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The effects of creative personality on scientist creativity

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A R T I C L E I N F O

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A B S T R A C T

Does a creative personality make scientists more creative? Previous research on creative personality, creative behavior, and performance has been mixed, with not all studies reporting a consistent positive relationship. We propose that this is, in part, because creativity is not solely determined by traits; instead, creative individuals require a specific context to fully realize their potential to create. Using trait activation theory, we show that, as scientific creativity is becoming more dependent on teamwork, creative personality interacts with scientists' social identities and collaborative behavior to affect scientists' creativity. Multisource data collected from 547 scientists from 36 research institutes in China revealed that two dimensions of scientists' creative personality (research ability and uniqueness) exhibited a positive effect on their creativity whereas two other dimensions of their creative personality had a negative effect (self-discipline) or no effect (self-verification) on their creativity. In addition, the breadth of research communication, expertise identity, and organizational identity exhibited positive moderating effects on creative personality and scientist creativity. Specifically, when research communication breadth was high, self-discipline boosted scientist creativity; when expertise identity was high, self-verification boosted scientist creativity; and when organizational identity was high, the uniqueness dimension of scientist personality boosted scientist creativity. We discuss implications for theory and practice.

1. Introduction

Workplace creativity, which ranges from minor changes to revolutionary breakthroughs (Beghetto & Kaufman, 2007), is critical to a wide variety of industries. Research has found that certain personality traits affect one's success in creative efforts (Amabile, 1988, 2011; Feist, 2006; Gilson & Shalley, 2004; Stock et al., 2016). For instance, several of the Big Five personality traits (conscientiousness, openness to experience, and extraversion) have been shown to be positively correlated with creativity, whereas neuroticism has been found to be negatively related to creativity (Gelade, 2002; Raja & Johns, 2010). However, scholars have documented low levels of reliability and validity, as well as cultural bias in the Big Five personality scales (Hough & Ones, 2002; Raja & Johns, 2010; Morgeson et al., 2007; Tett & Christiansen, 2007; Penney et al., 2011), which raises questions about their relationship with creativity.

In contrast, creative personality, which may be defined as the extent to which an individual is inventive and imaginative, is a relatively stable trait that has been found to predict an individual's creative behavior across a variety of domains (Shane & Nicolaou, 2015; Audenaert & Decramer, 2018). Researchers have developed an array of instruments designed to assess aspects of human

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personality that contribute to the development of creative personality characteristics (Selby et al., 2005). In particular, Gough's adjective checklist involves 30 adjectives that have been found to be a valid, reliable measure of creative personality, capable of capturing an individual's overall creative potential (Oldham & Cummings, 1996; Shane & Nicolaou, 2015). Some empirical studies have found that creative personality can predict individual creativity (Zhou & Hoever, 2014; Li et al., 2022), and is positively correlated with both self-reported and non-self-reported creativity (Ng & Feldman, 2012). However, other research has argued that creative personality alone is not a strong predictor of creative performance (e.g., Amabile, 2013; Feist, 2006).

This study aims to reconcile this mixed research by identifying an underlying mechanism that explains how creative personality affects scientist creativity, while taking into account the modern workplace's shift from a focus on individual to collective creativity. According to trait activation theory (TAT), personality is more predictive of trait-related outcomes in contexts containing trait-related elements (Tett & Guterman, 2000; Tett & Burnett, 2003; Judge & Zapata, 2015). It is likely that creative personality alone cannot fully account for all the variation in creativity, but instead is activated in conjunction with different situational factors that collectively foster creativity. It has been suggested that the inconsistent relationship between creative personality, creative behavior, and performance in earlier research may be due to the fact that creativity is not solely determined by traits; instead, creative individuals require a specific context to fully realize their potential to create (Hogan et al., 1996; Penney et al., 2011; Audenaert & Decramer, 2018).

Previous research has identified both individual and situational factors that affect creativity (Zhou & Hoever, 2014). For example, creative individuals often exhibit distinctiveness, eccentricity, and even paranoia, in their personality. Such a personality may exert a negative effect on collaborative work and decrease scientists' creativity. This "solitary genius" notion assumes that the creative individual works in isolation (Simonton, 1999). However, communication and collaboration can increase the probability of breakthrough innovations (Singh & Fleming, 2010). In light of rapid changes in technology and the workplace, synergistic cooperation between disciplines has become critical to creativity (Fang et al., 2015; Tang et al., 2022).

Given that creativity is an interindividual social process (Rank et al., 2004), individuals are motivated to act on behalf of a social unit, which in turn aligns them with the group to which they belong (Becker & Wagner, 2009). Moreover, individuals define themselves by the attributes they perceive in their social environment, resulting in diverse creative behavioral outcomes (Ashforth & Mael, 1989). Creative behaviors related to social identification are most likely to occur in the workplace when the forces generated by the activation of trait-related elements in professional tasks and organizations make these identities salient (Farmer & Van Dyne, 2010)

When explaining the impact of social identities on creativity, it is crucial to consider not only the strength of social identification, but also the content that constitutes group identification. Depending on the nature of the content, the direction of the effect of identities on creativity is expected to vary (Becker & Wagner, 2009; Lee et al., 2019). We consider two types of identification, expertise identity and organizational identity, which may influence scientist creativity. Expertise identity refers to the individual's perception of themselves as a distinct person in a particular field based on their professional knowledge and relevant expertise, cultivating an identity that inspires their creative efforts (Janssen & Huang, 2008; Tang et al., 2014). Individuals with high expertise identity use their knowledge to solve problems and validate their expertise, which can have a positive impact on their creativity.

Another type of identity, organizational identity, refers to the degree of psychological overlap between the self and a unit to which one belongs. As such, members with a high level of organizational identity are motivated to engage in behaviors that demonstrate their sense of belonging in the group (Lee et al., 2019). Organizational identity involves individuals feeling closely connected to the organization and believing that their self-worth is tied to the organization's perceived value. Thus, they are likely to make an effort to achieve organizational goals. Moreover, the norms and values in the organization may promote creativity (Dick et al., 2007; Tang et al., 2014).

Using questionnaire data from 36 research institutes in China, the purpose of Study 1 is to determine the effects of several components of scientists' creative personality (research ability, uniqueness, self-discipline, and self-verification) on their creativity. The purpose of Study 2 is to draw from TAT (Tett & Burnett, 2003) in proposing and empirically examining a model that reveals key moderators in this relationship. First, we argue that breadth of research communication will positively moderate the relationship between creative personality and scientist creativity. Moreover, considering the fact that creativity is an interpersonal social process, we propose that expertise identity and organizational identity will positively moderate the relationship between creative personality and creativity. Our study uniquely contributes to the existing literature by identifying a model that shows the mechanism through which creative personality affects scientist creativity. Further, we offer implications for principal investigators and managers within scientific research organizations. In the sections that follow we review the literature and present our hypotheses.

2. Preliminary study: creative personality of scientists

2.1. *Creative personality of scientists*

Personality is a relatively stable pattern of a person's thoughts, emotions, and behaviors that distinguishes individuals from one another (Côté & Moskowitz, 1998; Madrid et al., 2014; Marinova et al., 2013). The sociality and plasticity of personality affect an individual's internal goal orientation and behavioral paradigm (DeShon & Gillespie, 2005). DeShon and Gillespie (2005) suggested that an individual's personality is able to predict domain-specific patterns of achievement goals such as creative motivation, which is an individual's intrinsic drive for self-expression. Innovation motivation, reflecting the willingness and tendency of individuals to achieve innovative goals and behaviors, is also influenced by personality (Ahmadi et al., 2022; Gough, 1979; Marinova et al., 2013).

Creative personality is characterized as a synthesis of positive psychological qualities that relate to the production and realization of creative activities and outcomes, and provide the internal drive that activates, promotes, regulates, and controls the stability of motivation for innovative behavior (Benedek et al., 2020; Fuller & Marler, 2009; Tierney et al., 1999). Unlike general personality, creative personality promotes continuous creativity in various fields with elements such as adventurousness, curiosity, imagination, and taking challenges. Creative personality plays a significant role in explaining individual creativity by promoting novel and unique problem-solving behaviors, which promote creativity (Parker et al., 2006). Although creative personality alone does not predict creativity in all situations (e.g., Amabile, 2013; Feist, 2006), it is thought to be one of a number of factors that can influence creativity. Indeed, creative performance is the outcome of intricate interactions between an actor's characteristics and contextual factors. Specifically, personality, social influences, and contextual factors play important roles in enhancing or inhibiting creative performance (Audenaert & Decramer, 2018; Woodman et al., 1993), which is thought to be a key factor for creativity in research and scientific achievements (Barrick et al., 2001). In keeping with this line of reasoning, we propose the following:

Hypothesis 1. Creative personality is positively associated with the creativity of scientists.

2.2. Participants

To test our hypotheses, questionnaires were distributed to 560 scientists from the Chinese Academy of Sciences. After removing questionnaires with missing responses, our final sample included 547 scientists representing 36 research institutes across 30 provinces, yielding a response rate of 97.68 %. The sampling procedure involved obtaining consent from the personnel managers of the 36 institutes, who were asked to identify pairs of scientific research personnel with substantial differences in research performance within their respective institutes. The pairs were then screened to ensure that they had similar research fields and ages but significant differences in creativity outcomes, titles, and personal growth. To ensure that each institute's human resources department conducted a valid pairing procedure, we conducted a test for between-group differences in demographic characteristics, as well as performance. In line with relevant previous research (e.g., Tang & Kaufman, 2017), the scientists were evaluated by three close colleagues, who scored their creative personality using a questionnaire. The participants were informed that their responses were not required by their jobs, would remain anonymous, and that the completed questionnaires would be directly mailed to the study's lead investigator. After the samples were sorted, the scientists of the high performance group, evaluated by the personnel department based on performance and consulting experts in this field, were selected as the experimental group, and the scientists of the ordinary group were selected as the control group.

2.3. Measures

C*reativity* served as the dependent variable. Through consultation with the personnel department and experts in the field as outlined in the previous section, a paired sampling method identified two groups of participants: creative scientists (high performance; coded as a dummy variable 1) and non-creative scientists (ordinary; coded as a dummy variable 0). The personnel department then invited participants to voluntarily complete a questionnaire. The collected list of volunteers was coded to ensure anonymity during data analysis.

Creative personality served as the independent variable. The multidimensional scale included 23 personal trait adjectives of creative scientists, adapted from Tang and Kaufman's (2017) study. Using a Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree), three colleagues or students who had close contact with the participants were asked the extent to which the following characteristics describe the individual being rated, and the final value for each item is the average of the three individuals' ratings. An introductory sentence preceding the 23 items states that we are asking about personal traits demonstrated by the scientist in research projects and academic studies: "We would like to assess the extent to which you perceive the following traits of this scientist in scientific research and academic activities." A sample item is "I think this scientist has shown a strong characteristic of divergent thinking in scientific research and academic activities". Ten items ($\alpha = 0.92$) assessed *research ability* (e.g., divergent thinking, adaptability, strong communication skills). Seven items ($\alpha = 0.88$) assessed *self-verification* (e.g., concern with one's reputation, ambition, exhibiting one's accomplishments). Four items ($\alpha = 0.73$) assessed *self-discipline* (e.g., little concern with outside recognition, self-motivated, stable). Two items ($\alpha = 0.83$) assessed *uniqueness* (eccentricity, oddness).

Gender, professional field of study, nature of work, age, mentor reputation, undergraduate and graduate institutions, and doctoral and overseas doctoral institutions served as control variables. By controlling for these factors, we were able to better isolate the impact of the explanatory variable and minimize the influence of potentially confounding factors. Full descriptions of all measures can be found in the appendix (Table A1).

2.4. Results

The paired sampling accuracy test was first conducted using Stata 17.0 to verify the accuracy of the scientists' group selection. Next, an exploratory factor analysis (EFA) was conducted using SPSS 27.0 to validate the convergent validity of the 23 creativity-related personality trait items set to load on the four creative personality group factors. Subsequently, the reliability and validity of the model were tested through a confirmatory factor analysis (CFA) using Amos 26.0.

In order to test the validity of the paired sampling results, we examined common creativity indicators (Ng et al., 2005; Fuller & Marler, 2009): the number of paper citations, the total number of approved invention patents, the number of national key projects hosted, the total funding received for their projects, and honors and awards earned, as well as indicators of demographic characteristics: gender, age, professional field of study and nature of work. Since none of the nine indicators passed the homogeneity of variance test ($p < 0.001$), the non-parametric Mann-Whitney rank sum test was used. As shown in Table 1, in terms of creativity performance, the number of citations, total number of approved invention patents, number of national key projects hosted, total project funding, as well as honors and awards received were all significantly higher for the creative participants than for the non-creative participants ($p < 0.01$). Regarding the demographic characteristics of the paired samples, the differences between the groups in terms of professional field of study and nature of work were not significant ($p > 0.1$), indicating that the research fields of the paired samples are basically the same. Although there are significant differences in age and gender ($p < 0.001$), they are subsequently included in the regression model as control variables for analysis.

As noted earlier, we conducted an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA).to assess the measurement validity and robustness of four creative personality variables. Given the large number of items, our creative personality scale may be prone to multi-dimensionality/multicollinearity issues, making it challenging to interpret and analyze. EFA allows for the reduction of the number of observed variables to a smaller set of latent factors, simplifying the structure and making it more manageable. In addition, an EFA can reveal redundancy or overlapping content among items. If several items measure similar aspects of the construct, the EFA can identify these redundancies, helping us streamline the scale by retaining the most informative items. The CFA allows us to validate the factor structure suggested by EFA.

The Kaiser-Meyer-Olkin measure of sampling adequacy of the factors was 0.944, which is greater than the recommended value of 0.8. Bartlett's Test of Sphericity was significant ($\chi^2 = 8042.992$, df = 253, $p < 0.001$), indicating that we could proceed with the factor analysis. Our EFA used principal component analysis and orthogonal rotation with Kaiser standardization. After 6 iterations, 23 items were classified into 4 factors (*research ability, uniqueness, self-discipline*, and *self-verification*). The absolute values of the item loadings on the corresponding factors were greater than 0.5, and there were no cross-loaded items, indicating that the creative personality scale exhibited a high level of reliability. In addition, the fit indices of the four-factor model were significantly better than those of the alternative models ($\chi2 =$ 830.73, df = 224; root mean square error of approximation = 0.070, comparative fit index = 0.923, Tucker-Lewis index = 0.913, normed fit index = 0.906), in keeping with the cutoff values suggested by Hu and Bentler (1999) and Doll et al. (1994), indicating that the four variables empirically define unique latent factors (please see Table 2).Table 3 presents descriptive statistics and correlations of the study variables. The correlation coefficient matrix indicates that *research ability, self-verification, gender, age, mentor reputation, undergraduate school, masters graduate school,* and *overseas doctorate* were associated with scientists' creativity, providing initial support for our model. Moreover, the correlation coefficients among the independent variables were all below 0.60, and all of the variables had a VIF of significantly less than 5; thus, multicollinearity does not appear to be a serious concern in these data. Taken together, these results suggest that different influence paths and relationship patterns may affect scientists' creativity. A full listing of the means, standard deviations, and correlations of all study variables appears in the appendix (Table A2).

The results of the preliminary study support the idea that creativity may be regarded, in part, as a trait. It appears that creativity is not simply the product of external factors such as the work environment, training, or education, but is also grounded in individual personality traits. This finding reinforces the notion that creative individuals possess certain inherent characteristics that contribute to their innovative thinking. Our results also point to several practical implications. First, identifying and facilitating creative personality traits in hiring or training programs could boost organizational creativity initiatives. Second, research teams could be built to include members with creative personalities in order to foster a more innovative research environment that may lead to more collaborative discoveries. Finally, understanding the role of creative personality in scientific creativity could help guide resource allocation decisions that emphasize a creative culture within the scientific community.

Although our preliminary study provided valuable insights into the differential effects of creative personality on scientists' creativity, it left open the question of whether individual differences could moderate this relationship. Therefore, the study that follows aims to delve deeper into this topic by proposing that the breadth of research communication, expertise identity, and organizational identity will strengthen the relationship. By identifying moderating factors, we hope to offer a more comprehensive understanding of the complex dynamics between creative personality and the creativity of scientists.

Table 1
Accuracy test results of paired sampling method ($N = 547$).

Indicators	High performance Group		Ordinary Group		U	p
	Me	*IQR*	*Me*	*IQR*		
Paper Citations	50	400	1	50	2,702,948.86	***
Approved Invention Patents	0	3	0	1	2,305,824.78	***
National Key Projects Hosted	2	5	0	2	2,730,585.47	***
Total Project Funding (in ten thousand yuan)	331	1338	0	150	2,761,088.48	***
Honors and Awards	0	2	0	0	2,702,985.25	***
Gender	1	–	1	–	1,470,789.23	***
Age	37	10	40	11	2,709,670.59	***
Professional field of study	–	–	–	–	2,126,404.54	0.36
Nature of work	2	–	2	–	2,333,561.42	0.63

Note:.
*** $p < 0.001$.
"Me" refers to the Mean of the paired differences and "IQR" refers to the Interquartile Range of the paired differences.

Table 2
Confirmatory factor analysis results.

Model	RMSEA	GFI	AGFI	CFI	TLI	NFI
One-factor modele	0.131	0.637	0.564	0.728	0.701	0.707
Two-factor model	0.111	0.725	0.669	0.806	0.783	0.780
Three-factor model	0.097	0.768	0.718	0.852	0.834	0.836
Four-factor model	0.070	0.873	0.843	0.923	0.913	0.906
Recommended values	<0.08	>0.8	>0.8	>0.9	>0.9	>0.9

Note: One-factor model: research ability + self-verification + self-discipline + uniqueness; Two-factor model: research ability, self-verification + self-discipline + uniqueness; Three-factor model: research ability, self-verification + self-discipline, uniqueness; Four-factor model: research ability, self-verification, self-discipline, uniqueness.

Table 3
Descriptive statistics and correlations.

Variables	M	SD	1	2	3	4
1.Scientist creativity	0.513	0.500				
2. Research ability	4.210	0.597	0.243***			
3. Self-verification	4.511	0.563	0.127***	0.728***		
4. Self-discipline	2.951	0.654	0.027	0.305***	0.168***	
5. Uniqueness	1.580	0.621	0.039	−0.140***	−0.186***	0.401***

Note: ** $p < 0.01$.
*** $p < 0.001$.

3. Moderating factors of creative personality

3.1. Moderating influence of the breadth of research communication

It has been suggested that personality traits alone are not enough to facilitate the high levels of innovation required by today's workplace (e.g., Tang & Zhang, 2022). To achieve high-performance innovative behavior, individuals need situations that support their inner personality (Fuller & Marler, 2009). According to TAT, individual traits only exert an impact on performance when they fit situational characteristics such as formal job tasks and responsibilities, as well as informal group norms or organizational characteristics (Tett & Burnett, 2003).

A high frequency of knowledge exchange is one situational characteristic thought to boost the creativity component of an employee's work efforts (e.g., Tang et al., 2014). A growing body of research has shown that research collaboration is critical to scientist creativity in particular (e.g., Ahmadi et al., 2022; Fang et al., 2015; Tang & Zhang, 2022). For instance, R&D team members who identify strongly with their group tend to exhibit higher levels of creativity if they engage in knowledge sharing with their colleagues (Tang et al., 2014). In keeping with TAT, we propose that scientists who frequently participate in research communication with others are more likely to experience an activation of their creative personality, which enables them to exhibit higher levels of creativity. Taken together, we hypothesize the following:

Hypothesis 2. Breadth of research communication will strengthen the relationship between creative personality and scientist creativity.

3.2. Moderating influence of expertise identity and organizational identity

In addition to the breadth of research communication, we also expect an individual's expertise identity to boost the relationship between creative personality and scientist creativity. An individual's self-concept comprises all self-related knowledge, goals, and attitudes, which assign distinctive meanings to information, shape organizational memory and opinions, and regulate one's own cognition and behavior (Lord & Brown, 2003). Identification is a crucial component of a person's self-concept that involves numerous dimensions (Johnson et al., 20,210). The extent to which each level of identification is activated varies among individuals. Identification not only reflects the importance of the individual, emphasizing the degree of association between identification and the situation and the extent to which the individual recognizes the identification, but also underscores the social aspect, emphasizing the social recognition of identification and its impact.

Identification reflects an individual's desire for belonging, enabling individuals to align their self-identification with organizational goals and behave in a manner consistent with organizational expectations. Individual identification can improve self-awareness and identification utility by following internalized normative guidelines (Wry & York, 2017). Internalization occurs when an individual's goals and values align with those of the organization, and the individual incorporates these goals and values into their self-identification (Pratt, 1998). Identification has a profound impact on individual characteristics (Akerlof & Kranton, 2000; Tyler & Blader, 2003; Wry & York, 2017).

One particular type of identification, expertise identity, may be defined as the degree to which people define themselves by their expertise in the area or occupation in which they are engaged (Tang & Naumann, 2016). It is a psychological process in which individuals actively accept their own expertise level and realize the convergence of society and self-perception in terms of attitude, psychology, and behavior, which results in sustained cognitive and behavioral performance and a positive professional emotional state during the learning and growth process (Beijaard et al., 2004; Reid, 2015). Scientists with a high level of expertise identity set their social role reference group as science and technology workers, and are more likely to recognize the importance of innovation (Tang et al., 2014). Research has found that both expertise identity and team identity contribute to creativity (Tang & Naumann, 2016). In keeping with TAT, we posit that a strong sense of expertise identity will stimulate the elements of a scientist's personality that foster creativity. Thus, we hypothesize the following:

Hypothesis 3. Expertise identity will strengthen the relationship between creative personality and scientist creativity.

Along with expertise identity, we also expect that another dimension of individuals' identity, organizational identity, will boost the relationship between creative personality and scientist creativity. Scientific research organizations provide a crucial platform for scientists to display their high performance, highlighting the need to pay attention to the impact of organizational identity on their growth and creative outcomes. Organizational identity is a situational factor that significantly affects individual behavior within an organization (Gioia et al., 2000). It refers to the degree to which scientists define themselves as members of their research institutions, reflecting the position of scientists as organizational members (Hogg & Terry, 2000).

Individuals with a strong sense of organizational identity have a deep emotional connection with the organization, are willing to make genuine contributions to it, promote organizational development, take responsibility for the organization's innovation mission, and pursue the innovation goals set by the organization (Lee et al., 2015). Further, organizational identity is an inherent social attribute, enabling individuals to pay more attention to job expectations and behavioral norms, and perceive the requirements and evaluations of their job roles by leaders and colleagues around them (Gioia et al., 2000). In keeping with TAT, for scientists with a strong creative personality, organizational identity can broaden their perspective, encouraging them to consider the unique views and needs of organizational members beyond their own. This can help them to better position themselves within the organization to exhibit personal growth and creativity. To this end, we hypothesize the following:

Hypothesis 4. Organizational identity will strengthen the relationship between creative personality and scientist creativity.

Drawing on the theoretical arguments presented above, this paper proposes an analytical framework to examine the influence of creative personality on the creativity of scientists, as well as the underlying mechanisms that are activated in specific situations (see Fig. 1). The framework posits that creative personality can be a significant predictor of creativity for scientists, particularly when it is complemented by a greater breadth of research communication or a strong sense of identification. This also indicates from another perspective that specific situational factors can activate the mechanisms through which creative personality influences the creativity of scientists. By analyzing these factors and their interactions, the framework aims to provide a comprehensive understanding of the complex relationships among creative personality, the breadth of research communication, expertise identity, organizational identity, and scientist creativity.

3.3. Measures

Breadth of research communication. To capture the breadth through which scientists communicate with diverse internal and external collaborations, we measured the frequency of their internal and external engagement with methods adapted from prior studies (Ahmadi et al., 2022; Fang et al., 2015; Tang & Zhang, 2022). We provided respondents with lists of external parties (including other departments of the Chinese Academy of Sciences, universities, or research institutes outside the Academy, collaborators of scientific research projects, enterprises, and other institutions) internal parties (including their research group and their research institute) and asked them to assess the intensity of engagement with each one on a five-point Likert scale. As we are less interested in the interplay between the breadth and intensity of engagement, we defined *Breadth of research communication* as the number of internal and external parties with whom a scientist intensively (average frequency of communication of 3 points or above) collaborated.

Expertise and organizational identity. Using Callero's (1985) sorting method, participants were asked to rate five identities (expertise, organizational, unit, family, and group) based on the importance of each identity to their sense of self. This approach was selected to

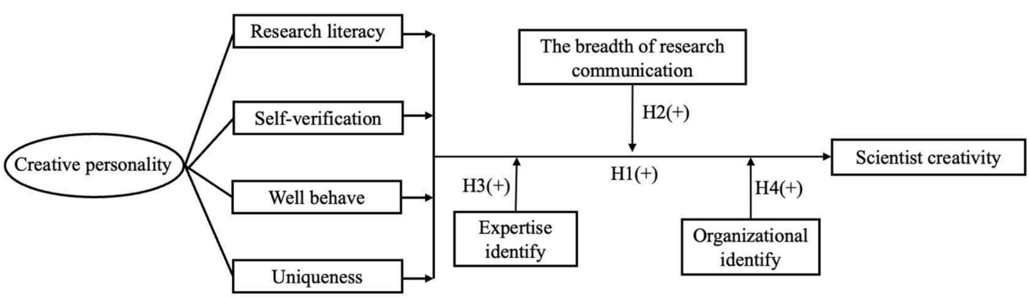

Fig. 1. Research framework and predicted effects of moderators.

(1) minimize time constraints associated with lengthy questionnaires and (2) obtain a more accurate representation of participants' identification rankings. A sample item included the following: "Rate the importance of expertise identity to you." We used a 5-point Likert scale ranging from 1 (not at all important) to 5 (very important).

3.4. Results

Because the dependent variable is dichotomous, a logistic regression model was estimated to assess the effect of the four creative personality dimensions on scientist creativity. Table 4 presents the results derived from our logit regression analyses. As shown in Model 1, *research ability* ($\beta = 1.468, p < 0.001$) and *uniqueness* ($\beta = 0.449, p = 0.014$) are significantly and positively related to scientist creativity. In contrast, the regression coefficient of *self-discipline* ($\beta = -0.395$, $p = 0.037$) is negative, which is significant at the 5 % confidence level. However, because of the nonlinearity of logit models, the coefficients cannot remain constant over the complete range of the independent variable. Therefore, we computed the marginal effect and statistical significance of the independent variables' (*research ability, uniqueness, self-discipline*, and *self-verification*) coefficient at the mean, as well as one standard deviation below and above the mean, while keeping all other independent variables at their mean values (Hoetker, 2007). As shown in Table 5, the average marginal effects of the four independent variables on scientist creativity, while keeping all other variables at their mean values, are positive and significant ($p < 0.001$). These findings provide partial support for Hypothesis 1. Specifically, the *research ability*

Table 4
Logit models for predicting scientist creativity.

	Model 1	Model 2	Model 3	Model 4	Model 5
Research literacy	1.468***	1.484***	1.474***	1.415***	1.482***
	(0.299)	(0.309)	(0.308)	(0.317)	(0.322)
Self-verification	−0.328	−0.335	−0.351	−0.253	−0.315
	(0.294)	(0.291)	(0.300)	(0.354)	(0.342)
Well behave	−0.395**	−0.387**	−0.374**	−0.380**	−0.360*
	(0.179)	(0.182)	(0.180)	(0.182)	(0.183)
Uniqueness	0.449**	0.451**	0.375*	0.486**	0.418*
	(0.190)	(0.190)	(0.200)	(0.202)	(0.219)
The breadth of research communication	−0.065	−0.069			−0.063
	(0.060)	(0.060)			(0.061)
Expertise identification	0.079		0.069		0.058
	(0.103)		(0.105)		(0.106)
Organizational identification	0.094			0.108	0.108
	(0.083)			(0.088)	(0.088)
The breadth of research communication × *Research literacy*		−0.101			−0.100
		(0.173)			(0.193)
The breadth of research communication × *Self-verification*		0.299**			0.353**
		(0.157)			(0.192)
The breadth of research communication × *Well behave*		0.015			0.018
		(0.101)			(0.109)
The breadth of research communication × *Uniqueness*		−0.015			0.053
		(0.091)			(0.120)
Expertise identification × *Research literacy*			−0.183		−0.174
			(0.288)		(0.269)
Expertise identification × *Self-verification*			−0.124		−0.181
			(0.370)		(0.337)
Expertise identification × *Well behave*			0.247*		0.268*
			(0.143)		(0.146)
Expertise identification × *Uniqueness*			−0.274		−0.356
			(0.182)		(0.200)
Organizational identification × *Research literacy*				0.254	0.160
				(0.364)	(0.379)
Organizational identification × *Self-verification*				−0.252	−0.003
				(0.344)	(0.381)
Organizational identification × *Well behave*				−0.099	−0.069
				(0.202)	(0.199)
Organizational identification × *Uniqueness*				0.306*	0.371*
				(0.184)	(0.193)
Constant	−1.286	−1.469*	−1.296	−1.451*	−1.58[7]*
	(0.853)	(0.856)	(0.863)	(0.866)	(0.886)
Pseudo-R^2	0.133	0.137	0.136	0.135	0.153
Log pseudo-likelihood	−299.103	−297.830	−298.183	−298.519	−292.070
Chi-squared	70.127	66.858	71.768	69.336	77.382

Note. $N = 547$, robust standard errors in parentheses; control variables included.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 5
Average marginal effect of independent variables on scientist creativity.

	Average marginal effect			
	Research literacy	*Self-verification*	*Self-discipline*	*Uniqueness*
Mean minus 1 SD	0.311***	0.560***	0.577***	0.441***
	(0.043)	(0.047)	(0.038)	(0.038)
Mean	0.517***	0.517***	0.517***	0.517***
	(0.025)	(0.025)	(0.025)	(0.025)
Mean plus 1 SD	0.718***	0.474***	0.457***	0.592***
	(0.040)	(0.047)	(0.038)	(0.037)

Note: ** $p < 0.01$.
*** $p < 0.001$.

and *uniqueness* dimensions of creative personality were positively associated with scientist creativity, whereas *self-discipline* was negatively associated with scientist creativity, and self-verification did not exhibit a direct significant relationship with scientist creativity.

In Model 2 of Table 4, we examine the moderating effect of *the breadth of research communication* and find that the interaction of *self-verification* with *the breadth of research communication* is significant and positively related to scientist *creativity* ($\beta = 0.299$, $p = 0.039$). Given the nonlinear nature of our logit models, we present the conditional marginal effects of *self-verification* at specified levels of *self-verification* and *the breadth of research communication* in Table 6 (Brauer et al., 2022). We find that, although *self-verification* has a negative and significant marginal effect at low (β = −0.164, $p = 0.019$), average (β = −0.177, $p = 0.036$), and high levels (β = −0.178, $p = 0.029$) of *self-verification* at low levels of *the breadth of research communication* (i.e., mean minus 0.75 SDs), it has no significant marginal effect at low (β = 0.052, $p = 0.479$), average (β = 0.052, $p = 0.482$), or high levels (β = 0.052, $p = 0.\ 479$) of *self-verification* at high levels of *the breadth of research communication* (i.e., mean plus 0.75 SDs). We also find that the difference in the marginal effect of *self-verification* between scientists with the low and high *the breadth of research communication* is statistically significant at low, average, and high levels of *self-verification*. The plots in Fig. 2 (Hoetker, 2007) show a strong relationship between *self-verification* and *scientist creativity* at low levels of *the breadth of research communication*, whereas no significant relationship exists between *self-verification* and scientist *creativity* at high levels of *the breadth of research communication*. These findings provide support for Hypothesis 2 that creative personality is more positively associated with scientist *creativity* the broader *the breadth of research communication* engaged in collaboration.

Model 3 of Table 4 shows that the interaction of *self-discipline* with *expertise identity* is significant and positively related to *scientist creativity* ($\beta = 0.247$, $p = 0.045$). Given the nonlinear nature of our logit models, we present the conditional marginal effects of *self-discipline* at specified levels of *self-discipline* and *expertise identity* in Table 6. Although *self-discipline* has a negative and significant marginal effect at low ($\beta = -0.134$, $p = 0.005$), average ($\beta = -0.137$, $p = 0.008$), and high levels ($\beta = -0.133$, $p = 0.004$) of *self-discipline* at low levels of *expertise identity*, it has no significant marginal effect at low ($\beta = -0.007$, $p = 0.886$), average ($\beta = -0.007$, $p = 0.875$), or high levels ($\beta = -0.007$, $p = 0.872$) of *self-discipline* at high levels of *expertise identity*. In addition, the difference in the marginal effect of *self-verification* between scientists with low and high *expertise identity* is statistically significant at low, average, and high levels of *self-discipline*. Moreover, the plots in Fig. 3 show a strong relationship between *self-discipline* and *scientist creativity* at low levels of *expertise identity*, whereas no significant relationship exists between *self-discipline* and *scientist creativity* at high levels of *expertise identity*. These findings provide support for Hypothesis 3 that creative personality is more positively associated with *scientist creativity* the greater the *expertise identity*.

Table 6
Effect of moderators on the conditional marginal effect of creative personality on scientist creativity.

	The breadth of research communication × self-verification		*Professional identification × well behave*		*Organizational identification × uniqueness*	
	Conditional marginal effect (low)	Conditional marginal effect (high)	Conditional marginal effect (low)	Conditional marginal effect (high)	Conditional marginal effect (low)	Conditional marginal effect (high)
Mean minus 1 SD	−0.164**	0.052	−0.134***	−0.007	0.036	0.139***
	(0.070)	(0.074)	(0.048)	(0.052)	(0.059)	(0.047)
Mean	−0.177**	0.052	−0.137***	−0.007	0.036	0.140***
	(0.084)	(0.074)	(0.052)	(0.052)	(0.059)	(0.049)
Mean plus 1 SD	−0.178***	0.052	−0.133***	−0.007	0.036	0.134***
	(0.082)	(0.074)	(0.047)	(0.052)	(0.059)	(0.043)

Note. Robust standard errors in parentheses. *$p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

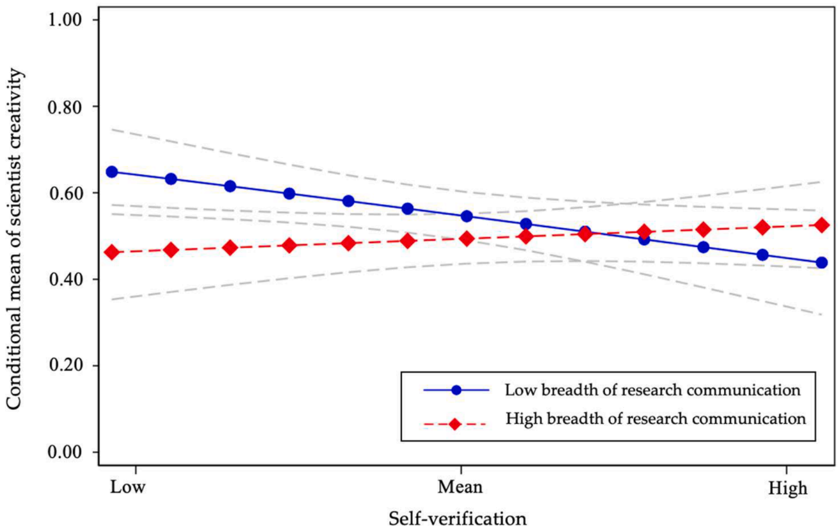

Fig. 2. Moderating Effect of Breadth of Research Communication on the Relationship Between Self-verification and Scientist Creativity with 95 % Confidence Intervals.

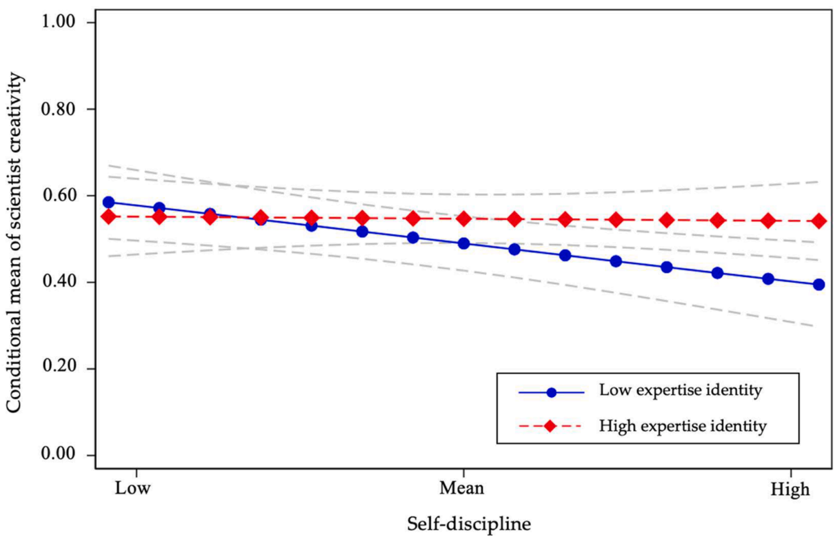

Fig. 3. Moderating effect of expertise identity on the relationship between self-discipline and scientist creativity with 95 % confidence intervals.

Model 4 of Table 4 shows that the interaction of *uniqueness* with *organizational identity* is significant and positively related to *scientist creativity* ($\beta = 0.306$, $p = 0.043$). Again, given the nonlinear nature of our logit models, we present the conditional marginal effects of *uniqueness* at specified levels of *uniqueness* and *organizational identity* in Table 6. We find that, although *uniqueness* has a positive and significant marginal effect at low ($\beta = 0.036$, $p = 0.546$), average ($\beta = 0.036$, $p = 0.547$), and high levels ($\beta = 0.036$, $p = 0.545$) of *uniqueness* at high levels of *organizational identity*, it has no significant marginal effect at low ($\beta = 0.139$, $p = 0.003$), average ($\beta = 0.140$, $p = 0.004$), or high levels ($\beta = 0.134$, $p = 0.002$) of *uniqueness* at low levels of *organizational identity*. We also find that the difference in the marginal effect of *self-verification* between scientists with low and high *organizational identity* is statistically significant at low, average, and high levels of *uniqueness*. Moreover, the plots in Fig. 4 show a strong relationship between *uniqueness* and *scientist creativity* at low levels of *organizational identity*, whereas no significant relationship exists between *uniqueness* and *scientist creativity* at high levels of *organizational identity*. These findings provide support for Hypothesis 4 that creative personality is more positively associated with *scientist creativity* the greater the *organizational identity*.

To further test the robustness of the moderating effect, we included the three moderating variables of *breadth of research communication, expertise identity*, and *organizational identity*, as well as the interaction items of the four creative personality dimensions in the model. As shown in Model 5 of Table 4, the significance of the interaction term did not change, suggesting that the empirical findings obtained in this study are robust.

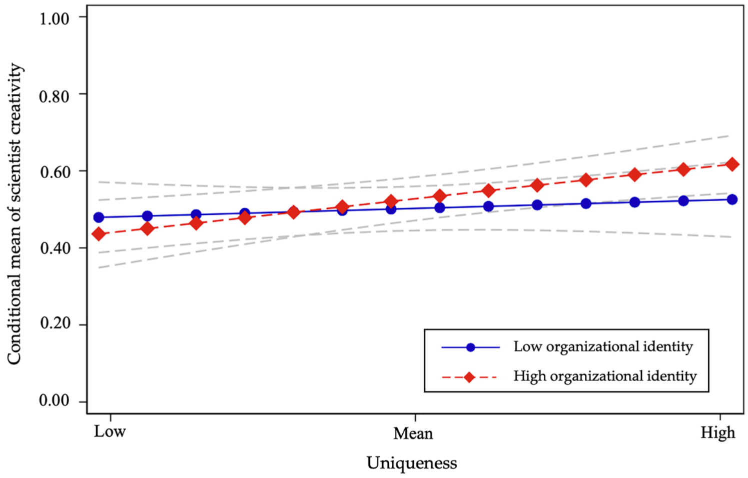

Fig. 4. Moderating effect of organizational identity on the relationship between uniqueness and scientist creativity with 95 % confidence intervals.

Additionally, the bootstrap method was applied to determine the significance of the moderation effects and to obtain robust standard errors for the parameter estimates (Hayes, 2009). This method produced 95 % bias-corrected confidence intervals (CIs) for these effects using 5000 data resamples. CI values that exclude zero indicate a significant effect.

4. Robustness checks

We ran supplementary analyses to ensure the robustness of our findings. The present study used a subjective measure of scientist creativity without considering their actual achievements and output. Therefore, we performed an additional analysis that replaced the subjective high performance assessment with the number of papers published in SCI journals and the number of citations in order to improve the robustness of the benchmark estimates. Since the count variables of paper publications and citations often have a large number of zero values, we used a zero-inflated model (Bruce et al., 2017). Furthermore, we considered the limitations of Poisson regression, which requires that the expectation and variance of the Poisson distribution are equal, a characteristic that often does not match real-world data. Thus, we tested the null hypothesis "H0: overdispersion parameter $\alpha = 0''$ and determined whether to use the zero-inflated Poisson model (ZIP) or the zero-inflated negative binomial regression (ZINB) based on the reported linear regression results. The results showed that, when using the number of papers published in SCI journals and the number of citations as the dependent variables for regression, the 95 % confidence intervals of α were (0.695, 0.949) and (1.486, 2.127), respectively. Thus, we rejected the null hypothesis of "$\alpha = 0''$ at the 5 % significance level (corresponding to zero-inflated Poisson regression), and considered using zero-inflated negative binomial regression to address the problem of overdispersion in the explained variables. As shown in Table 7, except for the insignificance of the interaction term between expertise identity and creativity in Model (2), all other results are consistent with the previous findings, indicating that the conclusions of this study are robust.

5. Discussion

This study explores the mechanisms by which creative personality affects the creativity of scientists. Our exploratory factor analysis uncovered four dimensions of creative personality that are associated with scientist creativity: research ability, self-verification, self-discipline, and uniqueness. We further contribute to the existing literature by using TAT to identify breadth of research communication, expertise identity, and organizational identity as moderators in the relationship between creative personality and scientist creativity. As such, our findings offer a unique contribution to the literature by showing that the effect of creative personality on scientists' creativity can be attributed in part to self-categorization, rather than simply motivation. In the sections that follow we highlight our study's novel findings.

5.1. Effect of creative personality on scientist creativity

Most studies examining the relationship between creative personality and behavior are based on motivation theory and self-determination theory, which suggest that creative personality has a direct or indirect positive impact on employees' creative behavior (Gough, 1979; Woodman et al., 1993; Selby et al., 2005). Our results, in line with previous evidence (Stock et al., 2016; Tang & Kaufman, 2017), showed that several dimensions of creative personality are closely associated with the creativity of scientists. In keeping with our expectations, the *research ability* and *uniqueness* dimensions of creative personality were positively associated with scientist creativity; however, *self-discipline* was negatively associated with scientist creativity. With regard to research ability, scientists who are skilled at the divergent thinking required in order to conduct high quality research are more likely to be successful at

Table 7
Robustness test results.

Variables	SCI (1)	Citation (2)
Research literacy	0.416***	0.511**
	(0.133)	(0.234)
Self-verification	0.039	−0.144
	(0.126)	(0.270)
Well behave	−0.018	0.191
	(0.089)	(0.169)
Uniqueness	0.039	0.313*
	(0.087)	(0.160)
Expertise identification	0.017	0.039
	(0.046)	(0.074)
Organizational identification	−0.021	−0.148
	(0.049)	(0.094)
The breadth of research communication	0.013	−0.066
	(0.028)	(0.045)
The breadth of research communication × Research literacy	−0.136*	−0.235*
	(0.072)	(0.129)
The breadth of research communication × Self-verification	0.219***	0.299**
	(0.068)	(0.129)
The breadth of research communication × Well behave	0.010	0.224**
	(0.055)	(0.090)
The breadth of research communication × Uniqueness	0.094	0.133
	(0.058)	(0.094)
Expertise identification × Research literacy	−0.022	−0.116
	(0.117)	(0.250)
Expertise identification × Self-verification	−0.089	−0.148
	(0.128)	(0.331)
Expertise identification × Well behave	0.250***	0.118
	(0.084)	(0.144)
Expertise identification × Uniqueness	−0.177**	−0.247
	(0.083)	(0.151)
Organizational identification × Research literacy	0.141	−0.235
	(0.125)	(0.270)
Organizational Identification × Self-verification	0.207	0.947**
	(0.132)	(0.384)
Organizational Identification × Well behave	−0.033	0.106
	(0.083)	(0.161)
Organizational Identification × Uniqueness	0.162*	0.303**
	(0.083)	(0.151)
Constant	−0.088	1.410**
	(0.367)	(0.659)
N	547	547
Log likelihood	−1998.906	−2261.834
Wald chi2	204.929	277.143

Note. Robust standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

generating innovative output than those with lower levels of research ability (Gough, 1979; Feist, 2006). In addition, researchers who fit the personality profile of the quirky, eccentric scientist are more likely to challenge established paradigms, adopt novel perspectives on emerging issues, and generate creative ideas (Csikszentmihalyi, 1997; Janssen & Huang, 2008).

Although we did not anticipate the negative direct relationship between self-discipline and scientist creativity, it may be that researchers who are fixated on their own performance with little concern for outside recognition are less likely to exhibit high levels of creative output. This finding is consistent with previous research that found that employing only one viewpoint to understand the psychological factors behind creativity does not show the complete picture. Yuan and Woodman (2010) found that individuals had higher levels of innovation when they expected that creativity would be beneficial to their jobs; yet, concurrently, apprehension about possible negative social impressions had a negative effect on innovation. Thus, the relationship between the various dimensions of creative personality is complex and, as our subsequent moderation results showed, is dependent on situational factors (e.g., breadth of research communication).

5.2. Moderating effects and theoretical implications

In line with previous research findings (Owens et al., 2013; Tang & Kaufman, 2017; Qu et al., 2019; Benedek et al., 2020), our study also showed that creative personality interacts with other factors to influence the creativity of scientists. However, our study took a more in-depth, micro-level approach by demonstrating the moderating effects of the breadth of research communication and two forms of identity on the relationship between four different dimensions of creative personality and scientist creativity.

One novel finding of our study is that the breadth of research communication positively enhances the relationship between the self-verification dimension of creative personality and scientist creativity. Specifically, we found that when the breadth of research communication is high, the contribution of self-verification to scientist creativity will be even higher. It appears that having frequent opportunities to exchange information with one's colleagues makes even more salient the part of one's creative personality that values showcasing one's accomplishments and enhancing one's reputation. Whereas this can be beneficial for organizations, a counterargument would be that when scientists are highly focused on self-verification, there is a risk of generating ego-driven behaviors. This may result in scientists prioritizing personal recognition over the collective advancement of knowledge, potentially leading to a less collaborative and more individualistic research culture.

Another interesting finding is that expertise identity boosted the positive relationship between creative personality and scientist creativity. Thus, scientists with a creative personality will be even more likely to exhibit creativity if they identify strongly with their field because they seek opportunities to validate their expertise by solving problems in novel ways. Indeed, it has been suggested that expertise identity enables scientists to express themselves in ways that enhance innovation (Benedek et al., 2020). Conversely, for scientists who do not identify strongly with their scientific research area (i.e., those with low expertise identity), their fixation on their personal performance and self-motivation may get in the way of generating novel creative output. Expertise identity may be seen as a reflection of an individual's perceptions toward research. In other words, when scientists do not hold a strong interest in the scientific profession but still pursue expressing their efforts individually, it may not be as conducive to their career development.

In addition, our results showed that a high level of organizational identity helps the uniqueness component of a scientist's creative personality to enhance their creativity. Scientists who identify with their organizations perceive that there is a large psychological overlap between the organization and their unique self and that their self-worth is linked with the organization's worth. As such, these scientists tend to be motivated to exceed their regular duties and take on creative challenges to benefit the organization (Hirst et al., 2009; Madjar et al., 2011) and, in turn, their own self-concept. Thus, because they are motivated to exhibit behaviors that show their belonging to the organization (Lee et al., 2019), they are more likely to align their individual goals with the organization's to proactively learn new approaches that foster creativity. By adopting the organization's goals as their own, scientists can use their unique personalities to pursue research and innovation goals, thus generating creativity.

Taken together, these findings regarding expertise identity and organizational identity make a theoretical contribution to the existing literature by demonstrating that the impact of creative personality on scientists' creativity can be seen not only as a motivation-oriented process but also as a process of self-categorization. Previous research has argued that self-categorization strongly affects innovation performance (Akerlof & Kranton, 2000; Lee et al., 2015; Wry & York, 2017).

Furthermore, this study contributes to TAT. According to this theory, there are two types of personality activation: internal and external (Tett & Burnett, 2003). Internal personality activation occurs when a person's traits are activated by situational cues or self-awareness. External personality activation occurs when situational factors trigger the expression of a person's traits. For example, in our study, having frequent opportunities to collaborate with one's colleagues makes even more salient the part of one's creative personality that values showcasing one's achievements and boosting one's reputation. Thus, this study integrates the two perspectives of personality activation and demonstrates that the relationship between external and internal activation is closely linked to the relationship between creative personality and individual creativity. Specifically, our study's findings show that scientists with creative personality are more likely to exhibit creative behaviors and performance when both internal traits (e.g., self-discipline) and external work characteristics (e.g., breadth of research communication) are activated.

5.3. Limitations and directions for future research

Some caveats should be considered in the interpretation of our study's results. First, our data were collected at a single point in time. Future research should examine our hypotheses with longitudinal research designs in order to place more confidence in our findings and to help examine their causal nature. For instance, it may be that aspects of the work environment in our study may act as predictors of creative personality rather than the other way around. Second, our findings might not be generalizable to organizations in other industries. For example, our study participants were employed by very well-regarded scientific organizations. In prestigious institutions such as these, scientists might not perceive a large distinction between expertise and organizational identification. Future studies should test our hypotheses in multiple industries and organizations. Third, our sample included scientists in China. As such, our findings should be grounded in the context of its culture and national identity (Rousseau & Fried, 2001). For instance, given that China has a collectivist culture with an emphasis on co-creation, our sample may have higher levels of breadth of research communication, as compared with those in other nations. Thus, our results may not be generalizable to other cultures, and future studies should test our hypotheses in other countries.

5.4. Practical implications

This paper offers insights for organizations in terms of how to encourage scientist creativity. Supervisors can take particular creative personality dimensions into account as they assemble research teams. For instance, to boost the creative potential of individuals with a strong self-verification dimension of their personality, managers can (1) recognize these scientists' expertise, accomplishments, and reputation through positive reinforcement or other compensation, (2) assign tasks that increase their visibility so that they will observe others valuing their expertise, and (3) make clear that their expert judgments are being considered in decisions (e.g., Swann et al., 2003). Indeed, organizations should align their actions with their values in order to reinforce a cohesive, authentic organizational culture that values creativity. In addition, to enhance the creative potential of individuals with a strong uniqueness dimension of their personality, managers can be trained to (1) create an accepting environment that includes those with odd, quirky, or eccentric personality traits, (2) communicate to these scientists that the organization's value is a direct result of their efforts, and (3) highlight the organization's reputation and how it is unique from other organizations. Finally, given the importance of the breadth of research communication to creativity, principal investigators and supervisors should introduce their scientists to new opportunities to collaborate in a wide variety of research settings, not only in their existing research group but other research institutes, enterprises, projects, etc.

CRediT authorship contribution statement

Chaoying Tang: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Writing – original draft. **Jiabing Xu:** Formal analysis, Investigation, Methodology. **Shibo Mao:** Formal analysis, Investigation, Methodology. **Stefanie E. Naumann:** Investigation, Methodology, Writing – review & editing.

Declarations of competing interest

None.

Data availability

The data that support the findings of this study are available from the first author upon reasonable request.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.tsc.2024.101465.

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