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## Curious and Persistent, but not Consistent: Self-regulation Traits and Creativity

### ABSTRACT

The present study examines two self-regulation traits, grit and curiosity, in predicting creative achievement in an adult sample ( $N = 522$ ). Grit has been related to achievement in various domains, and although prior empirical work failed to find associations with everyday creative activities in adolescent and young adult samples, theoretically it is relevant to long-term creative achievement (which requires persistence). Curiosity supports creative achievement through positive judgments of novelty and an intrinsic motivation to approach instead of avoid uncertainty, and both novelty and uncertainty are central to the creative process. Results showed that the perseverance dimension of grit positively predicted creative achievement, whereas the consistency of interests dimension was negatively related to creative achievement. Additionally, five curiosity dimensions predicted creative achievement above grit. In particular, thrill seeking predicted creative achievement in both art and science; deprivation sensitivity positively predicted creative achievement in art. Our research suggests that, instead of a narrow focus on consistency of interest, creative achievement benefits from curiosity.

*Keywords:* grit, perseverance, consistency of interests, curiosity, thrill seeking, creative achievement, creativity.

As combination of persistence and consistency of interests (Duckworth, Peterson, Matthews, & Kelly, 2007), grit has been popularized by books and social media and attracted much research attention (e.g., Fong & Kim, 2021; Jachimowicz, Wihler, Bailey, & Galinsky, 2018; Muenks, Wigfield, Yang, & O'Neal, 2017; Muenks, Yang, & Wigfield, 2018). Grit is associated with a variety of achievement outcomes from military training course completion to National Spelling Bee performance and academic outcomes (Duckworth et al., 2007; Duckworth & Quinn, 2009; Lam & Zhou, 2022; Tang, Upadyaya, & Salmela-Aro, 2021; Tang, Wang, Guo, & Salmela-Aro, 2019). The self-regulation of efforts to attain long-term goals, despite difficulties or obstacles, is theoretically and empirically related to creative decision-making and achievement (Helson, Roberts, & Agronick, 1995; Ivcevic & Nusbaum, 2017). Thus, grit should theoretically be relevant as an attribute of self-regulation predicting creativity.

However, existing empirical research on grit and creative achievement does not support these theoretical predictions. In three studies of college and high school students, Grohman, Ivcevic, Silvia, and Kaufman (2017) did not find a significant relationship between the two dimensions of grit and creative achievement. One proposed reason for this non-significant relationship is that creativity requires a wide breadth of interests and information seeking, which is in opposition to the consistency of interests dimension of grit.

Here, we propose that, instead of consistency of interests, creativity benefits from curiosity—the tendency to explore novelty and complexity in the environment (Kashdan et al., 2018; Kashdan, Rose, & Fincham, 2004). As a self-regulation attribute, curiosity plays a role in judging uncertainties as a feature of the environment to approach and explore rather than avoid (Kashdan et al., 2004). However, curiosity has not received much attention in creativity research despite the fact that it could be considered a feature of openness to experience (DeYoung, Quilty, & Peterson, 2007; Silvia & Christensen, 2020), which is the most reliable personality predictor of creative behavior and achievement across domains (Ivcevic & Mayer, 2009;

Kaufman, 2013; Kaufman et al., 2016; Oleynick et al., 2017; Puryear, Kettler, & Rinn, 2017). The present study focuses on public creative achievement, which is the sum of an individual's creative products throughout their lifetime (Carson, Peterson, & Higgins, 2005). We examine (a) the independent predictive power of grit and curiosity dimensions in relation to creative achievement and (b) incremental validity of curiosity to predict creative achievement over and above grit dimensions.

#### GRIT AND CREATIVE ACHIEVEMENT

Grit is the tendency to pursue long-term goals with hard work and sustained interest, which includes two related but distinct dimensions: persistence and consistency of interests (Duckworth et al., 2007; Duckworth & Quinn, 2009). It is a personality trait that can be conceptualized as a conscientiousness dimension pertaining to long-term effort regulation in achieving goals (Duckworth et al., 2007). Although there is agreement that grit is a trait in the broader conscientiousness domain, there is some disagreement about whether it can be considered an independent trait. Some analyses suggest that it is indistinguishable from conscientiousness, representing a case of a jangle fallacy (Ponnock et al., 2020). Supporting this interpretation, a meta-analysis found that persistence and consistency of interests were highly correlated with conscientiousness ( $r = .83$  and  $r = .61$ , respectively; Credé, Tynan, & Harms, 2017).

Duckworth and Gross (2014) placed grit in the broader framework of self-regulation and self-control. They describe that similarities and differences between self-control and grit can be understood within a hierarchical goal framework (Carver & Scheier, 1998; Kruglanski et al., 2002). Goals are organized hierarchically, with higher order goals being served by lower order ones (Fujita, Trope, Liberman, & Levin-Sagi, 2006; Kruglanski et al., 2002). Both self-control and grit involve the defense of valued goals in the face of setbacks and challenges. But they differ in the types of goals defended and the time duration involved. Self-control involves aligning conflicting actions between lower level goals with higher values in spite of momentary temptations. Those low on self-control might involve resisting immediate satisfaction that would be regretted later, such as choosing to work on a manuscript instead of watching Netflix. By contrast, grit entails a commitment to a superordinate goal over extended periods. Those low on grit can shift from one higher level goal to another, such as considering medical school one month and law school the next.

Grit was theoretically defined as including two related dimensions and some previous research has computed a total score of grit as a combination of these dimensions. In relation to creativity-related outcomes, Widodo (2021) found that grit was positively correlated with divergent thinking among science educators. However, in a sample of U.S. college students, Rojas (2015) found a negative relationship between overall grit and creative ideational behaviors. A meta-analysis examining the interrelationship between the two dimensions of grit questioned the practice of using a single grit score. Because the dimensions are only moderately correlated, they should be studied separately (Guo, Tang, & Xu, 2019). Supporting this proposition, the two dimensions have been found to have distinct relationships with creativity behavior and achievement outcomes. Grohman et al. (2017) conducted three studies to examine whether persistence and consistency of interests predicted everyday creative activities. In the two studies of college students, they found a non-significant relationship between both dimensions of grit and self-reported creative behavior and creative achievement. In their third study of high school students, creativity was assessed through peer nominations. Again, neither grit dimension predicted creativity outcomes. In older adults, Abuhassan and Bates (2015) found that perseverance, but not consistency of interests, was positively correlated with creative achievement. However, this study modified the CAQ by adding well-structured achievement domains (e.g., military) to the original measure, which puts into question whether the results should be interpreted as specific to creative achievement, or indicative of high achievement more generally. Accordingly, further research on grit and creative achievement is warranted.

Creative achievement accrues over extended periods of time, from months, to years, to a lifetime (Carson et al., 2005; Ivcevic, 2022a). Therefore, self-regulation toward sustained effort, which enables people to work hard and deal with adversity or failure during the often long creative process, is essential for creative achievement (Csikszentmihalyi, 1996; Ivcevic & Nusbaum, 2017). To produce a novel solution, story, painting, computer program, or creative achievement in any domain, an individual must devote a significant amount of time to working diligently (Csikszentmihalyi, 1988). When asked how he discovered the law of universal gravitation, Newton answered, "By thinking on it continually" (Westfall, 1980). Perkins (1994) also noted that creative achievements are the result of deliberate effort regulation, which can take several years. Moreover, obstacles and uncertainties are encountered during the creative process across domains, from art, music, and writing to design and science (Glaveanu et al., 2013). Coping with and overcoming these

obstacles have emerged as important self-regulation attributes in prominent creators (Adelson, 2003; Csikszentmihalyi, 1996). A longitudinal study conducted by Helson et al. (1995) showed that women described as persistent when encountering difficulties in college had higher occupational creativity in their early 50s. From his interviews with eminent poets, Wilson (1990) found they had not given up writing even when unacknowledged and suffering from financial deprivation. The evidence is consistent that persistence and perseverance of effort benefits creative achievement.

However, the other grit dimension, consistency of interests, focusing on one interest to the exclusion of others, may be contraindicated for creative achievement. The achievement goals studied by Duckworth et al. (2007) and Duckworth and Quinn (2009) (e.g., higher GPA, better ranking in the National Spelling Bee competition) are well defined; they have a fixed end point, a known set of steps toward achieving the goal, and clear indication of success. Consistency of interests contributes to these goals. In contrast, creative goals are ambiguous, ill-defined, and open-ended. There are no clear directions in how to approach problems, and there are multiple possible and acceptable solutions (Lubart, 1994; Reiter-Palmon & Illies, 2004; Simonton, 2014). To achieve such goals, people must face uncertainties (Beghetto, 2021). Because of these features of the creative process, self-regulating one's attention and interest in a single direction, as consistency of interests implies, might not be effective when pursuing creative goals. If individuals set a specific immutable goal or settle on one idea early in the creative process and do not deviate from it, regardless of any changes in their thinking or their environment, they will fail to revise and develop their ideas and the outcome will likely suffer.

Following theorizing and research on self-regulation of creative action (Ivcevic, Grossman, Cotter, & Nusbaum, 2023; Ivcevic & Nusbaum, 2017; Zielińska, Forthmann, Lebeda, & Karwowski, 2023; Zielińska, Lebeda, Ivcevic, & Karwowski, 2022), we argue that the requirements of the creative process are different from those of well-defined achievement goals. The consistency in following a predetermined direction can benefit self-regulation toward a well-defined goal (e.g., performance on a Spelling Bee; Duckworth et al., 2007). However, the creative process requires individuals to continually reflect and revise goals, and engage in extended problem finding. This process can result in starting ideas being very different from those evident in the final products or performances, which are the outcome of the creative process. Because of this, we expect that consistency of interests will be not significantly or negatively related to creative achievement.

#### CURIOSITY AND CREATIVE ACHIEVEMENT

Curiosity refers to the pursuit of and desire to explore novel, complex, conflicting, and uncertain stimuli (Kashdan et al., 2018) and it can be described as a dimension in the personality domain of openness to experience (correlations between dimensions of curiosity and total openness range from .15 to .60 across studies; Kashdan et al., 2009, 2018; Mussel, Spengler, Litman, & Schuler, 2011). Although early literature viewed curiosity as a unitary trait (Loewenstein, 1994; Spielberger & Starr, 1994), more recent models suggest multi-dimensionality. Kashdan et al. (2009) distinguished two dimensions of curiosity: stretching (desire for new information and experience) and embracing (willing to accept the uncertainties and complexity in everyday life). Litman (2005) classified epistemic curiosity into interest (desire to gain knowledge for its own sake) and deprivation (desire to know, otherwise will feel frustrated).

In Kashdan's five-dimensional curiosity framework, curiosity is defined as a trait that regulates one's response to novelty and challenge (Kashdan et al., 2004, 2018). Specifically, curiosity regulates cognition and action through the allocation of attention and other personal resources toward intrinsically rewarding tasks (Kashdan et al., 2004; Kashdan & Fincham, 2002). Such curious regulation includes understanding new interests and ideas, reframing uninteresting tasks, and taking intellectual risks. Consequently, curious individuals are able to accumulate and integrate novel perspectives and information in the service of creative actions and achievement.

Csikszentmihalyi (1997) identified curiosity as a common childhood trait in extraordinarily creative individuals. Loewenstein (1994) even expressed that, "it would be disturbing not to find a positive interrelationship (between curiosity and creativity)" (p. 79). As posited by theories and research on self-regulation of creative action (Ivcevic et al., 2023; Ivcevic & Nusbaum, 2017; Zielińska et al., 2022; Zielińska, Forthmann, et al., 2023), the intrinsic desire to explore and understand something novel and complex, as embedded in curiosity, is crucial. Given that the creative process is expected to be nonlinear with ups and downs, a key strategy in regulating creative action is actively adjusting one's approach (Ivcevic et al., 2023). This adjustment requires a willingness to explore unknown information and new directions, a process in which curiosity should help.

However, empirical research on curiosity and creativity is not as abundant as the theoretical models would suggest (Gross, Zedelius, & Schooler, 2020). A recent meta-analysis (Schutte & Malouff, 2020a) only included 10 studies conducted from 1978 to 2017, showing that trait curiosity is positively related to aggregated creativity (weighted effect size,  $r = .41$ ). Although this meta-analysis shows a general pattern, it used the pooled estimate of the umbrella term “creativity” in interpreting results. Given that creativity contains conceptually distinct aspects (Ivcevic, 2022a; Reiter-Palmon & Schoenbeck, 2020), this approach fails to show nuances across different aspects of creativity, such as performance on brief creative thinking tasks, relatively stable creative personality, or creative achievement. The studies included in this meta-analysis focused only on creative thinking tasks or creative self-beliefs, making it clear that more research is necessary in relation to other outcomes, such as creative achievement.

Although research on curiosity and creative achievement is scarce, research on curiosity and other aspects of creativity may be relevant. Theoretically, with a focus on creative behavior, Ivancovsky, Baror, and Bar (2023) recently proposed a framework suggesting that the manifestations of curiosity and creativity both involve novelty seeking and exhibit a high sensitivity to novel stimuli. Empirically, Gross, Araujo, Zedelius, and Schooler (2019) generated the curiosity score by aggregating the two dimensions of curiosity from Litman (2005)’s model, interest and deprivation, and found significant relationship with creative thinking task performance. In other studies, overall curiosity predicted creative self-efficacy and creative identity (Karwowski, 2012; Karwowski, Lebuda, & Wiśniewska, 2018; Puente-Díaz & Cavazos-Arroyo, 2017). These creative self-beliefs have been shown as necessary, but not sufficient predictors of creative achievement (Zhang et al., 2021). Examining different dimensions of curiosity and creativity yielded mixed results. Hunter, Abraham, Hunter, Goldberg, and Eastwood (2016) found that both the interest and deprivation dimensions of curiosity were positively related to creative personality. Another study found positive relationships between interest curiosity and creative problem-solving and creative performance on marketing plans but no relationship between deprivation curiosity and these creativity-related outcomes (Hardy, Ness, & Mecca, 2017).

More recently, Kashdan et al. (2018) developed a comprehensive five-dimensional model of curiosity by synthesizing multiple strands from the literature. Two emotion-related dimensions—joyous exploration and deprivation sensitivity—suggest curiosity involves pleasure from exploring novel information, as well as frustration and discomfort from lacking knowledge and the desire to gain it (parallel to Litman, 2005). This model also includes the social aspect of curiosity (Reio, Petrosko, Wiswell, & Thongsukmag, 2006; Renner, 2006). Social curiosity refers to a desire to know what other people are thinking and doing, given that observing and communicating with others is one of the most effective ways of acquiring new information. Finally, the model encompasses two cognitive appraisal components of curiosity—stress tolerance and thrill seeking. Stress tolerance pertains to the ability to cope with confusion, distress, and doubt when encountering new situations. Thrill seeking includes enjoyment of the intellectual stimulation associated with taking risks. The inter-correlations of dimension scores are the strongest for joyous exploration and deprivation sensitivity ( $r$  from .40 to .49 across studies; Birenbaum et al., 2019; Kashdan et al., 2018).

## THE PRESENT STUDY

The current study investigated how dimensions of grit (perseverance and consistency of interests) and curiosity (joyous exploration, deprivation sensitivity, stress tolerance, social curiosity, and thrill seeking) predict creative achievement in the arts and sciences. We have three hypotheses: (a) Perseverance will be positively related to creative achievement, whereas consistency of interests will be not related or negatively related to creative achievement; (b) curiosity dimensions will be positively related to creative achievement; and (c) curiosity dimensions will predict creative achievement above and beyond grit dimension. Because of the well-established importance of persistence for long-term creativity achievement, we want to put curiosity to the test by examining whether it has predictive effect independent of grit dimensions (especially its perseverance dimension).

## METHOD

### PARTICIPANTS

Data were collected on MTurk as part of a larger study based on a sample ranging in age from 18 to 70 years old. After removing those who failed one of two attention checks (6.12%), the final sample ( $N = 522$ ;  $M_{\text{age}} = 35.61$ ,  $SD = 10.39$ ; 48.85% female) was 58.81% White/Caucasian, 24.52% Asian, 5.17% Hispanic, 4.79% Black/African, 2.87% Multiracial, 2.49% American Indian or Alaska Native, and 1.34% other identities.

## MEASURES

## Grit

We measured two grit dimensions with subscales of the Grit Scale (Duckworth et al., 2007): perseverance of effort (e.g., “Setbacks don’t discourage me”; six items;  $\alpha = .81$ ) and consistency of interests (e.g., “I become interested in new pursuits every few months (reverse scored)”; six items;  $\alpha = .88$ ). Participants were asked to rate these items based on a five-point Likert scale (1 = *not like me at all*, 5 = *very much like me*).

## Curiosity

We assessed curiosity by five subscales in the Five-dimensional Curiosity Scale (Kashdan et al., 2018): joyous exploration (e.g., “I view challenging situations as an opportunity to grow and learn”;  $\alpha = .83$ ), deprivation sensitivity (e.g., “Thinking about solutions to difficult conceptual problems can keep me awake at night”;  $\alpha = .78$ ), stress tolerance (e.g., “The smallest doubt can stop me from seeking out new experiences (reverse scored)”;  $\alpha = .89$ ), social curiosity (e.g., “I like to learn about the habits of others”;  $\alpha = .81$ ), and thrill seeking (e.g., “Creating an adventure as I go is much more appealing than a planned adventure”;  $\alpha = .79$ ). Each subscale has five items and the items used a five-point Likert scale (1 = *does not describe me at all*, 5 = *completely describes me*).

## Creative achievement

We administered the Creative Achievement Questionnaire (CAQ; Carson et al., 2005), to measure public creative achievement throughout one’s life in 10 domains. Because the CAQ emphasizes high-level accomplishments, most individuals tend to have low ratings, resulting in positively skewed data (Silvia, Martin, & Nusbaum, 2009). Thus, following previous research (Grohman et al., 2017; Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012), the scores were averaged and log-transformed to produce the CAQ art (visual arts, music, dance, architectural design, creative writing, humor, theater, and film;  $\alpha = .87$ ) and CAQ science (inventions, scientific discovery, culinary;  $\alpha = .81$ ) scores.

## RESULTS

Descriptives (means and standard deviations) and correlations of all variables are presented in Table 1. Perseverance was positively correlated with CAQ science ( $r = .11$ ,  $p = .01$ ). Consistency of interests was negatively correlated with both CAQ scores (art:  $-.23$ ; science:  $-.21$ ; both  $p < .001$ ). Four of five curiosity dimensions—joyous exploration, deprivation sensitivity, social curiosity, and thrill seeking—were positively correlated with CAQ scores ( $r$  ranges from  $.12$  to  $.30$ ).

We conducted hierarchical regression analyses using SPSS Version 23. Before the regression analyses, we examined the variance inflation factor (VIF) to evaluate multicollinearity among all grit and curiosity predictors. The VIF values were all within an acceptable range (lower than 2.5 according to Johnston, Jones, & Manley, 2018). In Step 1, following previous research (Kaufman et al., 2016; Zabelina, Zaonegina, Revelle, & Condon, 2022), we entered the demographic control variables age and gender. Age was controlled because research showed an inverted U-shape relationship between age and creative achievement (Simonton, 1988; Zuckerman, 1996). Gender was controlled as previous studies have shown that creative activities and achievement differ by gender (Ahmetoglu, Harding, Akhtar, & Chamorro-Premuzic, 2015; Diedrich et al., 2018; Elisondo, 2021). In Step 2, we entered two dimensions of grit, and in Step 3, we entered the five dimensions of curiosity.

Table 2 displays the coefficients and standard errors for each construct as well as the  $R^2$  change from Step 1 to Step 3. In Step 1, control variables explained 4.9% and 2.6%, of the variance in CAQ art and CAQ science. Age is a significant negative predictor for CAQ art and science ( $\beta$  ranges from  $-.15$  to  $-.22$ ,  $p < .01$ ). Gender significantly predicted CAQ science ( $\beta = .09$ ,  $p = .04$ ), but the difference between female and male on CAQ science was minimal (Cohen’s  $d = .12$ ). In Step 2, grit significantly added to the prediction of CAQ scores (art:  $\Delta R^2 = .06$ ,  $p < .001$ ; science:  $\Delta R^2 = .08$ ,  $p < .001$ ), with perseverance as positive (CAQ art:  $\beta = .19$ ; CAQ science:  $\beta = .22$ ; both  $p < .001$ ) and consistency of interests as negative (CAQ art:  $\beta = -.25$ ; CAQ science:  $\beta = -.27$ ; both  $p < .001$ ) predictors.

The five dimensions of curiosity entered in Step 3 significantly added to the prediction of CAQ scores (art:  $\Delta R^2 = .05$ ,  $p < .001$ ; science:  $\Delta R^2 = .02$ ,  $p = .049$ ), showing that curiosity predicted creative achievement above and beyond grit. In this final step, the thrill seeking dimension of curiosity was a significant predictor for CAQ scores (art:  $\beta = .20$ ,  $p < .001$ ; science:  $\beta = .12$ ,  $p = .02$ ). The deprivation sensitivity dimension of curiosity only significantly predicted CAQ art ( $\beta = .11$ ,  $p = .03$ ).

TABLE 1. Descriptive Statistics and Correlations Among Study Variables

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
1. Perseverance	3.84	0.70	—									
2. Consistency of interests	3.19	0.86	.37**	—								
3. Joyous exploration	3.93	0.73	.58**	.16**	—							
4. Deprivation sensitivity	3.55	0.78	.37**	-.06	.54**	—						
5. Stress tolerance	3.09	1.06	.43**	.54**	.37**	-.01	—					
6. Social curiosity	3.53	0.85	.08	-.26**	.29**	.36**	-.21**	—				
7. Thrill seeking	3.15	0.88	.20**	-.25**	.41**	.34**	.09*	.28**	—			
8. CAQ art (log)	1.76	1.21	0.07	-.23**	.14**	.24**	-.11**	.21**	.30**	—		
9. CAQ science (log)	1.22	1.05	.11*	-.21**	.12**	.19**	-0.06	.12**	.22**	.49**	—	
10. CAQ total (log)	2.18	1.17	.12**	-.23**	.17**	.24**	-.07	.21**	.29**	.91**	.75**	—

Note. CAQ art = creative achievement in art; CAQ science = creative achievement in science; CAQ total = the total score on CAQ. \* $p < .05$ . \*\* $p < .01$ .

TABLE 2. Multiple Regression Predicting Creativity Achievement in Art and Science

	CAQ art					CAQ science						
	<i>b</i>	SE	$\beta$	Lower bound	Upper bound	$\Delta R^2$	<i>b</i>	SE	$\beta$	Lower bound	Upper bound	$\Delta R^2$
Step 1						0.05***						0.03**
Age	-0.03***	0.01	-0.22***	-0.04	-0.02		-0.02**	0.004	-0.15**	-0.02	-0.01	
Gender	0.07	0.11	0.03	-0.13	0.28		0.19*	0.09	0.09*	0.01	0.37	
Step 2						0.60***						0.08***
Age	-0.02***	0.01	-0.18***	-0.03	-0.01		-0.01*	0.004	-0.10*	-0.02	-0.002	
Gender	0.09	0.10	0.04	-0.11	0.29		0.20*	0.09	0.10*	0.03	0.38	
Perseverance	0.33***	0.08	0.19***	0.18	0.48		0.33***	0.07	0.22***	0.20	0.47	
Consistency of interests	-0.36***	0.07	-0.25***	-0.48	-0.23		-0.34***	0.06	-0.27***	-0.45	-0.22	
Step 3						0.05***						0.02*
Age	-0.01**	0.01	-0.12**	-0.02	-0.003		-0.01	0.005	-0.08	-0.02	0.002	
Gender	0.14	0.10	0.06	-0.06	0.34		0.26**	0.09	0.12**	0.08	0.44	
Perseverance	0.16	0.09	0.09	-0.02	0.35		0.24***	0.08	0.16**	0.07	0.40	
Consistency of interests	-0.20*	0.08	-0.14*	-0.35	-0.05		-0.30***	0.07	-0.24***	-0.43	-0.16	
Joyous exploration	-0.06	0.10	-0.03	-0.26	0.15		-0.06	0.09	-0.04	-0.24	0.12	
Deprivation sensitivity	0.17*	0.08	0.11*	0.013	0.33		0.14	0.07	0.10	-0.01	0.28	
Stress tolerance	-0.05	0.06	-0.04	-0.17	0.08		0.03	0.06	0.03	-0.08	0.14	
Social curiosity	0.08	0.07	0.05	-0.05	0.21		-0.04	0.06	-0.03	-0.15	0.08	
Thrill seeking	0.27***	0.07	0.20***	0.13	0.41		0.15*	0.06	0.12*	0.02	0.27	

Note. Gender: 0 = male, 1 = female, *N* = 522. \**p* < .05. \*\**p* < .01. \*\*\**p* < .001.



## DISCUSSION

The present study investigated how two self-regulation traits—grit and curiosity—predict creative achievement. The perseverance dimension of grit was positively related to creative achievement, whereas the consistency of interests dimension was negatively related to creative achievement. Five curiosity dimensions—joyous exploration, deprivation sensitivity, stress tolerance, social curiosity, and thrill seeking—predicted creative achievement and explained variance above grit dimensions. In particular, this predictive effect is primarily driven by the thrill seeking dimension of curiosity in both art and science. Additionally, deprivation sensitivity is a positive predictor of artistic creative achievement.

We found that grit dimensions predict creative achievement above demographic variables, with the two dimensions predicting achievement in opposite directions. Given that research has suggested that the two dimensions of grit are distinct (Guo et al., 2019), we discuss their relationships with creative achievement separately. Our result that the perseverance dimension of grit positively predicted creative achievement regardless of domain is consistent with prior research and theory (Csikszentmihalyi, 1996; Helson et al., 1995; Ivcevic & Nusbaum, 2017; Maw & Maw, 1970). The process that leads to creative achievement takes extended time, from months to years, is filled with obstacles, frustrations, and disappointments (Glaveanu et al., 2013). Thus, being able to maintain effort and continuously invest effort, even in the face of obstacles and lack of success, is necessary to actualize creative achievement.

In samples of college students, Grohman et al. (2017) found a nonsignificant relationship between perseverance (measured as the dimension of the grit scale, as here) and creative achievement (also measured by the CAQ used here), which is inconsistent with our findings. It is possible that because creative achievement is the lifetime sum of creative products and their level of social recognition, the young people in Grohman et al.'s (2017) study had not yet have a chance to accumulate it. For instance, a college student with interest in scientific creativity might be taking courses in science and even engaging in their first research studies, but would be unlikely to have published scientific papers, won national prizes for their scientific work, obtained research grants, or had their work cited in national publications (all items indicating high scientific achievement on the CAQ). By contrast, the adults in our sample have had more opportunities to build up their expertise and accumulate creative achievement (Plucker & Beghetto, 2004).

Consistency of interests was negatively related to creative achievement, suggesting that a narrow or inflexible commitment to an interest may be harmful for creative achievement in art or science domains. Unlike the well-structured goals studied by Duckworth et al. (2007) and Duckworth and Quinn (2009) (Park, Tsukayama, Yu, & Duckworth, 2020; Park, Yu, Baelen, Tsukayama, & Duckworth, 2018), creative goals are ill-defined and open-ended (Lubart, 1994; Reiter-Palmon & Illies, 2004; Simonton, 2014). That is, compared to well-defined goals (e.g., performance in the Spelling Bee competition) with clear problems, unambiguous direction or course of action, and unequivocal correct answers, creative goals are more complex. They involve identifying a problem or potential problems, generating ideas, evaluating and selecting original and effective ideas, reformulating and revising the problems and/or goals as necessary, and applying ideas in real actions (Ivcevic et al., 2023; Ivcevic & Nusbaum, 2017; Zielińska et al., 2022; Zielińska, Forthmann, et al., 2023). Throughout the creative process, there are multiple options that have pros and cons and creators have to make decisions with inadequate information. Maintaining a narrow focus on one interest or course of action is likely to prevent revisions and reformulations in the creative process. Therefore, it is unsurprising that consistency of interests is detrimental to creative achievement. This result is different from Grohman et al.'s (2017) finding that consistency of interests is not related to creative activity and achievement among college and high school students. Given that those samples were late adolescents and emerging adults, who are in a developmental stage that is characterized by the search for personal identity (which can be in part manifest through exploring and developing interests; Arnett, 2007; Tanner, Arnett, & Leis, 2009), it is possible that they have not yet committed to creative activities sufficiently to show the relevance of consistency of interests in one direction or another.

In our study, the two grit dimensions had different relationships with creative achievement. Perseverance was not related to creative achievement in arts (zero-order correlations). However, in the regression model (Step 2), when considering both perseverance and consistency of interests as factors predicting creative achievement, perseverance emerged as a significant predictor. These stress the importance of not using the total grit score in research, as some researchers interested in the overarching construct of grit have done (Rojas, 2015; Widodo, 2021), but examine the dimensions individually. Because each grit dimension may have a unique relationship with creativity-related outcomes, adding them together may have a suppressive effect. Given that grit is a dimension of conscientiousness, research examining aspects of this personality



dimension is relevant. Reiter-Palmon, Illies, and Kobe-Cross (2009) found that the conscientiousness aspect of achievement, which emphasizes persevering and overcoming obstacles, positively predicted creative problem-solving and creative activities, whereas the conscientiousness aspect of dependability, which focuses on self-discipline and orderliness, negatively predicted these creativity-related outcomes. Although grit dimensions of perseverance and consistency of interests are narrower in nature than the achievement and dependability aspects of conscientiousness, they have conceptual similarity. This research shows that solely depending on broad traits may mask the nuances that are revealed by narrower traits.

Furthermore, creative achievement requires curiosity, the desire to seek out novelty and complexity (Barron & Harrington, 1981; Gross et al., 2020; Kashdan & Fincham, 2002; Schutte & Malouff, 2020a). Our results showed that curiosity dimensions have incremental validity in predicting creative achievement above grit. In other words, it is not just the absence of a narrow focus on one's interests that contributes to creative achievement, but creative achievement benefits from active seeking of novelty. Curiosity and broad interests can help individuals explore information that could be vital for achieving novel and high-quality creative outcomes and avoid developing certainty too early in the creative process. Csikszentmihalyi (1988) stressed that if one's full attention is absorbed by too narrow interest, there would not be enough left over for new information and solutions. Finally, according to the network of enterprise model, creative work is nondeterministic (Gruber & Wallace, 2001). Given that the flow of creative work is continuous and branching toward newly identified possibilities, each action is only loosely connected to each other and has the potential to lead to a novel direction in every interaction. Therefore, those who are curious will be better equipped for the uncertainties in the creative process.

Researchers have suggested that curiosity facilitates long-term creativity by regulating attentional resources (Ivcevic & Nusbaum, 2017; Kashdan et al., 2004; Kashdan & Fincham, 2002). During the course of such self-regulation, curious individuals first allocate their interests toward new stimuli and begin to explore them. Then, they engage in multiple exploratory activities, including revising and reformulating perspectives and goals.

Schutte and Malouff (2020b) did not find significant relationships between the three dimensions of curiosity (joyous exploration, deprivation sensitivity, and stress tolerance) and individuals' performance on a creative thinking task (designing a water conservation program). Following the principle of the Brunswick symmetry, the prediction of creativity outcomes by curiosity will be maximized when these two constructs are matched in breadth (Ackerman & Kanfer, 2004; Wittmann, 1988). The umbrella construct of creativity contains multiple distinct aspects (e.g., creative self-perceptions, creative thinking, creative achievement; Ivcevic, 2022a; Reiter-Palmon & Schoenbeck, 2020), which vary in their breadth. Here, trait curiosity, which is relatively stable through time and across situations, may be a more suitable predictor of creative achievement, which is accumulated over a long period, than it is suitable in predicting performance on creative thinking tasks that typically take 3–4 min. This also suggests future research curiosity and creativity should target a range of aspects of creativity (Ivcevic, 2022a).

Moreover, the five dimensions of curiosity (Kashdan et al., 2018) adopted in the current study enable us to further examine whether and how relations exist with creative achievement. Among the five dimensions, thrill seeking predicted creative achievement in both the art and science domains. Unlike the behavioral disinhibition (e.g., excessive drinking, reckless driving) that is part of trait sensation seeking (Zuckerman, 2007; Zuckerman, Eysenck, & Eysenck, 1978), thrill seeking in the current study emphasizes the thrill of mastery and attraction to the unknown, such as making a friend who is excitingly unpredictable or going on a trip that is not fully planned. For thrill-seeking individuals, life is an adventure filled with hunting for novelty because exposure to new stimuli evokes feelings of interest, excitement and enjoyment (Hardy et al., 2017; Litman, 2005). Such feelings are features of intrinsic motivation, which is positively linked to creative achievement (Amabile, 1996; De Jesus, Rus, Lens, & Imaginário, 2013). Moreover, thrill-seeking individuals' intellectual risk-taking tendencies can empower them to overcome uncertainties in new environments, giving rise to their sense of competence and mastery in creative tasks, which in turn can facilitate more creative achievement (Beghetto, Karwowski, & Reiter-Palmon, 2021; Haase, Hoff, Hanel, & Innes-Ker, 2018; Kashdan et al., 2018; Wan, Lee, & Hu, 2021).

Furthermore, the deprivation sensitivity dimension predicted creative achievement in art. Deprivation sensitivity describes one's discomfort when a problem is not solved, which forces individuals to seek information to fill the gap (Kashdan et al., 2018; Litman, 2005; Noordewier & van Dijk, 2020). Because art is open-ended in nature, filling the gaps can be an ongoing process. Studies of the creative process show that artists often do not reach closure and satisfaction at completion of a particular work and continue to

address the discomfort across multiple pieces in a series (Glaveanu et al., 2013). People tend to feel frustrated and sad when experiencing the uncertainty of not knowing something (Kashdan et al., 2018), and such feelings have been reported by artists (e.g., painters, sculptors, composers) in their daily creative work (Glaveanu et al., 2013; Ivcevic, 2022b).

#### LIMITATIONS AND FUTURE DIRECTIONS

There are several limitations in the current study. First, we studied grit and curiosity, self-regulation traits in the broad domains of conscientiousness, and openness to experience, respectively. Given that conscientiousness and openness to experience were not assessed, we were unable to test whether relationships identified are significant beyond the effects of these broad traits. Although the present research examined two specific self-regulation traits in a multidimensional approach, yielding nuances that cannot be captured by higher order traits, future research should examine the unique roles of grit and curiosity in creative achievement beyond conscientiousness and openness to experience.

Controlling for the Big Five trait domain would be a strict test of the construct specificity of specific self-regulation traits. However, extensive research in personality psychology supports the validity and utility of narrower traits over broad trait dimensions (Ashton, 1998; Ashton, Paunonen, & Lee, 2014; Jenkins & Griffith, 2004; Paunonen, Haddock, Forsterling, & Keinonen, 2003; Reiter-Palmon et al., 2009). Ashton et al. (2014) showed that the fairness dimension outperformed the broad trait honesty–humility to which it belongs in predicting delinquency among college students. Another study found that the two lower traits of conscientiousness—achievement and dependability—significantly predicted creative activities and creative problem-solving, whereas overall conscientiousness did not (Reiter-Palmon et al., 2009).

Second, we only assessed creative achievement in the broad art and science domains; we did not measure other domains or forms of creative achievement (e.g., mechanical, humanities, business; Ivcevic & Mayer, 2009; Kaufman, 2012, 2013). Given that different personality traits may predict different types of creative achievement (Feist, 1998; Ivcevic & Mayer, 2006), it would be important to examine whether our results hold for creative achievement in other domains. Another limitation is that the CAQ measure assesses creative achievement based on the number of public recognitions, such as publications and awards. However, the quality of these achievements is not evaluated (Kaufman et al., 2016).

It could be argued that the CAQ rewards broad achievement. For instance, people will be more likely to obtain a high score if they have significant achievements in more than one artistic domain (e.g., visual art, music, and writing), rather than a single domain (only visual arts). Because of this feature of our chosen measure of creative achievement, it is possible that negative correlation with consistency of interests becomes more likely. It is imaginable that some forms of creative achievement could benefit from consistency of interests (such as when an artist creates extensive series of paintings with the same theme). According to the amusement park model of creativity (Baer & Kaufman, 2005), the higher the level of creativity (e.g., as we move from little-c to Pro-c), the greater the specialization in a particular domain. It may be that consistency of interests exerts a positive effect on creative achievement in areas characterized by high specialization or for highly technical problems which are closer to the well-defined end on the continuum of goal definition (e.g., researchers conducting meta-analyses). Thus, future studies should examine the role of consistency of interests in relation to a broader set of measures of creative achievement, which can take into account the nature of people's goals and products.

Moreover, the consistency of interests we studied here is domain-general. However, recent studies have found that levels of consistency of interests can vary across domains, such as sport versus school (Cormier, Dunn, & Dunn, 2019). Duckworth et al. (2007) have described consistency of interests as pertaining to passion (its goal commitment aspect), which is studied as a domain-specific attribute relating to specific activities (Cardon, Glauser, & Murnieks, 2017; Murad, Li, Ashraf, & Arora, 2021; Vallerand, 2010). Therefore, future research should explore how domain-specific consistency of interests relates to creative achievement in specific activity areas and domains.

Third, our study only focused on the end outcome of long-term creative work—creative achievement—with a cross-sectional design. Although stable trait curiosity is theoretically predicted to influence creative achievement, further examination of this causality is needed using longitudinal methods. In addition, longitudinal methods would enable future studies to explore the process underlying the relationship between trait curiosity and creative achievement. For example, researchers can use experience sampling to answer how self-regulation traits and actions contribute to creative achievement by studying activation of these traits across situations. Fleeson (2001) (Jayawickreme, Zachry, & Fleeson, 2019) defined traits as density

distributions of personality states and proposed a model how such states affect behavior. By assessing both trait curiosity (at baseline) and state curiosity (using diary or experience sampling methods across time and situations), within person and between person effects can be examined.

Curious individuals tend to be troubled by the absence of rich information when working on a task and anticipate seeking new information. Therefore, they may actively engage in information-seeking behaviors and idea linking (Hagtvedt, Dossinger, Harrison, & Huang, 2019; Ivancovsky et al., 2023; van Lieshout, de Lange, & Cools, 2020), which in turn can transform a curious disposition into creative actions and eventually achievements. In particular, the mediating effects of idea linking (i.e., using previous ideas as input for subsequent ones) may be especially salient in scientific and scholarly creative achievement because most tasks in these areas involve a clear sequential process in which early ideas are stepping stones to later ones in developing and deepening a line of inquiry. In addition, research showed that the relationship between creative activity and creative achievement is strengthened by the attentional aspect of self-regulation (e.g., ability to concentrate on an activity for a long time; Zielińska, Lebeda, & Karwowski, 2023). Future research should examine whether this extends to the trait of perseverance so that it moderates the link between curiosity and creative achievement.

Last, our study only showed the respective relationship between each curiosity dimension and creative achievement; it left the intra-individual profiles of curiosity unexamined. Kashdan et al. (2018) used a person-centered approach (i.e., cluster analysis) to identify distinct subgroups based on the intraindividual patterns of curiosity dimensions. Future studies can use this person-centered approach (Ivcevic, Grossman, & Ranjan, 2022; Lin & Muenks, 2022) to examine how distinct profiles are associated with creative achievement in different domains. For example, individuals with high joyful exploration and thrill seeking but low social curiosity may have relatively high solitary creative endeavors, whereas others with high stress tolerance and deprivation sensitivity may have high creative achievement in the science domain.

The creative process requires self-regulation (Zielińska, Forthmann, et al., 2023; Zielińska, Lebeda, & Karwowski, 2023). The current research deepens our understanding of two self-regulation traits, grit and curiosity, in creative achievement. We found that individuals who are persistent and able to regulate efforts to work on an idea long enough to transform it from conceptualization to final product may eventually obtain more creative achievement. However, due to the ill-defined nature of creative goals, only focusing on narrow interests and not opening up to new opportunities might obstruct creative achievement. Being curious with a strong desire to explore novel and complex stimuli in one's surroundings may facilitate revisions and reformulations of creative goals, and therefore lead to more creative achievement.

## DATA AVAILABILITY STATEMENT

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

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