Emotion

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The Role of Instrumental Emotion Regulation in the Emotions–Creativity Link: How Worries Render Individuals With High Neuroticism More Creative

Angela K.-y. Leung
Singapore Management University

Shyhnan Liou
National Cheng Kung University

Lin Qiu
Nanyang Technological University

Letty Y.-Y. Kwan
Sun Yat-Sen University

Chi-yue Chiu
Nanyang Technological University and Chinese Academy of Social Sciences

Jose C. Yong
Singapore Management University

Based on the instrumental account of emotion regulation (Tamir, 2005), the current research seeks to offer a novel perspective to the emotions–creativity debate by investigating the instrumental value of trait-consistent emotions in creativity. We hypothesize that emotions such as worry (vs. happy) are trait-consistent experiences for individuals higher on trait neuroticism and experiencing these emotions can facilitate performance in a creativity task. In 3 studies, we found support for our hypothesis. First, individuals higher in neuroticism had a greater *preference for* recalling worrisome (vs. happy) events in anticipation of performing a creativity task (Study 1). Moreover, when *induced* to recall a worrisome (vs. happy) event, individuals higher in neuroticism came up with more creative design (Study 2) and more flexible uses of a brick (Study 3) when the task was a cognitively demanding one. Further, Study 3 offers preliminary support that increased intrinsic task enjoyment and motivation mediates the relationship between trait-consistent emotion regulation and creative performance. These findings offer a new perspective to the controversy concerning the emotions–creativity relationship and further demonstrate the role of instrumental emotion regulation in the domain of creative performance.

Keywords: instrumental emotion regulation, creativity, neuroticism, emotions

Although the relationship between emotions and creativity has been extensively theorized and researched (e.g., Baas, De Dreu, & Nijstad, 2008; Forgas & George, 2001), it is still unclear which emotional state would benefit individual creativity most (Amabile, 1996a; Vosburg & Kaufmann, 1999). Whereas some studies showed that positive versus neutral moods facilitate cognitive complexity and creative problem solving across a broad range of settings (see Ashby, Isen, & Turken, 1999 for a review), others showed that negative moods (vs. positive or neutral moods) foster creative performance (e.g., Adaman & Blaney, 1995; Carlsson, Wendt, & Risberg, 2000; Clapham, 2001; Gasper, 2003).

Creativity has often been identified as the process of generating something both novel and useful (Amabile, 1996a). Given creativity's central role in human culture, previous research has amassed a huge body of empirical knowledge to discern the various determinants of creativity. Among one of the most researched factors is the role of emotions in creativity. Results from a recent meta-analysis of 63 empirical studies (Davis, 2009) support a *contextual perspective* to the emotions–creativity relationship (see also Martin & Stoner, 1996). There is general support for the facilitating effect of positive emotions on creativity. In contrast, the evidence for the creative benefits of negative emotions is mixed. Overall, the meta-analysis suggests that the moderating effects of negative emotions and even positive emotions on creativity are context dependent.

The feelings-as-information model provides an example that demonstrates the contextual perspective to the emotions–creativity

Angela K.-y. Leung, School of Social Sciences, Singapore Management University; Shyhnan Liou, Institute of Creative Industries Design, National Cheng Kung University; Lin Qiu, Division of Psychology, Nanyang Technological University; Letty Y.-Y. Kwan, Sun Yat-Sen Business School, Sun Yat-Sen University; Chi-yue Chiu, Division of Strategy, Management, and Organization, Nanyang Technological University and Chinese Academy of Social Sciences; Jose C. Yong, School of Social Sciences, Singapore Management University.

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Correspondence concerning this article should be addressed to Angela K.-y. Leung, School of Social Sciences, Level 4, 90 Stamford Road, Singapore Management University, Singapore 178903. E-mail: angelaleung@smu.edu.sg

link. The key premise of this model is that moods provide people important information (Clore, Schwarz, & Conway, 1994; Schwarz & Clore, 1988) and that the informational influence of current mood states is context dependent (Martin & Stoner, 1996). To the extent that moods provide people with information, a positive mood state may signal doing well on the creativity task and no further efforts are needed, thus potentially hampering creativity; conversely, a negative mood state may signal inadequate performance on the task and further efforts are needed, thus subsequently raising creativity (George & Zhou, 2002; Zhou & George, 2001). Interestingly, researchers also found that this feelings-as-information effect can be modulated by how the task is framed or construed (Friedman, Főrster, & Denzler, 2007). In a set of studies, when some creative generation tasks were framed as fun and silly, participants who were induced to feel positively performed better than when the same tasks were framed as serious and important. The reverse was true for the participants who were induced to feel negatively, so that they were more creative when the tasks were framed as serious and important (vs. fun and silly). These findings suggest that the emotions–creativity relation is a complex one that is largely dependent on the contextual construal of the task. As a result, creativity increases when the motivational inclination elicited by a given mood state (e.g., positive moods signaling safety and stimulation seeking) is compatible with the nature of task construal (e.g., fun).

Previous research has largely supported the contextual view as a useful framework to account for the emotions–creativity relation (Davis, 2009; George & Zhou, 2002, 2007). As such, the contextual perspective suggests that negative emotions might benefit creativity in certain situations (e.g., Baas, De Dreu, & Nijstad, 2011, 2012 works on how fear and uncertainty relate to creativity). For example, one recent research revealed that when the negative emotion of fear signals an unfulfilled prevention-focused state, this would lead individuals to generate as many original ideas and creative insights as under a promotion-focused state (Baas et al., 2011). In the current research, we present an alternative account to the contextual perspective by drawing on novel insights from the theoretical framework of instrumental emotion regulation (Tamir, 2009a; Tamir, 2011) in order to resolve the seemingly inconsistent findings pertaining to the link between negative emotions and creativity. Thus, adding to the contextual approach, we submit that the mixed results for negative emotions ensue from another possibility that negative emotions benefit individuals with certain personality dispositions only. In this light, we investigate how trait-consistent emotion regulation helps individuals attain higher creative performance.

According to the instrumental account of emotion regulation, experiences with trait-consistent emotions foster attainment of performance goals (Tamir, 2005, 2009b). Recognizing the instrumental benefits of trait-consistent emotions implies that emotion regulation is not always aimed at pleasure seeking. People can be motivated to attain positive outcomes for satisfying an instrumental motive rather than positive feelings for satisfying a hedonic motive. Therefore, when negative emotional experiences are instrumental for goal pursuit, individuals may be motivated to seek out these negative emotional experiences for the sake of goal attainment. For example, for the trait of neuroticism, individuals higher on this trait have a greater preference for worry- (vs. happiness-) enhancing activities before engaging in an effortful task (Tamir, 2005). As research on approach and avoidance motivational orientation suggests, emotions such as anxiety and worry are some trait-consistent emotions for individuals higher in neuroticism (Carver & Scheier, 1998; Carver, Sutton, & Scheier, 2000; Higgins, 1987). To elaborate, prior work has linked trait neuroticism with an avoidance system that prioritizes the motivation to prevent negative outcomes from happening. This avoidance motivation goes hand in hand with feelings of worry and anxiety, as individuals would feel worried and anxious in their anticipation or actual experience of negative outcomes. Such synchronization between the personality disposition and the often experienced affective state provides a strong motivational cue that effectively facilitates attainment of desired outcomes in a performance context. In addition, following the logic that trait-consistent affect regulation serves the functional goal of expending adequate effort for attaining high performance on a task, the instrumental benefit of trait-consistent affect was found to be more prevalent in cognitively demanding tasks, for these tasks require higher efforts to optimize performance (Tamir, 2005).

Drawing from this novel insight, the current research seeks to achieve four goals. First, applying the perspective of instrumental emotion regulation to the creative performance context, individuals higher in neuroticism who are in a worrisome (vs. happy) affective state will perform more creatively particularly when the creativity task is a cognitively demanding one. If confirmed, this finding will offer an alternative account to the contextual view of the emotions–creativity relationship (Davis, 2009) by recognizing the creative benefits produced by the congruence between individuals' trait disposition and their experienced emotional state. Essentially, we predict that negative emotions can improve creative performance mainly for individuals who have dispositional preferences for experiencing negative emotions before engaging in a challenging creativity task. Furthermore, this will show that the relationship between emotional states and creativity is not fixed. Instead, the same emotional state, regardless of its valence, can promote or retard performance depending on whether it is congruent with one's traits. To our knowledge, applying the theoretical perspective of instrumental emotion regulation to understanding the emotions–creativity link has never been explored in the vast literatures on emotions and creativity.

Second, the current research attempts to offer novel conceptual extension of the instrumental framework of emotion regulation by showing whether trait-consistent emotional experiences improve performance on tasks that require creative thinking. Prior research has found impressive evidence for the instrumental benefits of trait-consistent emotional experiences to performance on demanding cognitive tasks (Tamir, 2009b). Creativity as a performance domain is very different from other previously studied performance-related tasks in the instrumental emotion regulation literature (e.g., anagram task, preparation for a speech). For example, as compared with the anagram task, performing well in a creativity task requires more complex cognitive processing in order to create something both novel and useful (Amabile, 1996a). Given that no right or wrong answer is specified in creative idea generations as opposed to the presence of a correct answer to anagrams, it is reasonable to argue that completing an idea generation task demands much higher levels of cognitively flexibility to break set and persistence to prolong effort from the part of the individuals in order to excel in the task (see De Dreu, Baas, &

Nijstad, 2008 for a discussion on the dual pathway to creative performance). Besides the requirement of higher levels of cognitive processing, individuals engaging in a creativity task might be largely uncertain about their performance level even upon task completion. Whereas the performance level in an anagram task can be easily assessed and monitored by the individuals themselves, performance level in a creativity task is often not immediately accessible to the individuals. Their creative output has to await evaluations, with high performance requiring a certain degree of recognition by others or sufficient deviations from some normative standards. Therefore, it is theoretically interesting to examine if individuals will also engage in emotion regulation for instrumental reasons even when pursuing the performance task requires more complex and higher order cognitive processing, yet highly uncertain whether efforts can eventually be paid off. We believe that the current research is important because it sets out to challenge the theoretical boundary of the instrumental emotion regulation framework with a performance task that is of a different nature than those previously examined.

Third, whereas the past literature has shown robust findings regarding individuals' motivated affect regulation to *choose* to recall happy or worried events for possibly reaping instrumental benefits in an anticipated task, direct evidence on the instrumental benefits of actual performance outcome is relatively scant. To our knowledge, the benefit of instrumental emotion regulation on actual performance outcome was mainly examined with a cognitively demanding anagram task (Tamir, 2005, Study 4). It is therefore important to gather further evidence of whether instrumental emotion regulation impacts actual performance (vs. simply giving an expectation to perform in a task). Essentially, to shed novel insight to the literature on the moods-creativity link, it is critical to replicate the result with creativity tasks in order to observe the effects of different mood states on actual performance of individual creativity.

Fourth, aside from illustrating the applicability of the instrumental view of emotion regulation in the domain of creative performance, the current research seeks to understand the underlying psychological mechanism of the effect of trait-consistent emotion regulation on creativity. We posit that trait-consistent emotion regulation facilitates creative performance by increasing intrinsic task motivation, which may also explain other instrumental benefits of emotion regulation besides creativity. Past research has shown that a match between chronic personal preferences (e.g., orientations to approach or avoid) and evoked or task-induced states (e.g., happiness or anxiety) elicits the phenomenology of feeling right, which in turn motivates optimization of goal-pursuit strategies, and increases persistence and performance (Fulmer et al., 2010; Higgins, 1987; Higgins, 2000). The facilitation effect of the match between personal preferences and task-induced states can be attributed to an increase in intrinsic task enjoyment (Freitas & Higgins, 2002; Ryan & Deci, 2000; Shah & Kruglanski, 2000). In three studies, Freitas and Higgins (2002) showed that accomplishment-oriented individuals intrinsically enjoy eagerness-related actions more, whereas responsibility-oriented individuals intrinsically enjoy vigilance-related actions more. Regarding regulatory fit in the context of personality traits and goal pursuit strategies, one research showed that people higher in trait openness to experience are more motivated to pursue their hopes, aspirations, and goals framed in gain attainment, but less motivated to pursue their duties, obligations, and goals framed in loss avoidance (Vaughn, Baumann, & Klemann, 2008). This result demonstrates the motivating effect of regulatory fit between high openness and promotion (vs. prevention) focused strategy.

Besides research support for increased intrinsic motivation following a match between personal disposition and the experienced emotion state, evidence has shown that intrinsic motivation is highly conducive to creativity. Highly intrinsically motivated individuals are more deeply involved in the task and engage their creativity-relevant skills for attaining high creative performance (Amabile, 1996b). Relatedly, research suggested that individuals with a learning goal orientation, which is associated with high intrinsic motivation for increasing task competence, prefer solving challenging tasks with unconventional approaches (Vandewalle, 1997). Essentially, strong intrinsic interests are important for undertaking and excelling in a creativity task. Hence, consistent with the notion of regulatory fit, we hypothesize that for individuals with chronic tendencies to show high neuroticism, experiencing worrisome affective state can evoke a similar phenomenology of feeling right, which is manifest in increased intrinsic motivation and task enjoyment, leading to improved performance in demanding creativity tasks.

Overview of Studies

We sought to provide evidence for our hypotheses in three studies. In Study 1, we tested the hypothesis that individuals higher in neuroticism would *prefer* recalling worrisome (vs. happy) events in anticipation of performing an effortful creativity task. In Studies 2 and 3, we sought to show that when *induced* to recall a worrisome (vs. happy) event, individuals higher in neuroticism would generate more creative designs in a challenging idea generation task (Study 2) and generate more unusual uses of a common object under high cognitive load (Study 3).

We designed these three studies to achieve our research goals and to garner convergent evidence for our hypotheses in four ways. First, whereas Study 1 attempted to demonstrate that individuals higher in neuroticism would display stronger preferences for experiencing worry-related events prior to performing a creativity task, Studies 2 and 3 sought to show that the actual experience with worry-related events would actually enhance creative performance. Second, to assess the effect of experiencing trait-congruent affect on performance in cognitively demanding tasks, we used relatively effortful creative performance tasks in Studies 1 and 2. To provide further evidence that the creative benefits of experiencing trait-congruent affect would be particularly pronounced in a demanding task context, in Study 3 we experimentally manipulated the participants' cognitive load while performing the creativity task, using the procedure introduced by Macrae, Hewstone, and Griffiths (1993). Specifically, participants were required to rehearse either a two-digit (low load) or eight-digit (high load) number at the same time they engaged in the creativity task. Third, to provide convergent evidence for our hypotheses, we measured participants' creative performance with (a) peer ratings of creative designs in Study 2 and (b) relatively objective scoring criteria used in a standard creativity task (Alternate Uses Test) in Study 3. Finally, in Study 3, we used an analytical framework that combines moderation and mediation to test the mediation hypothesis that increased intrinsic motivation and task enjoyment mediate the

interaction effect of trait neuroticism and affective states on creative performance. In short, through these three studies, we seek to illustrate the facilitation effects of individuals' preferences for and actual experiences of trait-consistent emotions on creative performance in challenging task contexts.

Study 1

Preferences for trait-consistent emotions are more prevalent in the pursuit of an effortful performance goal, because such situations engage effortful self-regulation of emotions to maximize task performance (Tamir, 2005; Tamir, 2009b). Therefore, in the current study, we led the participants to anticipate a challenging creativity task before asking them to rate how much they preferred recalling different types of emotional events. We predicted that neuroticism would be related to higher preferences for recalling worrisome as opposed to other emotion-related events.

Participants

The participants were 261 Taiwanese students (178 males, 82 females, one did not report gender; $M_{age} = 20.36$, $SD_{age} = 1.29$) from a public university in Tainan, Taiwan who completed the study to receive course requirement credits.

Measures

Current emotion measure. Participants rated their current emotions with a 5-point scale (1 = *not at all* to 5 = *extremely*; adapted from Tamir, 2005; see also Larsen & Diener, 1992). The emotions included in the scale pertain to happiness (*happy*, *up*, and *enthusiastic*; $\alpha = .84$), worry (*anxious* and *worried*; $\alpha = .81$), sadness (*sad*, *down*, and *depressed*; $\alpha = .90$), and calmness (*calm*, *relaxed*, and *pleased*; $\alpha = .56$).

Neuroticism scale. Participants completed the 10-item neuroticism subscale of Goldberg's (1992) IPIP Big Five factor markers (e.g., "I often feel blue"; $\alpha = .85$). They indicated how self-descriptive each statement was on a 1 (*very inaccurate*) to 5 (*very accurate*) scale.

Preference for recalled events. Participants were presented with a list of 12 events (Tamir, 2005), with four events in each of the following contexts: family, friendship, and school. The four events in each context included an event that had evoked happiness (positive, high arousal emotion), worry (negative, high arousal emotion), calmness (positive, low arousal emotion), or boredom (negative, low arousal emotion). The participants rated (1 = *not at all* to 5 = *extremely*) the degree to which they would like to spend 10 min recalling each of the 12 events.

Procedure

The study was conducted via an online survey. Under the cover story that the study examined the relationship between memory and task performance, participants first completed the current emotion measure and the neuroticism subscale. Next, participants were told that they would perform a demanding creativity task, which requires them to consider and reconcile conflicting perspectives to come up with creative solutions to a complex problem. Participants were further instructed to recall a past event before working on the creativity task. At this point, the participants rated the degree to which they would prefer recalling each of the 12 emotional events. To check whether participants expected the upcoming task to involve an effortful creativity goal, they rated how (a) effortful and (b) cognitively demanding ($\alpha = .79$) the task would be (1 = *not at all* to 5 = *extremely*). We took the average of the two items to form an expected effort measure. As predicted, the mean of this effort measure ($M = 3.71$, $SD = 0.73$) was higher than the midpoint of the scale (i.e., the value of 3), $t(258) = 15.62$, $p < .0001$, indicating that participants expected the task to be an effortful one.

Results

Preliminary analysis showed that the contexts of the events (family, friendship, and school) did not qualify the effect of neuroticism on the type of emotional events (happy, worrisome, calm, and boring events) the participants preferred to recall, $F(1, 249) = 1.57$, $p = .21$, $\eta_p^2 = .01$. Thus, we collapsed the recall preference ratings across the three contexts to form recall preference ratings for the four kinds of emotional events (happiness, calmness, worry, and boredom). Next, we performed a mixed design General Linear Model analysis on the four recall preferences, with the level of arousal (high vs. low) and valence (positive vs. negative) of the emotional events as within-participant factors and neuroticism (mean centered) as a continuous predictor. We also controlled for the main and interaction effects of the four current emotions (all mean centered) and gender in the analysis.

Two main effects were significant. Participants preferred recalling positive ($M = 3.67$, $SD = 0.62$) versus negative events ($M = 2.82$, $SD = 0.67$), $F(1, 253) = 307.88$, $p < .0001$, $\eta_p^2 = .55$; and events that induced higher ($M = 3.59$, $SD = 0.65$) versus lower arousal ($M = 2.89$, $SD = 0.57$), $F(1, 253) = 272.69$, $p < .0001$, $\eta_p^2 = .52$. The predicted Arousal × Valence × Neuroticism interaction was also significant, $F(1, 253) = 10.21$, $p = .002$, $\eta_p^2 = .04$. To interpret this interaction, we ran separate multiple regressions on the preferences for recalling happy, worrisome, calm, and boring memories, with neuroticism as the predictor, again controlling for the main and interaction effects of current emotions and gender. Supporting our hypothesis, neuroticism predicted greater preferences for recalling worrisome memories ($b = 0.47$, $SE = 0.09$, $t = 5.04$, $p < .0001$), but not those for happy, calm, and boring memories ($ts < 1.72$, $ps > .09$). No effects involving current emotions ($Fs < 3.70$) and gender ($F < 0.03$) were significant in these analyses.

To estimate mean levels of preference for recalling worrisome experiences, we conducted simple regressions on the recall preference for worrisome events, with neuroticism at higher levels (1 *SD* above mean) and at lower levels (1 *SD* below mean) as predictors. Participants higher on trait neuroticism expressed stronger preferences for worrisome experiences (expected $M = 3.83$) than those lower on trait neuroticism (expected $M = 2.59$). Thus, our prediction that individuals higher in neuroticism prefer recalling worrisome events than others (happy, calm, and boring events) while anticipating a cognitively challenging creativity task was confirmed.

Study 2

Having shown in Study 1 that individuals higher in neuroticism have stronger preferences for experiencing worry-related events in

anticipation of an effortful creativity task, Study 2 (and Study 3) go beyond examining emotion preferences in response to an anticipated task by (a) situationally inducing emotional experiences and (b) testing subsequent actual performance in a creativity task. Specifically, we manipulated participants' emotional experiences before having them engage in a creative idea generation task. We predicted that the peer-rated creative performance of individuals higher in neuroticism would benefit more from experiencing a worrisome (vs. happy) state.

Participants

Forty Taiwanese students (19 males, 20 females, one did not report gender; $M_{age} = 22.55$, $SD_{age} = 4.78$) from a public university in Tainan, Taiwan participated in a 2-day creativity workshop. Most students in the creative industries program voluntarily participated in the interactive workshop to learn about individual and team creativity. They completed the study as workshop activities on the first day.

Procedure and Materials

In the morning session of the workshop, participants completed the same neuroticism subscale used in Study 1 ($\alpha = .87$) and other individual difference assessments unrelated to the current study. When the afternoon session began, through random assignment we manipulated participants' emotional experience by asking them to recall either a happy or worrisome experience. Participants were given 15 min to provide vivid and detailed descriptions of the recalled experience (see Pham, 1998; Schwarz & Clore, 1983). Some sample happy recalled events are: One participant described the fun of mango picking with friends; another participant recalled the celebration of his or her 18th birthday with high hopes and enthusiasm for the future. Some sample worrisome recalled events are: One participant recalled the difficulty of making friends when moving to a new school; another participant described his suspicion of his ex-girlfriend dating his best friend. Next, they completed the 20-item PANAS (Crawford & Henry, 2004; 10 positive emotions, e.g., "enthusiastic," $\alpha = .83$ and 10 negative emotions, e.g., "irritable," $\alpha = .89$), which was used as a measure of the extent to which they had felt positive and negative emotions at that moment (1 = *not at all* to 5 = *very much so*). In particular, for manipulation check purpose we extracted three worry-related emotions from the list of negative emotions ("afraid," "nervous," and "scared"; $\alpha = .87$) to test whether the worrisome (vs. happy) recall condition produced more worry-related emotions.

After this, the participants completed a creativity task that required them to generate a new design for the cabin of a commercial airplane in 30 min. Upon completing their design, participants convened in a preassigned group of three to five participants (a total of 10 groups) and gave a 5-min presentation of their design. Each group member then rated the design on three criteria ("it is creative," "it extends and breaks boundaries in design," and "it meets the stated goal of the design"; $\alpha = .80$) on a 7-point scale (1 = *not at all* to 7 = *extremely*). The average composite scores given by all members constituted our dependent measure of creativity. The task was intended to be a demanding one, given that the participants had only 30 min to generate the design and face peer evaluations of the design by giving an oral presentation.

Results

As a manipulation check, we performed a Recall Condition (between-participants factor: happy vs. worrisome) × Emotion Valence (within-participant factor: positive emotions vs. worry-related emotions) Analysis of Variance on the average amounts of positive and worry-related emotions reported by the participants. The two-way interaction was significant, $F(1, 38) = 11.01$, $p = .002$, $\eta_p^2 = .23$. Participants reported more positive emotions in the happy ($M = 3.11$, $SD = 0.63$) than the worrisome condition ($M = 2.53$, $SD = 0.75$), $F(1, 38) = 7.19$, $p = .01$, $\eta_p^2 = .16$. They also reported more worry-related emotions in the worrisome ($M = 2.27$, $SD = 1.06$) than the happy ($M = 1.63$, $SD = 0.81$) condition, $F(1, 38) = 4.77$, $p = .04$, $\eta_p^2 =$. 11. The recall task as a manipulation of participants' current emotional experiences was successful.

To test our hypothesis, we performed analyses based on the Social Relations Model (SOREMO; Kenny, 1994, 1998). Because each participant was nested within a group and rated by other group members, according to the Social Relations Model, it is important to separate three types of effects on the ratings: (a) the *rater effect*, which represents raters' individual differences in ratings, with some raters on average giving targets higher or lower ratings than other raters; (b) the *target effect*, which represents consistent differences in how the targets are rated, with some targets in each group consistently being rated higher or lower than other targets; and (c) the *relationship effect*, which represents the rater by target interaction, or the unique relationship between a given rater and a given target that has affected the ratings above and beyond the rater and target effects. Notably, these rater, target, and relationship effects that might emerge in a nested design are potential confounds on the dependent variable, and statistical procedures without controlling for these confounds will be less diagnostic (see also Footnote 1). The SOREMO procedure takes into account these confounding effects to ensure that the results found are more valid.

We organized the rating data into a round-robin structure to prepare for analysis using the SOREMO program. Specifically, we organized the creativity scores of each group into separate matrices, with each row of the matrix indicating the raters' ratings toward each target and the columns indicating the targets being rated. The diagonal entries of the matrices were zero because we did not collect participants' self-ratings. We also entered the recall condition, neuroticism (mean centered), and the interaction of recall condition and neuroticism into the analysis. Because SOREMO partitioned the variance in the creativity ratings into the rater, target, and relationship effects, we could examine whether the average percentage of variance of ratings attributable to each source differed significantly from zero.

Results revealed a nonsignificant rater effect (relative variance = 0.43, $t = 1.72$, $p = .12$), suggesting that different raters rated the same targets similarly. The target effect reached marginal statistical significance (relative variance = 0.18, $t = 1.95$, $p = .08$), suggesting that as expected the rated creative performance of some targets tended to be different from that of other targets. The relationship effect was not significant (relative variance = 0.40, $t = -1.37$, $p = .20$).

More importantly, we are interested in testing whether the target effect was associated with our variables of interest, namely, the

recall condition, individual levels of neuroticism, and their interaction. The SOREMO analysis revealed a significant main effect of neuroticism ($t = 2.65$, $p = .01$; $r = .54$), which as expected was qualified by a significant interaction between recall condition and neuroticism, $t = 2.09$, $p = .046$.[1] To follow up on this interaction, Figure 1 shows the simple main effects of the recall condition on creative performance among individuals with relatively higher (one standard deviation above mean) and lower (one standard deviation below mean) levels of neuroticism. Among individuals with relatively higher levels of neuroticism, they tended to perform more creatively after recalling a worrisome instead of a happy event, $t = 1.87$, $p = .07$. Among individuals with relatively lower levels of neuroticism, they tended to perform less creatively after recalling a worrisome instead of a happy event, $t = -1.93$, $p = .06$.

To summarize, the results offered preliminary support for our prediction that individuals higher in neuroticism tended to receive higher creativity ratings from their peers after recalling worrisome (vs. happy) events, but the reverse was true for individuals lower in neuroticism. By properly taking into account the rater, target, and relationship effects important to a nested design, the findings obtained from the SOREMO analysis confirm our prediction that actual induction of worrisome (vs. happy) experiences creates actual creative benefits among individuals higher in neuroticism.

Study 3

Although the findings of Study 3 generally support our contention that individuals with higher levels of trait neuroticism reap creative benefits from experiencing worrisome (vs. happy) events, the sample size of 40 participants was not the most ideal and the simple main effects of emotional induction on creative performance only reached marginal significance. Study 3 is an extension of Study 2 in four important ways. First, in addition to manipulating the recall of happy and worrisome events, we included a neutral condition. And we had recruited a much larger sample in Study 3. Second, recall that the creative generation task in Study 2 was a relatively demanding one, for participants had to design the cabin of a commercial airplane within a time limit of 30 min and later to convince other group members that the design is indeed creative in an oral presentation. The use of a cognitively demanding creativity task is in line with previous findings that the instrumental value of trait-consistent emotions is more prevalent in the pursuit of an effortful performance goal, because such situations require a higher level of emotional regulation to maximize task performance (Tamir, 2005; Tamir, 2009b). Although results in Study 2 are consistent with our expectation that participants higher in neuroticism received higher creativity ratings from the evaluators after recalling a worrisome (vs. happy) event, we did not systematically vary the levels of cognitive efforts required for the creativity task. In Study 3, we seek to provide more direct evidence that the creative benefits of trait-consistent emotional experiences are more likely to occur in a cognitively demanding task context. We manipulated the participants' cognitive load while performing the creativity task, with half of the participants performing the task while remembering a eight-digit number (high load condition) and the other half performing the same task while remembering a two-digit number (low load condition). We hypothesize that the expected instrumental emotion regulation effect is more likely to emerge under the high cognitive load situation.

Third, to extend the generality of Study 2's results, we used the Alternate Uses Test as a measure of creativity (Guilford, 1967). An advantage of this standard creativity measure is that it uses relatively objective criteria to assess both fluency (sheer number of ideas generated) and flexibility (number of different categories that characterize the ideas) of creative idea generation. This task nicely complements the creative idea generation task used in Study 2, which is a relatively more subjective task based on peer evaluations.

Finally, we took a general analytical framework for combining moderation and mediation (Edwards & Lambert, 2007) to evaluate (a) whether neuroticism moderates the relationship between the recalled emotional states and creative performance under cognitive load and (b) whether the moderating relationship described in (a) is produced by the mediating mechanism of intrinsic motivation.

Participants

The participants were 274 Taiwanese students (170 males, 93 females, 11 did not report gender; $M_{age} = 19.92$, $SD_{age} = 1.32$) from a public university in Tainan, Taiwan who completed the study to receive course requirement credits.

Procedure and Measures

Under the cover that the study examined factors that affect memory retention, participants first completed the neuroticism subscale ($\alpha = .84$) used in Studies 1 and 2. Next, they recalled a happy, worrisome, or neutral experience. The instructions for recalling the happy and worrisome experiences were identical to those used in Study 2. Following Pham (1998), we instructed the participants in the neutral condition to write about the experiences they usually have during a typical school day. At the end of the

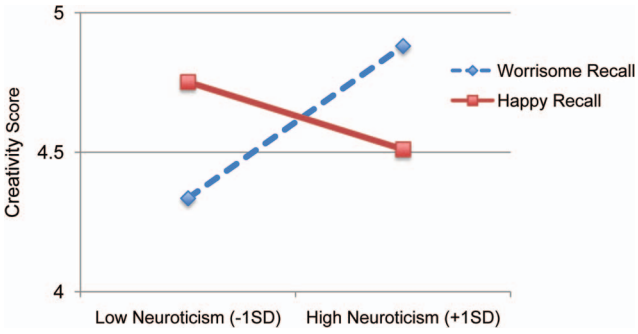

Figure 1. The effect of recall of emotional events on creativity task performance, Study 2. The color version of this figure appears in the online article only.

[1] Besides the SOREMO analysis, we also performed a regression to test the Recall Condition × Neuroticism (mean centered) interaction on the creativity composite score without taking into account the actor and partner effects. The result of the two-way interaction was consistent with that obtained from SOREMO, $b = -0.52$, $SE = 0.26$, $t = -1.98$, $p = .055$. No other effects were significant, $ts < 1.63$.

mood induction task, participants reported their current positive and negative emotions on the 20-item PANAS (Crawford & Henry, 2004; $\alpha = .88$ for positive emotions and .90 for negative emotions).

Next, following Macrae et al.'s (1993), we had half of the participants, randomly selected, study a two-digit number and the remaining participants an eight-digit number for 25 s. They were told that upon completion of the upcoming thinking exercise they would be required to recall this number. The thinking exercise was the Alternate Uses Test, which measures how well individuals can generate a large number of ideas and devise a diverse set of strategies of using a common object (a brick in the current study; Guilford, 1967). As in past studies (e.g., Cheng, Leung, & Wu, 2011; Hoff & Carlsson, 2002; Leung & Chiu, 2008; Leung et al., 2012; Lissitz & Willhoft, 1985), we instructed participants to list as many uses for a brick as possible by not limiting themselves to any kind of brick or to any uses they had seen or heard about before. Upon completing the creativity task, participants wrote down the number they recalled in the space given. Finally, by referring to the thinking exercise they just completed, they answered the four-item intrinsic motivation subscale adapted from the Situational Motivation Scale (SIMS; Guay, Vallerand, & Blanchard, 2000). The four items ($\alpha = .95$) are "I think that this task is interesting," "This task is fun," "I think that this task is pleasant," and "I feel good when doing the task." Participants responded to each item using a scale from 1 (*strongly disagree*) to 7 (*strongly agree*).

Results

As a manipulation check, we performed an Emotion Recall (between-participants factor: happy vs. worrisome vs. neutral) × Emotion Valence (within-participant factor: positive vs. worry-related emotions) repeated measures ANOVA on the average amounts of positive and worry-related emotions reported by the participants. As in Study 2, the worry-related emotions pertain to "afraid," "nervous," and "scared" ($\alpha = .83$) from PANAS. The two-way interaction was significant, $F(2, 271) = 4.09$, $p = .02$, $\eta_p^2 = .03$. Separate analyses performed on the positive and worry related emotions revealed that participants reported more positive emotions in the happy ($M = 3.20$, $SD = 0.78$) than the worrisome ($M = 2.93$, $SD = 0.78$) and neutral conditions ($M = 3.06$, $SD = 0.72$), $F(2, 271) = 2.63$, $p = .07$, $\eta_p^2 = .02$. Specifically, the extent of positive emotions differed significantly between the happy and worrisome recall conditions, $F(1, 178) = 4.96$, $p = .03$, $\eta_p^2 = .03$. The extent of worry-related emotions across the three recall conditions differed in the expected direction though not statistically significant ($M_{\text{worrisome}} = 1.92$, $SD = 1.07$; $M_{\text{neutral}} = 1.81$, $SD = 1$; $M_{\text{happy}} = 1.62$, $SD = 0.90$; $F(2, 271) = 1.87$, $p = .16$, $\eta_p^2 = .02$).[2]

We also conducted chi-square tests to show that the likelihood of correctly recalling the number did not differ across recall conditions for both high and low load conditions (percentages of correct recall are 86%, 83.3%, and 91.7% for worrisome, neutral, and happy conditions in the high load condition, respectively, $\chi^2(2, N = 134) = 1.25$, $p = .54$; percentages of correct recall are 92.7%, 95.6%, and 94.6% for worrisome, neutral, and happy conditions in the low load condition, respectively, $\chi^2(2, N = 137) = .38$, $p = .83$), suggesting that participants in all recall conditions took the recall task seriously.

Testing the moderating relationship between recalled emotions and neuroticism on creativity. The two measures of creativity were (a) fluency, or the number of ideas generated for using the brick; and (b) flexibility, or the number of different categories of ideas. For the fluency measure, a judge counted the total number of ideas the participants generated. For the flexibility measure, one judge first reviewed all responses to come up with the coding categories (e.g., building material, weapon, furniture) and coded the responses accordingly. Using the same coding categories and adding new ones if necessary, another judge independently coded the responses (interrater agreement = 84.44%). Finally, the two judges discussed any disagreements in their codings to reach a consensus. To test our hypothesis, we performed an Emotion Recall (happy vs. worrisome vs. neutral) × Cognitive Demand (low load/two-digit number vs. high load/eight-digit number) × Neuroticism (mean centered) Analysis of Variance separately on the two creativity measures.

None of the main or interaction effects on fluency were significant (Fs < 0.95). Nevertheless, the predicted three-way interaction on flexibility was significant, $F(2, 262) = 3.38$, $p = .04$, $\eta_p^2 = .03$. No other effects on flexibility were significant, Fs < 2.45. We obtained the expected interaction on flexibility but not fluency, possibly because the flexibility score (i.e., the number of diverse categories that characterize the ideas generated) is a more sensitive measure of creativity than the fluency score (i.e., the sheer number of ideas generated). It is not uncommon that individuals can manifest high fluency by generating a large number of ideas, with the ideas themselves not being particularly unusual or creative (De Dreu et al., 2008; Förster, Friedman, & Liberman, 2004; see also General Discussion).

To interpret the significant interaction, we conducted separate regressions for the low and high cognitive load conditions using dummy codings for the emotion recall conditions. When cognitive load was low, no main and interaction effects were significant (ts < -0.96; Figure 2). When cognitive load was high, the main effect of neuroticism was significant ($b = 1.48$, $SE = 0.55$, $t = 2.70$, $p = .01$), which was qualified by the significant Worrisome (vs. Happy) Recall × Neuroticism interaction ($b = -1.65$, $SE = 0.80$, $t = -2.08$, $p = .04$) and the Worrisome (vs. Neutral) Recall × Neuroticism interaction ($b = -2.20$, $SE = 0.76$, $t = -2.89$, $p = .01$). As shown in Figure 2, when under high cognitive load, individuals with relatively lower levels of neuroticism (1 *SD* below the mean) had higher flexibility scores after recalling neutral (vs. worrisome) events ($b = 1.47$, $SE = 0.68$, $t = 2.16$, $p = .03$). In contrast, among individuals with relatively higher levels of neuroticism (1 *SD* above the mean), there was a trend that recalling worrisome events produced higher flexibility than did recalling neutral events ($b = -1.30$, $SE = 0.68$, $t = -1.91$, $p = .059$) and happy events ($b = -1.12$, $SE = 0.72$, $t = -1.56$, $p = .12$).

[2] When we examined all the 10 negative emotions, the difference of the degree of negative emotions across the three recall conditions was marginally significant ($M_{\text{happy}} = 1.88$, $SD = 0.77$; $M_{\text{worrisome}} = 2.16$, $SD = 0.78$; $M_{\text{neutral}} = 2.02$, $SD = 0.82$; $F(2, 271) = 2.76$, $p = .07$, $\eta_p^2 = .02$). Moreover, the extent of negative emotions differed significantly between the happy and worrisome recall conditions, $F(1, 178) = 5.72$, $p = .02$, $\eta_p^2 = .03$.

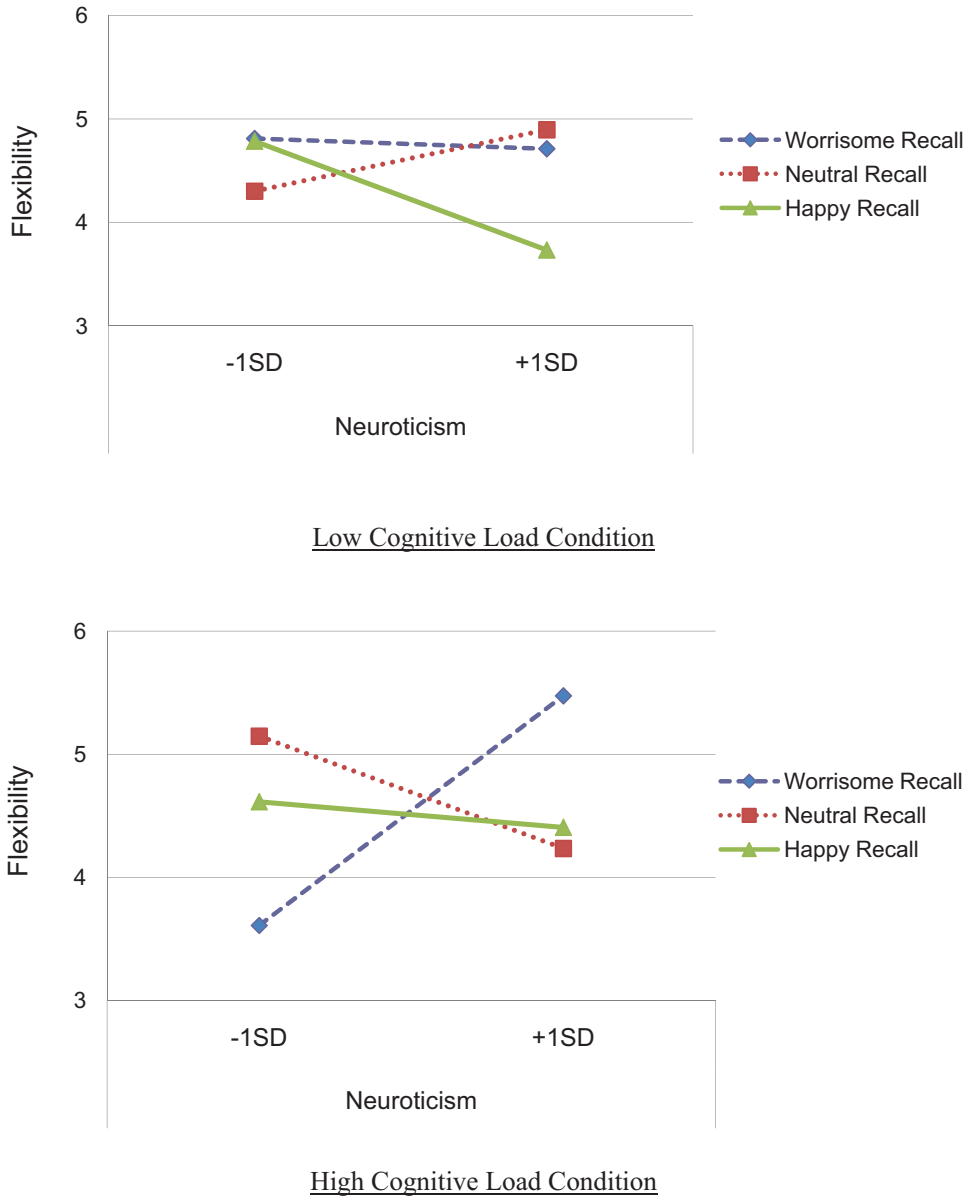

Figure 2. The effect of recall of emotional events on flexibility, Study 3. The color version of this figure appears in the online article only.

Testing intrinsic motivation as the mediator. We predicted that under high cognitive load, intrinsic task motivation would mediate the link between recalled emotional states and flexibility, with the effect of recalled emotional states on intrinsic task motivation moderated by the participants' levels of neuroticism. Using the framework outlined by Hayes (2013; SPSS macro), we tested the first stage moderation model (Edwards & Lambert, 2007; see Figure 3) using a series of linear regressions (see Table 1). Under the high cognitive load condition, the first regression confirms a significant interaction between worrisome (vs. happy) recall and levels of neuroticism, with intrinsic task motivation as the dependent variable ($b = -0.70$, $SE = 0.35$, $t = -2.00$, $p = .048$). The interaction between worrisome (vs. neutral) recall and neuroticism on intrinsic motivation, however, was not significant ($b = -0.06$, $SE = 0.35$, $t = -0.16$, $p = .87$). Follow-up analyses revealed that trait neuroticism was positively associated with intrinsic task motivation when worrisome memories were induced ($b = 0.75$, $SE = 0.30$, $t = 2.50$, $p = .02$), but not when neutral ($b = 0.06$, $SE = 0.30$, $t = 0.19$, $p = .85$) or happy ($b = -0.21$, $SE = 0.30$, $t = -0.71$, $p = .48$) memories were induced. Next, the second regression demonstrates that greater intrinsic task motivation predicts higher flexibility ($b = 0.39$, $SE = 0.17$, $t = 2.28$, $p = .02$).

In contrast, under low cognitive load condition, regression analyses did not show interactions between worrisome (vs. happy) recall and neuroticism and between worrisome (vs. neutral) recall

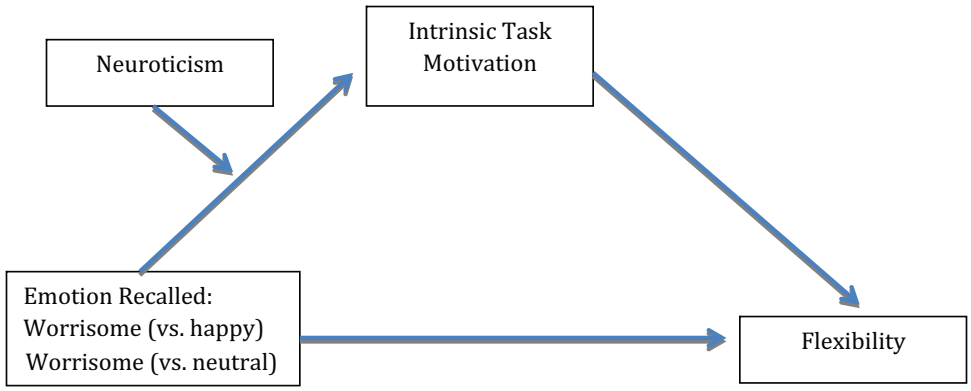

Figure 3. First stage moderation model with (a) intrinsic task motivation mediates the link between recalled emotional states and flexibility and (b) neuroticism moderates the link between recalled emotional states and intrinsic task motivation, Study 3. The color version of this figure appears in the online article only. The color version of this figure appears in the online article only.

and neuroticism on intrinsic motivation ($t = -0.79$, $p = .43$ and $t = 0.21$, $p = .84$, respectively).

To confirm that under high cognitive load intrinsic task motivation mediates the effect of worrisome (vs. happy) recall on flexibility for individuals with higher levels of neuroticism but not those with lower levels of neuroticism, we obtained the bootstrap confidence intervals for this conditional indirect effect. Using a bootstrap procedure with 1,000 bootstrap samples, the analysis yielded a bootstrap 95% bias-corrected confidence interval [−0.90, −0.01] at higher levels of neuroticism (1 *SD* above the mean), suggesting that intrinsic motivation mediated the link between worrisome (vs. happy) recall and flexibility for individuals with higher neuroticism. When neuroticism was at lower levels (1 *SD* below the mean) or at the mean level, analyses yielded a bootstrap 95% bias-corrected intervals of [−0.14, 0.37] and [−0.48, 0.03] respectively, suggesting that the same mediation did not occur.

These results confirm that when recalling worrisome (vs. happy) events under high cognitive load, individuals higher in trait neuroticism have higher levels of intrinsic motivation than their counterparts lower in trait neuroticism. Higher levels of intrinsic motivation in turn predict greater flexibility in idea generations. Taken together, the current findings provide preliminary evidence that intrinsic motivation mediates the joint effect of worrisome (vs. happy) emotion recall and neuroticism on flexibility when individuals need to expend greater cognitive efforts in completing the creativity task.

Table 1
Summary of Linear Regression Results, Study 3

	Dependent variables	
	Intrinsic task motivation	Flexibility
Emotion recalled		
Worrisome (ref) vs. happy	−0.29 (0.24)	0.06 (0.47)
Worrisome (ref) vs. neutral	0.25 (0.23)	0.11 (0.44)
Neuroticism	0.43* (0.21)	
Worrisome (vs. happy) × Neuroticism	−0.70* (0.35)	
Worrisome (vs. neutral) × Neuroticism	−0.06 (0.35)	
Intrinsic task motivation		0.39* (0.17)

Note. The entries are unstandardized coefficient estimates with standard errors in parentheses.
* $p < .05$.

General Discussion

In three studies, we have demonstrated the role of instrumental emotion regulation in the emotions–creativity link. Individuals higher (vs. lower) in neuroticism showed stronger preferences for experiencing worrisome emotions in anticipation of a demanding creativity task (Study 1). By systematically manipulating the experience of emotional states, those who actually experienced worrisome emotions produced creative designs that were rated as being more creative by their peers (Study 2) and were more cognitively flexible in generating unusual uses of a common object under high cognitive load (Study 3). Preliminary evidence from Study 3 also shows that increased intrinsic motivation is a mediator of the creative benefits of instrumental emotion regulation.

Some limitations of the current research deserve discussion. Recall that in Study 2 participants were asked to give an oral presentation of their creative design so other group members could evaluate their performance. One can reasonably argue that there is a possibility that presentation skills of the participants may help raise the creativity ratings. We acknowledge this possibility, but believe that such confounding effect is minimal. First, we doubt that good presentation skills will override the actual creativity of the design to result in high creativity ratings. Second, three to five evaluators rated the design, so we doubt that all the evaluators were affected by the presentation skills without paying much attention to the design itself. Third and more importantly, we did not rely on only one creativity measure that is potentially confounded with presentation skills to draw our conclusions. We obtained consistent results from three studies that used different methodologies and creativity tasks. With a triangulation of designs and measures, findings are largely supportive of our hypotheses.

In Study 3, instrumental emotion regulation affected cognitive flexibility, but not fluency of idea generations, possibly because fluency, which is based on the sheer number of ideas generated, is a less sensitive measure of creativity (DeDreu et al., 2008). Individuals can be quite fluent, but not flexible if they generate many ideas that belong to one or a few categories. Relatedly, being more cognitively flexible or being able to generate ideas that spread across diverse categories (vs. simply being more fluent in generating multiple ideas) requires higher intrinsic motivation. As the current research suggests that intrinsic motivation is one mechanism underlying instrumental emotion regulation, this might explain why the predicted effect of experiencing trait-congruent affect was observed in cognitive flexibility rather than fluency.

The present findings offer new insights into the controversy concerning the relationship between emotional states and creativity. The emotions that benefit creativity may not be the same for all individuals. Individuals' choices of emotional experiences are likely to be consistent with the experiences they typically encounter (Mayer & Stevens, 1994). As suggested by the current findings, individuals vary in their preferences for experiencing happy or worrisome emotions prior to performing a creativity task, particularly when it is demanding or needs to be performed under high cognitive load. These results highlight that trait-consistent emotion regulation enhances creative performance through its instrumental rather than hedonic motivational properties (Tamir, Mitchell, & Gross, 2008).

The current findings support the regulatory benefits of worrisome (vs. happy) emotional experiences for individuals higher in neuroticism when they engage in a creativity task. Future research could explore the creative benefits of instrumental emotion regulation with other personality traits and identify the specific kind of motivationally adaptive emotional states for a given trait. For example, for the trait openness to experience, it would be interesting to test whether affective states such as inspired and carefree are instrumentally beneficial for open-minded individuals. Such research efforts would broaden our understanding of the pragmatic benefits of experiencing trait-consistent affect.

Another direction for future research regarding the emotions–creativity link pertains to studying the instrumental benefits of emotion regulation for another important type of creativity—insight creativity—as opposed to creative idea generation investigated in the current research. Although insight creative problem-solving, like creative idea generation, requires individuals to overcome cognitive fixedness to generate multiple ideas, it also requires activating the cognitive process of forging broader associative links among given stimuli in order to arrive at the best solution (Dewhurst, Thorley, Hammond, & Ormerod, 2011; Rossmann & Fink, 2010). The search for the best answer or the most creative solution is likely to be an iterative process that requires cognitive focus and persistence. Whereas Study 3 offers preliminary support that intrinsic motivation driven by task enjoyment might account for why trait-consistent emotional experiences enhance creative idea generation, it is reasonable to argue that cognitive persistence might account for why trait-consistent emotional experiences enhance insight creativity. Future research can extend the current findings to different types and domains of creativity to better understand the operative motivational and cognitive mechanisms underlying the relationship between trait-emotion fit and creative performance, shedding further light on the emotions–creativity link.

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