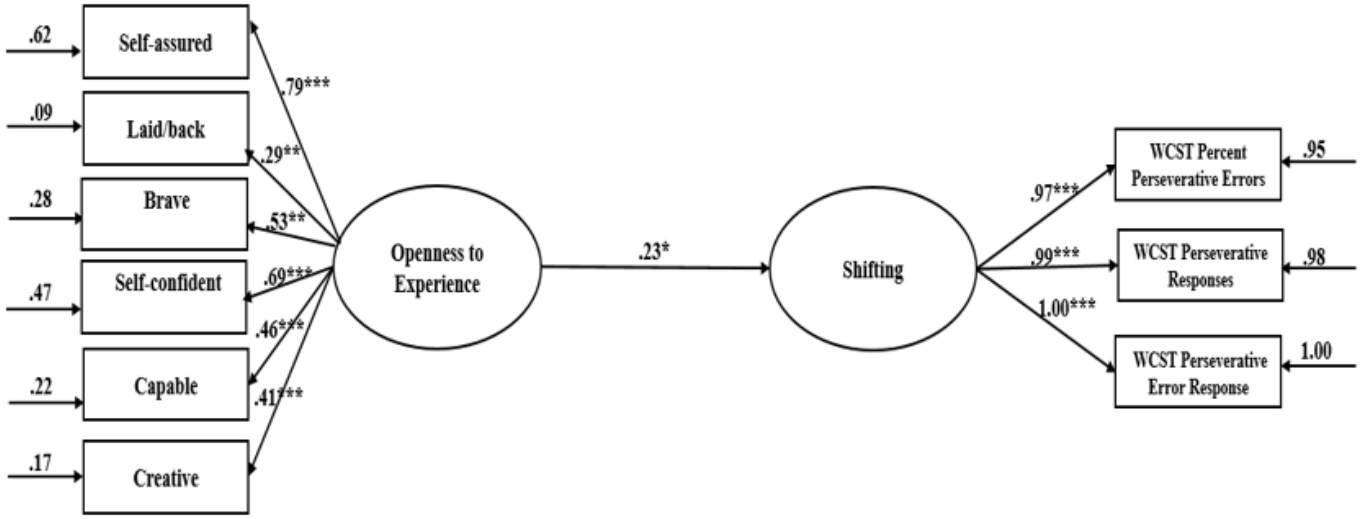

Figure 2. Second structural equation model showing the relationship between five personality traits and shifting executive function (*p≤.05, **p<.01***p<.001)

some researches openness to experience is related to risk taking behavior.[2,16] They showed that risk taking had increased with increase of openness to experience. In the present study, the decline in WCST performance can be explained by individuals' increase risk taking tendency. High levels of risk taking can lead to poor performance some cognitive tasks such as WCST required to be formed and maintained concepts. The increases in perseveration scores indicate vicious circle of thinking, low reasoning ability and abstract thinking. Thus, it can be concluded that individuals who are high in openness to experience tend to have perseverative thinking and exhibit relatively ineffective use of the reasoning skills. As a consequence, it is suggested that openness to experience personality trait needs to be redefined. It is further recommended that future researches should investigate the relationship between openness to experience and cognitive functions.

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