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The Relationship Between Stressors and Creativity: A Meta-Analysis Examining Competing Theoretical Models

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Competing theoretical models and equivocal evidence leave unanswered questions regarding stressors' effect on creativity. The present meta-analysis of 76 experimental studies (including 82 independent samples) aims to clarify this association and identify factors that may explain differences between studies. Our results suggest that the effect of stressors on creative performance depends on how stress-inducing the stressor is and what type of stress is induced. We found a curvilinear relationship between evaluative stress and creativity such that low evaluative contexts *increased* creative performance over control conditions, whereas highly evaluative contexts *decreased* creative performance. We found a linearly negative relationship between uncontrollability and creativity such that more uncontrollability decreased creative performance. The results suggest that stressors' effect on creativity is more complex than previously assumed and points to the need for understanding boundary conditions that shed light on inconsistent findings.

Keywords: creativity, originality, stress, stressors, meta-analysis

The relationship between stressors (e.g., time pressure or competition) and creativity has received considerable attention in the psychological, organizational, and educational literatures. Yet the strength and form of the relationship remains unclear: Studies have found positive (e.g., Baer, 1998), negative (e.g., Amabile, Goldfarb, & Brackfield, 1990), and curvilinear (e.g., Landon & Suedfeld, 1972) relationships between stress and creativity. Further, the distinct cognitive and motivational processes underlying creative—as opposed to routine—performance may limit the extent to which theory and research focusing on routine performance may generalize to creative performance. Therefore, we aim to clarify this association—and examine potential moderators of the association—by conducting a quantitative synthesis of experimental studies considering stressors' effect on creative performance.

We focus on experimental studies examining stressors for several reasons. First, such studies offer a key advantage over other research designs in that they help to establish causality. Second, an increasing body of research supports a key underlying assumption: stress-responses, particularly those associated with fear and anger, are often automatic, reflexive, and independent of conscious cognition (e.g., Öhman & Wiens, 2004). Third, theoretical support exists for a direct effect between stressors and creativity (e.g., Anderson, De Dreu, & Nijstad, 2004). Further, the vast majority of studies examining stressors and creativity are experimental studies.

The results of this analysis may have numerous theoretical and practical implications. Because we are considering competing theoretical perspectives, the results can help to resolve the theoretical debate concerning stressors and creativity. They can also help explain variability found among studies and determine when stressors may increase or decrease creativity. Lastly, they have practical relevance because determining whether and to what extent various stressors help or hinder creativity may point to interventions that can increase creativity.

Hypothesized Relationships Between Stressors and Creativity

Before we review the various theoretical models and their hypothesized relationships between stress and creativity, we define the primary constructs investigated in this analysis. We use a stimulus definition of stress, consistent with most studies that have examined stress in relation to creativity. Studies employing a stimulus approach are concerned with stressors, that is, physical (e.g., noise) or psychological (e.g., evaluation) conditions that necessitate an adaptive response (Jex, Beehr, & Roberts, 1992; LePine, Podsakoff, & LePine, 2005). We use a product-based approach to creativity, which is the most widely accepted approach to studying creativity: Creativity is the production of ideas, solu-

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tions, or products that are novel (i.e., original) and appropriate (i.e., useful) in a given situation (e.g., Amabile, 1996; Oldham & Cummings, 1996).

According to theories, such as distraction arousal theory (Teichner, Arees, & Reilly, 1963), stressors *decrease* creative performance. People have a limited pool of mental resources and they devote some of these resources to attend to stressors, leaving fewer cognitive resources available for other tasks. The reduction of cognitive resources available may also result in the use of simpler cognitive strategies, such as using a narrow attentional focus (Eysenck, 1995). Simple cognitive strategies are likely to result in the production of more common, less original ideas (Baron, 1986; Drwal, 1973). In short, stressors decrease creativity by demanding cognitive resources that are then not available for creative thinking and that result in the use of simpler cognitive strategies that are likely to undermine creativity. Thus, we propose the hypothesis:

Hypothesis 1a: Stressors decrease creative performance.

Alternatively, other theories suggest that stressors *increase* creativity. Stressors increase arousal, which elicits the use of creative thought and motivates persistence toward deriving solutions (e.g., Anderson et al., 2004; Nicol & Long, 1996). When exposed to stressors, individuals may engage in focused problem-solving strategies, leading to enhanced creativity (Bunce & West, 1994). That is, stressors enhance creativity by creating a demand for creative solutions and by providing the cognitive stimulation and motivational arousal that are necessary for creative thinking (Andrews & Farris, 1972; Pelz, 1988). We propose the alternative hypothesis:

Hypothesis 1b: Stressors increase creative performance.

Some scholars have proposed a third alternative form for the relationship between stressors and creativity. Namely, stress may be *curvilinearly* related to creativity (e.g., Yerkes & Dodson, 1908). According to activation theory (e.g., Gardner, 1990), stressors can increase performance but only to a point—too much activation lowers performance, particularly for complex tasks such as creative tasks. Individuals will be most creative at moderate levels of activation because moderate activation levels increase task engagement, result in the optimal use of cognitive resources, decrease negative affect, and increase positive affect (e.g., Baer & Oldham, 2006; Gardner, 1986). Conversely, too little or too much activation can lead to a lack of engagement and cause cognitive interference, which can hinder performance on cognitively demanding tasks. Given that cognitive, emotional, and behavioral engagement are important processes underlying creativity (Drazin, Glynn, & Kazanjian, 1999), moderate levels of activation are likely to be associated with the most creativity.

Testing a curvilinear relationship requires quantifying how activating a stress stimulus is. We adopt Dickerson and Kemeny's (2004) framework to quantify stressors in terms of the number of social–evaluative threats and uncontrollable elements present because both have been found to be associated with increases in hormonal markers of a stress response. Social self-preservation theory forms the theoretical basis for this framework, according to which "humans are driven to preserve the social self and are vigilant to threats that may jeopardize their social esteem or status" (p. 357). Further, examining social–evaluative threats and uncontrollable elements has some basis in the creativity literature in that both have been proposed to affect creativity (e.g., Elsbach & Hargadon, 2006; Maier & Seligman, 1976). As both social–evaluative threats and uncontrollability likely increase activation, we alternatively propose an inverted-U shaped form:

Hypothesis 1c: Stress stimuli are curvilinearly related to creative performance (in an inverted U-shaped form).

However, the effect of stressors on creativity may not be simply a function of how stressful a stressor is (i.e., the number of stress stimuli present) but also of the type of stress stimuli; different stress stimuli may work through distinct mechanisms to differentially affect creativity. Specifically, social–evaluative threats and uncontrollability may affect different aspects of the self, which may, in turn, be differentially associated with the cognitive and motivational processes underlying creativity.

Social–evaluative threats "occur when an aspect of self is or [can] be negatively judged by others" (Dickerson & Kemeny, 2004, p. 361). Such threats may pose a threat to one's creative self-identity in situations when creative performance is demanded (e.g., Stets & Burke, 2000). Such threats to self-concept or identity may motivate individuals to preserve their self (Dickerson & Kemeny, 2004) and maintain consistency between one's own and others' evaluations (Higgins, 1989; Stryker & Burke, 2000). Therefore, situations characterized by low levels of social–evaluative threat may motivate individuals to maintain congruence between their creative self-identity and reflected self-appraisal by exerting more effort toward being creative.

However, when faced with high levels of evaluative stress, individuals' creative self-identity—or perhaps, more generally, individuals' identity as competent—may become increasingly salient. Such an increase in identity salience is likely to cause individuals to experience psychological distress (Burke, 1991; Thoits, 1991) and distract them from being creative as they "shift their attention to the forthcoming evaluation" (Burke, 1991: 845). Further, they may protect their valued self-identity from disparagement by reducing their creative output (Farmer, Tierney, & Kung-McIntyre, 2003). Thus, whereas some social–evaluative threats may motivate individuals to be more creative, too many threats may hinder creativity.

Hypothesis 2: Social–evaluative threats are curvilinearly related to creativity (in an inverted U-shaped form).

Uncontrollability occurs when individuals believe that their effort or behavior is not likely to appreciably affect outcomes (Dickerson & Kemeny, 2004). Conditions characterized by uncontrollability are likely to thwart innate psychological needs such as the need for autonomy and competence, which form the basis for self-motivated or intrinsically motivated behaviors (Ryan & Deci, 2000). Such conditions are said to hinder self-determination, which can diminish intrinsic motivation to be creative and cause decrements in creative performance (Oldham & Cummings, 1996). This may be particularly true for creative performance because creative performance is believed to be more dependent on intrinsic motivation than are other types of performance. In short, creativity is believed to thrive in conditions of freedom (Amabile, 1996), and

uncontrollability creates conditions that are antithetical to creative expression.

Hypothesis 3: Uncontrollability decreases creative performance.

In this meta-analysis, we are concerned with determining when stressors may increase or decrease creativity. Because people vary in their perceptions of and reactions to stressors (e.g., Lazarus & Folkman, 1984), individual differences, such as trait anxiety, may help to determine the effects of stressors. Trait anxiety seems a likely moderator of the stressor–creativity relationship because trait anxiety reflects differences in vulnerability to stressors (e.g., Spielberger & Rickman, 1990). High-anxious individuals are thought to perceive stressors as threats and, consequently, experience more stress symptoms in response to stressors (e.g., Pearson & Thackray, 1970). These cognitive and behavioral outcomes are likely to prompt the use of more routine and less creative responses (e.g., Shaham, Singer, & Schaeffer, 1992). Conversely, low-anxious individuals are thought to perceive stressors as challenges (Spielberger & Rickman, 1990). Thus, for those low in anxiety, stressors may act as a drive and increase creativity.

Hypothesis 4: Trait anxiety moderates the relationship between stressors and creativity performance such that stressors have a more negative effect on creative performance for those high in anxiety and a more positive effect on creative performance for those low in anxiety.

Method

Criteria for Inclusion

This meta-analysis focused on experimental studies that examined individuals' exposure to psychological or physical stressors generally associated with the experience of stress (such as evaluation or time pressure) and subsequent creative performance on a task(s) on which creativity was possible, such as divergent thinking tasks (e.g., alternate uses tests or the Torrance Test of Creative Thinking) or artistic tasks (e.g., collages or drawings). To be included, studies had to be published or, if unpublished, completed by December 31, 2006; include an effect size or data that could be used to calculate an effect size (e.g., *d*, *F*, or *t*); and be in the English language.

Search Strategy

We first searched PsycINFO and Research Library databases using the search terms *creativity, innovation, divergent,* or *creative* in combination with the terms *anxiety, challenge, competition, evaluation, frustration, hassles, obstacles, overload, pressure, stress,* or *threat,* which resulted in 2,800 citations. After eliminating studies clearly not meeting our inclusion criteria, we retrieved and reviewed the remaining studies. We also e-mailed 17 prominent creativity scholars requesting unpublished studies, of which 16 responded. Lastly, we manually searched the reference lists of included studies to locate studies that we may not have located in our other searches. We then searched the reference lists of studies found from this search.

A total of 76 studies (representing 82 independent samples and 7,417 participants) met the inclusion criteria, including 46 journal articles, 27 dissertations, one unpublished manuscript (Yuan & Zhou, 2008, which has since been published), one book chapter, and one conference proceedings paper. Table 1 describes these studies and their relevant characteristics, such as the type of stressor, the type of creativity measure used (classified according to Hocevar's, 1981, taxonomy), and the moderators examined here.

Calculating the Effect Size

We calculated *d,* the standardized mean difference between creative performance of the experimental group (i.e., those exposed to an experimentally manipulated stress condition) and control group; positive (negative) effect sizes indicate that stressors increased (decreased) creative performance. We did not consider groups exposed to positive stimuli, such as a funny movie or positive feedback, as control conditions; thus, the effect sizes of some studies are based on a subsample of study participants. We did include as comparison groups those groups that were exposed to more neutral stimuli, such as being told that they would evaluate themselves or watching a neutral film clip. To observe the need for statistical independence, we averaged similar measures or dimensions of creativity, and used Wood's (2008) procedure for detecting duplicate study effects. Eight studies were excluded because they reported on the same data set; these are marked with double asterisks in the reference section.

Analysis Strategy

For the meta-analysis, we calculated random-effects analyses using the Hunter and Schmidt (2004) method. We individually corrected all observed effect sizes for attenuation due to unreliability in measurement using the interrater reliability coefficient for the creativity measure used. Although most studies provided the relevant reliability coefficient, when studies did not provide these data, we inputted the average coefficient for similar measures. We then weighted each effect size as a function of its sample size and the study's attenuation factor (Hunter & Schmidt, 2004). For the overall analysis, we calculated an optimally weighted corrected mean effect size and its corresponding 95% confidence interval. When the 95% confidence interval does not include zero, then the estimate is significantly different from zero. Next, we subjected each analysis to two tests of homogeneity, the Hunter and Schmidt (H-S) 75% rule and an 80% credibility interval (Hunter & Schmidt, 2004). Using the H-S 75% rule, a search for moderators is warranted when less than 75% of the observed variance has been accounted for by study artifacts, such as sampling error variance and measurement unreliability. The 80% credibility interval indicates how much heterogeneity is present in the underlying population. Wider credibility intervals indicate more heterogeneity.

When warranted, we tested continuous moderators by fitting a weighted least squares regression (weighted by the inverse sampling variance) and correcting the standard errors using the recommended calculations (Steel & Kammeyer-Mueller, 2002). To test the significance of the moderator, we calculated Z_{HO}, the unstandardized regression coefficient divided by the corrected

Table 1
Effect Sizes and Study Characteristics for the Studies Included in the Meta-Analysis

Author (year)	*d*	*N*	Stressor type	Creativity task	Social–evaluative threats	Uncontrollable elements
Abramson (1976)	0.405	72	CP	DT	1	0
Adams (1968)	−0.432	112	CP	DT	1	0
Aiello et al. (1977)	−0.643	32	ES	DT	0	1
Akinboye (1982)	−0.621	30	TP	DT	0	1
Allred (1967)[a]	0.172	213	TC	DT	0	0
Amabile (1979)	−0.655	95	PE	JP	1	0
Amabile (1982)	−1.113	22	CP	JP	1	0
Amabile et al. (1990)						
Study 1	−1.113	48	PE	JP	1	0
Study 2						
A vs. control	−1.284	40	PE	JP	1	0
B vs. control	−0.642	40	PE	JP	1	0
C vs. control	−1.422	40	PE	JP	2	0
Bader (1970)	−.084	90	TC	DT	1	0
Baer (1997)	−0.178	128	PE	JP	1	0
Baer (1998)						
Study 1	0.430	70	PE	JP	1	0
Study 4	0.389	81	PE	JP	1	0
Bartis et al. (1988)	0.175	111	PE	DT	1	0
Belcher (1975)	−0.411	60	TC	DT	2	0
Bergman (1978)[a]	0.243	64	PE	DT	0	0
Boersma & O'Bryan (1968)	−0.877	46	TC	DT	1	1
Buteau (1987)	−0.439	92	TP	DT	0	1
Carroll (1979)	0.262	307	PE	DT	1	0
Cates (1985)						
Pilot study	0.812	37	PE	DT	1	0
Main study	0.430	120	PE	DT	1	0
Cheek & Stahl (1986)[a]	0.180	42	PE	JP	1	0
Conti et al. (1995)	−0.376	75	TC	JP	1	0
Demartini (1980)	−0.151	53	PE	DT	1	0
Drwal (1973)	−0.631	39	TC	DT	2	0
El-Dreny (1976)	−0.536	120	HA	DT	0	1
Fleischer & Cohen (1965)[a]	0.139	160	TC	DT	1	0
D. B. Frost (1975)	−0.195	60	CP	DT	1	0
K. B. Frost (1975)	−0.309	120	HA	DT	0	1
K. B. Frost (1976)	−0.139	24	HA	DT	0	1
Gerhart (1982)	0.261	80	PE	JP	1	0
Gerrard et al. (1996)	−0.235	103	CP	JP	1	0
Hadley (1965)[a]	−0.644	201	TC	DT	2	0
Hargreaves (1974)	−0.357	124	TC	DT	0	0
Hattie (1980)	0.385	168	TC	DT	0	0
Heinzen (1989)	0.471	72	HA	DT	0	0
Hennessey (1989) Study 2	−0.450	39	PE	JP	1	0
James et al. (1992) Study 2	−0.086	57	CF	DT	0	0
Johns et al. (2000)						
Study 1	0.276	22	TP	DT	0	1
Study 2	−0.397	20	TP	DT	0	1
Kane (1992)	−0.119	80	PE	JP	1	0
Khatena (1971)	−0.294	142	TP	DT	0	1
Khatena (1972)	−0.494	87	TP	DT	0	1
Khatena (1973)	−0.568	90	TP	DT	0	1
Kitay (1986)	0.650	70	PE	DT	1	0
Koestner et al. (1984)	−1.008	44	HA	JP	0	1
Kogan & Morgan (1969)[a]	0.497	104	TC	DT	1	0
Krop et al. (1969) Study 1	−1.023	40	OT	DT	0	1
Leith (1972)	0.427	106	TC	DT	0	0
Lim (2005)	0.596	250	PE	JP	1	0
Little (1984)	0.154	187	CP	DT	1	0
Maginn & Harris (1980)	−0.030	76	PE	DT	0	0
Matthews (1986a)						
Study 1[a]	0.151	36	HA	DT	0	1
Study 2[a]	0.104	80	HA	DT	0	1

Table 1 (*continued*)

Author (year)	*d*	*N*	Stressor type	Creativity task	Social–evaluative threats	Uncontrollable elements
McDaniel (1986)	0.410	180	PE	JP	1	0
Norlander et al. (2003)	0.209	32	HA	JP	0	1
Parzivand (1985)	0.183	90	PE	DT	1	0
Phillips (1997)	0.167	151	PE	JP	0	0
Raina (1968)	1.540	40	CP	DT	1	0
Rand & Rand (1978)	−1.159	308	TC	DT	2	0
Rogers (1999)	0.064	186	PE	DT	0	0
Rollins & Calder (1975)	−0.482	22	HA	DT	1	1
Sandlund et al. (2001)	0.010	40	HA	JP	0	1
Shalley (1995)						
Study 1	0.000	84	PE	JP	1	0
Study 2	0.204	136	PE	JP	1	0
Shalley & Oldham (1997)	0.717	75	CP	DT	1	0
Shalley & Perry-Smith (2001)	−0.498	80	PE	JP	1	0
Shanteau & Dino (1993)	−1.151	32	ES	DT	0	1
Sherwood (1969)	−0.254	80	TC	DT	1	1
Smith et al. (1990)	0.198	132	TC	DT	1	0
Suedfeld (1968)	−1.025	40	ES	JP	0	1
Suedfeld & Landon (1970)	−0.992	50	ES	DT	0	1
Szymanski & Harkins (1992)	0.332	58	PE	DT	0	0
Talley (1974)	−0.200	32	TC	DT	0	1
Trentham (1979)[a]						
Hassles	−0.741	72	HA	DT	0	1
Testing conditions	−0.156	72	TC	DT	1	0
Wagner (1972)	−0.139	131	TP	DT	0	1
Walton (2006) Study 2	0.396	184	CP	DT	0	0
Williams & Fleming (1969)	0.304	36	TC	DT	0	0
Wilner (1974)						
Time pressure	−0.796	60	TP	DT	0	1
Testing conditions	−1.070	60	TC	DT	2	0
Yuan & Jhou (2008)	−0.444	73	PE	JP	1	0
Zhou (1998)	−0.550	126	TC	JP	1	1
Zhou & Oldham (2001)	0.034	46	PE	JP	0	0

Note. *d* = uncorrected effect size; *N* = sample size of relevant effect size. Type of stressor is coded performance evaluation (PE), testing conditions (TC), competition (CP), time pressure (TP), environmental stressor (ES), hassles (HA), conflict (CF), and other (OT). Creativity task is coded divergent thinking test (DT) or judgment of products (JP). Social–evaluative threats and uncontrollable elements indicate the number of threats or elements in the experimental condition over and above those in the control condition.

[a] Study included in the moderator analysis of trait anxiety.

standard error (Sánchez-Meca & Marín-Martínez, 1998) and determined whether it exceeded the critical value. To further explicate the moderator or to examine categorical moderators, we split the group into subgroups based on the moderator and conducted a separate meta-analysis on each subgroup (Aguinis, Sturman, & Pierce, 2008). Kristin Byron coded all studies; Shalini Khazanchi, Deborah Nazarian, or a graduate student coded a 20% subsample to assess interrater reliability (i.e., intraclass correlation [r_1]), which is listed below.

Moderators

Social–evaluative threats (r_1 = .93). We coded how many social–evaluative threats were present in the manipulation (as compared with the control condition) using Dickerson and Kemeny's (2004) coding system. Social–evaluative threats involved situations in which "an aspect of the self (e.g., trait, ability) is or could be negatively judged by others" (p. 361). Social–evaluative elements included: (a) videotaping the participants, (b) having an evaluative audience present, or (c) being told of a negative social comparison individual or group. Each study was coded to create a continuous variable ranging from 0 (*no social-evaluative threats present*) to *n* (*number of social–evaluative threats present*).

Uncontrollable elements (r_1 = 1.00). We coded the number of uncontrollable elements present in each manipulation condition (as compared with the control condition) using Dickerson and Kemeny's (2004) coding system. Uncontrollability involved situations "when behavioral responses could not appreciably affect outcomes, and it would have been reasonable for participants to expect that outcomes were not contingent on their behavior (e.g., it would have been quite difficult for participants to avoid negative consequences, terminate an aversive experience, or succeed despite their best efforts)" (p. 361). Uncontrollable elements included: (a) making a task more difficult (e.g., increasing time constraints), (b) providing false negative feedback, (c) criticizing or harassing participants about their speed, effort, or ability, or (d) introducing distractions (e.g., noise) or other emotionally distressing stimuli (e.g., confinement) during the task. Each study was coded to create a continuous variable ranging from 0 (no uncontrollable elements present) to *n* (number of uncontrollable elements present).

Participant trait anxiety. Nine studies (indicated by an asterisk in Table 1) provided data allowing us to examine whether individuals' general trait anxiety or test anxiety moderated the stressor–creativity relationship. In these studies, high-anxiety and low-anxiety participants were exposed to a stressor or participated in a control condition.

Results

Table 2 includes the number of outcomes (k) and participants in each analysis (N), weighted (uncorrected and corrected) mean random-effects sizes (d and d_c), the 95% confidence interval, two homogeneity statistics, the 80% credibility interval, and the percentage of variance accounted for by sampling and measurement error. Table 3 includes the results of the weighted least squares regression, including the standardized regression coefficients.

First, we considered Hypotheses 1a, 1b, and 1c, which predicted a negative, positive, or curvilinear relationship between stressors and creative performance, respectively, by examining the results of the overall analysis (first line in Table 2) and the weighted least squares regression (Model 1 in Table 3). These results fail to provide support for Hypotheses 1a or 1b. Although the results of the overall analysis suggest that stressors tend to decrease creativity ($d_c = -.078$), significant heterogeneity (as indicated by the homogeneity statistics) underlies this mean effect size. Further, although the 95% confidence interval does not include zero, the effect size is near zero and explains a trivial (<1%) amount of variance in creativity.

Therefore, we proceeded to consider Hypothesis 1c. First, the squared term is statistically significant (ß = −.25, $p < .001$), which indicates that stress stimuli are curvilinearly related to creative performance and that its negative sign indicates an inverted U-shape. Second, the results of the subgroup analyses explicate this relationship. Namely, low-level stressors (i.e., those having no social–evaluative threats or uncontrollable elements) tended to significantly increase creative performance ($d_c = 0.173$; 95% *CI*: 0.072, 0.274) over and above control conditions. More stress stimuli tended to have a less positive effect on creative performance. For studies with one social–evaluative threat or uncontrollable element, the 95% confidence interval included zero ($d_c = -0.047$; 95% *CI*: −0.102, 0.008). Lastly, high-level stressors (i.e., those with two or more stress stimuli) tended to significantly decrease creative performance ($d_c = -0.832$; 95% *CI*: −0.975, −0.699). Taken together, these results support Hypothesis 1c.

Next, we considered whether the type (and number) of stress stimuli is differentially related to creative performance. The mean effect sizes for the different types and number of stress stimuli and their corresponding confidence intervals are shown in Figure 1. As shown in Model 2 of Table 3, the squared term is statistically

Table 3
Standardized Regression Coefficients for the Weighted Least Squares Regression of Effect Size on Stress Stimuli

	Step 1		Step 2	
Variable	β	Z_{HO}	β	Z_{HO}
Model 1				
Stress stimuli	−.52	10.98***	−.53	11.79***
Stress stimuli × stress stimuli			−.25	5.20***
ΔR^2	.27***		.06**	
Model 2				
Social–evaluative threats	−.23	4.87***	.01	0.24
Social–evaluative threats × social–evaluative threats			−.55	10.42***
ΔR^2	.05*		.24***	

Note. $k = 82$. $N = 7{,}417$. Stress stimuli refers to the total number of social–evaluative or uncontrollable elements in the experimental manipulation; social–evaluative threats refer to the total number of social–evaluative elements in the experimental manipulation.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2
Mean Stressor–Creativity Effect Sizes and Moderator Analyses

						Homogeneity statistics	
Variable	k	N	d	d_c	95% *CI*	80% *CrI*	% Variance
All studies	82	7,417	−0.073	−0.078	−0.124, −0.032	−0.616, 0.460	23%
Stress stimuli							
Zero	14	1,541	0.161	0.173	0.072, 0.274	−0.039, 0.384	60%
One	62	5132	−0.043	−0.047	−0.102, 0.008	−0.536, 0.442	28%
Two	10	962	−0.767	−0.832	−0.975, −0.699	−1.143, −0.520	50%
Type of stress stimuli							
One social–evaluative	38	3,664	0.100	0.109	0.044, 0.174	−0.314, 0.532	31%
One uncontrollable	24	1,468	−0.408	−0.434	−0.542, −0.330	−0.714, −0.155	62%
One uncontrollable, one social–evaluative	4	274	−0.491	−0.545	−0.807, −0.307	−0.545, −0.545	152%
Two social–evaluative	6	688	−0.888	−0.946	−1.121, −0.787	−1.237, −0.655	49%
Participant trait anxiety							
High anxiety	9	369	−0.102	−0.121	−0.331, 0.085	−0.230, −0.011	95%
Low anxiety	9	358	0.317	0.393	0.185, 0.615	0.393, 0.393	136%

Note. Studies (k) = refer to the number of independent samples included in each analysis; some dissertations, manuscripts, or articles included multiple samples; N = refers to the number of individuals in each analysis; d = indicates the mean-weighted effect size; d_c = is the corrected, optimally weighted effect size; 95% *CI* = is the corresponding 95% confidence interval for d_c; 80% *CrI* = is the 80% credibility interval; and % variance = is the percentage of variance accounted for by sampling error and study artifacts.

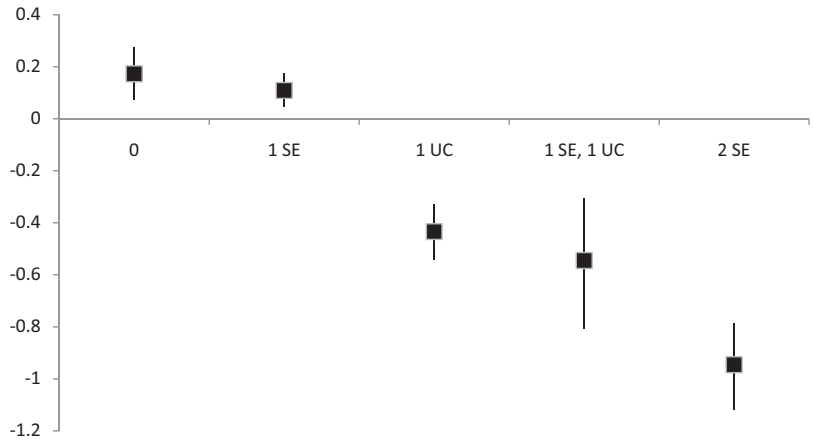

Figure 1. Mean stressor–creativity effect sizes (d_c) and 95% confidence intervals for studies by stress stimuli. SE = social–evaluative threats; UC = uncontrollable elements present in the experimental manipulation.

significant and negative (ß = −.55, $p < .001$), which indicates that social–evaluative threats are curvilinearly related to creative performance in an inverted U-shape. Stressors characterized by fewer social–evaluative threats increased creative performance over control conditions ($d_c = 0.173$ and $d_c = 0.109$; 95% *CI*: 0.044, 0.174, for zero and one social–evaluative threats, respectively). However, stressors with two social–evaluative threats decreased creative performance as compared with control conditions ($d_c = -0.946$; 95% CI: −1.121, −0.787). Thus, these results support Hypothesis 2.

Hypothesis 3 predicted that uncontrollability is negatively (linearly) related to creative performance. Two results provide support for Hypothesis 3. First, as shown in Table 2 and Figure 1, stressors characterized by one uncontrollable element decreased creative performance ($d_c = -0.434$; 95% *CI*: −0.542, −0.330). Additionally, although stressors with one social–evaluative threat increased creativity, stressors characterized by one uncontrollable element and one social–evaluative threat decreased creative performance ($d_c = -0.545$; 95% *CI*: −0.807, −0.307).

Lastly, we examined whether trait anxiety moderates the stressor–creative performance relationship (Hypothesis 4). As predicted, for participants high in trait anxiety, stressors decreased (although not significantly so) creative performance ($d_c = -.121$; 95%*CI*: −.331, .085). In contrast, for participants low in trait anxiety, stressors significantly increased creative performance ($d_c = .393$; 95% *CI*: .185, .615). Furthermore, for both analyses, we should note that all or nearly all of the variance observed between studies was accounted for by sampling and measurement error. In sum, these results suggest participants' trait anxiety moderates the relationship between stressors and creative performance.

Discussion

Our results indicate that it is an oversimplification to state that stressors have either a positive or negative effect on creativity. Rather, our findings indicate that the effect of stressors on creative performance depends on how stress inducing the stressor is. In general, low stress-inducing situations caused increases in creative performance, and high stress-inducing situations caused decreases in creative performance. More specifically, it matters in what way the stressors may induce stress. Our results suggest that the extent to which an evaluative context is made salient can serve to either increase or decrease creative performance, whereas contexts characterized by uncontrollability serve to only decrease creative performance. Overall, the results of our meta-analytic review suggest that both the level of the demand and the type of demand matter in predicting creativity.

Theoretical Implications

In this meta-analysis, we considered three competing models of the stressor–creative performance relationship, which predicted alternative forms (i.e., positive, negative, or curvilinear) for the relationship between stress and creativity. The results of this meta-analysis help to resolve this theoretical debate from our use of a strong inference approach in this meta-analysis (see, e.g., Balkundi & Harrison, 2006). Namely, our results provide some support for the Yerkes–Dodson law (Yerkes & Dodson, 1908) and activation theory (Gardner, 1986, 1990), as we found evidence to support a curvilinear relationship between evaluative stress and creativity. More specifically, whereas minor levels of evaluative stress appeared to increase creativity over control conditions, high levels of evaluative stress appeared to significantly hinder creativity, perhaps because stressors increase arousal and/or activation.

These results are also consistent with the dual-tuning model of creativity, which, among other tenets, proposes that both positive and negative emotions can enhance creativity (e.g., George & Zhou, 2007). Perhaps evaluative contexts can increase positive and negative emotional arousal, serving to promote creativity. Conversely, the lack of evaluative stress or more intensely evaluative contexts, however, may stimulate only negative emotion, causing pressure and lower feelings of self-determination (e.g., Ryan & Deci, 2000). Our results suggest that expected evaluation has the potential to both offer benefits (perhaps by motivating effort and clarifying expectations) and cause decrements in creative performance (perhaps by creating undue pressure and lower feelings of control). Additionally, our finding that a lack of control signifi-

cantly stifles creativity parallels the theoretical tenets of the job demand–control model, which postulates that low control increases stress and that the most stressful jobs are those characterized by high demands and low control (e.g., Karasek & Theorell, 1990).

Lastly, our findings also have other broader theoretical implications. We found that stressors (usually an evaluative context) increased creative performance for low-anxiety individuals but were not significantly related to creative performance for high-anxiety individuals. These results provide some support for cognitive appraisal models of stress (e.g., Lazarus & Folkman, 1984) by suggesting that individual factors (such as trait anxiety) affect how people perceive and react to stressors. This finding suggests that models of stressors and creativity should incorporate individual differences that account for how people differentially interpret and react to different stressors.

Directions for Future Research

The findings of our study provide directions for future research. Although we identified a fairly large number of studies (76) to be included in this analysis, we found that some research questions have been largely unexplored. We found a clear lack of studies that examined a possible recursive relationship between creativity and stress. Creative problem solving may decrease strain by helping employees cope or may increase strain when creative ideas are met with resistance from others (e.g., Janssen, 2004). Future studies should conduct experiments as well as longitudinal studies to determine the effect of creativity on the experience of stress.

Although it seems likely that mediators, such as strains and motivation, may further explain the relationship between stressors and creative performance, we found a dearth of research examining possible mediating mechanisms of the stressor–creativity relationship. Our finding that trait anxiety determines the effects of stressors seems to suggest that cognitive appraisals of stressors may play an important role in determining stressors' effect. Similarly, our finding that social evaluative and uncontrollable stress stimuli have different effects on creative performance points to several possible mediators of the stressor–creativity relationship, such as creative self-identity or self-determination and other associated psychological needs. Therefore, we recommend that future research examine mediating mechanisms, such as strains (Lazarus & Folkman, 1984), intrinsic motivation, and self-efficacy (e.g., Ryan & Deci, 2000). Additionally, future research can also benefit from examining the moderating effect of individual variables, such as openness to experience and creative role identity, in the context of stress and creativity (e.g., Baer & Oldham, 2006).

Because we used Dickerson and Kemeny's (2004) coding system, we examined the effects of social–evaluative threats and uncontrollability separately. We should note that some research suggests that evaluation can be framed as controlling. Shalley and Perry-Smith (2001) framed expected evaluation as either informational (i.e., providing information to improve performance) or controlling (i.e., setting standards of performance). Whereas the former increased creativity, the latter decreased creativity, supporting our general contention that uncontrollability inhibits creativity. Future research should further consider the intersection of controlling and evaluative elements in situations and examine their combined effects.

Lastly, some scholars have differentiated artistic and scientific creativity. These two types of creativity vary in their concern (artistic creativity is concerned with aesthetics; scientific creativity, with discovering answers or solutions to problems) and focus (artistic creativity is more introspective; scientific creativity, more externally focused; Feist, 1998). Consequently, they may differ in the degree to which they are influenced by external factors such as stressors. Although there was insufficient variation within each subanalysis to examine artistic and scientific creativity, we suggest that future research consider whether different stressors, such as evaluation or competition, have varying effects on these two types of creativity.

Practical Implications

Many organizations seek to increase creativity among their employees, and our findings form an empirical basis for possible organizational interventions to increase employee creativity. Specifically, the results point to primary stress management interventions, interventions aimed at preventing employees' exposure to specific stressors (e.g., LaMontagne, Keegel, Louie, Ostry, & Landsbergis, 2007). Our results suggest that managers seeking to increase creative performance among their employees should ensure that their employees feel a sense of control over their situation. Managers may increase creative performance by removing stressors that are likely to be associated with feelings of uncontrollability, such as bureaucratic red tape, role conflict, and time pressure.

Further, managers must walk a fine line when using evaluation, as too much emphasis on evaluation may decrease creativity. Some of the studies that involved performance evaluation had no social–evaluative threats according to Dickerson and Kemeny's (2004) coding system. Such studies, which were associated with increases in creative performance, did so by using an absolute, rather than relative, evaluation standard. These findings suggest that managers may increase creative performance by letting employees know that they will be evaluated. On the other hand, managers may decrease employees' creative performance by overemphasizing evaluation. Managers should avoid emphasizing comparisons with others or the negative consequences associated with lower relative performance and refrain from closely monitoring employees' performance.

Lastly, the results suggest that managers cannot expect a "one-size-fits-all" solution. Managers may seek to selectively add stressors to the work environments of some employees, such as those low in anxiety, in order to improve their creative performance. Further, managers may seek to help highly anxious employees to be less reactive in stressful situations and better cope with stressors such as evaluation and time pressure, given their ubiquity in workplaces.

Limitations

Despite the strengths of this meta-analysis, some limitations warrant attention. First, as with any meta-analysis, there were differences in the methodological and reporting quality in the studies included in this analysis (e.g., there exists considerable heterogeneity in how investigators manipulated stressful conditions). We advise future researchers to use true control conditions

and provide thorough explanations of their experimental manipulations. Second, it is likely that there remains considerable between-person variation in how much creative potential and other relevant cognitive abilities participants have and how participants cognitively appraise experimental manipulations of stressors. We urge more research that employs within- and between-person designs to account for initial differences in creative potential and that examines individual differences in awareness and appraisal of stressors.

Third, considering Hocevar's (1981) taxonomy of creativity measures, the studies included in this analysis were of two types of creative performance measurement: divergent thinking tests and judgments of products— (see Table 1). Little research has examined—though much debate surrounds—the extent to which these measures have predictive validity and generalize to creativity in the workplace (e.g., Cropley, 2000). Therefore, future research should examine the extent to which these findings generalize to the workplace.

Conclusions

The findings from this quantitative review move beyond examining the general nature of the relationship between stress and creativity to highlight inconsistent findings regarding how different stress stimuli are related to creativity. Our findings suggest that the relationship between stress and creativity is complex and may not be captured by merely describing the relationship as positive or negative. Future research should further elucidate this relationship by exploring promising mediators and moderators to determine for whom and under what conditions stress affects creativity.

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References marked with an asterisk indicate studies included in the meta-analysis. References marked with two asterisks indicate studies that were excluded because they were they reported on the same data set as that used in another included study.

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