Effects of Creative Thinking and Its Personality Determinants on Negative Emotion Regulation

Fa-Chung Chiu
Department of Counseling, Chinese Culture University, Taipei, Taiwan, ROC

Chih-Chun Hsu
Center for Teaching and Learning Development, National Taiwan Normal University, Taipei, Taiwan, ROC

Yao-Nan Lin
Department of Business Administration, Fu Jen Catholic University, New Taipei City, Taiwan, ROC

Cheng-Hong Liu
Center for Teacher Education, National Tsing Hua University, Hsinchu, Taiwan, ROC

Hsueh-Chih Chen
Department of Educational Psychology and Consulting, National Taiwan Normal University, Taipei, Taiwan, ROC

Chi-Hsiang Lin
Department of Psychology and Social Work, National Defense University, Fu Hsing Kang College, Taipei City, Taiwan, ROC

Abstract
This study investigated the relationship between creativity and negative emotion, and the effects of integrating creative insight into the reappraisal process on negative emotions. In Study 1, participants’ creativity and baseline anxiety levels were measured; then anxiety was induced, and anxiety levels were reassessed. In Study 2, participants wrote about past negative events and then completed the positive and negative affect schedule. They were split into three groups (insight reappraisal, simple reappraisal, or control groups); each of them received a separate intervention, and then they completed positive and negative affect schedule again. In Study 3,

Corresponding Author:
Fa-Chung Chiu, Chinese Culture University, 55, Hwa-Kang Road, Yang-Ming-Shan, Taipei, Taiwan 11114, ROC.
Email: fachung1014@gmail.com
participants were randomly assigned to insight reappraisal or control groups; apart from measuring cognitive changes, the procedures were identical to Study 2. All participants were undergraduate students. Results showed that flexibility, originality, risk-taking, and complexity are negatively correlated with anxiety, and that insight reappraisal can induce insight experience and enhance cognitive changes, and reduce negative emotional responses. Therefore, integrating creative insight into the reappraisal process can enhance its effectiveness in reducing negative emotions.

**Keywords**
Anxiety, creative tendency, divergent thinking, insight experience, reappraisal

**Introduction**

For individuals to have effective interpersonal relationships in their social networks and work environments, they must be able to manage their negative emotions (Gross, 1998). Numerous methods for regulating negative emotion have been proposed, including distraction (e.g., Van Dillen & Koole, 2007), reappraisal (e.g., Gruber, Hay, & Gross, 2014), mindfulness (e.g., Lutz et al., 2014), and suppression (e.g., Gross & Thompson, 2007). Previous studies have determined that positive emotions can enhance creativity (De Dreu, Baas, & Nijstad, 2008; Estrada, Isen, & Young, 1994; Greene & Noice, 1988; Isen, Johnson, Mertz, & Robinson, 1985; Madjar, Oldham, & Pratt, 2002), and effects in the opposite direction have also been observed; creative thinking can influence emotions (e.g., Brunyé et al., 2013; Chermahini & Hommel, 2012).

However, in most studies, the emotional responses of participants were observed after they completed a creative task, and the focus was on observing the influence of creative thinking on emotions in natural conditions. In addition, only short-term effects of creative thinking on emotion were observed (e.g., Bujacz et al., 2016; Chermahini & Hommel, 2012; Shenhav, Barrett, & Bar, 2013). Whether stable, long-term creativity can regulate negative emotion has not been explored. Therefore, we examined whether creativity can inhibit negative emotion; if this is so, then improving creativity can enhance the regulation of negative emotion.

Reappraisal, which is an effective method for emotion regulation, refers to obtaining a different viewpoint about negative stimuli by considering new information from the stimuli (Ochsner & Gross, 2008). Empirical studies have found reappraisal related to mild depression symptoms (Garnefski & Kraaij, 2006). Both reappraisal (Gross, 1998) and insight problem-solving (Knoblich, Ohlsson, Haider, & Rhenius, 1999) involve considering problems from various perspectives, and integrating creative insight into the reappraisal of emotional regulation may enhance the effectiveness of reappraisal in reducing negative emotions. Moreover, in cognitive behavioral therapy, deep insight can predict the alleviation of symptoms. Insight may be a mediating variable related to symptom
alleviation (Perivoliotis et al., 2010), given that the insight experience from solving an insight problem may enhance the effectiveness of reappraisal. In practice, it takes time for clients to use insight to produce therapeutic effects. However, if a psychotherapist can actively raise insight problems to clients to help the clients attain insight experience, the therapeutic process can be shortened because of the enhanced therapeutic effect. This furnishes the rationale for this study.

In summary, the first aim of this study was to explore the relationship between creativity and emotion. The second aim was integrating creative insight into the reappraisal of emotional regulation to enhance the effectiveness of reappraisal in reducing negative emotions.

**Creativity**

Rhodes (1961) defined and examined creativity according to the 4P model (Product, Person, Process, and Press). “Product” refers to a person’s ability to generate novel and appropriate products or ideas (Sternberg & Lubart, 1999); “process” mainly involves the mental processes of creative thinking; “person” relates personality to creativity (Feist, 1998); and “press” refers to the environments that can evoke the creative performance of an individual (Amabile, 1990). The definition of creativity adopted in the current study was centered on the “process” and “person” aspects.

In the creative process, creative thinking includes remote association, insight, and divergent thinking. Mednick (1962) defined creativity as the ability to associate two unrelated (i.e., remote) ideas or objects to produce creative products. When investigating insight, Metcalfe and Weibe (1987) indicated that the feeling of “warmth” (i.e., the feeling of answers emerging) differs when solving insight-based versus non-insight-based problems. Participants in their study experienced warmth when answers to non-insight problems were nearly apparent, and soon obtained the correct answers; however, the feeling of warmth was lacking when they encountered problems requiring insight. The answers to insight problems were unexpected and typically appeared spontaneously in the form of an “Aha!” moment. Guilford (1956) defined divergent thinking as the ability to generate diverse creative ideas, and measured it with the Unusual Uses test, in which participants were asked to list unusual or alternative uses for bricks. These were evaluated according to the indicators of fluency, originality, and flexibility. Fluency is the ability to generate numerous ideas; originality is the ability to generate novel ideas; and flexibility is the ability to generate ideas for several conceptual categories.

Regarding the “person” aspect, the meta-analysis performed by Feist (1998) revealed that creative people tend to be more “autonomous, introverted, open to new experiences, norm-doubting, self-confident, self-accepting, driven, ambitious, dominant, hostile, and impulsive” (p. 299). Other studies have supported
that a relationship exists between personality and creativity (e.g., Batey, Chamorro-Premuzic, & Furnham, 2010; Bidjerano & Dai, 2007; Borkenau & Ostendorf, 1993; Furnham & Bachtiar, 2008; James & Mazerolle, 2002; Kelly, 2006; Sung & Choi, 2009). Therefore, people with certain personality traits are considered more creative.

Creativity and positive emotions

Numerous studies have indicated that positive emotions can enhance creativity. Six probable mechanisms for this phenomenon are (a) positive affect resulting in the broad and associative processing of individual thinking (Brunyé et al., 2013); (b) enhanced cognitive variation (Clore, Schwarz, & Conway, 1994); (c) more flexible methods used to process information (Isen & Daubman, 1984; Isen, Rosenzweig, & Young, 1991); (d) positive valence materials (i.e., creative materials that are relatively extensive and diverse) evoked in the memory (Hirt, Levine, McDonald, Melton, & Martin, 1997; Mikulincer & Sheffi, 2000); (e) less apprehension regarding task performance (Schwarz, 1990; Schwarz & Bochner, 1996); and (f) increased willingness to take risks (Schwarz, 2001). In a classic empirical study conducted by Isen and Daubman (1984), participant happiness was triggered and then the participants were asked to complete the category inclusion task developed by Rosch (1975). In the task, the participants assessed how typically certain objects (e.g., “bus” and “camel”) belonged to a particular category (e.g., transportation). The results indicated that compared with the control group, the participants experiencing happiness tended to assess atypical instances (e.g., camel) to be of higher typicality. This response demonstrated that positive emotions enabled relatively more extensive cognitive categories, which are favorable for cognitive flexibility and enhanced creativity (Amabile, 1983; Eysenck, 1993). In a more recent study, Fernández-Abascal and Diaz (2013) used the film “When Harry Met Sally” to induce happiness and then asked participants to complete divergent thinking tasks (i.e., the Torrance Tests of Creative Thinking). The results suggested that compared with sadness, happiness generated more divergent thinking. Other studies have also determined that positive emotions can enhance the responses of participants in free association tasks in terms of extensive extent (Isen et al., 1985), novel responses (Isen, 1999), insight-based problem-solving (Estrada et al., 1994; Greene & Noice, 1988; Isen, Daubman, & Nowicki, 1987), remote association tests (Isen et al., 1987), and the emergence of more unusual word associations (Isen et al., 1985). In sum, positive emotions can enhance creativity.

Creativity and negative emotions

In an empirical study, Brunyé et al. (2013) discovered that generating broad associations could decrease negative affect and increase positive affect.
In addition, Chermahini and Hommel (2012) observed that positive emotions were enhanced after the completion of alternate use tasks (i.e., the divergent thinking test; Guilford, 1967). By contrast, requiring participants to think about restricted topics and events tended to induce negative affective states (Segerstrom, Tsao, Alden, & Craske, 2000). In their research on cranial nerves, Shenhav et al. (2013) discovered an overlapping sensitivity whereby the left medial orbitofrontal cortex responded to increasingly positive affective emotion and stronger association. Brunyé et al. (2013) argued that creative thinking can reduce negative emotions, whereas other studies argued that creative thinking can enhance positive emotions (Shenhav et al., 2013).

Regarding why creative thinking affects emotions at all, Bar (2009) proposed that broad, progressive associative processing might facilitate more predictions about future events, thereby reducing uncertainty and related negative emotions. Moreover, Bujacz et al. (2016) suggested that creative activities may enhance autonomous self-expression, consequently enhancing positive emotion.

An alternate consideration is that inducing positive emotions relieves negative emotions, a phenomenon that is termed the undoing effect (Fredrickson & Levenson, 1998). In one empirical study, after evoking anxiety in participants by requiring them to deliver a speech, the contentment and amusement induced by watching films produced faster cardiovascular recovery than did neutral or sad films (Fredrickson, Mancuso, Branigan, & Tugade, 2000). Other studies have also supported the undoing effect (Bahrami, Kasaei, & Zamani, 2012; Falkenstern, Schiffrin, Nelson, Ford, & Keyser, 2009; Yuan, McCarthy, Holley, & Levenson, 2010). A reasonable explanation for the undoing effect is that the simultaneous occurrence of positive and negative emotions can increase the likelihood of appraising the negative emotions, thus reducing the threat (Moneta, Vulpe, & Rogaten, 2012). The positive emotions may also improve self-regulation (Aspinwall, 1998). Moreover, according to the broaden-and-build theory, positive emotions can broaden an individual’s scope of thought and allow for flexible attention, which, in turn, can reduce negative emotions (Fredrickson, 2004).

These studies have indicated the direct effects of creative thinking on reducing negative emotions and the indirect, mediating role of the undoing effect. The present study consequently derived Hypothesis 1: Creativity and negative emotions are negatively correlated.

The experience of insight problem-solving facilitates reappraisal

The mechanism of creative thinking that reduces negative emotions may be related to the insight problem-solving process, which is a component of creativity. When people attempt to solve an insight problem, they typically reach an impasse (Knoblich et al., 1999) and must then restructure the representation of the problem for the solution to suddenly enter into consciousness (Knoblich...
et al., 1999). This experience is defined as “insight” (Ohlsson, 1992). When solving a problem, individuals initially use their prior knowledge, thereby activating their knowledge nodes (Ohlsson, 1992). However, if an ineffective knowledge element is activated, the key element of the knowledge required for problem-solving may be inhibited, leading to an impasse. To resolve this situation, the initial ineffective problem representation must be altered or restructured (Knoblich et al., 1999). After the problem representation is altered, the key knowledge node can be retrieved, leading to the resolution of the insight problem (Knoblich et al., 1999; Patrick & Ahmed, 2014). Metcalfe and Weibe (1987) determined that the solution to an insight problem typically appears rapidly, unpredictably, and unexpectedly, frequently accompanied by an “Aha!” moment.

Insight problem-solving is similar to reappraisal, which, as an emotional regulation strategy used to alter negative emotions, is a cognitive mode that changes an individual’s initial assessment of a situation, thereby influencing his or her emotional responses (Gross, 1998). The idea of reappraisal can be summarized as “changing the way we think in order to change the way we feel” (Ochsner & Gross, 2004, p. 229). Specific methods of reappraisal to regulate emotions involve thinking about stimulus-related new information and adopting a different perspective toward the target of the stimulus (Gross & Thompson, 2007; Ochsner & Gross, 2008). For example, opportunities can be found during adversity. In an empirical study, Jackson, Malmstadt, Larson, and Davidson (2000) asked participants to reassess distressing pictures from a neutral perspective and found that this process reduced the participants’ startled response. In addition, other studies have verified that reappraisal is an effective technique to alter emotional responses (Gross, 1998; Ochsner, Bunge, Gross, & Gabrieli, 2002; Ray, Wilhelm, & Gross, 2008).

Insight problem-solving and reappraisal both involve interpreting events from multiple perspectives (Ochsner & Gross, 2008). The process of insight problem-solving begins with restructuring the representation of the problem; reappraisal similarly requires altering the interpretation of negative events when coping with negative emotions. In both processes, novel perspectives are required for the initial representation of the event to be altered. Moreover, when solving an insight problem, people experience an “Aha!” moment when the solution emerges. This experience may assist with the cognitive alteration in reappraisal.

“Aha!” moments can promote reappraisal efficacy because insight is the acquisition of new understanding (Holtforth et al., 2007), in which individuals consciously recognize inaccurate thoughts and substitute more accurate ones (Beck, 1976). Individuals become aware that they can obtain the answer to a problem if they can view the problem from a different perspective. This awareness can transfer to the reappraisal of negative events that an individual must face, enhancing the effectiveness of reappraisal. Considering this process, Schooler (2002) proposed the concept of a “processing shift,” in which the cognitive procedure activation that people experience when participating in
one task is maintained and transferred to subsequent tasks. If the activated procedure facilitates processing the subsequent task, the procedure is considered “transfer appropriate” (e.g., Förster, Friedman, & Liberman, 2004). Because the cognitive procedure of insight problem-solving is similar to that of reappraisal, it is transfer appropriate for the subsequent reappraisal process. According to the effectiveness assessment of cognitive behavioral therapies investigated by Perivoliotis et al. (2010), superior cognitive insight can predict the efficacy of symptom relief, rendering insight a possible mediating variable for symptom relief. Therefore, incorporating the insightful “Aha!” moment experience into the reappraisal process may enhance the effectiveness of reappraisal. Therefore, if an individual solves insight problems before reappraisal, the insight experience could be transferred to the reappraisal process, facilitating the reduction of negative emotions. On this basis, we derived Hypothesis 2: Insight experience mediates the relationship between insight reappraisal and reducing negative emotions.

In summary, previous studies have examined only the influence of creative thought on emotions produced in natural circumstances, without considering whether creative thinking can reduce negative emotional responses when people are in negative situations. In addition, most studies have explored only the short-term influence rather than the relationship between stable, long-term creativity (i.e., creative ability and creative tendency) and emotion. To fill this gap in the literature, this study explored whether creativity was negatively correlated with the negative emotional responses produced in negative circumstances (Hypothesis 1). Moreover, given the similarities between the processes of insight problem-solving and reappraisal, this study explored the integration of insight problem-solving into the reappraisal for reducing negative emotional responses (Hypothesis 2).

Study 1

Study 1 was designed to test Hypothesis 1, which states that in negative situations, creativity and negative emotions (in this case, anxiety) exhibit a negative correlation.

Method

Participants. The participants in this experiment comprised undergraduate students in Taiwan between 19 and 26 years of age ($M = 23, SD = 1.99$). A total of 90 participants were recruited, 41 men (46%) and 49 women (54%).

Materials

Situational Anxiety Inventory. This inventory was based on the state–trait anxiety inventory developed by Spielberger, Gorsuch, and Lushene (1970). This
questionnaire, which mainly measured feelings of anxiety, comprised two subscales: state anxiety (SA) and trait anxiety (TA). The traditional Chinese version of the questionnaire was developed by Chung and Lung (1984), who established reliability and validity coefficients that were comparable with the original values. In this experiment, only the SA subscale, including 20 items measured on a 4-point Likert-type scale, was used. The Cronbach’s $\alpha$ values of the two tests in this experiment were .91 and .92.

Creative Tendency Scale. This experiment used the Creative Tendency Scale of the Creativity Assessment Packet developed by Williams (1980). The traditional Chinese version of this questionnaire was developed by Lin and Wang (1994), who established reliability and validity coefficients that were comparable with the original values. This questionnaire consisted of 50 items divided into the four subscales of curiosity, imagination, complexity, and risk-taking, all measured on a 3-point Likert-type scale. The Cronbach’s $\alpha$ values for each subscale in this study are respectively .60, .65, .69, and .69. In addition, Cronbach’s $\alpha$ value for the total scale is .90.

Creative thinking test. In this experiment, the figural subscale of the creative thinking test (Wu et al., 1998), which is a divergent thinking test, was employed to measure creative potential. Participants were asked to draw a picture or an object on the Chinese character 人, which means “human,” and to name the images they had drawn. Three indicators were assessed in the task: (a) fluency (the number of responses), (b) originality (unusual responses), and (c) flexibility (the number of categories into which the responses fell). Wu et al. developed the creative thinking test norm, according to which the scores of originality and flexibility were obtained. An experienced rater rated the divergent thinking abilities based on grading standards and norms. The fluency score was calculated according to the total numbers of responses, and the flexibility score was calculated based on the number of categories of responses. Originality was scored based on the incidence of each response among the total normative sample. If 5% or more of the sample provided the same response, no point was awarded; if 2% to 5% provided the same response, one point was allocated; and if less than 2% provided the same response, two points were awarded. The originality final score was the sum of the points awarded from each item. The rater began scoring the experiment results only after fully understanding the scoring process.

Procedures

The experiment was conducted individually in a laboratory. Before the experiments, the researchers explained the procedure to the participants. Every participant was required to sign a consent form before participating. The experiment involved two stages: in the first stage, each participant completed
the first situational anxiety inventory, creativity tendency scale, and creative thinking test sequentially. In the second stage, to induce anxiety, the following instructions were given:

Shortly, you will be required to give an impromptu speech. You will be informed of the topic later. The speech should last no more than 10 minutes, and there is no limit to the minimum duration. You may stop the speech whenever you like. We will film your speech and assess your performance afterward based on the content of the speech. The content of the speech will be kept confidential, and I will leave the room when you are delivering the speech. Thank you.

A similar experimental procedure for inducing anxiety has been used in several previous studies (Davidson, Marshall, Tomarken, & Hendriques, 2000; Hofmann, 2007; Hofmann, Moscovitch, & Kim, 2006). Participants were required to complete the situational anxiety inventory a second time after receiving these instructions, to measure the anxiety induced by the anticipation of giving the speech. After the anxiety inventory was completed, the participants were informed that the requirement to deliver the speech was merely an experimental manipulation that did not need to be fulfilled. At the end of the experiment, the participants were debriefed, and a NT$50 coupon was given as a token of gratitude.

Results

**Manipulation check.** The differences in the anxiety indicators before and after the announcement of the speech were analyzed. The scores after the request ($M = 44.38$, $SD = 10.69$) were higher than those before the request ($M = 38.26$, $SD = 9.33$; $t(89) = 6.56$, $p < .001$), indicating that the manipulation effectively increased participants’ anxiety levels.

**Zero-order correlation and partial correlation between creativity and anxiety.** Table 1 presents the zero-order correlations among variables in Study 1. Table 1 shows that the $r$ value for the baseline anxiety indicator (the measurement before the anxiety manipulation) and curiosity was $-.22$ ($p = .04$). However, the baseline anxiety indicator was not significantly correlated with other creativity indicators ($rs = .01$ to $-.19$, $ps > .07$). Following the anxiety manipulation, the anxiety indicator was not significantly correlated with fluency, flexibility, or imagination ($rs = -.13$ to $-.19$, $ps > .08$), but it was significantly correlated with the remaining variables ($rs = -.32$ to $-.22$, $ps < .04$).

In Study 1, partial correlation statistics were used to test the hypothesis concerning the relationship between anxiety and creativity, with the baseline anxiety indicator as the control. Table 1 indicates that the $r$ values between anxiety and the flexibility and originality of divergent thinking were $-.27$ and $-.31$, respectively.
respectively ($p < .003$); however, anxiety was not significantly correlated with fluency ($r = -.16, p = .14$). These results imply that under the induced anxiety condition, the higher flexibility and originality are, the lower the level of anxiety felt by the participants. Regarding the correlation between creativity tendency and anxiety, the $r$ value of anxiety to risk-taking was $-.26$ and to complexity was $-.22$ ($p < .04$). However, anxiety was not correlated with curiosity and imagination ($r = -.11, -.16, p > .13$), suggesting that under induced anxiety, higher levels of risk-taking and complexity correlate with a lower level of anxiety felt by the participants. By contrast, curiosity and imagination are not correlated with anxiety.

Thus, the indicators of flexibility, originality, risk-taking, and complexity were negatively correlated with anxiety during stressful conditions, supporting Hypothesis 1; however, the indicators of fluency, curiosity, and imagination do not satisfy Hypothesis 1.

**Study 2**

Study 2 investigated the effects of integrating insight problem-solving into reappraisal to reduce negative emotional responses (Hypothesis 2). The independent variable manipulated in this experiment comprised the three groups that the participants were assigned to: the insight reappraisal group, the simple reappraisal group, and the control group. The insight reappraisal group experienced
insight problem-solving and reappraisal. In other words, the insight of creative thinking was integrated into the reappraisal of emotional regulation. The experimental treatment for the simple reappraisal group was reappraisal, involving manipulating emotional regulations. The control group was simply the baseline against which to compare the other two groups. Insight experience and negative emotional response were used as dependent variables, and insight experience was also employed as a mediator.

To test the effects generated in the experimental treatments, negative emotions had to be induced. This experiment adopted the method proposed by Strack, Schwarz, and Gschneidinger (1985), in which participants were required to recall and write about negative events they had experienced.

**Method**

**Participants.** All participants were undergraduate students in Taiwan aged between 18 and 27 years (\(M = 20.08, SD = 1.34\)). A total of 113 participants were recruited, including 74 men (66%) and 39 women (34%). The number of participants in each of the three groups: the insight reappraisal group, \(n = 37\); the simple reappraisal group, \(n = 38\); and the control group, \(n = 38\).

**Materials**

**Insight problems.** The insight reappraisal group were presented with insight problems. Schooler, Ohlsson, and Brooks (1993) proposed three features for an insight problem: (a) they can be solved by anyone; (b) a person may encounter a bottleneck and be unable to identify a solution to the problem; and (c) when a solution is suddenly found, it is typically accompanied by an “Aha!” moment. An insight problem that satisfied these criteria was used as the experimental manipulation.

Figure 1 (This is rigidity: do you have it?, 2015) depicts the adopted insight problem. The problem was divided into the following five levels, with four problems were presented one by one in sequence on the slides in Microsoft PowerPoint.

**Level 1 (Problem 1):** Image 1 was presented, with the explanation: “The image comprises 4 parts, A, B, C, and D. One-quarter of A, B, and C are shaded. How would you divide the unshaded area in A into two identical parts, each with the same surface area?” Participants were allowed to consider the problem for 10 seconds before the answer was provided. (In Figure 1, the answer to Problem 1 is Image 2.)

**Level 2 (Problem 2):** Image 2 was presented, with the instruction, “Divide the unshaded area in B into three identical parts, each with the same surface area. Participants were allowed to consider the problem for 10 seconds before the answer was provided. (In Figure 1, the answer to Problem 2 is Image 3.)
Level 3 (Problem 3): Image 3 was presented, with the instruction, “Divide the unshaded area in C into four identical parts, each with the same surface area.” Participants were allowed to consider the problem for 10 seconds before the answer was provided. (In Figure 1, the answer to Problem 3 is Image 4.)

Level 4 (Problem 4): Image 4 was presented, with the instruction, “Divide the unshaded area in D into seven identical parts, each with the same surface area.” Participants were allowed to consider the problem for 15 seconds. Level 5: The answer to Problem 4 was presented (Image 5 in Figure 1).

The key lies in Problem 4. If Problem 4 had been presented at the beginning, participants would not be fixated and could identify the solution easily. However, because they worked their way through Problems 1–3 first, they became fixated by the method used to solve the first three problems, creating an impasse at which the answer becomes elusive. Therefore, to solve Problem 4, the problem representation had to be restructured (MacGregor & Cunningham, 2009). To verify that this problem was an insight problem, we asked 20 participants to describe “the extent to which this problem produced an ‘Aha!’ moment” after they completed all four problems. The insight problem (Problem 4) in this experiment produced a stronger “Aha!” moment (\(M = 5.70; \ SD = 0.98\)) than did the deduction problems (Problems 1–3) (\(M = 2.10; \ SD = 1.52; \ t[19] = 8.72, \ p < .001\)). On a 7-point scale, participants rated the degree of the “Aha!” moment during the insight problem greater than the middle value of 3.5, (\(t[19] = 10.05, \ p < .001\)), confirming that the insight problem used in this experiment did elicit insight experience.

Scale of insight experience. Because the insight is based on restructuring problems, the “Aha!” moment, and a sudden change in feeling (Schooler et al., 1993),
the questions used to assess insight experience were as follows: “To what extent have the experiment instructions suddenly changed your perspective on your own problems?,” “To what extent have the experiment instructions suddenly produced an ‘Aha!’ moment during your personal impasses?,” and “To what extent have the experiment instructions suddenly altered your opinion of negative events?” The participants evaluated these items on a 7-point Likert-type scale. Cronbach’s $\alpha$ for the insight experience scale was .83.

**Positive and negative affect schedule.** The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) comprised 20 questions and was primarily used to assess the emotional state of the participants. The scale was divided by positive and negative affect into two scales (10 items each). Participants were asked the extent to which they felt a variety of emotions, such as excitement, anger, sadness, and happiness, rating each item on a 4-point scale. The internal consistency reliability for the participants’ scores was estimated to be .79 and .86 for positive affection and .72, and .83 for negative affection (pre and post measures).

**Procedures**

In the first stage, the participants were randomly assigned to the insight reappraisal, simple reappraisal, or control groups. The experiment was conducted in a group of five people at once in a laboratory. The experimental materials or instructions were presented on the slides in Microsoft PowerPoint. In the second stage, the three groups were asked to recall negative events that had occurred in their life that were “very disturbing or distressing.” To enhance the effects of this manipulation, they wrote down the people, objects, and situations involved in the event and related their feelings (within 3 minutes). In the third stage, the participants were tested using PANAS to assess their feelings toward the negative event that they had recalled in the second stage (i.e., pretest). In the fourth stage, each group was exposed to a separate instructional manipulation. The insight reappraisal group was instructed to solve the five levels of the insight problem sequentially (see Materials). Subsequently, the relationship between insight problem-solving and reappraisal was explained to the participants as follows:

The previously encountered geometrical problem clearly induced fixation on the problem because of the problem orientation within a short period of time; thus, the answer to Question 4 (see Figure 1) was elusive, because our brains had accumulated various fixed concepts. Emotional distress originates from the manner in which we perceive things, not from the actual object or situation. If we can break free from a fixed way of thinking when distressed, we can determine various perspectives through which to consider a situation. Therefore, when faced with
disturbing problems that elicit a negative response, we should change our mode of thinking and perspective.

The instructions and explanation provided to the simple reappraisal group were similar to that provided to the insight reappraisal group (minus the first two sentences). The control group was provided with a neutral statement from a scientific article describing the nature of science and the process of scientific progress, and asked the participants to read. In the fifth stage, after the manipulations of each condition were conducted separately, the scale of insight experience was employed, and in the sixth stage, PANAS was administered to all three groups (i.e., posttest). At the end of the experiment, the experimental objectives were explained to the participants, and a NT$50 coupon was given as a token of gratitude (see Figure 2 for Experimental procedures).

Results

Manipulation check. Table 2 presents the means and standard deviations of insight experience for the three groups. Regarding the insight experience index, analysis of variance (ANOVA) was performed using the groups as the independent variable and insight experience as the dependent variable. The results indicated that the main effect of the groups was significant, $F(2, 110) = 4.45, p = .01, \eta_p^2 = .08$. After conducting a post hoc comparison, results showed that the scores from the insight reappraisal group ($M = 14.54, SD = 2.40$) were higher than those of the control group ($M = 12.00, SD = 4.78$) ($p = .004$); however, there was a nonsignificant difference between the simple reappraisal group ($M = 13.29, SD = 3.56$) and the control group ($p = .13$). This indicates that only the insight reappraisal group effectively obtained insight experience, and that the insight reappraisal manipulations employed in this experiment were valid.

The effects on emotions. An ANOVA was performed using groups as the independent variable and positive and negative emotional responses as the dependent variable, employing the difference between the positive and negative emotional responses in the PANAS results from Stages 3 and 6. A greater difference indicated a greater degree of reduced negative emotions or increased
positive emotions. Table 2 presents the means and standard deviations of positive and negative emotional responses for the three groups. The results indicate that significant differences existed among the three groups regarding negative emotional responses, \( F(2, 110) = 11.37, p < .001, \eta_p^2 = .17 \). The results of the post hoc comparisons revealed that the insight reappraisal group (\( M = 6.30, SD = 3.60 \)) and the simple reappraisal group (\( M = 4.03, SD = 5.21 \)) were both superior to the control group (\( M = 1.84, SD = 2.97; p < .001 \) and \(.02\)), and that the insight reappraisal group was superior to the simple reappraisal group (\( p = .02 \)). However, no significant difference was observed among positive emotional responses, \( F(2, 110) = 2.87, p = .06, \eta_p^2 = .05 \). Therefore, the insight reappraisal and the simple reappraisal groups could reduce the negative emotions elicited by negative events. Compared to the simple reappraisal group, the insight reappraisal group reduced negative emotions to a greater extent. Therefore, the results of Study 2 support Hypothesis 2.

**Mediating analyses.** Using Hayes’ (2014) PROCESS bootstrapping command with 5000 iterations (model 4), we tested a mediation model with the following causal sequence: (i) the insight reappraisal treatment increased the insight experience; (ii) the insight experience decreased participants’ negative emotional response. The model presented in Figure 3 suggests that, as expected, the insight reappraisal treatment increased the insight experience (\( \beta = .24, t = 2.55, p = .012 \)), which in turn increased participants’ negative emotional response (\( \beta = .27, t = 2.30, p = .01 \)). More importantly, the analysis revealed that the insight reappraisal treatment effect on decreasing participants’ negative emotions (\( \beta = .36, t = 4.07, p < .001 \)) was reduced after the mediator (i.e., the insight experience) was considered in the model (\( \beta = .31, t = 3.50, p = .01 \)), and the indirect effect of

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<thead>
<tr>
<th>Groups</th>
<th>Insight (( n = 37 ))</th>
<th>Simple (( n = 38 ))</th>
<th>Control (( n = 38 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>( M )</td>
<td>SD</td>
<td>( M )</td>
</tr>
<tr>
<td>Insight experience</td>
<td>14.54</td>
<td>2.24</td>
<td>13.29</td>
</tr>
<tr>
<td>Positive emotion pretest</td>
<td>18.50</td>
<td>4.69</td>
<td>18.47</td>
</tr>
<tr>
<td>Positive emotion posttest</td>
<td>20.26</td>
<td>6.25</td>
<td>18.13</td>
</tr>
<tr>
<td>Difference of positive emotion pre- and posttests</td>
<td>1.76</td>
<td>3.68</td>
<td>-3.4</td>
</tr>
<tr>
<td>Negative emotion pretest</td>
<td>25.97</td>
<td>3.84</td>
<td>23.75</td>
</tr>
<tr>
<td>Negative emotion posttest</td>
<td>19.67</td>
<td>4.66</td>
<td>19.72</td>
</tr>
<tr>
<td>Difference of negative emotion pre- and posttests</td>
<td>6.30</td>
<td>3.60</td>
<td>4.03</td>
</tr>
</tbody>
</table>
insight reappraisal treatment (insight reappraisal → insight experience → negative emotion path) was significant (confidence interval [CI]: [0.04, 0.57]). Because zero is not on the 95% CI, the indirect effect is significantly different from zero ($p < .05$), thus establishing an indirect effect. Creativity thus reduced the negative emotional response and insight experience had mediating effects, supporting Hypothesis 2. In other words, insight problem-solving can induce insight experience and enhance the effectiveness of reappraisal.

**Study 3**

**Method**

*Materials and procedures.* Study 2 did not directly test whether the effect of insight problem-solving on negative emotion change was mediated by the efficiency of the reappraisal process. Therefore, Study 3 examined whether the insight reappraisal treatment increased the insight experience, increasing cognitive change (i.e., the direct effect of reappraisal) and in turn decreasing participants’ negative emotion. The independent variable included only two groups (insight reappraisal and control), given the indication of Study 2 that only insight reappraisal reduced negative emotions. Moreover, in Study 3, only the negative subscale of PANAS was used to measure negative emotions; the internal consistency reliability for the participants’ scores (Cronbach’s $\alpha$) was estimated to be .77 and .87. The same methods as Study 2 were used to measure insight experience (internal consistency reliability = .87). In addition, the measurement of efficiency of the reappraisal process, because reappraisal involves reinterpreting the meaning of a situation to feel differently about it (Gross, 1998; Gross & Thompson, 2007). In Study 3, the efficiency of the reappraisal process was called cognitive change, which is measured by the three items. The items were “What is your level of changes regarding viewing your problem after receiving instruction?,”

![Figure 3. Results of the mediation model assessing the following insight reappraisal intervention: insight reappraisals → insight experience → reduced negative emotions from Study 2. Numbers represent the standardized regression coefficient. *$p < .05$.*](image)
“What is your level of seeing other aspects of an event after receiving instruction?” and “What is your level of seeing the positive aspects of an event after receiving instruction?” The participants evaluated the items using a 7-point Likert-type scale. The internal consistency reliability for the participants’ scores was estimated to be .85.

**Participants.** A total of 152 participants were recruited, all of them undergraduate students in Taiwan aged between 18 and 23 years ($M = 19.78$, $SD = 1.06$); 64 of them were men (42%) and 88 were women (58%). In experimental group, there were 77 participants; and in the control group, there were 75 participants.

**Results**

A $t$ test statistical analysis was conducted to compare the insight experience of the insight reappraisal group and the control group. The results indicate that the insight reappraisal group exhibited superior insight experience ($M = 14.12$, $SD = 4.01$) compared to the control group ($M = 11.99$, $SD = 4.69$); $t(150) = 3.1$, $p = .003$, Cohen’s $d = 0.49$. The insight reappraisal group also demonstrated greater cognitive change ($M = 14.55$, $SD = 3.51$) compared with the control group ($M = 12.03$, $SD = 4.28$); $t(150) = 3.97$, $p < .001$, Cohen’s $d = 0.64$. The decreased negative emotion scores of the insight reappraisal group ($M = 6.51$, $SD = 4.20$) were higher than those of the control group ($M = 2.25$, $SD = 4.30$); $t(150) = 6.12$, $p < .001$, Cohen’s $d = 1.00$. The results of Study 3 indicate that after insight reappraisal treatment, participants’ insight experience was enhanced, inducing cognitive change and decreasing negative emotion.

**Mediating analyses.** Using Hayes’ (2014) PROCESS bootstrapping command with 5000 iterations (model 6), we tested a mediation model with the following causal sequence: (i) the induction of insight reappraisal increased insight experience; (ii) the insight experience led to a cognitive change; (iii) the cognitive change decreased negative emotion. The model presented in Figure 4 suggests that, as expected, the insight reappraisal treatment increased the insight experience ($\beta = .24$, $t = 3.01$, $p = .01$), which in turn increased perceived cognition change ($\beta = .86$, $t = 22.17$, $p < .001$), which in turn decreased participants’ negative emotion ($\beta = .44$, $t = 6.43$, $p < .001$). More importantly, the analysis revealed that the insight reappraisal effect on decreasing participants’ negative emotion ($\beta = .45$, $t = 6.12$, $p < .001$) was reduced after the two mediators (i.e., insight experience and cognition change) were considered in the model ($\beta = .34$, $t = 4.65$, $p < .001$), and the indirect effect of insight reappraisal treatment (insight reappraisal → insight experience → cognitive change → negative emotion path) was significant (confidence interval [CI]: [0.15, 0.96]). Because zero is not on the 95% CI, the indirect effect is significantly different from zero ($p < .05$), thus confirming an indirect effect.
The results of Study 3 answered the lingering questions in Study 2, indicating that the insight reappraisal treatment induced insight experience, facilitated cognitive change, and finally reduced the negative emotional responses in negative situations. Therefore, the results of Study 3 support Hypothesis 2.

**General discussion**

According to the results of Study 1, the correlation between baseline anxiety indicator and curiosity was significant. However, the baseline anxiety indicator was not significantly correlated with other creativity indicators. Following the anxiety manipulation, the anxiety indicator was not significantly correlated with fluency, flexibility, or imagination, but it was significantly correlated with the originality, risk-taking, and curiosity. After controlling the influence of the baseline anxiety indicator, the indicators of anxiety produced during stressful circumstances were negatively correlated with flexibility, originality, risk-taking, and complexity; however, the indicators of fluency, curiosity, and imagination were not correlated with anxiety.

The correlations between the anxiety indicator (the results of Partial correlation) and each creativity indicator after excluding baseline were discussed below. According to the indicators of divergent thinking, based on findings that the extensiveness of creative thinking which facilitate changing of perspective toward events can buffer negative emotions (Brunyé et al., 2013), this study established that flexibility (determining various categories of ideas using divergent thinking) and originality (determining novel ideas using remote association) were more representative of the extensiveness of creative thinking (Fredrickson, 2004). Therefore, these two indicators were negatively correlated with anxiety responses. However, fluency was only an indicator for the number of ideas
generated and did not ensure generating various categories of ideas or novel ideas using remote association. Consequently, fluency was not negatively correlated with anxiety responses.

Regarding creative tendency, a previous study indicated that avoiding risk-taking was negatively correlated with anxiety (Maner et al., 2007). Another study found that a negative correlation existed between the complexity and anxiety (Skrzypek, 1969). Therefore, the results regarding risk-taking and complexity in this study were consistent with those of previous studies. However, the correlations between curiosity and imagination and anxiety were −.11 and −.16, respectively, which were nonsignificant correlation. From Study 1, the reliability of the creative tendency scale (Cronbach’s $\alpha = .60, .65, .69$, and .69) in this study was low; Chan, Chen, and Lavallee (2013) obtained similar results (Cronbach’s $\alpha = .71, .71, .60$, and .72). Therefore, large measurement errors (Linn & Gronlund, 2000) may reduce the correlation between anxiety and the indicators of curiosity and imagination (Cronbach’s $\alpha = .60$ and .65). Why risk-taking has effect of buffering anxiety? From the aspect of direct effect, anxious participants made significantly fewer risky choices because they tend to avoid risks (Giorgetta et al., 2012) and they have higher perception of negative outcomes (e.g., Maner & Schmidt, 2006). Therefore, anxious negatively related to risk-taking which indicates that risk-taking might have direct buffering effects on anxious. In addition, Zafar and Meenakshi (2012) discovered that risk-taking had positive relation with extroversion, and extroversion also positively related to joy. It indicates that risk-taking positively related to positive emotion. Based on undoing effects, positive emotion could ease negative emotion, thus risk-taking could have indirect buffering effects on anxiety though undoing effects (Fredrickson & Levenson, 1998). Why there was a negative relation between complexity and anxiety might be because of that individuals with high complexity have more diverse worldview and more flexible view of negative events, so they can buffer negative emotions. For example, Pancer, Hunsberger, Pratt, and Alisat (2000) found that individuals with high cognitive complexity could be easier adapting to the first year in college. These two indicators may therefore become significantly and negatively correlated with anxiety.

Above mentioned were explanations of relationships between each creativity indicators and SA, which was induced by the impromptu speech, after controlling TA. In fact, the anxiety measured during the baseline stage and during the stage after anxiety manipulation (i.e., give an impromptu speech) were different. In the baseline stage, TA was measured, and SA was measured after anxiety manipulation. TA indicates individual differences in the sensitivity to threat. Individuals with high TA tend to feel higher anxiety (Spielberger, 1983). SA indicates one’s anxiety responses under certain circumstances. For example, in Study 1, impromptu speech was applied to indicate SA (Krusemark, Novak, Gitelman, & Li, 2013). Regarding TA, the results of Study 1 showed that the buffering effect of creativity only revealed by curiosity. It indicated that simply
analyzed the indicators of TA and creativity could not observe the buffering effect of creativity. However, while individuals’ SA was induced by stressors, originality, risk-taking, curiosity, and complexity were found to be able to buffer SA. Additionally, the relationship between the creativity and SATA was found to be moderated by TA. For example, after excluding the influence of TA, the negative relation between flexibility and curiosity turned to be not related. The results suggest that TA could improve flexibility and curiosity buffering SA.

Studies 2 and 3 show that after exposure to insight reappraisals, the performance of the insight reappraisal group was superior to that of the simple reappraisal and the control groups. Both the insight reappraisal and simple reappraisal groups mitigated negative emotions more effectively than the control group did, and the insight reappraisal group mitigated negative emotions more effectively than did the simple reappraisal group. However, no significant differences were observed among the increases in positive emotions. In addition, insight experience contributed to mediating the relationship between insight reappraisal and reducing negative emotions. Therefore, providing the experience of insight problem-solving increased the effectiveness of reappraisals for emotion regulation. Hypothesis 2 was thus supported by both Studies 2 and 3.

That simple reappraisal effectively mitigated negative emotional responses is consistent with previous findings (Hofmann, Heering, Sawyer, & Asnaani, 2009). The participants in the insight reappraisal group, which had the additional experience of insight problem-solving, were more capable of reducing their negative emotional responses toward distressing events compared to those in the simple reappraisal group. Moreover, insight experience contributed to mediating insight reappraisals and reducing negative emotions. The greater a person’s insight experience, the greater the effect on emotional regulation and reappraisal promotion. Therefore, insight problem-solving is recommended for people to conduct the reappraisal of emotional regulation when faced with negative events. The insight experience gained from the problem-solving can enable the person to reappraise, which provides an opportunity to change their perspective toward negative events (Gross, 1998) and achieve emotional regulation.

Experiencing insight problem-solving may improve the emotional regulation effect of reappraisal by providing the experience of deconstructing and reconstructing a fixed structure (Goldin, Manber-Ball, Werner, Heimberg, & Gross, 2009; MacGregor & Cunningham, 2009), conferring new understandings for individuals (Holtforth et al., 2007) and prompting them to change their perspective of negative events. Because solving insight problems is similar to the cognitive processing of reappraisals, the cognitive processing of insight problems is transferred to the subsequent processing of reappraisals (Schooler, 2002), increasing its efficiency. Alternately, the experience of solving insight problems may have caused the participants to believe in the effectiveness of reappraisals, motivating their cognitive processing. This idea requires further research.
This study observed little effect on positive emotions because the participants recalled distressing negative events during the emotional manipulations; thus, during the reappraisal process, only negative emotional responses were affected. This result reflects the internal validity of this study.

Although Studies 2 and 3 indicated that participants’ negative emotions could be reduced by insights coming after insight problem-solving, some study limits should be noticed, that is, the manipulation of independent variables among the insight reappraisal, the simple reappraisal, and the control groups were different. For instance, the insight reappraisal group contained an extra manipulation which is insight problem-solving than the control group. Therefore, the more complex the manipulations that the participants underwent could change the predominant affect, namely, reducing negative emotional responses. Additionally, because there were two more sentences in the instruction of the insight reappraisal group than that of the simple reappraisal group, which might lead to an engagement of mind-set then lead the participants unable to solve simple insight problem. In addition, the instructions explained that it was caused by experiences, and this kind of instructions per se might teach participants the reappraisal rules then to reduce negative emotion responses. Therefore, did insight experience enhance reappraisal then buffered anxiety? Or the instruction effect led to buffing anxiety? This is the issue to be clarified.

Regarding studying cognitive creativity, in Study 1, divergent thinking was used to measure creativity, but in Studies 2 and 3, insight problem-solving was used to stimulate participants’ representational change and “aha” experience. Therefore, the natures between the two creative tasks were different. Authors focused especially on how the difference between divergent thinking and insight problem-solving could buffer anxiety.

Previous studies found that in insight problem-solving, the key part is to change the representation of the problem. For example, chunk decomposition (Wu, He, Zhou, Xiao, & Luo, 2017) and constraint relaxation (Knoblich et al., 1999). Additionally, insight problems contain analytical thinking which is different from divergent thinking. Kaufmann and Vosburg (1997) found that positive mood had negative relation with insight problem-solving, marginal significant positive relation with negative emotion, and its relation with TA ad SA were -.29 and -.22, respectively. Vosburg (1998) further pointed out that positive emotions facilitate divergent thinking; however, negative mood inhibit divergent thinking. In summary, each creativity indicator which buffers negative emotions has different mechanism. Regarding buffering negative emotions, divergent thinking mechanism could broaden an individual’s scope of thought and allow for flexible attention, which, in turn, can reduce negative emotion (Fredrickson, 2004). Regarding insight problem-solving, representation changing and “aha” experiences could improve individuals’ reappraisal and reduce negative emotions. In addition, how analytical thinking of insight problem-solving plays the role in buffering anxiety is the issue to be clarified. In Study 2,
there is a limitation of a small number of participants; therefore, for the purposes of mediation analysis, the results were with small power. In future study, more participants will be recruited to replicate this study to verify whether the results of the study are reliable.

Based on the results of Studies 2 and 3, we recommend that people solve insight problems before engaging in a reappraisal strategy to contend with negative events, to enhance the effectiveness of consultation or treatment. Additionally, practitioners can actively provide their clients with insight problems instead of waiting for the clients to passively develop insight. Thus, insight problems are an extremely useful tool.

We recommend that future studies investigate the effects that various reappraisals incorporating insight problem-solving have on the regulation of emotions generated by negative events, such as fear, anxiety, and grief. Additionally, this investigation could be designed specifically for psychiatric patients to broaden the scope of the suitability of insight problem interventions. Moreover, other emotional regulation strategies, such as mindfulness (Kabat-Zinn, 1994, p. 4) and attentional deployment (Gross & Thompson, 2007), can be combined with insight problem-solving to increase the efficiency of emotional regulation.

To the authors’ knowledge, this is the first study to explore the relationship between individuals’ creativity and negative emotion (anxiety) under pressure. The results revealed that creativity can buffer the negative emotional responses prompted by stressful stimuli. In addition, this study was the first to combine insight problem-solving with emotional regulation, and the results indicate that solving insight problems can enhance reappraisal efficiency. This finding prompts further investigation of the theoretical and practical processes of emotional regulation.

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Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.
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**Author Biographies**

Fa-Chung Chiu is a professor in the Department of Counseling, Chinese Culture University, Taiwan. He is an educational psychologist and cognitive psychologist specializing in creativity, humor, positive psychology, and education research.

Chih-Chun Hsu is a research & development manager in office of academic affairs at National Taiwan Normal University. Her research interests are in the fields of creativity, humor and emotion.

Yao-Nan Lin is an associate professor in the Department of Business Administration at Fu Jen Catholic University. His research interests are in the fields of creativity, consumer behavior, and the positive psychology in the workplace.

Cheng-Hong Liu is a professor in the Department of Educational Psychology and Counseling at National Tsing Hua University, Taiwan. He is a social psychologist and educational psychologist specializing in social cognition, personality, and learning motivation research.

Hsueh-Chih Chen is a professor and the dean of Education College at National Taiwan Normal University, Taiwan. His research interests focus on cognition psychology, humor studies, creativity research, and Chinese characters learning for CSL learners.

Chi-Hsiang Lin is a therapist of National Taichung University of Science and Technology, Taiwan. His research interests focus on mindfulness, emotion regulation, creativity research.