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Convergent, Discriminant, and Incremental Validities of Person–Environment Fit Scale for Creativity in Predicting Innovative Behavior

ABSTRACT

This study examined the validity of a 14-item two-factor person–environment fit scale for creativity (PEFSC) to measure the personal and environmental components of creativity. A sample of 2,475 participants completed the PEFSC for evaluating the factor structure. For convergent, discriminant, and incremental validities, a subsample ($N = 362$) completed the creative self-efficacy scale, support for innovation subscale of the team climate inventory, and innovative behavior measure. Results indicated the two-factor correlated model showed a better goodness of fit than the one-factor model. Measurement invariance of PEFSC was observed across different genders and educational groups. Internal consistency reliabilities were satisfactory ($\alpha \geq .87$). The personal dimension indicated stronger associations with creative self-efficacy than with support for innovation, whereas the environmental dimension was related more closely to support for innovation than to creative self-efficacy. Incremental validity was confirmed by significant and additional explanations from PEFSC in predicting innovative behavior. These results consolidated the application of person–environment fit theoretical framework in creativity research.

Keywords: person–environment fit, creativity, innovative behavior, validity.

Creativity, as a manifestation of individual virtue (Duan et al., 2012; Peterson & Seligman, 2004), has been widely investigated in psychological and organizational settings. Creativity is defined as the generation and development of novel and potentially useful ideas (Amabile, 1983; Shalley, Zhou & Oldham, 2004). Previous studies have attempted to understand creativity by focusing on personal characteristics (Duan & Bu, 2017; Zhou & Oldham, 2001) or environmental factors (Coelho, Augusto & Lages, 2011; Dong, Bartol, Zhang & Li, 2017). Other studies have illustrated that both personal and environmental factors play important roles (Dorniak-Wall, 2016; Niu, 2007; Zhou & Hoever, 2014) in understanding creativity, which was referred to as person–environment (P–E) fit perspective (Caplan & Vanharrison, 1993). Person–environment fit indicates the correspondence and compatibility when personal and environmental characteristics are well matched (Kristof-Brown & Guay, 2011). Based on P–E fit theory, Sen, Acar and Cetinkaya (2014) developed a commensurate 14-item P–E fit scale for creativity (PEFSC). PEFSC involves personal dimension (e.g., "I like to see different point of views") and environmental dimension (e.g., "There is cultural diversity in my environment") in a "fit" point of view. Individuals with high mean scores in the two dimensions implied a high capacity for creative accomplishment.

Only Sen et al. (2014) and Cayirdag (2016) applied PEFSC in the Turkish population and culture. Therefore, we aim to further examine the convergent, discriminant, and incremental validities of PEFSC in the current study. Previous research has distinguished the construct of creativity from individual innovative behavior by designating creativity as a person's perception of new and useful ideas (Amabile, 1983). Innovative behavior refers to the transformation of creative ideas into useful applications (G. Chen, Farh, Campbell-Bush, Wu & Wu, 2013; Janssen, 2000). The construct measured by PEFSC to distinguish other related variables (i.e., creative self-efficacy and support for innovation) in predicting innovative behavior can help achieve these goals.

The dynamic componential model of creativity and innovation (Amabile & Pratt, 2016) suggests that a harmonious relationship between the person and environment promotes innovation and progress in the creative process. This theory suggests that innovative behavior can be predicted by personal characteristics (e.g.,

creativity traits, creative self-efficacy, and creative personal identity), environmental factors (e.g., the climate for creativity, support for innovation, and relationships with supervisors and co-workers), and their fit. Numerous studies have demonstrated the above assumptions. From the perspective of personal dimension, creative self-efficacy is the self-judgment of the ability to produce creative outcomes and effectively predicted creative performance (Tierney & Farmer, 2002, 2011). Haase, Hoff, Hanel and Innes-Ker (2018) revealed the strong links between the creative self-efficacy and creativity-related outcomes and process. A longitudinal examination further confirmed the joint growth relationship between creative self-efficacy and innovative behavior (Hsu, Hou & Fan, 2011). From the perspective of environmental dimension, when individuals perceive support for innovation, they have the motivation and initiative to engage in creative activities (Mumford, Scott, Gaddis & Strange, 2002), facilitating positive associations between support for innovation and innovative behavior (Hsu & Chen, 2017; Ren & Zhang, 2015). A meta-analysis of the antecedents of innovation was conducted on 104 independent studies to indicate that support for innovation was related strongly to innovative behavior (Hulsheger, Anderson & Salgado, 2009). Thus, it can be hypothesized that personal and environmental dimensions of PEFSC can be used to predict innovative behavior.

The personal dimension of PEFSC reflected mainly personal characteristics (e.g., openness, independence, and curiosity), whereas the environmental dimension of PEFSC indicated the environmental factors (e.g., cultural diversity, resources to learn, and rewards for original ideas). Therefore, the two dimensions of PEFSC should show relatively high or low correlations with the corresponding constructs. Personal dimension and environmental dimension should be closely related to creative self-efficacy and support for innovation, respectively, to reflect convergent validity. The weak correlation between personal dimension and perceived support for innovation, as well as that of between environmental dimension and creative self-efficacy, was expected in reflecting discriminant validity. PEFSC can also be used to divide individuals into fit and misfit categories (Cayirdag, 2016; Sen et al., 2014). In the fit category, the participants had equal levels of personal characteristics and perceived environmental factors. That is, the mean score of PEFSC reflected the creativity potential of the person and the supportive environmental conditions for creativity. Hence, when comparing PEFSC with other combined but single creative-related measures (e.g., creative self-efficacy and support for innovation) in explaining innovative behavior, significant incremental validities are expected at a statistical level.

This study aims to examine the convergent, discriminant, and incremental validities of PEFSC. Furthermore, existing studies on gender (Hardy & Gibson, 2017; Kaufman, Baer & Gentile, 2004) and education (Amabile, 1983; Amabile & Pillemer, 2012) differences in creativity showed inconsistent results. Hence, the factor structure and measurement invariance of PEFSC are also examined using a large-scale community sample. The present study may consolidate and enhance the application of the P–E fit theoretical framework in creativity research and can guide in the implementation of intervention strategies for the development of creativity and innovative behavior.

METHODS

PARTICIPANTS AND PROCEDURES

Participants were recruited, and data were collected through the Internet. This approach is generally equivalent to the paper-and-pencil approach (De Beuckelaer & Lievens, 2009; Weigold, Weigold & Russell, 2013). A survey link of questionnaires was distributed through social software (e.g., WeChat and QQ Zone). Participants voluntarily visited the website to complete the first questionnaire including demographic information and PEFSC and sign consent forms before completion. Those with self-reported active physical and mental illnesses or aged 18 years old and below were excluded. At the end of the questionnaire, the participants were requested to indicate their willingness to fill out other questionnaires, including creative self-efficacy scale (CSES), support for innovation subscale of the team climate inventory (SI), and innovative behavior measure (IBM). Participants who clicked "Yes" were invited further to complete these questionnaires. Ethics approval was obtained by the Human Subjects Ethics Sub-Committee of Wuhan University.

The entire sample included 2,475 (1,562 females) from 34 provincial administrative regions in China. Mean age was 26.32 years (SD = 7.22, range = 19–73). A total of 335 (13.54%) participants did not go to college, whereas 1,589 (64.20%) were studying for a bachelor's degree or had already obtained it. The remaining 551 (22.26%) were studying for a postgraduate degree or had already obtained it. Among these participants, 362 agreed to fill out the other questionnaires. The total sample was used to evaluate factor structure, whereas the subsample was adopted to examine convergent, discriminant, and incremental validities.

MEASUREMENTS

PEFSC

The person-related aspects (personal dimension, seven items) and environment-related aspects of creativity (environmental dimension, seven items) were measured in a P–E fit orientation using PEFSC (Sen et al., 2014). The participants were asked to rate the extent of their disagreement (1 = extremely disagree) or agreement (5 = extremely agree) on a five-point Likert scale. Sample items included "I like to see different point of views" for the creativity potential of the person and "There is cultural diversity in my environment" for the supportive environmental condition. High mean scores of personal and environmental dimensions and the fit between the two dimensions indicate high capacity or probability for creative expression and accomplishment. The Cronbach's alpha coefficients were .84–.87 and .83–.90 for personal and environmental dimension, respectively (Cayirdag, 2016; Sen et al., 2014). In the current study, the Cronbach's alpha coefficient was .88 and .87 for personal and environmental dimension.

CSES

Creative self-efficacy scale is a three-item self-report scale used to assess personal creative self-efficacy (Tierney & Farmer, 2002). The participants were required to answer three items on a seven-point Likert scale, from 1 = extremely disagree to 7 = extremely agree. A high mean score indicates a high level of creative self-efficacy. One of the sample items was "I have confidence in my ability to solve problems creatively." Previous studies have indicated the satisfactory psychometric characteristics of the Chinese version (Gong, Huang & Farh, 2009). The Cronbach's alpha coefficient was .84 in this study.

SI

Support for innovation subscale of the team climate inventory is a subscale of the Team Climate Inventory which consists of eight items used to assess the extent of time, cooperation, practical support, and resources for innovation and creativity given by the team and team members (Anderson & West, 1998). The participants were required to indicate the extent of their disagreement (1 = disagree) or agreement (5 = agree) on a five-point Likert scale. Sample item was "Assistance in developing new ideas is readily available." The Chinese version was developed, and the psychometric attributes were validated by Tseng, Liu and West (2009). The Cronbach's alpha coefficient was .90 in the current subsample.

IBM

Innovative behavior measure was used to measure personal innovative behavior (Scott & Bruce, 1994). A five-point Likert scale was used to enable participants to rate their innovative behavior from 1 (disagree) to 5 (agree). A high mean score means a high degree of innovative behavior. Sample item was "I search out new technologies, processes, techniques, and product ideas." A previous study has indicated this scale can be used in the Chinese context (Feng, Huang & Zhang, 2016). The Cronbach's alpha coefficient was .80 in this study.

DATA ANALYSIS STRATEGY

First, confirmatory factor analysis (CFA) using maximum likelihood parameter estimates with standard errors and a mean-adjusted chi-square test statistic (MLM) was performed on the entire sample to evaluate the factor structure of PEFSC. Comparative fit index (CFI), standardized root-mean-square residual (SRMR), root-mean-square error of approximation (RMSEA), and Tucker–Lewis index (TLI) were reported to evaluate the models. TLI > .90, CFI > .90, SRMR < .08, and RMSEA < .08 were adopted as evaluation criteria (Hu & Bentler, 1999). Previous studies have revealed a high correlation (r > .90) between the two dimensions of PEFSC. This high correlation implies all 14 items may load on one factor rather than on two related factors. Therefore, the one-factor model and two-factor correlated model were constructed to explore this issue. The two-factor correlated model was expected to exhibit an improved goodness of fit. Furthermore, multi-group CFA using MLM was adopted to examine the measurement invariance of PEFSC across genders and educational levels. Participants were divided into high educational group (i.e., undergraduate and postgraduate; n = 2,140; 86.46%) and low educational group (i.e., primary, middle, high, and secondary school; n = 335; 13.54%). CFAs were performed in the different subgroups to examine the baseline models for each subgroup. Then, four levels of equivalence, including configural, weak/metric factorial, strong/scalar factorial, and strict/uniqueness factorial invariance, were tested individually (Meredith, 1993). $|\Delta CFI| < 0.010$

and $|\Delta RMSEA| < 0.015$ were adopted as evaluation criteria (Pendergast, von der Embse, Kilgus & Eklund, 2017).

Descriptive statistics and Pearson's correlation coefficients were calculated for all researched variables. Positive correlations were generally expected among all these variables. Thus, partial correlation should be examined to reveal clear associations. After controlling for the environmental dimension of PEFSC, personal dimension was expected to exhibit a high correlation with creative self-efficacy. After controlling for personal dimension, the environmental dimension was expected to exhibit a high correlation with support for innovation. For further examination of the incremental validity in a matched sample, standardized *z*-scores of the means of personal and environmental dimensions were used as a cut-point to divide the subsample ($n = 362$) into fit and misfit categories. Three independent hierarchical regressions were conducted in the fit category to examine the incremental validity. Innovative behavior was set as a dependent variable in all the regressions. In the first regression, the creative self-efficacy scores were entered in the first step, and the P–E fit for creativity scores was added in the second step. In the second regression, the scores for support for innovation were entered in the first step, whereas the P–E fit for creativity scores was added in the second step. In the third regression, the creative self-efficacy and support for innovation scores were entered in the first step, whereas the P–E fit for creativity was added in the second step of the analysis. Significant changes in R^2 were expected to be obtained by the PEFSC in all regressions. Data analyses were performed using SPSS 21.0 and Mplus 7.4.

RESULTS

CONFIRMATORY FACTOR ANALYSIS AND FACTOR INVARIANCE

Two independent CFAs were constructed to evaluate the construct validity of PEFSC. The results indicated the two-factor correlated model ($\chi^2 = 965.459$, $df = 69$, $\chi^2/df = 13.99$, SRMR = .047, RMSEA = .072, CFI = .923, TLI = .898) showed better goodness of fit than the one-factor model ($\chi^2 = 1152.460$, $df = 70$, $\chi^2/df = 16.46$, SRMR=.050, RMSEA = .079, CFI = .907, TLI = .879). The standardized factor loadings of the personal (from .639 to .773) and environmental dimension (from .649 to .761) were all significant at .001 levels in the two-factor correlated model. Further examinations of factor invariance in different genders and educational groups implied the configural, weak, strong, and strict invariance were achieved (Table 1).

DESCRIPTIVE AND CORRELATION ANALYSIS

The descriptive statistics show the mean scores and standard deviation of the variables. The correlation values indicated that P–E fit for creativity was related significantly to creative self-efficacy ($r = .498$, $p < .001$), support for innovation ($r = .445$, $p < .001$), and innovative behavior ($r = .540$, $p < .001$). Positive correlations were noted between personal dimension and creative self-efficacy ($r = .434$, $p < .001$) and support for innovation ($r = .332$, $p < .001$). Environmental dimension was positively related to creative self-efficacy ($r = .455$, $p < .001$) and support for innovation ($r = .463$, $p < .001$). The results are presented in Table 2.

CONVERGENT AND DETRIMENTAL VALIDITY

Table 3 presents the results of partial correlations. The results showed personal dimension was correlated positively with creative self-efficacy ($r = .277$, $p < .001$) and correlated insignificantly with support for innovation ($r = .077$, $p = .144$) when environmental dimension was controlled. Environmental dimension was correlated positively correlated with support for innovation ($r = .350$, $p < .001$) and creative self-efficacy ($r = .271$, $p < .001$) when personal dimension was controlled. The correlation coefficient between environmental dimension and support for innovation is higher than its correlation coefficient with creative self-efficacy.

INCREMENTAL VALIDITY

The subsample was divided into the high person–high environment group ($N = 135$), the low person–low environment group ($N = 129$), the low person–high environment group ($N = 40$), and the high person–low environment group ($N = 58$). That is, 264 individuals belonged to the fit category. Hierarchical regressions were performed to test the incremental capability of P–E fit for creativity. As described in the data analysis plan section, three regressions were constructed. Table 4 summarizes the main results. In the three regressions, the P–E fit for creativity additionally explained 4.3%, 10.7%, and 2.3% variance of innovative behavior beyond creative self-efficacy, support for innovation, and both, respectively.

TABLE 1. Fit Statistics for Measurement Equivalence/Invariance of PEFSC scores across Gender and Education groups (N = 2,475)

Model	χ^2	$\Delta\chi^2$	*df*	Δdf	SRMR	RMSEA (90% CI)	ΔRMSEA	CFI	ΔCFI	TLI
Male (n = 913)	337.763	–	69	–	.045	.065 (0.058 to 0.072)	–	.938	–	.918
Female (n = 1,562)	733.493	–	69	–	.050	.079 (0.073 to 0.084)	–	.913	–	.885
Configural	1,054.038	–	138	–	.048	.073 (0.069 to 0.077)	–	.922	–	.898
Metric	1,100.242	46.204	150	12	.051	.072 (0.068 to 0.076)	0.000	.920	0.002	.902
Scalar	1,191.643	91.401	162	12	.055	.072 (0.068 to 0.076)	0.000	.913	0.007	.902
Strict	1,203.433	11.790	164	2	.053	.072 (0.068 to 0.075)	0.000	.912	0.001	.902
Low education (n = 335)	171.400	–	69	–	.048	.067 (0.054 to 0.079)	–	.930	–	.907
High education (n = 2,140)	918.462	–	69	–	.050	.076 (0.072 to 0.080)	–	.918	–	.892
Configural	1,109.960	–	138	–	.050	.075 (.071 to. 080)	–	.920	–	.894
Metric	1,150.880	40.920	150	12	.051	.073 (.070 to 0.077)	.002	.917	.003	.906
Scalar	1,226.658	75.778	162	12	.052	.073 (0.069 to 0.077)	.000	.912	.005	.901
Strict	1,249.847	23.189	164	2	.059	.073 (0.069 to 0.077)	.000	.910	.002	.900

TABLE 2. Descriptive and Correlations Analysis (N = 362)

	1	2	3	4	5	6
1 Person–environment fit for creativity	–					
2 Personal dimension	.891***	–				
3 Environmental dimension	.897***	.598***	–			
4 Creative self-efficacy	.498***	.434***	.455***	–		
5 Support for innovation	.445***	.332***	.463***	.475***	–	
6 Innovative behavior	.540***	.476***	.489***	.716***	.518***	–
M	3.781	3.936	3.626	4.471	3.310	3.368
SD	0.369	0.408	0.418	0.944	0.548	0.512

Note. ***$p < .001$ (two-tailed).

TABLE 3. Partial Correlations of PEFSC Dimensions with Creative Self-Efficacy and Support for Innovation in Sample (N = 362)

	Creative self-efficacy	Support for innovation
Creative self-efficacy	–	
Support for innovation	.335***	–
Personal dimension	.227***	.077
Creative self-efficacy	–	
Support for innovation	.390***	–
Environmental dimension	.271***	.350***

Notes. Partial correlation for Personal Dimension controlling for Environmental Dimension; Partial correlation for Environmental Dimension controlling for Personal Dimension.
***$p < .001$ (two-tailed).

DISCUSSION

The present study aims to examine the convergent, discriminant, and incremental validities of PEFSC. The results indicated the two-factor correlated model of PEFSC and its factor invariance among different age and educational groups. The construct measured by PEFSC also showed convergent, discriminant, and incremental validities compared with other related variables (i.e., creative self-efficacy and support for innovation) in predicting innovative behavior. The partial correlation results indicated stronger correlations between the personal dimension of PEFSC and creative self-efficacy, as well as the environmental dimension of PEFSC and supportive environmental condition for creativity. Separate dimensions and the whole instrument also contributed explained variances ranging from 2.3% to 10.7% in explaining innovative behavior. These results suggested the P–E fit for creativity evaluated commensurately the creative potential or capacity.

The significance of PEFSC was the presentation of incremental validity over other combined but noncommensurate measures (i.e., creative self-efficacy and support for innovation) in explaining innovative behavior. As shown in the regression results, the PEFSC explained further the innovative behavior among the fit group (i.e., individuals perceived the compatibility between personal characteristics and environmental support). In an experiment of business simulation, Navaresse, Yauch, Goff and Fonseca (2014) found that individuals behave more creatively when the person and environment equally emphasize innovation. In addition to the dynamic componential model of creativity and innovation (Amabile & Pratt, 2016) mentioned above, the systems model of creativity (Csikszentmihalyi, 2014) emphasizes that common support from the personal and the environmental factors leads to superior creative performance. Edwards (1994) indicated personal and environmental characteristics have a stronger combined effect on individual behavior than either alone. Although many studies have admitted the importance of P–E fit to creativity to innovative behavior (Chen, Chang & Chang, 2015; Choi, 2004; Puccio, Talbot & Joniak, 2000), most of them adopted combined but single measures, rather than a commensurate one, to assess personal and environmental

TABLE 4. Incremental Validity of the Person–Environment Fit Scale for Creativity in Predicting Innovative Behavior. (N = 264)

Independent variables	Dependent variable: Innovative behavior	
	β (t)	
	Step 1	Step 2
Creative self-efficacy	.410*** (18.590)	.334*** (13.244)
Person–environment fit for creativity		.324*** (5.381)
R^2 (F)	.569 (345.587***)	.612 (205.711***)
ΔR^2 (ΔF)		.043 (28.957***)
Support for innovation	.609*** (12.608)	.420*** (8.231)
Person–environment fit for creativity		.491*** (7.366)
R^2 (F)	.378 (158.965***)	.485 (122.770***)
ΔR^2 (ΔF)		.107 (54.261***)
Creative self-efficacy	.325*** (12.898)	.284*** (10.725)
Support for innovation	.272*** (5.924)	.220*** (4.744)
Person–environment fit for creativity		.246*** (4.081)
R^2 (F)	.620 (212.823***)	.643 (155.941***)
ΔR^2 (ΔF)		.023 (16.652***)

Note. ***$p < .001$; **$p < .01$ (two-tailed).

factors, respectively. As the experimental study mentioned above, Navaresse et al. (2014) combined the Abbreviated Torrance Test for Adults (measuring fluency, originality, flexibility, and elaboration of the person) and the items extracted from Team Climate Inventory (measuring supportive environmental conditions for creativity) to explore the predictive effect of personal characteristics, environmental factors, and P–E fit in individual creative behavior. According to French and Kahn (1962), person and environment can only compare each other when they consist of commensurate dimensions. PEFSC has commensurate subscales with the same fit theoretical mindset to measure person, environment, and their interaction, hence it can be used to examine monotonic (i.e., a continuous increase or decrease in the dependent variable as the fit increases), asymptotic (i.e., a continuous increase or decrease trend until a point and then remain stable), or optimal (i.e., a continuous increase or decrease trend until an optimum point and then the trend reversed) models of creativity and creative performance (Sen et al., 2014). The incremental validity of PEFSC illustrated the significance of commensurate measure in personal and environmental dimensions of creativity using one instrument, which highlighted the commensurate attribution of P–E fit framework and revealed additional information on the differentiation between the personal and environmental components.

The findings provide at least two practical implications for creativity training and innovation behavior management practitioners. First, PEFSC can be used to screen the creativity profile (i.e., fit or misfit category) of individuals. Different intervention or training programs can be operated with a specific focus (e.g., personal characteristic, environmental factor, or both). For instance, the Learn to Think intervention program was developed to increase creativity by enhancing divergent thinking abilities (Hu et al., 2013). Future study can adopt the PEFSC to further develop the program to clarify whether the participants need a supportive environment to parallel with their divergent thinking. Compatibility of personal and environmental factors may also be effective in transforming creative ideas into useful applications (i.e., innovative behavior). Therefore, improving the compatibility between the individual and the environment can be a viable approach to promote innovative behavior. Another intervention study compared the effectiveness of innovative thinking ability training group and mobile support system and innovative thinking ability training combined group in enhancing innovation performance. The results implied the combined group had better performance in terms of innovative behaviors (Wu, Hwang, Kuo & Huang, 2013). Our findings provide theoretical support and empirical evidence for similar projects that involve simultaneous interventions based on individuals and the environment.

Limitations and further directions should also be considered. First, the predictive role of PEFSC in explaining innovative behavior in the current study was examined using cross-sectional data. In the future,

longitudinal design, repeat-measures, or experimental study should be conducted to re-examine the causal relationship between them. Other criteria-related measurements of creativity on the individual, organizational, or both levels should be considered to examine further the discriminant validity of PEFSC. Second, the current sample contained several highly educated participants that may bias the results. The uneven distribution of subsamples in evaluating the factor invariance should be considered in future studies by involving individuals with preliminary educational levels. The social desirability bias resulted from self-reported measures or the same data source in creativity research was a problem (McKibben & Silvia, 2017). Using multiple informants in future research can improve the diagnostic accuracy (Alexander, McKnight, Disabato & Kashdan, 2017), and triangulating data from different sources (e.g., supervisors and teachers) can strengthen the conclusions of this study. Studies have signified the importance of multilevel consideration of environment factors empirically (Chen et al., 2013; Wang, Rode, Shi, Luo & Chen, 2013). Therefore, future studies should address cross-level issues, incorporating individual-, team-, and organization-level predictors to test multilevel models for improved understanding of the precise role of environmental factors at different levels. Finally, the present results did not reveal how and when (i.e., mediator and moderator) P–E fit for creativity should relate to innovative behavior. For example, Hsu and Chen (2017) performed a cross-level-mediated model, and the results suggested employee psychological capital may have more influence than the supportive environment throughout each stage of the innovation process. All these issues should be explored in the future.

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