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B. N. Al-Samarrai

College of Humanities and Sciences, Ajman University, Ajman, UAE, n.alsalhi@ajman.ac.ae

N. R. Alsalhi

College of Humanities and Sciences, Ajman University, Ajman, UAE\ Humanities and Social Sciences Research Center (HSSRC), Ajman University, Ajman, UAE\ Nonlinear Dynamics Research Center (NDRC), Ajman University, Ajman, UAE, n.alsalhi@ajman.ac.ae

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Openness to Experience, Divergent Thinking, and Gender Differences: Domain and Facet Traits

B. N. Al-Samarrai¹ and N. R. Alsalhi^{1, 2, 3,*}

¹College of Humanities and Sciences, Ajman University, Ajman, UAE

²Humanities and Social Sciences Research Center (HSSRC), Ajman University, Ajman, UAE

³Nonlinear Dynamics Research Center (NDRC), Ajman University, Ajman, UAE

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Abstract: Recent creativity studies have provided strong evidence supporting the role of the personality trait of Openness to Experience (Openness) in predicting creative behaviors. These studies have been largely conducted within the framework of the broad Big Five personality traits. In contrast, the validity of narrow traits of which compositing the broad traits has not been adequately addressed. We expected that considering narrow traits might help us deeper understand the role of Openness in creativity. We examined the extent to which narrow personality traits contribute to the prediction of divergent thinking beyond the Big Five factors. To this end, 144 Arab undergraduate students provided data on the domain and facets of Openness. Creativity was measured by Alternative Uses tests. This study has yielded two important results. First, Openness was, at the domain as well as at the facet level, a significant and positive predictor of creativity. Second, the Openness to Feelings is a main predictor for creative female students whereas Openness to Ideas is a significant predictor for creative men students. The limitations and implications of these findings are discussed in the light of previous research.

Keywords: Openness to experience, divergent thinking, gender differences, broad traits, narrow traits.

1 Introduction

People in general and psychologists in specific have been concerned with creativity for a long time and have attempted to understand this phenomenon and clarify many relevant concepts and issues. For psychologists, cognition, genetics, environment, and biology are factors that attribute to individual differences in creativity [1, 2]. Researchers generally agree that personality is another core factor that helps us interpret and predict creative thoughts and behaviors. Traits are core units of personality that gradually develop to form a multilevel hierarchical structure. Personality traits control the degree that behaviors manifest, making some behaviors more likely to be powerful and important and others less. The Five Factor Model (FFM) that was created by [3] is one of the most widely adopted structural models of personality traits [4]. Openness to experience (Openness) is one of the main domains in personality that the FFM describes in most detail and identifies its distinctive features. People who are open to experience are imaginative, willing to engage in new ideas, one's appreciation of esthetics products, desire for depth of discussion and curiosity in novel situations. The FFM factors are structured in terms of a hierarchy, with five higher order personality factors aggregating a few heterogeneous facet traits. In the FFM, Openness domain includes six facets (specific traits): Fantasy, Aesthetics, Feelings, Actions, Ideas, and Values.

Studies of the creative personality using the FFM have repeatedly found a relationship between creativity and Openness and the correlations of openness with creativity were positive, and their magnitudes ranged from moderate to high [5, 6, 7, 8, 9, 10]. According to [5] Openness was a better factor in the prediction of creativity when conceived as ideation behavior compared with creativity when conceived as production behavior.

Openness was the most obvious characteristic that distinguished scholars and non-scientists. Creative Scientists vs. Less Creative Scientists; And artists versus non-artists [6]. [7] confirmed the openness-creativity link using the alternative uses tests in measuring divergent thinking, while [8] confirmed the same link using the CDQ-R (Revised Creativity Domain Questionnaire) as a Self-report measure of creative ability. In a study by [9] regression analyses revealed openness as the strongest predictor for both self-estimated creativity and divergent thinking performance. According to [4], there are significant associations between divergent thinking and NEO-PI openness scores in self-reports, peer evaluations, and pair evaluations.

*Corresponding author e-mail: n.alsalhi@ajman.ac.ae

The recent studies investigating the personality-creativity links have been largely conducted within the framework of the broad FFM traits. In contrast, the validity of facet traits has not been adequately addressed. Although some scholars have argued that personality traits at the level of domain may be better predictors of broad criteria [11, 12, 13], other scholars support conceptually the use of personality facets in prediction because they may yield more information than their domains and they could account for important components of criterion variance and that, in turn, increases the effectiveness of criterion prediction [14, 15, 16, 17]. Many Empirical research on the predictive validity of personality provides evidence supporting this theoretical view. Of few studies exploring the relation of Openness facets with creativity, [4] found divergent thinking was significantly associated with all six facets of Openness, (correlations extend from .17 to .31) even after controlling for age and years of education. In the same line, [18], when predicting ideational behavior, demonstrated that aesthetics, ideas, and actions as facets of the Openness domain increased the explained variance beyond the global openness and they explained 35% of the amount of variance in ideational behavior. Another study by [19] reported that Openness global and Openness facets were major components of a creative personality with significant effects. Until now, no field study has been conducted to test possible associations between the facets of Openness and product performance as an indicator of creativity. In this study we assess the incremental validity of the facets above and beyond global openness to provide further insight regarding how Openness to experience, at levels of domain and facets related to divergent thinking.

Another aspect for investigating the predictive power of Openness to creativity is to examine the openness-creativity relationships across different sexes. Several studies have explored gender differences on the Openness domain. Some studies have found that women score slightly higher (Cohen's $d = 0.19$) than men on the openness domain including [20], using one of the largest US public samples ($N=320,128$).

Other studies have reported large apparent gender differences in the facet traits of openness, [21] found that NEO-PI-R Openness to Aesthetics, Feelings, and Actions facet traits were higher with females, but Openness to Ideas facet was lower. There are no consistent gender differences on Openness to Fantasy or Values. In another study by [20], using the Openness access version of the Five-Factor Model of personality (IPIP-NEO-120), women were found to be higher in facet trait Openness to Emotions, but men showed markedly higher scores only on facet trait Openness to Intellect.

Unlike personality, overall, the lack of differences in genders is found in a large portion of creativity studies, exceeding 50% [22], when such differences are found, there is no consistency regarding which groups perform best [23]. Similarly, [24] stated that research results have pointed in various and contradictory directions, thus the general picture about link between gender and creativity is still not obvious.

The above studies analyzed the role of gender differences in either personality or creativity. Research is needed to explore how the three psychological constructs are possibly intertwined. In our study, we addressed two core questions to investigate the influence of gender on the Openness-divergent thinking links: Are there differences in personality characteristics between creative man and creative woman? and to what degree is the prediction of creativity using Openness traits influenced by the gender variable?

2 Methodologies

2.1 Participants

A sample of Arab undergraduate students was selected from a university located in the United Arab Emirates. All participants possessed a high degree of English language proficiency, in accordance with university admission requirements. One hundred and forty-four undergraduates (53 males, 91 females). Their ages ranged from 18 to 24 ($M 19.34$, $SD 2.45$). 85% of students study in medical majors and the rest major in Computer and Engineering.

2.2 Measures

Among the various DT measures available, the Alternate Uses Task AUT, created by J.P. Guilford in 1967 as part of his Structure of Intellect (SOI) [25] has been the dominant measure in evaluating divergent thinking abilities for many years and remains the most frequently utilized task within creativity literature [26]. We used an Alternate Uses Task for a brick to measure divergent thinking. People were told that the tasks concerned creative thinking and that they should try to come up with creative responses. They had 5 minutes to accomplish the task. One promising method is snapshot scoring of divergent thinking tasks. In this method, two raters view the complete set of responses and give a single holistic rating to the set. After reviewing the scoring guidelines, the raters read and scored the divergent thinking task directly from the original response sheets. They scored each sheet—each set of responses—with a single number. The raters used a 1–5 scale that ranged from “not at all creative” to “very creative.”

The NEO-FFI Openness of Experience Scale. Openness to Experience scale is a part of the Revised NEO Personality Inventory (NEO-PI-R) [3], which is a well-established and widely used 240-item questionnaire that assesses the Big Five personality factors, namely, Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness, as well as the thirty underlying facets. The Openness to Experience scale consists of the six facets: Openness to Fantasy, Openness to Aesthetics, Openness to Feelings, Openness to Actions, Openness to Ideas, and Openness to Values. Each Facet is measured with 8 items. Participants were asked to respond to these items using a five-point Likert scale (0 = “strongly disagree” to 4 = “strongly agree”). Higher scores indicated higher levels of tendency toward these traits. Many studies have proved the validity and reliability of this instrument like the instrument of [3] study which the manual shows impressive indexes of reliability and validity.

2.3 Data collection

Data were collected as part of an introductory class on statistics. The Alternative Uses Test of Creativity and the NEO-FFI Openness of Experience Scale were administered in-house internet sites because the university study during Covid was online. The respondents were tested in two sessions separated by a one-day period. Participants completed the divergent thinking measure first, followed by the self-report scale of Openness to Experience. They were assured of their confidentiality and anonymity.

3 Results

3.1 Intercorrelations Between Openness to Experience and Its Facet Traits.

Table 1. presents the results of the interrelationships between global Openness and its six narrow traits. Of the six narrow traits, the highest correlation with the global Openness was Aesthetics (.76), whereas the lowest correlation was Action (.48). This implies that the Aesthetics trait is more central to the global Openness than the other narrow traits, and it also suggests that global Openness scores are driven to a lesser extent by the Action than by anything else. When one examines the intercorrelations between the narrow traits, the intercorrelations ranged from .16 (Action–Feelings) to .54 (Feelings–Aesthetic), suggesting that the six narrow traits have low to moderate intercorrelations. Based on the correlations between gender and the global Openness and its six facets, we assume gender has an influence on other variables. Note that the correlations between the Openness domain and its six facets somewhat declined when corrected for gender; however, most correlations remained significant.

Table 1 Correlation Matrix for Creativity and Openness Measure.

	AU	O	O1	O2	O3	O4	O5	GN
AU: Alternative Uses	-							-.001
O: Openness to experience	.46** (.46)	-						-.23**
O1: Fantasy	.44** (.44)	.61** (.60)	1					-.13
O2: Aesthetics	.14 (.14)	.76** (.74)	.22** (.20)	1				-.24**
O3: Feelings	.32** (.32)	.70** (.68)	.28** (.26)	.54** (.51)	1			-.29**
O4: Action	.21** (.21)	.48* (.47)	.22** (.21)	.21** (.20)	.16* (.14)	1		-.09
O5: Ideas	.28** (.28)	.65** (.66)	.29** (.29)	.39** (.40)	.34** (.34)	.18* (.18)	1	-.02
O6: Values	.41** (.41)	.68** (.67)	.32** (.31)	.44** (.43)	.39** (.37)	.31** (.31)	.22** (.22)	-.10

GN refers to the gender variable: code- Female=1, Male=Notes: Values in Parentheses Are Partial Correlations, corrected for gender. *P < 0.05 and **P < .01

3.2 Validity Coefficients by Creativity Criterion.

Correlations matrix for Openness, its narrow traits and Alternative Uses are reported in Table 1. The results indicate that Openness (r= .46, p<.01) were significantly and positively related to Alternative Uses measure scores. Of the Openness facets, Fantasy (r= .44, p< .01), Values (r= .41, p< .01), Feelings (r= .32, p< .01) and Ideas (r= .28, p< .01)

showed significant and positive relations with Alternative Uses measure scores, suggesting that these narrow traits have high to moderate intercorrelations. Whereas the other facets of Openness showed the lowest significant relations.

3.3 Incremental Validity for creativity

To assess incremental validity for creativity, regression analyses using the SPSS enter method were conducted. This analysis suggested three models. AU was first regressed on the gender (Model 1). AU was second regressed on the gender and the global Openness measure (Model 2). Subsequently, we enter the narrow traits of the global variable (Model 3). The standardized coefficients, t values, R^2 , and change in R^2 associated with the models are reported in **Table 2**. The regression analyses demonstrated three important results. First, the control variable gender has no contribution to the regression analyses. Second, analyses on the domain level indicated that the global Openness to Experience was significantly successful at predicting AU and the amount of variance explained was 21%. Third, regarding the question of incremental validity, table 2 shows, the Openness facets Fantasy ($St.\beta = .48$, $p < .01$), Feelings ($St.\beta = .37$, $p < .01$), Actions ($St.\beta = .18$, $p < .05$), Ideas ($St.\beta = .32$, $p < .01$) and Values ($St.\beta = .46$, $p < .01$) were significant predictors of AU. When entered in combination with the global variables, the facets of Openness added significant incremental variance to the prediction of AU ($\Delta R^2 = 12\%$, $p < .01$). Note that while the global Openness explained 21% of the variance in AU, the facets explained a higher percentage, namely 33%. Thus, there indeed was evidence the facets were significantly more strongly related to AU than the domain scale.

Table 2 Hierarchical Regression Results for Overall Creativity

Variable	$St.\beta$	t	R^2	ΔR^2
<i>Model1</i> : Gender $F(1,139) = 0.00$	.001	-.013	.001	
<i>Model2</i> : Gender	.11	1.37	.00	.
Global Openness to Experience $F(1,138) = 19.15^{**}$	.48	6.19**	.21	.21
<i>Model3</i> : Gender	.084	1.12	.21	
Global Openness to Experience $F(7,133) = 9.54^{**}$	-.67	-2.32*	.33	.12
Fantasy	.48	4.42**		
Feelings	.37	2.84**		
Actions	.18	1.87*		
Ideas	.32	2.54**		
Values	.46	3.62**		

3.4 Incremental Validity for creativity by gender differences

As Table 3 shows, for female data the Openness facets of Fantasy ($St.\beta = .52$, $p < .01$), Feelings ($St.\beta = .47$, $p < .01$), Ideas ($St.\beta = .30$, $p < .05$) and Values ($St.\beta = .38$, $p < .01$) were significant predictors of AU. When entered in combination with the global variable, the facets of Openness added significant incremental variance to the prediction of AU ($\Delta R^2 = 16\%$, $p < .01$). For males' data, the Openness facets of Fantasy ($St.\beta = .38$, $p < .05$), Ideas ($St.\beta = .37$, $p < .05$) and Values ($St.\beta = .68$, $p < .05$) were significant predictors of AU. When entered in combination with the global variables, the facets of Openness added significant incremental variance to the prediction of AU ($\Delta R^2 = 13\%$, $p < .01$). Note that, for females, while the global Openness explained 23% of the variance in AU, the facets explained a higher percentage, namely 38%. A similar note can be seen for males, while the global Openness explained 21% of the variance in AU, the facets explained a higher percentage, namely 34%. Thus, regardless of student gender, there indeed was evidence the facets were significantly more strongly related to AU than the domain scale.

Table 3 Hierarchical Regression Results for Creativity by Gender.

Variable	$St.\beta$	t	R^2	ΔR^2
Creativity by Females (n= 92)				
<i>Model1</i> : Global Openness to Experience $F(1,91) = 26.66^{**}$	.48	5.16**	.23	
<i>Model 2</i> : Openness to Experience $F(6,86) = 8.91^{**}$	-.67	-2.00	.38	.16
Fantasy	.52	3.95**		
Feelings	.47	3.27**		
Actions	.09	.82		
Ideas	.29	1.86*		
Values	.38	2.86**		
Creativity by Males (n= 47)				
<i>Model1</i> : Global Openness to Experience $F(1,46) = 12.30^{**}$	.46	3.51**	.21	
<i>Model 2</i> : Global Openness to Experience $F(6,41) = 3.54^{**}$	-.62	-1.12**	.34	.13
Fantasy	.38	1.93*		

Feelings	.10	.42	
Actions	.23	1.25	
Ideas	.37	1.61*	
Values	.68	2.24**	

4 Discussion

The correlation analyses reported that Openness to Experience was, at the domain and facet levels, significantly associated with divergent thinking even after controlling for gender. A validity was reported at .48. Also, the correlations of divergent thinking scores with all six facets of Openness, extended from .14 (Openness to Aesthetics) to 0.44 (Openness to Fantasy). This pattern of correlations is very close to the pattern obtained by [4] study.

Openness to experience was, at the domain level, a significant and positive predictor of divergent thinking and able to explain 21% of the variance against divergent thinking criteria. This finding confirms the results of several recent studies like [5,7,8,9]. Therefore, we support the idea that students with certain personal characteristics, such as imaginativeness, willingness to engage in new ideas, desire for depth of discussion and curiosity in novel situations, are expected to be creative well in an academic context.

On the facet level, this study concluded that the addition of Openness facets seems to be valuable in explaining incremental variance in divergent thinking criteria. Among the Openness facets, Fantasy, and Values were the most important and significant predictors of creativity. These findings suggest that students who are highly imaginative and have an active fantasy life, as well as are more ready to re-exam social, political, and religious values will be more creative people. This finding contrasts with the results of [18] study which demonstrated that aesthetics, ideas, and actions are the most important predictors. The variation in type of facets emerged due to variations in assessment methods of creativity and definition of creativity.

In addition, the addition of facets of Openness to the main factor improved the explanation of variance in divergent thinking. Note that while the global Openness explained 21% of the variance in AU, the facets combined with the domain explained a higher percentage, namely 33%. These results agree with the Batey' study that demonstrated that the facets increased the explained variance beyond the global Openness, and they explained 35% of the amount of variance in ideational behavior.

The study examined whether gender differences have an impact on the Openness-divergent thinking relationships and the power of explanation of criterion variance. The results showed that male students are different from females in the number and types of openness predictors of creativity. For both male and female data, the contribution of global Openness to divergent thinking scores was high, significant, and positive. Similarly, on the facet level, Openness to Fantasy and Openness to Values were important predictors of creativity for both males and females. Differently, Openness to Feelings was strongly associated with creative female students whereas Openness to Ideas was associated with creative male students. Interpretation of these relations indicates that the female students who highly consider one's own inner emotion and assess emotion as an important part of life and that male students who hold open-mindedness, a willingness to consider new and unconventional ideas are more creative within academic settings. Although this finding was found in non-western culture, it confirms the results of several recent Western studies like [4, 20] study. The incremental validity of facets was another aspect of the difference between males and females. Note that, for females, the global Openness combined with the facets explained 38% of the variance in AU. Different notes can be seen for males, while the global Openness combined with the facets explained 34% of the variance in AU.

This study is one of the first to examine the relationships between openness and divergent thinking among college students in Arab society. Research on personality and creativity would benefit from considering different cultures. As reviewed before, cultures influenced not only personality [27] but also creativity [28]. One implication of the present research is that there is value in looking beyond a Western population [29]. Hence, it is necessary to test cross-cultural predictions to enhance our understanding of the "creative" personality.

5 Limitations

There are limitations to this analysis of divergent thinking. First, given the rather small sample size compared with the number of predictors investigated in the regression analyses, it cannot be ruled out that the regressions weights are likely to be unstable. Thus, a larger sample of undergraduate students is needed to give a more accurate indication of regression results. The sample should be enough size to deal with the number of the predictors under study. Second, the study is limited to only gender differences as an influencer on the Openness-creativity relationships, leaving open the generalizability of results to other variables such as study major. Previous studies like [31,30, 19, 32] have shown that study majors may have explained significant variance of creativity and have indicated whether creativity is related to

study major. Future research studies with larger student samples with different majors will be needed to extend the number of investigated control variables and understand deeper individual differences in creativity and the generalizability of the results. Lastly, DT tasks were, in early time of its development, subjected to criticisms due to psychometric problems like [33], much recent research has attempted to find the best ways to improve the psychometric attributes of DT tasks and investigate their relationships with intelligence and personality traits like [34]. Our study was limited on alternative use tasks as a way to measure DT and to investigate the relationship with Openness to Experience and its facets.

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Data availability:

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Compliance with Ethical Standards

Ethical approval

This study was approved by Research Ethics Committee /Deanship of Graduate Studies and Research of Ajman University

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Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

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