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Learning to relax versus learning to ideate: Relaxation-focused creativity training benefits introverts more than extraverts

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Highlights

- Brief training in ideational skills resulted in enhanced creative performance
- Brief training in relaxation resulted in enhanced creative performance
- Success of training depended on the specific personality traits of trainees
- Ideation skills training was particularly beneficial for extraverts
- Relaxation training was particularly beneficial for introverts

Abstract

This study compared the short-term effectiveness of two creativity training programs (ideational skills vs relaxation), and assessed whether training effectiveness in each program was dependent on participant personality. Participants comprised 163 volunteers who were allocated to one of three experimental conditions (ideation training, relaxation training, and no training control). All participants completed several self-report questionnaires, as well as tests of creative performance both before and after training. Consistent with previous research, results indicated that Extraversion and Openness were predictors of creative performance overall. More interestingly, however, results revealed a three-way interaction between Extraversion (introverts vs. extraverts), training type (ideation skills training vs. relaxation training), and time (pre- vs. post-training), suggesting that relaxation training is particularly beneficial for introverts whereas ideation skills training is more effective for extraverts. Our results offer new evidence that the expected utility of creativity training program-types may vary according the personality of trainees. On a practical note, our research has implications for organizations looking to tailor creativity-training programs in order to maximize the benefit of such programs on individual performance.

Keywords: Personality, Creativity, Extraversion, Creativity training, Relaxation training

1. Introduction

Creative thinking remains an important determinant of success in a variety of domains, such as education, the workplace, and leadership performance. In education, creative students have been shown to outperform less creative students in general, and particularly on tasks requiring long-term and sustained attention (e.g., Chamorro-Premuzic, 2006). Similarly in the workplace, employee creativity has been shown to enhance job satisfaction (Robinson & Beesley, 2010; Shalley, Gilson, & Blum, 2000) and, more broadly, the likelihood of ongoing organizational success (Baer & Oldham, 2006), with many business leaders emphasizing the importance of continuous change and reinvention to long-term success (Thomke, 2003; Thompson, 2003). In terms of leadership performance, research has demonstrated that creative leaders tend to be more effective overall (Gumusluoğlu & Ilsev, 2009; Shin & Zhou, 2003) and particularly effective at leading change (Matthew, 2009). It is no surprise, then, that many individuals and organizations have sought to foster creative thinking, with organizations in particular having spent large sums of money on programs designed to enhance creative thinking in employees (Oldham, 2003; Scott, Leritz, & Mumford, 2004; Solomon, 1990).

The current study had two primary goals. Our first goal was to empirically assess whether two brief forms of creativity training, namely, ideation skills and relaxation training, would produce short-term improvements in creative performance. Our second goal was to investigate whether the efficacy of these two forms of creativity training was dependent on participant personality traits (Extraversion, Openness). We focused on ideation training and relaxation training because both are empirically supported forms of training, appropriate for brief, instructor led programs. Additionally, these forms of training target certain cognitive processes that

theoretically might be more effective for some individuals than others (as outlined in detail later). We specifically investigated Extraversion and Openness in terms of training efficacy, because both traits have been shown to predict creativity (Sung & Choi, 2009) as well as trainability in cognitive tasks (Barrick & Mount; 1991; Dean, Conte, & Blackenhorn, 2006). Our study is the first to individually compare these two forms of creativity training and to investigate the impact of personality on the effectiveness of these two programs.

2. Creativity and Creativity Training

Creativity is most commonly defined as a cognitive process involving the generation of an idea, action, or object that is both novel and useful (Amabile, 1996; Amabile, Conti, Coon, Lazenby, & Herron, 1996; Wiseman, Watt, Gilhooly, & Georgiou, 2011). Individuals who engage in creative behavior therefore tend to approach problems and tasks with an open and uninhibited mind, and ultimately generate a range of novel and sometimes unorthodox ideas that tend to result in positive outcomes.

Agogué and colleagues (2014, p.33) argue that "creativity is not an innate quality", and as such, requires developing cognitive skills in order to reason, problem-solve, and generate ideas. The conceptualization of creativity as primarily a cognitive process lends credibility to the idea that creativity can be trained (see Runco, 2004). Such training can take the form of tailored programs (e.g., in the workplace), as well as other well-known programs, such as Edward de Bono's (2009) lateral thinking program, Tony Buzan's (1991) mind-mapping techniques, and Isaksen and Treffinger's (2004) Creative Problem Solving Process (CPS). However, not all training programs are equivalent. A meta-analysis by Scott et al. (2004) evaluated the

effectiveness of a range of different creativity training programs as well as their underlying components (i.e., theoretical approach, processes, techniques, design, use of media, and opportunity for practice). Overall, they concluded that creativity training does tend to enhance subsequent creative behavior, and that the most effective programs are those that include activities targeting the cognitive processes underlying creativity.

Clapham (1997) described an interesting study where the efficacy of a "full" creativity training program was compared with a single-component creativity training program. The aim was to determine whether the two training programs would be comparable in terms of creative improvement. The full creativity training program covered a number of techniques used in empirically-supported techniques, such as idea generation, relaxation, applied problem solving, and visualization (Birdi, Leach, & Magadley, 2012; Kabanoff & Bottger, 1991; Scott et al., 2004). In contrast, the more specific, but less comprehensive, single-component training program focused only on ideation skills (i.e., idea generation) training. Results showed that both types of training programs predicted improvements in creativity and that ideation was as effective as general creativity training in increasing participants' creative behavior.

Other research supports the notion that specific training in ideation can improve creative behavior. For example, Baruah and Paulus (2008) found that participants trained in idea generation performed significantly better in a brainstorming task than participants in a control condition. Specifically, they found that exposing participants to a short (75 minute) training program resulted in enhanced performance in terms of both quantity and quality of ideas. Consistent with previous research then, and considering that ideation is a key component to creativity (Basadur, Graen, & Green, 1982; Runco & Albert, 1990), we believe that well-

constructed and delivered ideation training will generally result in enhanced creative performance in the short-term. We therefore hypothesize:

Hypothesis 1a. Participants trained in ideational skills will experience greater average improvements in creative performance than untrained participants.

A second form of creativity training we investigate in this study is known as "relaxation training". In this paper, we utilize a broad definition of relaxation training, whereby we consider it to involve techniques designed to relax trainees (e.g. stretching techniques, breathing techniques) and reduce anxiety in trainees (e.g. freeing the mind from negative thoughts). Relaxation has many known benefits for improving health and well-being, and there is growing research suggesting that relaxation and related constructs (such as imagery, meditation, and hypnosis) can also have positive effects on creativity (e.g., Karwowski & Soszyński, 2008; Krampen, 1997). Indeed a recent meta-analysis on mindfulness and creativity (Lebuda, Zabelina & Karwowski, 2015) revealed a moderate relationship (r =.22) between creativity and mindfulness. Importantly the authors reported similar results for correlational and experimental studies, leading them to suggest that the relationship between mindfulness and creativity is likely to be causal (Lebuda et al., 2015).

Our conceptualization of creativity as a cognitive construct provides grounds for a theoretical perspective on why relaxation training might improve creativity. Specifically relaxation training, which involves techniques such as controlled breathing, brief meditation, and stretching, is likely to produce a state of self-awareness and mindfulness, which research has shown enhances emotional and cognitive functioning (Carson & Langer, 2006; Moore, & Malinowski, 2009;

Sedlmeier et al., 2012). Theoretically, it has been suggested that a state of mindfulness fosters sustained focused attention as well as attention switching – the ability to switch focus between stimuli – which should enhance cognitive functioning (Chambers, Lo, & Allen, 2008). Additionally, the focus on reducing anxiety in relaxation training is likely to further benefit creative performance. We suggest that replacing negative self-talk with positive self-talk is likely to enhance creative self-efficacy trainees, which is a known predictor of creativity (Gong, Huang, & Farh, 2009; Tierney & Farmer, 2002).

Recently, more focused research exploring the cognitive basis of creativity have integrated dual process models of cognition (see Sowden, Pringle, & Gabora, 2015). Briefly, Dual Process models of cognition differentiate between two types of cognitions, termed "type 1 processes" and "type 2 processes". Type 1 processes refer to rapid, automatic cognitive processing related to associative conditioning, and type 2 processes refer to conscious, structured thinking and evaluation (see Evans, 2008; Frankish, 2010; Sowden et al., 2015). In the context of creative performance, type 1 processing occurs in the initial, idea generation stage, whereas type 2 processes occur when ideas are evaluated, refined, and selected (Gabora, 2005; Howard-Jones, 2002). According to a recent review (Sowden et al., 2015), optimal creative performance not only requires effective type 1 and type 2 processing, but perhaps more importantly, the ability to shift between these modes of thinking (i.e., temporarily suppress idea generation for evaluation processes and vice-versa) (see also Gabora, 2005; Nijstad, De Dreu, Rietzschel, & Baas, 2010). It follows, therefore, that enhancing such "shifting" abilities in people will have positive effects on their creativity.

There is a lack of consensus in the literature relating to how to enhance effectively shifting between the two processes; however, some research suggests that

mindfulness might play a role. In particular, Langer (1992) differentiates between mindlessness (not thinking) and mindfulness (focused thinking), and has found that mindfulness enhances creative performance, possibly because being focused on the present moment allows individuals to rapidly utilize their instincts and evaluate such instincts in light of new information (see Langer, Russell & Eisenkraft, 2008). Indeed, this explanation seems plausible, because effectively shifting between type 1 and type 2 processing has been related to attention (Bristol & Viskontas, 2006; Vartanian, Martindale, & Matthews, 2009), and mindfulness has known benefits on attention (Chambers et al., 2008), and as outlined previously, is known to directly predict creativity (Lebuda et al., 2015). Overall, then, because relaxation training should enhance a state of mindfulness and enhance self-efficacy in participants, we believe relaxation focused training will enhance creative performance in the short term:

Hypothesis 1b. Participants trained in relaxation skills will experience greater average improvements in creative performance than untrained participants.

2.1. Personality

When considering the effects of personality on creative performance, an appropriate starting point is the Big Five model of Personality (Goldberg, 1990) because this model represents the most empirically supported taxonomy of personality traits validated across a range of populations (see Gurven, von Rueden, Massenkoff, Kaplan, & Lero Vie, 2013). According to the Big Five model, variation in personality can be largely accounted for by variation in the five traits of Extraversion, Neuroticism, Openness to Experience, Agreeableness, and Conscientiousness. Research using the Big Five model to explore the relationship

between personality and creativity has consistently found that Extraversion and Openness positively predict creativity (e.g., Furnham, Monsen, & Ahmetoglu, 2009; Sung & Choi, 2009; Walker & Jackson, 2014). Furnham and Bachiar (2008), for example, found Extraversion and Openness to be important predictors of one popular measure of creativity (divergent thinking), reporting that the two personality variables accounted for 47% of the variance in divergent thinking.

Extraversion reflects the degree to which individuals are sociable, assertive, and active (Eysenck, 1981). Recent theories have linked Extraversion to heightened reward sensitivity (Smillie, 2013) and proactive behavior in seeking out potential rewards (Sung & Choi, 2009). Because creativity requires proactive behavior in initiating novel methods of solving problems (Sung & Choi, 2009) as well as some level of stimulation-seeking and risk-taking (Batey & Furnham, 2006), it is unsurprising that Extraversion has consistently been identified as a predictor of creativity. Empirically, Extraversion has been positively associated with verbal creativity (King, Walker & Broyles, 1996), self-rated creativity (Furnham, Batey, Anad, & Manfield, 2008), divergent thinking, and artistic talent (Furnham & Bachtiar, 2008). Therefore, we expect Extraversion to be related to creativity in this study:

Hypothesis 2a. Extraversion will be a positive predictor of creativity.

Openness is associated with inquisitiveness, nonconformity, imagination, tolerance, and independent thought (Goldberg, 1992; McCrae & Costa, 1986). Individuals high in this trait are attracted towards new ideas and situations, which enable them to have novel experiences and perceptions (Goldberg, 1990). In contrast, individuals low in Openness tend to be reserved and cautious, and find comfort in

familiarity because of the reduced uncertainty (Choi, 2004; George & Zhou, 2001). Openness has been linked to artistic preference (Furnham & Chamorro-Premuzic, 2004), divergent thinking (George & Zhou, 2001; Wuthrich & Bates, 2001), flexible problem solving (Watson & Hubbard, 1996), and self-assessed creative ability (Kaufman & Baer, 2002). Longitudinal research has also demonstrated positive associations between Openness and objective measures of creativity (Soldz & Valliant, 1999). Therefore, we expect Openness to be related to creativity in this study:

Hypothesis 2b. Openness will be a positive predictor of creativity.

2.2. Personality and trainability

There is some research demonstrating that personality is related to training proficiency across a range of domains. In a seminal paper, Barrick and Mount (1991) found that both Openness and Extraversion were valid predictors of training proficiency across a sample of five occupational groups. However, results have been mixed regarding exactly which traits and situations foster individual differences in training proficiency. For instance, Dean and colleagues (2006) reported positive associations between Openness and Extraversion on performance in a simulation-based training exercise but not on pen and paper tests. Further, reviews by Hough, Eaton, Dunnette, Kamp and McCloy (1990) and Salgado (1997) identified links between training proficiency and Openness but not Extraversion. Others have found that Extraversion is associated with learning, but only in the context of potential reward (Robinson, Moeller, & Ode, 2010). In this study, we test whether the

dimensions of Openness and Extraversion influence the efficacy of different types of creativity training.

Arguably, the most well-known and influential theory of Extraversion was proposed by Hans Eysenck (1967, 1994). Eysenck suggested that introverts and extraverts operate at different levels of cortical arousal, with introverts generally experiencing higher levels of arousal than extraverts. According to this theory, arousal level is related to the pleasantness of the experience. Somewhat counter-intuitively, this means that for extraverts, a low level of arousal is associated with an unpleasant experience, and for introverts, a high level of arousal is associated with an unpleasant experience. Therefore, where introverts seek environments that are quiet and generally non-arousing, extraverts seek out stimulating environments that increase their arousal. Although empirical support for Eysenck's theory has been mixed (see for example, Anderson & Revelle, 1994; Revelle, 1995), it has nevertheless had substantial empirical success. Indeed, one of the strongest findings from biological personality research to date is that arousal moderates the relationship between Extraversion and stimuli-response (see Matthews & Gilliland, 1999).

A more contemporary theory of extraversion was proposed by Depue and colleagues (e.g., Depue & Collins, 1999; Depue & Morrone-Strupinsky, 2005). According to this theory, trait extraversion reflects individual differences in the brain's processing of reward (i.e., the behavioral activation system or BAS; Gray, 1991) arising from functional variations in dopaminergic activity (Depue & Collins, 1999). Ultimately, the theory argues that extraverts are more sensitive to signals of reward, and experience greater positive affect upon attaining rewards than introverts. The theory has been influential in personality neuroscience (see Smillie, 2013) and has influenced current, integrative theories of personality (e.g., DeYoung, 2015). In

contrast to Eysenck's (1967, 1994) theory then, which focuses on arousal, Depue and Collins' (1999) reward-processing theory of extraversion focuses on neurobiological systems related to underlying incentive motivation. Nevertheless, the two models are not completely inconsistent, given that cortical arousal tends to co-occur with sensory simulation (Stelmack, 1990).

Applying these theoretical perspectives to the current research, we hypothesize that introverts will respond better to relaxation-focused creativity training, whereas extraverts will respond better to ideation-based training. We argue that introverts will respond better to relaxation training because it should reduce arousal, which should enhance performance for introverts but not extraverts (Eysenck, 1967, 1994). Additionally, being in a state of mindfulness is likely to be particularly beneficial for introverts, because introverts have more difficulty with divided attention (Matthews, Deary & Whiteman, 2003), which likely affects their ability to shift between type 1 and type 2 processes. As noted above, mindfulness seems to enhance this shifting process. Related to this, it follows that introverts will have particular difficulty in shifting from type 1 (analytical) thinking to type 2 (associative) thinking, because introverts have a bias towards analytical thinking (Allinson & Hayes, 1996). Theoretically, individuals with biases towards analytical thinking will benefit from interventions enabling them to shift to associative thinking (Howard-Jones, 2002).

Similarly, we argue extraverts will respond better to ideation-based training because it is likely to increase arousal (it is more stimulating and cognitively demanding than relaxation training) which is the preferred state of extraverts (consistent with Eysenck, 1967, 1994). Additionally, the ideation-based training contains more novelty and is more outcome-focused than relaxation training, and

extraverts are highly motivated by novelty and reward (Consistent with Depue & Collins, 1999). Therefore we hypothesize:

Hypothesis 3a. Extraverts will be more responsive to ideation training, whereas introverts will be more responsive to relaxation training.

As noted previously, *Openness* has been shown to predict training proficiency across a variety of groups (Barrick & Mount, 1991). Theoretically this makes sense because, as Barrick and Mount (1991) pointed out, individuals high in Openness are curious thinkers who have a disposition to seek out new and unconventional experiences. Individuals high in openness seem to possess the ability to discriminate between creative ideas (Silvia et al., 2008).It seems likely, therefore, that those high in Openness will respond best to ideation-based creativity training, as open individuals should theoretically respond best to training focusing on expanding knowledge and developing new ways of thinking.

Those low in Openness, on the other hand, tend not to be particularly curious and tend to show little motivation to seek out new and unconventional experiences. Indeed, thinking creatively, or thinking "out of the box", would likely present an unusual and possibly anxiety-provoking situation for such individuals. Such individuals might simply benefit from reducing their anxiety and removing barriers preventing them from thinking creatively. For this reason, it is suggested that individuals low in Openness will respond better to relaxation-focused creativity training rather than ideation-based training:

Hypothesis 3b. Participants high in Openness will respond better to ideation training, whereas those low in Openness will respond better to relaxation training.

3. Methods

3.1. Participants

Participants comprised 111 female and 52 male volunteers recruited from a first-year participant pool at a large Australian university. The age of participants ranged from 17 to 50 (M = 22.5; SD = 6.01). Participation was voluntary and each participant was offered course credit in exchange for his/her time. The majority of the participants (76%) were employed, either on a casual (79), part-time (25), or full-time (20) basis.

3.2. Measures

3.2.1. Creativity

We collected two pre- and post-training measures of creative performance, namely adapted versions of the Welch Reorganization Test (Welch, 1946) and Guilford's (1967) alternate uses divergent thinking test. Guilford's alternate uses test measures creativity in terms of divergent thinking and Welch's Reorganization Test measures creativity in terms of creative problem solving. Our use of such measures was likely cognitively demanding for participants because of the time-based individual nature of the task. Such challenging conditions are ideal in tests of creative performance where cognitive efficiency is important (see Hong, Hwang, Chen, Chen, & Liu, 2012; Hong, Hwang, & Tai, 2013).

Guilford's (1967) alternate uses test is a widely used measure of creativity (see Gilhooly, Fioratou, Anthony, & Wynn, 2007), which requires participants to think of as many unusual alternate uses for common objects (e.g., newspaper, paperclip) as possible in two minutes. The test is scored by assessing how participants perform on the four criteria of fluency (number of responses), flexibility (range of ideas), originality (unusual responses), and elaboration (level of detail). Responses are scored out of 10 on each criterion, and summed to form a score out of 40, such that higher scores are indicative of greater creativity. Inter-rater reliability in this study across two expert raters was consistently high, ranging from $\alpha = .84$ (pre-training) to $\alpha = .88$ (post-training).

The Welch Reorganization Test (Welch, 1946) measures creative problem solving. In this task, participants recombine common ideas according to four unfamiliar patterns. The premise is that the ability to readily rearrange and recombine ideas in adherence to a pattern or plan is essential to creative thinking. The test comprises four subtests in which written materials are used in the first three subtests, and blocks are used in the fourth subtest. Due to time restrictions, only subtests one and three were utilized in this study. In the first subtest, participants were presented with 10 groups of 10 words and were instructed to create as many meaningful grammatical sentences as possible in 10 minutes. In the third subtest, participants were presented with a list of 20 words and were instructed create a grammatically correct and logical story utilizing these words. Responses in both tests were rated on the criteria of fluency, flexibility, and originality. Inter-rater reliability of two expert raters was sufficient, ranging from $\alpha = .69$ (pre-training) to $\alpha = .76$ (post-training). Responses were summed with responses from Guilford's (1967) test in order to create

an overall creativity index. To minimize the impact of practice effects, the first subtest was used in the pre-test stage and the third subtest was used in the post-test stage.

3.2.2. Personality

Openness and Extraversion were measured using the International Personality Item Pool, 5 NEO Domains, (Goldberg et al., 2006). This 50-item questionnaire measures Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness on a 50-item, five-point likert-type scale. Example statements include "I feel comfortable around people" (Extraversion) and "I have a vivid imagination" (Openness). Coefficient alpha reliabilities for the current sample are reported in Section 4.2.

3.2.3. Control variables

We controlled for intelligence using the Wonderlic Cognitive Ability Test (Wonderlic Inc., 2000) and affect using the Positive And Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). We controlled for these variables as previous research has shown these constructs to influence creativity (e.g., Batey & Furnham, 2006; Clapham, 2001; Furnham & Chamorro-Premuzic, 2004; Furnham, Crump, Batey, & Chamorro-Premuzic, 2009; Isen, Daubman, & Nowicki, 1987; Kim, 2005).

3.3. Creativity training

Participants were randomly assigned into one of the two experimental conditions: ideational skills training (n = 50) and relaxation training (n = 62). A further 50 participants were assigned to a control condition once sufficient numbers were obtained in each of the experimental conditions. Training was presented in the format of videos, which opened with an introduction (i.e., what is creativity and why

is it important), followed by the training content of each program (e.g., techniques, examples), and concluded with a summary.

3.3.1. Ideational skills training

The ideational skills training video was eight minutes in duration, and consisted of an instructor explaining and providing examples of idea-generating techniques. The instructor was filmed in person and used a number of embedded slides to assist explanation. The techniques discussed included brainstorming (i.e., allowing all ideas to be considered without criticism), forced relation (i.e., utilizing items in one's immediate surroundings to generate or develop ideas), checklist (i.e., considering a checklist of three terms – "maximize", "minimize", and "rearrange" – to enhance components of an existing idea, by asking oneself "Can an idea be improved by enlarging, rearranging, or reducing any of its components?"), and catalogue (i.e., referencing a catalogue to stimulate or expand ideas). These techniques were utilized in accordance with research findings demonstrating the effectiveness of these techniques in enhancing ideational thinking ability (Bull, Montgomery, & Baloche, 1995; Clapham, 1997; Smith, 1998; Warren & Davis, 1969).

3.3.2. Relaxation training

The relaxation training video ran for 10 minutes in total. The instructor from the ideation video was again used, and the video was presented in the same format (i.e., filmed instructor with slides). In this video the instructor focused on tasks designed to reduce barriers to creative thinking. Tasks included relaxation, meditation, stretching, breathing exercises (breathing deeply and slowly), and enhancing awareness of personal factors which may inhibit creative performance (such as stress, anxiety, and worry). For example, at one point during the video, participants were briefly taken through guided meditation, where they were shown an image of someone meditating

and instructed on how to do this themselves. They were told to focus their attention on their breathing (feel the air flowing in and out of their lungs) while allowing distracting thoughts to fade away. At another point, participants were told about progressive muscular relaxation, and briefly guided through this technique. The instructor also trained participants in positive self-talk, goal setting, and visualization in order to further assist participants in overcoming potential stress, anxiety, and worry. These techniques were utilized in accordance with published studies on relaxation-based creativity training (e.g., Clapham, 1997; Constantino, Kellam, Cramond, & Crowder, 2010; Domino, 1977; Krampen, 1997).

Consistent with theories of effective learning (e.g. transfer of learning theory; Bransford, Brown, & Cocking, 1999), the relaxation focused creativity training video (as well as the ideation training video) included segments where participants were asked to engage in specific techniques while watching the video (i.e., practice). Additionally, also consistent with transfer of learning theory, the videos emphasized understanding concepts and methods, rather than simply memorizing what these methods are.

3.3.3. Control condition

The control condition included an educational video created in a similar format to the training videos; however, it focused on the topic "Emotional Intelligence" (nine minute video) and did not cover any content related to creativity. Please note that our emotional intelligence video was purely educational and not designed to train participants in emotional intelligence.

3.4. Procedure

At time one (pre-training), participants completed the personality, intelligence, and affect questionnaires. Participants were then administered the pre-training creativity measures. Upon completion of these measures, participants were shown either the ideation video, relaxation video, or Emotional Intelligence video. After viewing the respective videos participants were then presented with the post-training creativity measures.

3.4.1. Design and analysis

The study utilized a mixed-subjects design. The within-subjects factor was "time" with two levels (pre-training and post-training). There was one manipulated between-groups factor (creativity training condition) with three levels (ideational skills training, relaxation training, and control). The present study incorporated two measured between-subjects variables (low vs high Extraversion and low vs high Openness to Experience), and two covariates (intelligence and affect). Data were analyzed via SPSS as two Repeated Measures ANOVAs (multivariate method) with affect and intelligence included as covariates in each analysis.

4. Results

4.1. Diagnostics and assumptions

To check assumptions associated with the present analyses, a range of tests were conducted for outliers, multicollinearity, and homogeneity of variance. First, the possible presence of within-group outliers was assessed by converting observed scores (within groups) to z scores, and then inspecting whether any of these scores fell beyond the $p < 0.001$ cut off (i.e., z-scores of +/- 3). Based on this criterion, no within-group outliers were identified. Second, homogeneity of variance was assessed

using Box's M statistics for each of the Repeated Measures ANOVAs. All Box's M statistics were not significant, indicating that the assumption of homogeneity of variance–covariance was met in the present case. Finally, sphericity, although an assumption of the Repeated Measures ANOVA, was not assessed here because there were fewer than three levels in the repeated measures factor (see Tabachnick & Fidell, 2007). Additionally, since the Repeated Measures ANOVA (via MANOVA) is robust to violations of this assumption, potential problems with sphericity posed no threat to the current analyses.

4.2. Data preparation and hypotheses testing

Scores from the two measures of creativity were highly correlated (0.57 in the pre-test, 0.50 in the post-test) and were consequently combined to form a measure of "general creativity". Median splits were conducted on measures of Openness and Extraversion to allow for these variables to be used as categorical variables in the Repeated Measures ANOVAs, and consequently be used in tests of three-way interactions. Table 1 presents the means and standard deviations for pre- and post-training creativity index scores for the ideational skills training and relaxation training groups at high and low levels of Extraversion and Openness.

Table 1 Pre- and post-training means and standard deviations for creativity index scores for the ideational skills training and relaxation training.

	Control		Relaxation Training		Ideational Skills Training	
	Pre-Training M(SD)	Post-Training M(SD)	Pre-Training M(SD)	Post-Training M(SD)	Pre-Training M(SD)	Post-Training M(SD)
Extraversion (Low)	65.36 (22.73)	69.24 (20.65)	69.54 (18.90)	89.95 (15.61)	70.79 (27.05)	81.08 (30.57)
Extraversion (High)	74.48 (23.71)	78.68 (20.44)	79.97 (22.41)	95.34 (21.89)	74.12 (21.97)	94.75 (23.16)
Openness (Low)	66.00 (19.67)	70.63 (20.35)	68.57 (22.39)	86.59 (20.37)	65.49 (24.07)	79.91 (28.72)
Openness (high)	73.53 (27.89)	77.04 (22.73)	81.01 (17.99)	98.91 (15.20)	80.42 (22.02)	97.00 (21.84)

To assess the hypotheses in the present study, two Repeated Measures ANOVAs (multivariate) were conducted. Both ANOVAs comprised a 2 (time) x 3 (training condition) x 2 (personality trait) design, enabling the key research question to be assessed (i.e., does Extraversion/Openness impact the extent to which training improves performance?). Intelligence and affect (positive and negative) were controlled in each of these analyses.

4.3. Extraversion

The Repeated Measures ANOVA (multivariate) revealed a significant main effect of time, $F(1, 153) = 5.02$, $p = .02$, $\eta_p^2 = .03$, indicating that, overall, creative performance was significantly higher at Time 2 compared with Time 1. There was a significant main effect of the covariate Intelligence $F(1, 153) = 4.00$, $p = .04$, $\eta_p^2 = .03$, but neither positive affect, $F(1, 153) = .22$, $p = .64$, $\eta_p^2 < .01$ nor negative affect, $F(1, 153) = .42$, $p = .52$, $\eta_p^2 < .01$ was significant.

There was a main effect of training condition, $F(2, 153) = 3.41$, $p = .04$, $\eta_p^2 = .04$, and a significant two-way interaction between training condition and time $F(2, 153) = 21.27$, $p < .001$, $\eta_p^2 = .22$, indicating a differential change in performance over time based on training conditions. Follow-up tests of simple effects revealed highly significant increases in performance for both relaxation, $F(1,153) = 147.29$, $p < 0.001$ (mean difference = 17.94, 95% CI [15.02, 20.86]) and ideation, F, $(1, 153) = 88.35$, $p < 0.001$ (mean difference = 15.47, 95% CI [12.21, 18.72]), and a lesser, but still significant, increase in the control condition, $F(1, 153) = 5.60$, $p = .02$ (mean difference = 3.93, 95% CI [.65, 7.21]). The significant two-way interaction therefore seems to be due to the *greater* increase in performance in the training conditions compared with the control condition (see Figure 1). In support of both Hypothesis 1 and Hypothesis 2, then, participants in both relaxation and ideation training conditions experience greater improvements in performance compared with the control condition.

In terms of the specific hypotheses relating to Extraversion, as predicted, tests of between-subjects effects revealed a significant main effect of Extraversion, $F(1, 153) = 4.27$, $p = .04$, $\eta_p^2 = .03$, supporting Hypothesis 3 and demonstrating that as Extraversion increased, so too did creative performance. The hypothesized three-way interaction between time, training condition, and Extraversion was significant, $F(2,$

153) = 6.21, p = .003, η_p^2 = .08, demonstrating that, consistent with Hypothesis 5, training program effectiveness over the three conditions was differentially affected by participants' levels of Extraversion (see Figure 1). This test was then replicated *without* the control condition to ensure this interaction was not caused by the presence of this condition. This test revealed a *more* significant three-way interaction between training condition, Extraversion, and time, $F(1, 104) = 10.96$, $p < 001$ $\eta_p^2 = .10$.

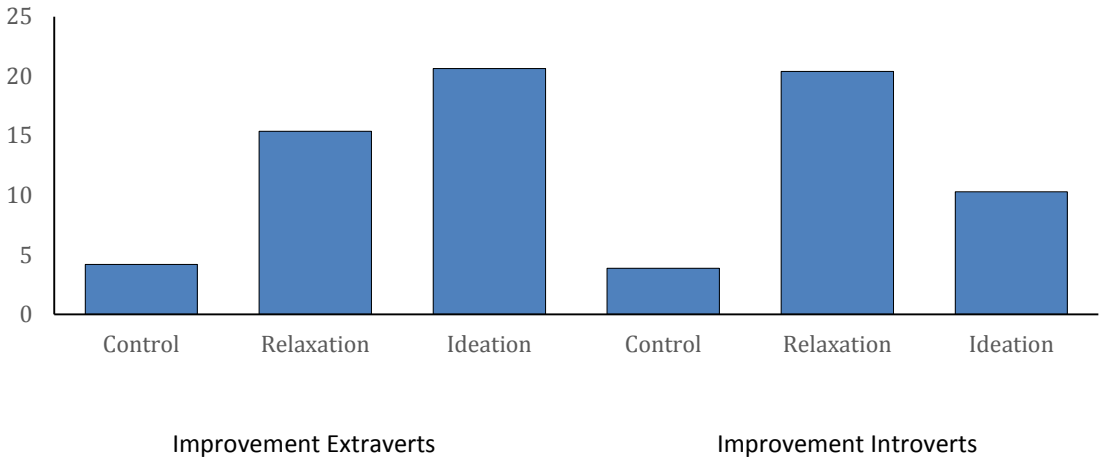

Fig. 1. Improvement in creativity performance for extraverts and introverts over the three conditions. It was hypothesized that extraverts would benefit most from ideation training and introverts would benefit most from relaxation training.

Overall, Figure 1 indicates that, while both types of training are beneficial for introverts and extraverts, introverts get *more* benefit from relaxation training (EMM difference = 20.42, 95% CI [16.26, 24.57]) than ideational skills training (EMM difference = 10.18, 95% CI [5.57, 14.80]), whereas extraverts get *more* benefit from ideational skills training (EMM difference = 20.75, 95% CI [15.93, 25.56]) than relaxation training (EMM difference = 15.47, 95% CI [11.23, 19.70]). Consistent with this, a simple main effect analyses for time revealed a highly significant increase in creative performance for introverts in the relaxation training condition (EMM

difference = 20.42, $p < .001$, $\eta_p^2 = .38$) and a highly significant increase in creative performance for extraverts in the ideational skills training condition (EMM difference = 20.75, $p<001$, $\eta_p^2 = .32$.)

4.4. Openness

Consistent with the findings for Extraversion, the Repeated Measures ANOVA revealed a significant main effect of time, $F(1, 153) = 4.16$, $p = .04$, $\eta_p^2 = .03$, indicating that, overall, creative performance was significantly higher at Time 2 compared with Time 1. Again, there was a significant main effect of the covariate Intelligence $F(1, 153) = 4.30$, $p = .04$, $\eta_p^2 = .03$, but neither positive affect, $F(1, 153) = 2.99$, $p = .09$, $\eta_p^2 < .01$, nor negative affect, $F(1, 53) = .001$, $p = .97$, $\eta_p^2 < .01$, was significant. Again, consistent with the results for Extraversion, there was a main effect of training condition, $F(2, 153) = 4.01$, $p = .02$, $\eta_p^2 = .04$, and a significant two-way interaction between training condition and time $F(2, 153) = 19.38$, $p < .001$, $\eta_p^2 = .20$, indicating a differential change in performance over time based on training conditions.

In terms of the specific hypotheses relating to Openness, tests of between-subjects effects revealed a significant main effect of Openness, $F(1, 153) = 9.37$, $p = .003$, $\eta_p^2 = .06$, supporting Hypothesis 4 and demonstrating that individuals with higher levels of Openness tended to have higher scores for creative performance. The hypothesized three-way interaction between time, training condition, and Openness, however, was not significant, $F(2, 153) = .12$, $p = .89$, $\eta_p^2 < .01$, demonstrating that training program effectiveness over the three conditions was *not* differentially affected by participants' levels of Openness; Hypothesis 6 was therefore not supported.

4.5. Robustness Check

In order to run the analyses detailed above, we conducted a median split on Extraversion and Openness. We note that conducting median splits of continuous variables is sometimes problematic, and we therefore checked the robustness of our key findings by re-running the analysis using hierarchical multiple regression. This involved the creation of dummy variables for the categorical IV (condition), mean centering predictors, and calculating four interaction terms (the two dummy variables multiplied by each personality IV). Interaction terms were assessed at the final stages of two hierarchical multiple regressions (one conducted for Extraversion, one conducted for Openness). Results of this analysis supported our key finding; the increase in performance across the three training conditions did not depend on Openness (R^2 *change* = .008, *F change* (2, 150) = .78, p = .46), but did depend of Extraversion (R^2 *change* = .05, *F change* (2, 150) = 5.09, p = .007). Simple slopes analysis of this interaction was consistent pattern of results illustrated in Figure 1; extraverts benefited more from ideation training whereas introverts benefited more from relaxation training.

5. Discussion

This study investigated the differential impact of personality characteristics on the effectiveness of two different types of creativity training programs. Results revealed support for the efficacy of both ideation and relaxation training for short-term increases in creativity. Consistent with previous research, results also demonstrated that those high in Extraversion and Openness tend to be more creative than those low in these traits. Importantly, key results demonstrated that the effectiveness of different types of training programs is somewhat dependent on a

participant's personality. Specifically, results indicated that relaxation training tended to benefit individuals low in Extraversion more than those high in Extraversion. Ideational skills training, on the other hand, tended to benefit those high in Extraversion more than those low in Extraversion. Results did not support a similar effect for Openness.

These findings hold both theoretical and practical implications. First, enhanced creative performance of participants on post-measures of creative performance is consistent with the idea that individuals can be trained – at least in the short term – in the metacognitive processes involved in creativity. In the current study, both training programs brought about an immediate increase in creative performance when compared to the control condition. Therefore, it seems that individuals can be taught to actively apply the concepts discussed in training and consequently improve their creative performance.

Second, the pattern of results obtained here suggests that Extraversion and Openness are important characteristics in the prediction of creative performance. Results for Openness are consistent with previous findings by Feist (1998), McCrae (1987) and, more recently, Sung and Choi (2009) and Lin, Hsu, Chen, and Wang (2012), who similarly found that individuals high in openness tend to score more highly on creative performance. Considering that Openness represents the degree to which a person is imaginative and unconventional (Mount & Barrick, 1995) these results are not surprising. Similarly, results for Extraversion are not surprising, as extraverts tend to score more highly in measures of creativity than introverts. Taken together, these findings add additional weight to existing empirical evidence that shows that Openness and Extraversion predict creativity.

The key finding in this study is the significant three-way interaction between

time, Extraversion, and training type in predicting creativity. Extraverts tended to respond better to ideation training, whereas Introverts tended to respond better to relaxation training. Consistent with the rationale used to develop this hypothesis, it is likely that Extraverts are more suited to ideation training, because ideation training focuses on teaching *novel skills and ideas* rather than relaxation. It is therefore more stimulating and cognitively demanding than the relaxation condition, and therefore more likely to increase arousal in participants. Conversely, it is possible that introverts are particularly suited to relaxation training, because this type of training is particularly likely to help them reduce arousal and also assist them in shifting between the two types of cognitive processes. As outlined in the introduction, there is good reason to believe that introverts have difficulty with shifting between the two types of cognitive processes due to their known difficulty with divided attention (Matthews et al., 2003). Additionally, introverts who tend to have a bias towards analytical thinking (Allison & Hayes, 1996) likely received enhanced benefit from relaxation and mindfulness training, because such tasks probably served to encourage type 2 processes in introverts, or put more colloquially, 'get them out of their heads'.

Numerous practical implications stem from these findings. Firstly, based on the obtained results, it is argued that organizations and practitioners with limited financial and human resources may reduce the cost of lengthy creativity programs by delivering brief, online programs, like those utilized here, to successfully enhance creative performance. Indeed, although improvements in creativity performance might only be short-term (as was assessed here), short-term improvements are nevertheless important. For example, a 10-minute training program may only improve creative performance for 24 hours, but if implemented at the start of a planning-day, short-term improvements in creativity can nevertheless translate into long-term

organizational benefits.

Further to this, differential effectiveness of relaxation training for levels of Extraversion suggest that organizations and trainers may benefit from initial personality assessment as a means of assigning trainees to different creativity programs. In this way, businesses can enhance the effects of creativity training and, by doing so, may further enhance the creative performance of their employees. However, our recommendations can only extend to training programs similar to those described here (i.e., short-term ideational and relaxation training programs). The possible relevance of personality in the efficacy of other popular creativity training programs is yet to be investigated.

5.1. Limitations and future research

There were three main limitations in this study. First, by conducting this experiment on a sample of university students it is possible that the results may not be entirely generalizable to the population of working adults. Second, it is likely that practice effects played a role in the overall pattern of results. However, we believe that our use of different pre- and post-test items, as well as the inclusion of a control condition, minimized the likely impact of such effects. Third, our ideation training video (eight minute's duration) was two minutes shorter than our relaxation training video (10 minutes duration). Although not ideal, this limitation probably did not impact the key finding in our study (that ideation training is more effective for extraverts, whereas relaxation training is more effective for introverts). This is because if video length enhanced the effectiveness of creativity training, then this should result in a main effect of training (i.e., relaxation training resulting in better creativity performance overall) rather than the conditional effects that we found (i.e.,

the efficacy of training depending on participant personality). Although there was a main effect of training, this was due to the two training conditions scoring higher than the control condition, rather than being different from each other.

In the current study, we focused on Openness and Extraversion in prediction of creativity because research has consistently found these two traits relate to creativity (e.g., Carson & Langer, 2006; Furnham & Bachiar, 2008; King et al., 1996; McCrae, 1987; Walker & Jackson, 2014) as well as training proficiency in general (Barrick & Mount, 1991). However, it is plausible that other dimensions from the five factor model (i.e., Agreeableness, Conscientiousness, Neuroticism) might predict responsiveness to training under some conditions. In particular, it seems likely that individuals high in Neuroticism (the tendency to feel fear, anxiety, and worry) might benefit from relaxation focused creativity training. Indeed, consistent with this possibility, a recent study by Walker & Jackson (2014) demonstrated that trait fear measured using Gray's Fight/Fright/Freezing system predicts divergent thinking when controlling for Extraversion and Openness. Future research could therefore assess the potentially beneficial effects of relaxation focused creativity training for individuals high in Neuroticism

6. Conclusion

The present study sought to determine the role of personality in creative performance in general, as well as the increment in creative performance due to different, brief training programs. The empirical analyses conducted in this study revealed that: 1) both ideation and relaxation training are beneficial overall; 2) that Openness and Extraversion predict creativity overall; and 3) that ideation training is particularly beneficial for extraverts whereas relaxation training is particularly

beneficial for introverts. These results enhance our current understanding of creativity performance by offering a more fine-grained understanding of when and why creativity training is likely to be successful. Although several limitations in this research were identified, results of this study nonetheless provide some support for the idea that personality characteristics may interact with types of creativity training to bring about differential creative outcomes. It is recommended that, following further investigation of this topic, professionals involved in creativity training take into account participants' personalities when designing creativity programs.

References

Agogué, M., Poirel, N., Pineau, A., Houdé, O., & Cassotti, M. (2014). The impact of age and training on creativity: a design-theory approach to study fixation. *Thinking Skills and Creativity*, *11,* 33–41.

Allinson, C. W., & Hayes, J. (1996). The cognitive style index: a measure of intuition-analysis for organizational research. *Journal of Management studies*, *33*, 119–135.

Amabile, T. M. (1996). *Creativity in context*. Boulder, CO: Westview Press.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, *39*, 1154–1184.

Anderson, K. J., & Revelle, W. (1994). Impulsivity and time of day: is rate of change in arousal a function of impulsivity? *Journal of Personality and Social Psychology*, *67*, 334–344.

Baer, M., & Oldham, G. R. (2006). The curvilinear relation between experienced creative time pressure and creativity: moderating effects of Openness to experience and support for creativity. *Journal of Applied Psychology*, *91*, 963–970.

Barrick, M. M., & Mount, M. K. (1991). The Big Five personality dimensions and job performance: a meta-analysis. *Personnel Psychology*, *44*, 1–26.

Baruah, J., & Paulus, P. B. (2008). Effects of training on idea generation in groups. *Small Group Research*, *39*, 523–541.

Basadur, M. S., Graen, G. B., & Green, S. G. (1982). Training in creative problem solving: effects on ideations and problem findings and solving in an industrial research organization. *Organizational Behavior and Human Performance*, *30*,

41–70.

Batey, M., & Furnham, A. (2006). Creativity, intelligence, and personality: a critical review of the scattered literature. *Generic, Social and General Psychology Monographs*, *132*, 355–429.

Birdi, K., Leach, D., & Magadley, W. (2012). Evaluating the impact of TRIZ creativity training: an organizational field study. *R&D Management*, *42*, 315–326.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). *How people learn: brain, mind, experience, and school*. Washington, DC: National Academy Press.

Bristol, A., & Viskontas, I. (2006). Dynamic processes within associative memory stores. In J. Kaufman, & J. Baer (Eds.), *Creativity and reason in cognitive development* (pp. 60–80). Cambridge, UK: Cambridge University Press.

Bull, K. S., Montgomery, D., & Baloche, L. (1995). Teaching creativity at the college level: a synthesis of curricular components perceived as important by instructors. *Creativity Research Journal*, *8*, 83–90.

Buzan, T. (1991). *Use both sides of your brain: new mind-mapping techniques*. New York, NY: Plume Books.

Carson, S.H., & Langer, E.J. (2006). Mindfulness and self-acceptance. *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, *24*, 29–43.

Chambers, R., Lo, B. C. Y., & Allen, N. B. (2008). The impact of intensive mindfulness training on attentional control, cognitive style, and affect. *Cognitive Therapy and Research*, *32*, 303–322.

Chamorro-Premuzic, T. (2006). Creativity versus conscientiousness: which is a better predictor of student performance? *Applied Cognitive Psychology*, *20*, 521–531.

Choi, J. N. (2004). Individual and contextual predictors of creative performance: the

mediating role of psychological processes. *Creativity Research Journal*, *16*, 187–199.

Clapham, M. M. (1997). Ideational skills training: a key element in creativity training programs. *Creativity Research Journal*, *10*, 33–44.

Clapham, M. M. (2001). The effects of affect manipulation and information exposure on divergent thinking. *Creativity Research Journal*, *13*, 335–350.

Constantino, T., Kellam, N., Cramond, B., & Crowder, I. (2010). An interdisciplinary design studio: how can art and engineering collaborate to increase students' creativity? *Art Education*, *63*(2), 49–53.

De Bono, E. (2009). *Lateral thinking: a textbook of creativity*. London, UK: Penguin Books.

Dean, M. A., Conte, J. M., & Blankenhorn, T. R. (2006). Examination of the predictive validity of Big Five personality dimensions across training performance criteria. *Personality and Individual Differences*, *41*, 1229–1239.

Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, *22*, 491–517.

Depue, R. A., & Morrone-Strupinsky, J. V. (2005). A neurobehavioral model of affiliative bonding: implications for conceptualizing a human trait of affiliation. *Behavioral and Brain Sciences*, *28*, 313–349.

DeYoung, C. G. (2015). Cybernetic Big Five theory. *Journal of Research in Personality*, *56*, 33–58.

Domino, G. (1977). Transcendental meditation and creativity: an empirical investigation. *Journal of Applied Psychology*, *62*, 358–362.

Evans, J. S. B. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology*, *59*, 255–278.

Eysenck, H. J. (1967). *The biological basis of personality* (Vol. 689). Transaction Publishers.

Eysenck, H. J. (Ed.) (1981). *A model for personality*. New York, NY: Springer.

Eysenck, H. J. (1994). Personality: biological foundations. In P. A. Vernon (Ed.), *The neuropsychology of individual differences* (pp. 151–199). London, UK: Academic Press.

Feist, G. J. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, *2*, 290–309.

Frankish, K. (2010). Dual-process and dual-system theories of reasoning. *Philosophy Compass*, *5*(10), 914–926.

Furnham, A., & Bachtiar, V. (2008). Personality and intelligence as predictors of creativity. *Personality and Individual Differences*, *45*, 613–617.

Furnham, A. F., Batey, M. D., Anand, D., & Manfield, J. (2008). Personality, hypomania, intelligence, and creativity. *Personality and Individual Differences*, *44*, 1060–1069.

Furnham, A., & Chamorro-Premuzic, T. (2004). Personality, intelligence, and art. *Personality and Individual Differences*, *36*, 705–715.

Furnham, A., Crump, J., Batey, M., & Chamorro-Premuzic, T. (2009). Personality and ability predictors of the 'Consequences' Test of divergent thinking in a large non-student sample. *Personality and Individual Differences*, *46*, 536–540.

Furnham, A., Monsen, J., & Ahmetoglu, G. (2009). Typical intellectual engagement, Big Five personality traits, approaches to learning, and cognitive ability predictors of academic performance. *British Journal of Educational*

Psychology, *79*, 769–782.

Gabora, L. (2005). Creative thought as a non-Darwinian evolutionary process. *Journal of Creative Behavior*, *39*, 65–87.

George, J. M., & Zhou, J. (2001). When openness to experience and conscientiousness are related to creative behavior: an interactional approach. *Journal of Applied Psychology*, *86*, 513–524.

Gilhooly, K. J., Fioratou, E., Anthony, S. H., & Wynn, V. (2007). Divergent thinking: strategies and executive involvement in generating novel uses for familiar objects. *British Journal of Psychology*, *98*, 611–625.

Goldberg, L. R. (1990). An alternative description of personality: the Big Five factor structure. *Journal of Personality and Social Psychology*, *59*, 1216–1229.

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment*, *4*, 26–42.

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. C. (2006). The International Personality Item Pool and the future of public-domain personality measures. *Journal of Research in Personality*, *40*, 84–96.

Gong, Y., Huang, J. C., & Farh, J. L. (2009). Employee learning orientation, transformational leadership, and employee creativity: the mediating role of employee creative self-efficacy. *Academy of Management Journal*, *52*, 765–778.

Gurven, M., von Rueden, C., Massenkoff, M., Kaplan, H., & Lero Vie, M. (2013). How universal is the Big Five? Testing the Five-Factor model of personality variation among forager-farmers in the Bolivian Amazon. *Journal of Personality and Social Psychology*, *104*(2), 354–370.

Gray, J. A. (1991). Neural systems, emotion and personality. *Neurobiology of Learning, Emotion, and Affect*, *4*, 273–396.

Guilford, J. P. (1967). *The nature of human intelligence*. New York, NY: McGraw-Hill.

Gumusluoğlu, L., & Ilsev, A. (2009). Transformational leadership and organizational innovation: the roles of internal and external support for innovation. *Journal of Product Innovation Management*, *26*, 264–277.

Hong, J. C., Hwang, M. Y., Chen, Y. J., Chen, M. Y., & Liu, L. C. (2012). Using eight trigrams (BaGua) approach with epistemological practice to vitalize problem-solving processes: a confirmatory analysis of R&D managers. *Thinking Skills and Creativity*, *7*, 187–197.

Hong, J. C., Hwang, M. Y., & Tai, K. H. (2013). Applying the BaGua to revitalize the creative problem solving process during a goal oriented contest. *Thinking Skills and Creativity*, *9*, 120–128.

Hough, L. M., Eaton, N. K., Dunnette, M. D., Kamp, J. D., & McCloy, R. A. (1990). Criterion-related validities of personality constructs and the effects of response distortion on those validities. *Journal of Applied Psychology*, *75*, 581–595.

Howard-Jones, P. A. (2002). A dual-state model of creative cognition for supporting strategies that foster creativity in the classroom. *International Journal of Technology and Design Education*, *12*, 215–226.

Isaksen, S. G., & Treffinger, D. J. (2004). Celebrating 50 years of reflective practice: versions of creative problem solving. *The Journal of Creative Behavior*, *38*, 75–101.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology*, *52*,

1122–1131.

Kabanoff, B., & Bottger, P. (1991). Effectiveness of creativity training and its relation to selected personality factors. *Journal of Organizational Behavior*, *12*, 235–248.

Karwowski, M., & Soszyński, M. (2008). How to develop creative imagination? *Thinking Skills and Creativity*, *3*, 163–171.

Kaufman, J. C., & Baer, J. (2002). Could Steven Spielberg manage the Yankees? *The International Journal of Creativity & Problem Solving*, *12*, 5–14.

Kim, K. H. (2005). Can only intelligent people be creative? *Journal of Secondary Gifted Education*, *16*, 57–66.

King, L., Walker, L., & Broyles, S. (1996). Creativity and the Five Factor model. *Journal of Research in Personality*, *30*, 189–203.

Krampen, G. (1997). Promotion of creativity (divergent productions) and convergent productions by systemic-relaxation exercises: empirical evidence from five experimental studies with children, young adults, and elderly. *European Journal of Personality*, *11*, 83–99.

Langer, E. J. (1992). Matters of mind: mindfulness/mindlessness in perspective. *Consciousness and Cognition*, *1*, 289–305.

Langer, E., Russell, T., & Eisenkraft, N. (2008). Orchestral performance and the footprint of mindfulness. *Psychology of Music*, *37*(2), 125–136.

Lebuda, I., Zabelina, D. L., & Karwowski, M. (2015). Mind full of ideas: a meta-analysis of the mindfulness-creativity link. *Personality and Individual Differences*, *93*, 22–26.

Lin, W.-L., Hsu, K.-F., Chen, H.-C., & Wang, J.-W. (2012). The relations of gender and personality traits on different creativities: a dual-process theory account.

Psychology of Aesthetics, Creativity, and the Arts, *6*, 112–123.

Matthew, C. T. (2009). Leader creativity as a predictor of leading change in organizations. *Journal of Applied Social Psychology*, *39*, 1–41.

Matthews, G., Deary, I. J., & Whiteman, M. C. (2003). *Personality traits*. Cambridge, UK: Cambridge University Press.

Matthews, G., & Gilliland, K. (1999). The personality theories of H. J. Eysenck and J. A. Gray: a comparative review. *Personality and Individual Differences*, *26*, 583–626.

McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology*, *52*, 1258–1265.

McCrae, R. R., & Costa, P. T. (1986). Personality, coping, and coping effectiveness in an adult sample. *Journal of Personality*, *54*(2), 385–404.

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness, and cognitive flexibility. *Consciousness and Cognition*, *18*, 176–186.

Mount, M. K., & Barrick, M. R. (1995). The Big Five personality dimensions: implications for research and practice in human resources management. In G.R. Ferris (Ed.), *Research in personnel and human resources management* (pp. 153–200). Greenwich, CT: JAI Press.

Nijstad, B. A., De Dreu, C. K., Rietzschel, E. F., & Baas, M. (2010). The dual pathway to creativity model: creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*, *21*, 34–77.

Oldham, G. R. (2003). Stimulating and supporting creativity in organizations. In S. E. Jackson, M. A. Hitt, & A.S. DeNisi (Eds.), *Managing knowledge for sustained competitive advantage* (pp. 243–273). San Francisco, CA: Jossey-Bass.

Revelle, W. (1995). Personality processes. *Annual Review of Psychology*, *46*, 295–328.

Robinson, R. N., & Beesley, L. G. (2010). Linkages between creativity and intention to quit: an occupational study of chefs. *Tourism Management*, *31*, 765–776.

Robinson, M. D., Moeller, S. K., & Ode, S. (2010). Extraversion and reward-related processing: probing incentive motivation in affective priming tasks. *Emotion, 10,* 615–626.

Runco, M. A. (2004) Creativity. *Annual Review of Psychology*, *55*, 657–687.

Runco, M. A., & Albert, R. S. (1990). *Theories of creativity*. Newbury Park, CA: Sage Publications, Inc.

Salgado, J. F. (1997). The Five Factor model of personality and job performance in the European community. *Journal of Applied Psychology*, *82*, 30–43.

Scott, G., Leritz, L. E., & Mumford, M. D. (2004). Types of creativity training: approaches and their effectiveness. *Journal of Creative Behavior*, *38*, 149–179.

Sedlmeier, P., Eberth, J., Schwarz, M., Zimmermann, D., Haarig, F., Jaeger, S., & Kunze, S. (2012). The psychological effects of meditation: a meta-analysis. *Psychological Bulletin, 138,* 1139–1171.

Shalley, C. E., Gilson, L. L., & Blum, T. C. (2000). Matching creativity requirements and the work environment: effects on satisfaction and intentions to leave. *Academy of Management Journal*, *43*, 215–223.

Shin, S. J., & Zhou, J. (2003). Transformational leadership, conservation, and creativity: evidence from Korea. *Academy of Management Journal*, *46*, 703–714.

Silvia, P. J., Winterstein, B. P., Willse, J. T., Barona, C. M., Cram, J. T., Hess, K. I., Martinez, J. L., & Richard, C. A. (2008). Assessing creativity with divergent

thinking tasks: exploring the reliability and validity of new subjective scoring methods. *Psychology of Aesthetics, Creativity, and the Arts*, *2*, 68–85.

Smillie, L. D. (2013). Extraversion and reward processing. *Current Directions in Psychological Science*, *22*, 167–172.

Smith, G. F. (1998). Idea generation techniques: a formulary of active ingredients. *Journal of Creative Behavior*, *32*, 107–134.

Soldz, S., & Vaillant, G. E. (1999). The Big Five personality traits and the life course: a 45-year longitudinal study. *Journal of Research in Personality*, *33*, 208–232.

Solomon, C. M. (1990). Creativity training. *Personnel Journal*, *69*, 64–71.

Sowden, P. T., Pringle, A., & Gabora, L. (2015). The shifting sands of creative thinking: connections to dual-process theory. *Thinking & Reasoning*, *21*(1), 40–60.

Stelmack, R. M. (1990). Biological bases of extraversion psychophysiological evidence. *Journal of Personality*, *58*, 293–311.

Sung, S. Y., & Choi, J. N. (2009). Do Big Five personality factors affect individual creativity? The moderating role of extrinsic motivation. *Social Behavior and Personality*, *37*, 941–956.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Boston, MA: Pearson/Allyn & Bacon.

Thomke, S. H. (2003). *Experimentation matters: unlocking the potential of new technologies for innovation*. Boston, MA: Harvard Business School Press.

Thompson, L. (2003). Improving the creativity of organizational work groups. *Academy of Management Executive*, *17*, 96–109.

Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: its potential antecedents and relationship to creative performance. *Academy of Management Journal*, *45*,

1137–1148.

Vartanian, O., Martindale, C., & Matthews, J. (2009). Divergent thinking ability is related to faster related judgments. *Psychology of Aesthetics, Creativity, and the Arts*, *3*, 99–103.

Walker, B. R., & Jackson, C. J. (2014). How the Five Factor model and revised Reinforcement Sensitivity Theory predict divergent thinking. *Personality and Individual Differences*, *57*, 54–58.

Warren, T. F., & Davis, G. A. (1969). Techniques for creative thinking: an empirical comparison of three methods. *Psychological Reports*, *25*, 207–214.

Watson, D., & Hubbard, B. (1996). Adaptational style and dispositional structure: coping in the context of the Five-Factor model. *Journal of Personality*, *64*, 737–774.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.

Welch, L. (1946). Recombination of ideas in creative thinking. *Journal of Applied Psychology*, *30*(6), 638–643.

Wiseman, R., Watt, C., Gilhooly, K., & Georgiou, G. (2011). Creativity and ease of ambiguous figural reversal. *British Journal of Psychology*, *102*, 615–622.

Wonderlic, Inc. (2000). *Wonderlic personnel test and scholastic level exam: user's manual*. Libertyville, IL: Author.

Wuthrich, V., & Bates, T. C. (2001). Schizotypy and latent inhibition: non-linear linkage between psychometric and cognitive markers. *Personality and Individual Differences*, *30*, 783–798.