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Exploring the Effects of Creativity Training on Creative Performance and Creative Self-Efficacy: Evidence from a Longitudinal Study

ABSTRACT

In organizations and educational institutions, creativity trainings are the preferred approach to enhancing individual creative abilities. However, three issues regarding these trainings still remain largely unsolved. First, the question of how long-lasting creativity training effects are has not been sufficiently answered so far. Second, the question arises whether all participants benefit from such trainings equally in terms of their creative performance (CP). Third, an increasing number of studies have shown that creativity trainings may also be able to increase participants' creative self-efficacy (CSE), that is, the confidence in one's own creativity. Other studies, however, did not find evidence for this effect. Therefore, this article aims to address these issues by analyzing data from three measurement waves. Results reveal that participants' CP increased during the training and decreased only slightly 4 weeks after the training. Additionally, we found an effect of diminishing training returns in that the higher a participant's CP before the training the lower the training effect was. In contrast to most prior literature, we found no support for an effect of creativity training on participants' CSE. We discuss these findings and offer implications for both theory and practice. Finally, we state this study's limitations and derive avenues for further research.

Keywords: creativity training, creative performance, creative self-efficacy, CSE, longitudinal study.

There is no doubt that creativity and innovation play an important role in fostering organizational performance, success, and growth (Anderson, Potočnik, & Zhou, 2014). In particular, the capability of generating and implementing ideas that are both novel and useful has become a decisive success factor for any organization (Anderson, De Dreu, & Nijstad, 2004). Taking the individualistic perspective, researchers have long investigated personal characteristics and contextual factors as the basis to enhance creativity in the workplace (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Choi, 2004; Woodman, Sawyer, & Griffin, 1993). These insights led educational institutes as well as other organizations to develop different approaches for encouraging creativity (Scott, Leritz, & Mumford, 2004). Out of these, creativity training programs aiming at developing specific personal dispositions in order to increase participants' creative problem-solving skills have been the preferred approach (Clapham & Schuster, 1992; Mansfield, Busse, & Krepelka, 1978).

Despite researchers' general agreement on the beneficial results of creativity trainings (Valgeirsdottir & Onarheim, 2017), three questions remain largely unanswered so far. First, to be considered successful, creativity trainings need to generate sustainable and long-lasting effects that should persist beyond the period of the actual training. However, most of the studies investigating creativity trainings are limited to pre- and post-training comparisons of creative performance (CP) with two measurement waves. Only few studies exist that investigate the consistency of creativity training effects so far, and the question whether creativity training effects are long-lasting has not yet been resolved. Second, the question arises whether all participants benefit from such trainings equally in terms of their CP, that is, a participant's performance regarding a creative task. We assume that training effectiveness highly depends on certain personal (pre-) conditions or individual criteria. Research on learning curves has shown that while people develop a certain skill, returns on training diminish the more the skill is trained. This means that training effects are lower for individuals that are already quite saturated or experienced in a specific domain, and vice versa. Since it would

be worth finding out whether the effects revealed in other training settings could also be discovered in the field of creativity, we propose to look at creativity training effects through the lens of such learning curves. Third, an increasing number of studies (e.g. Mathisen & Bronnick, 2009; Tang & Werner, 2017) have shown that creativity trainings may also be able to increase participants' creative self-efficacy (CSE), that is, the valuation and confidence in one's own creativity (Jaussi, Randel, & Dionne, 2007; Puente-Díaz & Karwowski, 2017; Tierney & Farmer, 2002, 2011). Other studies, however, seem to contradict these results as they did not find evidence for this effect, and authors have, therefore, questioned whether creativity trainings really are a viable option to increase participants' CSE (Starkey, McKay, Hunter, & Miller, 2017). In sum, studies regarding the underlying dynamics on how exactly creativity trainings affect participants' CP and their CSE are still scarce. Since it is highly relevant to understand this complex relationship, there is an urgent need for studies focusing on this topic (Karwowski, 2011).

Therefore, the aim of this paper is threefold: First, we aim at investigating the consistency of the effects of creativity trainings on CP. Second, we aim at exploring whether all participants profit equally from creativity trainings regardless of their individual pre-conditions. We, therefore, take a closer look at the role of participants' initial CP on the effectiveness of the trainings. Third, we aim at investigating whether creativity trainings are not only able to enhance participants' CP but also their CSE.

The paper is structured as follows. First, we provide an overview on previous literature in this field. By referring to meta-analyses on the effectiveness of creativity trainings and on self-efficacy theory (Bandura, 1977), we develop hypotheses regarding the effects of creativity training on CP and CSE. Afterward, we describe the procedure of the three-wave study and the applied creativity training approach. Subsequently, we present and discuss the results with regard to theoretical and practical implications, followed by limitations and recommendations for further research.

THEORETICAL BACKGROUND AND DEVELOPMENT OF HYPOTHESES

Creativity training has its roots in the work of Osborn (1953), who was the first to contrive methods aiming to enhance creativity. In the following decades, more and more approaches emerged that advanced the understanding of how creativity can be stimulated, being consecutively followed by the development of various training programs based on his seminal work (Jaušovec, 1994). To date, hundreds of approaches for enhancing creative thinking have evolved (Karwowski & Soszynski, 2008; Nickerson, 1999), ranging from programs for kindergartners (e.g. Dziedziewicz, Oledzka, & Karwowski, 2013; Meador, 1994) or primary school students (Dziedziewicz, Gajda, & Karwowski, 2014) to management trainings (Basadur, Wakabayashi, & Takai, 1992).

In order to measure their impact, a broad range of studies has investigated the effectiveness of creativity trainings. Four of these studies are particularly noteworthy since they comprehensively aggregate previous findings. First, Torrance (1972) analyzed 142 creativity training studies and found that the vast majority of analyzed trainings enhanced participants' creativity. Second, Rose and Lin (1984) conducted the first meta-analytic study on creativity trainings and assessed an overall positive but moderate effect size of the studied trainings on CP. Third, Scott et al. (2004) conducted the second meta-analytic study on creativity trainings. Being the first to account for various training characteristics, such as different course contents and delivery methods, the authors found that training characteristics differ in their creativity enhancing effect. Fourth, a further meta-analytic study by Ma (2006) found an even stronger effect of creativity trainings on CP than the studies mentioned previously. In contrast to Scott et al. (2004), Ma's (2006) study further analyzed the boundary conditions of creativity trainings. He found that the training effect was consistent across different creativity measurement instruments and independent from the training duration. To sum up, the majority of these studies indicate that creativity trainings generally have a positive effect on CP with effect sizes between 0.47 and 0.76 (for a comprehensive review, see Ma, 2006).

Yet, positive effects from creativity training are only helpful if they are long-lasting. Scott et al. (2004), for example, conclude that many studies on creativity trainings fail or are not able to show whether training effects sustain beyond their actual training period. Moreover, several researchers raised concerns about the revealed positive effects of creativity trainings and their transferability to "real-life" situations and actual behavior. For example, Wallach (1971) argued that improved scores especially for divergent thinking might be attributed to the mere training effect of individuals consciously dealing with creativity-related tasks and content. Similarly, Mansfield et al. (1978) argued that the instructional settings of creativity tests such as requesting especially novel, original, or creative ideas from study participants may conceal actual training outcomes. The fact that most of the studies they reviewed only compared pre- and post-training values

without follow-up investigations leaves the question open whether training effects lasted beyond the training sessions. Yet, some studies exist that tackle this question. Glover (1980), for example, found lasting effects of the creativity training on idea fluency, flexibility, and originality.

Next to the basic question whether the effects of creativity trainings outlast the actual training period, the long-term effectiveness of creativity training may also depend on the structure of the training itself and the methods applied. A standardized few-days training in creativity, for instance, might result in a short period of enthusiasm and thus lead to a brief increase in CP. As soon as participants continue with their daily activities, however, these effects may fade (Mathisen & Bronnick, 2009). In contrast, a participant-focused, interactive, and feedback-oriented course that lasts over a longer period of time may result in training effects that are more sustainable (Tang & Werner, 2017). Thus, we expect that participants' initial enthusiasm will have an overall positive training effect and will consequently lead to an increase in CP. We further assume that CP, however, will slightly decrease after the training period since participants are no longer exposed to and actively involved in creativity-related content. Taken together, we argue that the training effect is sustainable in a way that:

Hypothesis 1 (H1): Creativity training will have a positive effect on participants' CP in the sense that CP will increase during the training but will slightly decrease after the training.

Creativity scholars generally agree that creativity is an ability that can be taught and developed on an individual level (Ma, 2006). As already mentioned, most studies on creativity trainings found positive effects of the trainings on participants' CP (e.g. Cheung, Roskams, & Fisher, 2006; Rose & Lin, 1984; Scott et al., 2004). Despite the consensus on the positive effects of creativity trainings, important questions, however, of whether all participants profit equally from creativity training or how exactly creativity is learned remain largely unanswered. Given the variety of influencing factors regarding the development of creative potential (Cropley, 1997), providing further insights into these relationships seems crucial for educators and scholars.

Research in the field of psychology has already acknowledged the presence of learning curves when individuals are confronted with complex tasks (Anzai & Simon, 1979). Studies argue that the efficiency of solving these complex tasks depends on prior experience and, therefore, increased skill, resulting from repetitive behavior or "learning by doing" (Anzai & Simon, 1979; Day & Montgomery, 1983; Grantcharov & Funch-Jensen, 2009). Thus, the more experience individuals have regarding a given task, the higher their output will be (Adler & Clark, 1991). Yet, with progressing time, output levels are likely to reach a natural limit (Harlow, 1949). Against this background and considering that creativity is a complex yet learnable skill that can be stimulated, for example, through creativity trainings, we may observe the same effects that have already been studied in other fields. Therefore, investigating the effects occurring in creativity trainings through the lens of learning curves might be a promising approach. Thus, in line with the notion of diminishing returns, we assume that individuals with a higher proficiency in creativity at the beginning of the creativity training will receive relatively lower incremental gains in CP compared with individuals who have not yet fully developed their creative ability. Hence, we assume that especially those participants will profit from creativity training that initially have a lower CP compared with participants that show a high CP before the start of the training. Therefore, we suppose the following:

Hypothesis 2 (H2): The effectiveness of creativity training depends on a participant's initial CP in a way that the higher the initial CP, the lower the training effect will be.

Based on Bandura's (1977, 1997) self-efficacy theory of behavioral change, Tierney and Farmer (2002) developed the concept of CSE in order to assess "the belief one has about the ability to produce creative outcomes" (p. 1138). Self-efficacy theory explains individual behavior through self-perceived efficacy expectations. According to the theory, individuals engage in a certain behavior not only because they anticipate a beneficial outcome from an activity, but also because they are confident that they can successfully perform the behavior required to create the desired outcome (Bandura, 1977, 1997). Consequently, self-efficacy can play an important role in determining a person's performance (Locke, Frederick, Lee, & Bobko, 1984) and creativity (Beghetto & Karwowski, 2017; Hsu, Hou, & Fan, 2011; Tierney & Farmer, 2002, 2011).

Although several empirical studies have found correlations between CSE and CP (Beghetto, Kaufman, & Baxter, 2011; Malik, Butt, & Choi, 2015), how to actually enhance CSE is less understood (Starkey et al., 2017). One promising way to enhance CSE could be to address participants' creative mindset. Recent research revealed that two mindsets exist regarding how creative abilities are developed. On the one hand, there is the conviction that individuals can develop their creative abilities (growth mindset); on the other

hand, it has been found that creativity is perceived as a stable trait that can hardly be changed (fixed mindset) (Hass, Katz-Buonincontro, & Reiter-Palmon, 2016; Karwowski, 2014; Karwowski & Brzeski, 2017; Tang & Werner, 2017). Among other things, creativity training confronts participants with their mindset through, for example, reports of creative experts and how they acquired their skills. In this way, participants face their own creative mindset and are able to reevaluate it. Moreover, engaging in wicked problem-solving tasks during creativity training can be a rewarding experience, especially for participants who value creativity. This could, in turn, lead participants to calibrate their CSE (Beghetto & Karwowski, 2017).

Some studies have already examined the effect of creativity trainings on CSE. Comparing their results to a control group, Mathisen and Bronnick (2009) found positive effects of 1- and 5-day creativity trainings on CSE for college students and employees. The authors further found evidence for the stability of this effect by measuring CSE at three different points in time. More recently, Byrge and Tang (2015) confirmed this positive effect by investigating the effectiveness of a 39-hour embodied creativity training. Their results further indicate that CSE could be enhanced not only by strengthening trainees' creative abilities but also by changing training participants' notion of creativity and attitudes toward creativity. In a recent study, Tang and Werner (2017) investigated the effect of an intercultural creativity training program on participants' CSE. Their results confirm the positive impact of training on CSE. However, measuring CSE 1 year after the program, they found that CSE fell significantly for a proportion of their initial sample. Yet, other studies exist that contradict the general positive perception of previous findings. Starkey et al. (2017), for example, could not detect significant differences in students' CSE before and after taking part in a creative exercise. One explanation for this might be the fact that the 2-hour creative exercise that had to be completed in their study was rather short in comparison to the already mentioned effective 1- or 5-day training provided by Mathisen and Bronnick (2009). Taken together, although recent studies revealed ambiguous findings, most of the studies' results indicate that CSE can be improved through creativity exercises. Reflecting that, we assume that creativity training not only affects participants' overall CP, but also their CSE:

Hypothesis 3 (H3): Creativity training has a positive effect on participants' CSE.

METHOD

TRAINING APPROACH

We tested our hypotheses on longitudinal data from students receiving creativity training through a credit-bearing one-semester university course in *Creativity and Design in Innovation Management* offered by the School of Business and Economics at a major German university. The course mainly followed Mathisen and Bronnick's (2009) creativity training approach and was developed on the basis of three of Bandura's (1977) antecedents of self-efficacy: (a) performance accomplishments aim at building participants' creative self-belief by letting them experience success through being creative by themselves; (b) vicarious experience incorporates participants' observations of the lecturer or other classmates being creative; and (c) verbal persuasion aims at convincing participants verbally that they are capable of becoming creative. Furthermore, the course was developed to build on Scott et al.'s (2004) findings on the most effective creativity training elements, namely idea production training, imagery training, cognitive training, and thinking skills training. For the purpose of this study, the course consisted of two substantial elements described below in more detail: a creativity training including lectures and a group work on creativity; and lectures on design that were not directly related to the training.

First, participants attended eight 90-minute lectures in a weekly cycle that included the following major topics:

- *Essentials of creativity.* As an introduction, the lecturers explained the development of different views of approaching creativity, including Kaufman and Beghetto's (2009) Four C model, Amabile's (1996) componential model, and Csikszentmihalyi's (2014) systems model of creativity.
- *Individual creativity.* Based on the models mentioned above and through various examples of the lives of outstanding creative personalities, the lecturers emphasized that creativity is an ability that can be trained, thereby encouraging everyone to live up to their creative potential. Furthermore, the lecturers drew attention to mental barriers that hinder creativity. The latter part was largely based on the work of Niku (2009).
- *Team and organizational creativity.* The lecturers revealed the prerequisites of creative teams (Von Stamm, 2003). Finally, current examples of organizational activities to foster creativity were presented,

including creative work environments, creative leadership, and innovative idea management. These examples demonstrated the opportunities for, and pitfalls of, fostering organizational creativity.

Two of the authors of this article instructed the course. To a large part, the lecture sessions were an interactive dialog that actively welcomed questions as well as experiences from the audience. During the whole course, the lecturers provided feedback on participants' questions. Additionally, creative thinking was encouraged by letting the students individually solve insight problems during the lectures, including the popular nine-dot problem and the candle task (Duncker, 1945).

Second, the course consisted of an adapted version of the Creative Problem Solving Program which has shown to be an effective training mechanism (Isaksen & Treffinger, 2004). Students were given 1 month to elaborate on a case in groups of approximately five members to transfer their gained knowledge on creativity into practice. Their task was to apply one out of six given creativity techniques to generate creative ideas on a given assignment ("How would you increase the attractiveness of your university?"). For example, the students applied brainwriting, or the provocation technique. Brainwriting is a popular approach to generate creative ideas in organizations (Stroebe, Nijstad, & Rietzschel, 2010). It is similar to brainstorming, but differs in that, basically, each individual writes down ideas before sharing them in the group (Meinel & Voigt, 2017; VanGundy, 1984). The provocation technique was developed by De Bono (1970) and aims at enhancing creativity through canceling, reversing, or exaggerating typical solutions for a problem (Herrmann & Felfe, 2014). At first, participants informed themselves about the creativity technique of their choice through literature research. Afterward, strictly according to the procedure proposed in the respective literature, they applied the selected technique in their group and documented their generated ideas in a three-page paper.

Finally, the course concluded with four 90-minute lectures on the essentials of design. These lectures mainly referred to the works of Niku (2009) and Heufler (2004), and provided insights on the design process as well as on design elements, such as form and function, colors, composition, and style. Although these lectures complemented the course content, they had no direct reference to the creativity training before.

PARTICIPANTS AND PROCEDURE

The elective course was open to students from various disciplines, including general management, marketing, industrial engineering, and business education. Overall, we collected data from the 192 participants at three points in time: before the training (Time 0, October 2015), after the training (Time 1, December 2015), and at the end of the non-training period (Time 2, January 2016). We received 189 responses for Time 0, 145 for Time 1, and 192 for Time 2. The participants (42.3% female) were graduate students majoring in industrial engineering (33.9%), general management (21.2%), business education (21.2%), marketing (12.7%), mechanical engineering (8.5%), and others (2.6%). Participants' age ranged from 21 to 31 years, with an average of 24.46 years (SD = 1.84). Table 1 depicts a comparison of basic demographic data of the three waves. It is shown that the demographics at Time 0, Time 1, and Time 2 do not vary in terms of gender, age, and major, indicating that participation in the study had no serious impact on the effects analyzed.

TABLE 1. Characteristics of Participants for Each Time of Data Collection

	Time 0	**Time 1**	**Time 2**
N	189	145	192
Female (in %)	42.3	46.9	44.3
Age			
Mean	24.46	24.43	24.85
SD	1.84	1.68	1.76
Range	21–31	20–29	20–31
Major (in %)			
Industrial engineering	33.9	35.9	34.4
General management	21.2	22.1	20.8
Business education	21.2	17.9	21.4
Marketing	12.7	16.6	15.1
Mechanical engineering	8.5	4.9	5.2
Other	2.6	2.8	3.1

MEASURES

At each point of data collection, we assessed students' CP through a creativity test and CSE through paper and pencil questionnaires. CSE was measured using a 3-item 5-point Likert scale, ranging from 1 (*completely disagree*) to 5 (*totally agree*) (Tierney, 1997; Tierney & Farmer, 2002). The items were translated from English into German by a professional translator using the double-back translation process (Brisner, Lonner, & Thorndike, 1973). Due to low loadings of the third item ("I have a knack for further developing the ideas of others"), we eliminated it and calculated CSE as the average of the remaining two indicators ("I feel that I am good at generating novel ideas," and "I have confidence in my ability to solve problems creatively"). Final Cronbach's alpha results were 0.70 (Time 0), 0.66 (Time 1), and 0.73 (Time 2), indicating a sufficient level of internal consistency (Nunnally, 1978).

We measured participants' CP with the Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002). The ATTA is a shortened version of the Torrance Tests of Creative Thinking (TTCT) and was specifically developed for adult samples (Torrance, 1966, 1998). Out of at least 250 instruments that claim to objectively measure creative abilities (Cropley, 2000), the TTCT is the most widely used and most researched test to assess individual creativity (Kim, 2006). Consistent to the original TTCT, the ATTA contains three tasks: one verbal idea generation task and two figural picture or figure completion tasks. The ATTA measures four cognitive abilities associated with creative thinking: ideational fluency, originality, cognitive flexibility, and elaboration. Furthermore, the test assesses 15 creativity indicators, including resistance to premature closure and abstractness of titles. The ATTA has shown predictive validity (Althuizen, Wierenga, & Rossiter, 2010) and has already been applied in various settings (Kharkhurin, 2009; Mohamed, 2016).

The ATTA comes with pre-formulated protocols to ensure standardized administration (Goff & Torrance, 2002). However, we slightly modified the original test to ensure comprehensibility for the participants. Each task should be performed within 3 minutes. We coded the participants' responses according to the detailed guidelines of the ATTA manual (Goff & Torrance, 2002) to get an overall creativity index ranging from 24 to 84. We trained two graduate students, who did not participate in the course, to code the test results independently. To ensure inter-rater reliability, we followed the approach of Cropley and Kaufman (2012) and treated raters as items. Consistency among the raters (Cronbach's alpha) for the scores of the four cognitive abilities associated with creative thinking ranged from 0.85 to 0.97 and consistency for the creativity indicators (combined score) was 0.73. Due to at least sufficient inter-coder reliability (Nunnally, 1978), we combined the ratings and proceeded with each participant's averaged rating of the creativity index. An overview of the whole data collection procedure and course structure is presented in Figure 1.

The applied creativity tests were identical for each participant and at each point of data collection. To rule out biases due to possible learning effects related to participants' threefold completion of the creativity test, we employed a control group (Group B, $N = 31$) next to the main group (Group A). Please note that we did not introduce the control group to control for the hypothesized effect, but for the possible effect of training on the creativity test. Both Group A and Group B took part in the whole creativity training. Yet, data from Group A were first collected at Time 0 (before the training), whereas data from Group B were first collected at Time 1 (after the training). We controlled for possible learning effects regarding the creativity test in two ways. First, if such a learning effect existed, Group A should have shown a higher CP in Time 1 than Group B because they could already have become accustomed to the creativity test. Yet at Time 1, we did not find a significant difference in CP between Group A ($M = 68.58$, $SD = 6.71$) and Group B ($M = 66.65$ $SD = 6.00$, $p > .1$). Second, if such a learning effect existed, Group B should have shown an increase in CP from Time 1 to Time 2, because this group performed the creativity test for the first time in Time 1, and the effect of learning on the test should have occurred between Time 1 and Time 2. However, our analysis revealed no significant difference in CP for Group B between Time 1 ($M = 66.65$, $SD = 6.00$) and Time 2 ($M = 65.94$, $SD = 9.60$, $p > .1$). This indicates that it is not likely that any learning effect due to the multiple completion of the creativity test biased our findings. Means and standard deviations of the study variables are presented in Table 2.

RESULTS

To test our hypotheses, we applied hierarchical linear (mixed) modeling (HLM). HLM is an adequate method to investigate within-subject variance and between-subject variance at different levels (Bryk & Raudenbush, 1992; Hofmann, 1997; Hofmann, Griffin, & Gavin, 2000). In our study, within-subject variance accounts for each participants' CP development over time (level 1), and between-subject variance accounts

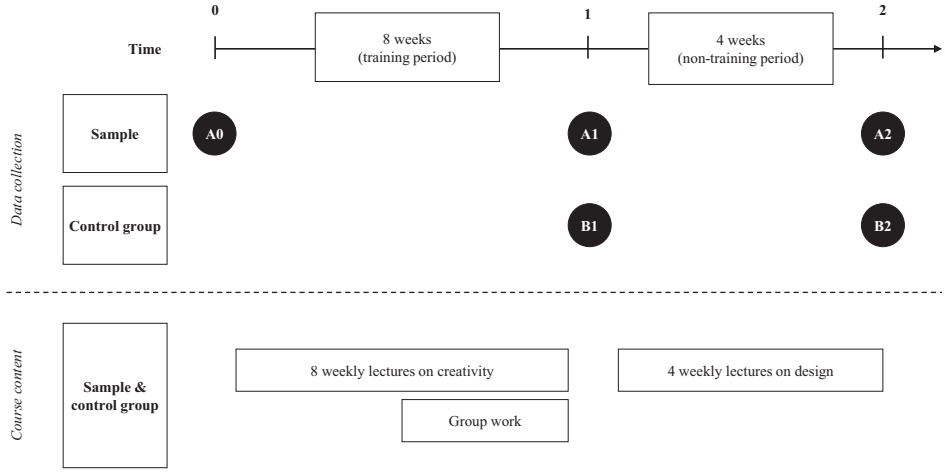

FIGURE 1. Overview of the course and data collection procedure.
Note. A = data collection of main group; B = data collection of control group.

TABLE 2. Means and Standard Deviations of Study Variables for Group A and Group B

Participants	CP, *M* (*SD*)			CSE, *M* (*SD*)		
	Time 0	Time 1	Time 2	Time 0	Time 1	Time 2
Group A	61.95 (8.48)	68.58 (6.71)	66.44 (8.51)	3.48 (.85)	3.56 (.71)	3.51 (.79)
Group B	–	66.65 (6.00)	65.94 (9.60)	–	3.63 (.71)	3.63 (.85)

Note. We did not introduce the control group (Group B) to control for the hypothesized effect, but for the possible effect of training on the creativity test. Both Group A and Group B took part in the whole creativity training.

for the differences between individual participants (level 2). We used the mixed-model procedure of IBM SPSS Statistics 25 to analyze the data.

We first computed a null model (Model 1) to determine whether there exists sufficient variance in our sample, both between and within subjects, and to compute baseline goodness of model fit that we need for later comparison of the models. We calculated Akaike's information criterion (AIC) to measure model fit, which is common practice (Wagenmakers & Farrell, 2004). Generally, lower AIC values indicate better model fit. Model 1 contains no predictors, but only accounts for the intercept variance. Analysis revealed significant variance between subjects (Intercept = 63.84, $F = 12{,}355.19$, $p < .001$) and significant variance within subjects ($p < .001$; ICC = .46), thus allowing us to proceed with the multilevel analysis.

We then introduced time as a fixed effect (Model 2a) to test for the hypothesized main effect of creativity training on CP (Hypothesis 1). Since the training took part between Time 0 and Time 1, we assume that CP increases through the training period and stabilizes after the training period. Therefore, we added two separate predictors for time as fixed effects in our model: *time_linear* (coded as 0 for Time 0, 1 for Time 1, and 2 for Time 2) predicting the linear effect over time and *time_quadratic* (coded as 0 for Time 0, 1 for Time 1, and 4 for Time 2) predicting the quadratic effect over time. The analysis revealed a significant effect of both predictors on CP. The significant linear effect of training over time ($\beta = 11.58$, $p < .001$) means that participants' CP generally increases through the training and the significant quadratic effect ($\beta = -4.63$, $p < .001$) means that the increase in CP diminishes over time. This results in a slight decrease from Time 1 to Time 2 as can be seen in Table 2. Thus, Hypothesis 1 is supported.

To test whether the increase in participants' CP through creativity training differs between individuals (Hypothesis 2), we entered the linear time variable as an additional random effect in Model 2b. Allowing individual growth rates over time revealed significant unexplained within-subject variance for the training effect over time ($p < .001$). Moreover, the analysis revealed (1) significant between-subject variance in the intercept ($p < .001$), (2) significant between-subject variance in the slope ($p < .01$), and (3) significant covariance between both the intercept and the slope ($p < .01$). Based on these results, we further modified our model in two ways, resulting in Model 3. First, we introduced participants' initial CSE as a predictor of the intercept (fixed effect), since previous studies have shown high correlations between CSE and CP. For example, Tierney and Farmer (2002) found positive significant correlations between CSE and supervisor-evaluated CP for employees of a consumer product company. The analysis revealed a significant positive effect of initial CSE on participants' CP ($\beta = 1.36$, $p < .05$) and also resulted in a better model fit. Second, in order to test whether a participant's initial CP influences the training effect, we forced the model to predict a correlation parameter for the covariance between participants' intercept and slope. The model predicted a significant correlation ($\beta = -0.64$, $p < .001$), implying that the higher a participant's initial CP, the lower the training effect. Thus, Hypothesis 2 is supported.

In a last model (Model 4), we tested the proposed effect of creativity training on participants' CSE (Hypothesis 3). In equivalence to Model 2a, we entered the linear and quadratic time variables as fixed effects into the model, but no random effect. Our analysis revealed no significant effect of creativity training on CSE ($ps > .05$), leading to the rejection of Hypothesis 3. In Table 3, we provide a summary of the different models we have tested.

DISCUSSION AND CONCLUSIONS

This study's overall objective was to examine the consistency of the effects of creativity training on CP and CSE. In particular, we aimed at investigating three specific effects that are important to understand how creativity trainings work, but which have received only limited scholarly attention so far or showed contradictory findings. By investigating these effects in a creativity training offered to students at a large German university, our study presents new evidence on these relevant phenomena and, therefore, contributes in many ways to theory and practice.

THEORETICAL IMPLICATIONS

First, our findings confirm the general effectiveness of creativity trainings for enhancing participants' CP. This substantiates the positive effect of creativity training on CP consistently reported in the literature so far (e.g. Ma, 2006; Rose & Lin, 1984; Scott et al., 2004). Moreover, our findings are one of the first studies to show that the increase in CP stabilized, albeit CP slightly decreased again after the training. This expands the findings of Glover (1980), who showed that CP improvements remained constant beyond the training period. This is an important finding, since without long-term stability, "quick wins" regarding CP are fruitless.

Second, the results of this study emphasize the importance of participants' initial CP on the effectiveness of creativity trainings. In particular, individuals with a comparatively lower initial CP profited strongly from the creativity training. This finding is interesting, because it supports the notion of creativity as a complex

TABLE 3. Comparing Results of Hierarchical Linear Mixed-Model Analysis

Variables	Model 1[a]	Model 2a[a]	Model 2b[a]	Model 3[a]	Model 4[b]
Intercept	63.84***	61.13***	61.13***	56.27***	3.57***
Time_linear		11.58***	11.53***	11.63***	.06
Time_quadratic		−4.63***	−4.57***	−4.60***	−.03
CSE_initial				1.36*	
AIC	2,856.39	2,772.68	2,765.04	2,759.80	798.72

Notes. Model 1 (null model): no predictors; Model 2a: Time_linear and Time_quadratic as fixed predictors; Model 2b: Time_linear and Time_quadratic as fixed predictors and Time_linear as random predictor; Model 3: Time_linear, Time_quadratic, and CSE_initial as fixed predictors and Time_linear as random predictor; Model 4: Time_linear and Time_quadratic as fixed predictors.

[a]Dependent variable: CP.

[b]Dependent variable: CSE. *$p < .05$. ***$p < .001$.

cognitive ability that depends on prior experience (Kleibeuker, De Dreu, & Crone, 2016). More precisely, the findings expand prior studies in showing how creativity is learned in the context of different individual pre-conditions. Moreover, we contribute to the literature in that we find first evidence for individual learning curves in creativity trainings, which seems to be an interesting yet underrepresented theoretical lens to look through.

Third, studies in the field of creativity have emphasized the important role of CSE (Gong, Huang, & Farh, 2009; Hsu et al., 2011; Tierney & Farmer, 2002, 2011), but only few have empirically investigated the role of CSE in the context of creativity trainings. Although we found that CSE is an important influencing factor of CP, our results did not reveal an effect of creativity training on participants' CSE. Therefore, CSE seems not as responsive to change as actual CP, implying that an individual's CSE may be more stable over time. This finding contradicts the results of several studies published so far (Byrge & Tang, 2015; Mathisen & Bronnick, 2009; Tang & Werner, 2017), which reported a positive effect of creativity training on participants' CSE. The results of this study indicate that the interdependencies between CSE and CP are more complex than supposed so far. Therefore, this study contributes to a better understanding of CSE and its relation to CP in creativity research.

PRACTICAL IMPLICATIONS

Our findings also provide concrete practical implications for educators and practitioners.

First, our results find further evidence for the general effectiveness of creativity trainings and show support for the short-term sustainability of such trainings in particular. Thus, the results suggest that courses on creativity can be a viable approach to foster and improve creative skills among individuals. Practitioners might, therefore, be interested in approving and promoting an educational background in creativity when recruiting qualified personnel for jobs where these skills are especially beneficial. In addition, managers may encourage their employees to participate in creativity trainings to further develop their creative abilities.

Second, our findings revealed that participants' creative ability before the training determined their individual training effectiveness. In particular, we found that participants with low initial performance took more from the training than participants that were already more creative. A practical explanation for that could be that the training procedures and content that we provided yield higher effectiveness for creative novices, since professional creativity depends much more on a complex interplay of cognitive, motivational, and situational prerequisites than on divergent ability alone (Mansfield et al., 1978). Cleary and Zimmerman (2001), for example, found that experienced basketball players have different training strategies than novices. For example, they set goals that are more specific and selected more technique-oriented strategies. Additionally, Ericsson (1998) found that to become a creative expert, deliberate training and daily practice are needed. Thus, it seems to be useful to identify participants' initial creativity and to provide them either with a rather standardized training for "low creatives" or with a rather individual training for highly creative participants.

Third, our findings add to the discussion on the optimal duration of creativity trainings, where controversial findings have been revealed (Mumford, 2003). While Ma (2006) found no correlation between length of training and training effectiveness, Scott et al. (2004) found that training time was positively related to creativity training effectiveness. Mathisen and Bronnick (2009) then again found evidence for the effectiveness of both a 1-day and a 5-day training course. Still, they found their 5-day training to induce stronger effects. Supporting this notion, the few-hours training provided in the study of Starkey et al. (2017) yielded no improvements. The training program in the present study proceeded for several days over a 2-month period. Due to repeated exposure to creativity-related content, participants had several opportunities to reflect on their own creative behavior. However, the long-term and interval nature of this study's training and the large number of participants could be a reason why the effects observed in this study did not result in a CSE improvement. Nonetheless, due to the different psychological mechanisms especially affecting CSE as explained previously, we recommend in accordance to Mumford (2003) that sufficient training time should be provided to let creativity trainings take full effect.

LIMITATIONS AND FURTHER RESEARCH

Although the longitudinal nature of this study contributes to the understanding of the effects of creativity trainings on CP and CSE, this study has several limitations, which offer suggestions for further research. First, since the study was conducted during a regular university course, we, therefore, could not control for participation in the course, which may lead to limited generalizability of the results. Additionally, the students in this study were provided with a rather broad task. This helped the course administrators increase

comparability of the results. Yet, previous studies (Mathisen & Bronnick, 2009; Scott et al., 2004) suggested letting the participants choose tasks based on their own interests. Hence, future studies with larger and more controlled samples or self-chosen creativity tasks could investigate whether the effects observed in the present study are replicable.

Second, it should be noted that some caution is required when interpreting the results related to Hypothesis 2. The fact that especially participants with initially lower CP profited most from the training could also be explained by a phenomenon referred to as "regression toward the mean" (Tversky & Kahneman, 1974). This phenomenon posits that an identified change in the outcome variable between two consecutive measurements may be the result of random error, particularly in case of initially extreme values (Barnett, van der Pols, & Dobson, 2005). Thus, revealed improvements in a variable between different occasions could be due to the fact that values may have moved closer toward their "true mean" from one to the other occasion (Nesselroade, Stigler, & Baltes, 1980). Therefore, regarding the present study, one could also argue that the comparably stronger improvements in CP for participants with particularly low initial CP could be ascribed to this statistical phenomenon. Hence, future researchers may consider this when measuring and analyzing CP at different points in time.

Third, this study's creativity training was situated within an academic context. Previous studies have mainly indicated that creativity trainings in organizational settings are more effective than in university settings. However, in Mathisen and Bronnick's (2009) study, creativity training affected employees and students alike. Thus, further studies could investigate in what way the effects observed in the present study are transferable to organizational training settings. Moreover, we did not account for any group-specific aspects that could have influenced the effects at the individual level. Research has shown that various group variables such as trust (e.g. Barczak, Lassk, & Mulki, 2010) or diversity (e.g. Shin, Kim, Lee, & Bian, 2012; Somech & Drach-Zahavy, 2013) influence creativity. Hence, further studies could also take team-related variables into account that could further explain remaining variance.

Fourth, a challenging task in longitudinal studies is to define the points of data collection and the periods between the assessments. Theory is often not precise regarding the optimal length of time intervals for measuring change in variables (Mitchell & James, 2001). The present study investigated change in CP and CSE after an 8-week training period and after another 4-week non-training period. Bandura (1997) argued that for accurate measurement, it is critical to investigate self-efficacy and performance measures in temporal closeness since self-efficacy impacts behavior concurrently. Empirical studies (Shea & Howell, 2000) support this notion. However, there might exist time lags between the accomplishment of a creative task, one's reflection on the creative behavior, and the adjustment of one's CSE. Finally, although we took great care that the 4-week non-training period was not directly related to the previous training period, one may argue that lessons in design as a specific creative domain could have also influenced participants' CP in the third measurement wave. Therefore, future researchers should consider these issues when designing their study.

Fifth, the scale we used to measure CSE (Tierney, 1997; Tierney & Farmer, 2002) lacked reliability. Therefore, we eliminated one item ("I have a knack for further developing the ideas of others"), and calculated CSE as the average of the remaining two items. Thus, the implications we draw from the findings regarding the impact of training on CSE should be treated with caution. Beghetto and Karwowski (2017) discuss recent issues regarding the measurement of CSE based on their categorization of different creative self-beliefs. They recommend CSE items to be written so that they include (1) future orientation, (2) perceptions of confidence, (3) key features of level or task performance, and (4) using broader-ranging scales. Future studies should build on these recommendations to reveal whether they can improve the accuracy of CSE measurement.

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