ABSTRACT

This study investigated the effects of different types of creativity interventions on different facets of creative potential, also including more school-related creativity demands. In a sample of 77 fourth-graders in the age between 9 and 12 years, we administered a verbal and a figural creativity training, realized in two school lessons over two consecutive days each. As outcome measures, creative potential in both the verbal and the figural domain by means of two well-established divergent thinking tasks was assessed. As additional measures of creative potential, a story completion task and a picture painting task were administered to examine training effects on more school-related types of creative behavior. The verbal training was found to increase both verbal and figural divergent thinking ability, but not creative potential in the story completion and the picture painting task. The figural training yielded significant training effects only regarding the picture painting task. Findings suggest a specific training effect of the figural creativity training, and moreover indicate that the verbal creativity training, rather than stimulating “verbal” creative abilities per se, was more strongly concerned with domain-general creativity processes including ideational fluency, flexibility, and originality that are characteristics of divergent thinking tasks across different domains.

Keywords: training, verbal creativity, figural creativity, domain-specificity.

Training studies on creativity are numerous and often highly variegated, covering a broad range of training tasks, experimental approaches, outcome criteria, and creativity domains. Despite this obvious diversity, however, the overall picture of outcomes is remarkably coherent. For example, there is a considerable amount of evidence revealing beneficial effects of positive affect on different facets of creative potential (for overview see e.g., Ashby, Isen, & Turken, 1999; Baas, De Dreu, & Nijstad, 2008; Davis, 2009). Likewise, increases in creative ideation were found when people were cognitively stimulated via actively attending to ideas of others, but effectiveness depended on quantity and quality of ideas (e.g., Dugosh & Paulus, 2005; Dugosh, Paulus, Roland, & Yang, 2000; Fink et al., 2010, 2012; Paulus & Brown, 2007; Sun et al., 2016). Other studies found improvements in creativity as a result of meditation techniques (Colzato, Ozturk, & Hommel, 2012; So & Orme-Johnson, 2001), unilateral hand contractions (Rominger, Papousek, Fink, & Weiss, 2014), or even after drinking tea (Huang et al., 2018). Another exciting research line revealed positive effects on creativity after physical activity interventions such as aerobic workout or aerobic dance (Steinberg et al., 1997), walking (Oppezzo & Schwartz, 2014), or cycling (Colzato, Szapora, Pannekoek, & Hommel, 2013). Though these striking and promising findings certainly await to be replicated and extended in future research, they clearly indicate that creativity, or at least some facets of it, is malleable and sensitive to environmental demands.

Scott, Leritz, and Mumford (2004a) conducted a quantitative meta-analysis of 70 training studies on creativity and reported an overall effect size of $\Delta = 0.68$, indicating that creativity training programs yielded performance gains across various criteria, experimental settings and samples of participants (see also Ma, 2006; Rose & Lin, 1984). However, an important finding of that meta-analysis was that more successful training programs were more likely concerned with directed and structured exercises aiming at developing specific, task-relevant cognitive skills operating on available knowledge. In contrast, interventions utilizing more open exploratory techniques such as imaginative exercises were even negatively related to training success. This finding was further substantiated by a subsequent analysis of training efficacy as a function of the
specific type of training (Scott, Leritz, & Mumford, 2004b). In that study, Scott and colleagues identified 11 common types of creativity trainings in 156 relevant training studies and found that interventions involving idea production (e.g., processes related to idea generation, divergent thinking, brainstorming, etc.) and cognitive training (e.g., developing of specific problem-solving strategies such as conceptual combination; cf. Scott et al., 2004b) were particularly effective in improving creativity-related skills.

More recent literature provides various examples of how people can be effectively cognitively stimulated in the context of creativity enhancement (e.g., Abraham, Asquith, Ahmed, & Bourisly, 2018; Ritter & Mostert, 2017; van de Kamp, Admiraal, Drie, & Rijlaarsdam, 2015). Significant performance gains in psychometrically determined creativity were also seen as a result of continuous engagement in divergent thinking tasks (Benedek, Fink, & Neubauer, 2006; Fink, Grabner, Benedek, & Neubauer, 2006; Fink et al., 2015; Kleibeuker et al., 2017; Stevenson, Kleibeuker, de Dreu, & Crone, 2014). For instance, Benedek et al. (2006) developed and tested a computer-aided, multifaceted verbal divergent thinking training based on tasks from well-known creativity tests. The training was organized in several training units over a time period of several weeks and required participants to fluently generate a broad range of creative ideas in exercises such as finding slogans, producing nicknames, generating sentences with given stimulus words, or inventing product improvements. The training was found to improve different performance indicators of creative potential, paralleled by significant training effects at the level of the brain (Fink et al., 2006, 2015).

Fasswald-Magnet, Hefler, Papousek, Weiss, and Fink (2014) developed a creativity training (Ideefix) for primary-school children and evaluated it in a sample of 146 fourth grade children in the age range between nine and 11 years. The training consisted of three-day training sessions (one school lesson per day). In each session, children worked on exercises drawing on different creativity-related task demands involving verbal creativity (e.g., exercises based on the classic Alternative Uses Test), figural creativity (e.g., completing abstract figures in an original way), and movement-related creativity (e.g., moving creatively from one place to another). Results showed that the training yielded significant training effects in both the verbal and the figural creativity domain. More specifically, there were significant training effects in each single performance measure in verbal and figural divergent thinking (fluency, flexibility, and originality). However, an important limitation of that study was that training effects were only assessed through divergent thinking tasks, while potential transfer effects to other types of creative behavior that might be more closely linked to school-related creative abilities (and hence more ecologically valid) were not examined. In fact, the understanding of how a creativity training impacts more real-life creativity demands is generally rather fragmentary (Clapham, 2003). Also, the training of the Fasswald-Magnet et al. (2014) study was a conglomerate of various types of creativity exercises, which did not allow to assess which specific content of the training was associated with improvements in which specific facet of creativity. Evidence related to the generality vs. specificity or possible transfer effects of creativity trainings is generally rather sparse. In one of the rare studies in this field, Baer (1996) trained seventh-grade students in poetry-relevant divergent thinking demands and found a greater effect on creativity involved in poetry writing than in a different, though closely related task (story writing). This finding indicates that training outcomes strongly depend on the specific tasks trained.

The present study was designed to test the effects of different types of creativity interventions on different facets of creative potential, also including the transfer to more school-related creativity demands. To this end, the training material of the Fasswald-Magnet et al. (2014) study was compiled into two different variants, one involving divergent thinking tasks in the verbal domain, and the other including creativity exercises in the figural domain. Each training was administered in two school lessons over two consecutive days. As outcome measures, we assessed creative potential in both the verbal and the figural domain by means of two well-established divergent thinking tasks (Alternative Uses test and Cued Drawing task). In addition, we administered a story completion task and a picture painting task to test training effects on more school-related types of creative behavior, again in the verbal and figural domain, respectively. If creativity were domain-general, then any kind of creativity training would affect outcomes across various creativity domains (e.g., Baer, 2012). However, research indicates that at least more complex creative performances and their neural underpinnings are specific to a particular domain (e.g., Baer, 1996, 1998; Baer & Kaufman, 2005; Boccia, Piccardi, Palermo, Nori, & Palmiero, 2015; Fink, Bay et al., 2018; Fink, Rominger et al., 2018). Therefore, this study tested whether a training of creativity focusing on verbal and figural task demands primarily affects measures in the verbal or figural domain, respectively.
MATERIAL AND METHODS

PARTICIPANTS

Ninety fourth-graders from four classes in local elementary schools participated in the present study. The domain of the creativity training was randomly assigned to these classes, with two classes receiving the verbal and two classes the figural creativity training. From the initial sample, 13 participants had to be excluded from data analysis (11 students were absent on either pre- or post-test, 1 student on one training day, 1 student could not participate due to physical and mental limitations). The remaining sample comprised 77 children (41 girls) between 9 and 12 years \((M = 9.39, SD = 0.59)\). Half of the sample (38 students) received the verbal, and the other half (39 students) the figural creativity training. The groups neither differed in age \((9.29\ vs. \ 9.49\ years, t(75) = -1.49, p = .14)\), nor in gender distribution \((18\ vs.\ 23\ girls, \chi^2 = 1.04, p = .31)\). To further control for potential differences in verbal and figural abilities, we assessed the students’ marks in the school subjects German (their L1) and Arts (drawing). The marks neither differed in German \((1.76\ vs.\ 1.86, t(71) = 0.53, p = .60)\), nor in Arts \((1.11\ vs.\ 1.03, t(55.03) = 1.37, p = .18)\) between the verbal and the figural training group. The study was approved by the authorized ethics board and the regional education board. All parents gave written informed consent for their children.

CREATIVITY TRAINING AND PSYCHOMETRIC ASSESSMENT

Creativity training

Both the verbal and the figural creativity training consisted of six game-like tasks each. Most of them were adopted from the original Ideefix training by Fasswald-Magnet et al. (2014). Since this training did not cover a sufficient number of verbal and figural game-like tasks, additional tasks were constructed based on typical tasks drawing on verbal or figural creative thinking demands. It is important to note that the majority of tasks of the verbal training has a strong focus on stimulating student’s ability to fluently generate creative new ideas to open-ended problems, rather than enhancing “verbal” abilities per se. The figural training, in contrast, strongly requires students to work creatively with figures and pictures with a clear focus on drawing. An overview of the training tasks is given in Table 1.

Assessment of creative potential

The effects of the verbal and the figural creativity training were assessed regarding different facets of creative potential in the verbal and the figural domain. We administered two well-established divergent thinking tasks (verbal and figural) taken from well-known creativity tests, on the one hand, and two tasks assessing more school-related types of creative behavior (again verbal and figural), on the other hand. For the pre- and the post-test, parallel test versions were administered. The order of presentation of the parallel test versions in the pre- and post-test was counterbalanced within each training group.

Verbal divergent thinking was measured by means of an adapted version of the Alternate Uses task (e.g., Guilford, 1967). In this task, students had to write down as many unusual uses of two conventional everyday objects which were presented as pictures (set 1: “fork”, “garden hose”; set 2: “toothbrush”, “umbrella”). They worked on each object for 5 minutes. At the pre-test, before working on this task, an example item (“watering can”) was presented to the entire class, and students were asked to produce as many and as original alternate uses for this object. This practice activity was administered to make students familiar with this task demand.

Figural divergent thinking was measured by means of an adapted version of the Cued Drawings task taken from a creativity test for preschool and schoolchildren (Krampen, Freilinger, & Willems, 1996). On a page of 16 identical figures of a geometrical object (triangle or square), students were asked to complete these figures in a manner that new pictures emerge from the geometrical object. They were required to write down a title under each completed figure. The time limit for this task was 10 minutes.

To assess more school-related types of behavior in the verbal domain, students completed a picture story (story completion). At each the pre- and the post-test, they were presented with three pictures showing part of a story sequence and a fourth picture with a question mark. Within 20 minutes, they had to think of a particularly creative and funny end of this story and write it down.

Finally, more school-related creative potential in the figural domain was assessed by means of painting a picture. Specifically, students were instructed to paint a particularly creative and funny picture, either of the world’s best playground or of the world’s best school. Similar to the picture story completion, they had 20 minutes for this task.
TABLE 1. Overview and Description of the Game-Like Tasks in the Verbal and Figural Creativity Training

| Verbal tasks | Figural tasks |
|--------------|--------------|
| Dice-Words<sup>a</sup> | Living Shapes<sup>a</sup> | Students were given a page with unfinished drawings and were asked to complete them, so that something new emerges from them (10 minutes) |
| Mysterious Bag<sup>a</sup> | Divided Drawing<sup>a</sup> | Students sitting in a circle were given a pre-folded empty page and were asked to draw the upper part of a creature or object. Then, the page was folded and passed over to the next student who added another drawing of an upper part. After three times, students were asked to draw a lower part (again three times). Finally students discussed potential names for the resulting fantasy creatures or objects. Overall time was about 10 minutes |
| Lonely Island<sup>a</sup> (verbal version) | Lonely Island (figural version) | In contrast to the verbal version of this game (see above), students were asked to draw the desired objects (9 minutes) |
| Visiting Aliens<sup>a</sup> | Dressing Up Friends<sup>a</sup> | Students were asked to draw funny Halloween or Carnival costumes for his/her best friend, mother/father, and class teacher (10 minutes) |
| Bathtub (verbal version) | Bathtub (figural version) | Students were given a page with 12 drawings of a simple bathtub and asked to draw further features of the bathtub to make it the best bathtub of the world (10 minutes). Each idea should be realized in a separate drawing |
| Initial Letters | We Draw A Picture | Students were asked to imagine that a big bag full of different things falls from heaven and bursts. Then, each student drew one potential object from this bag on a flipchart poster, avoiding repetitions of objects. Afterward, the students discussed how the different objects can be combined to new ones (10 minutes) |

Notes. <sup>a</sup>Game of the original Ideefix training (Fasswald-Magnet et al., 2014).
Control variables

Since participants’ mood has been found to be associated with creativity (e.g., Baas et al., 2008; Davis, 2009), we administered two scales of the Self-Assessment-Manikin (Bradley & Lang, 1994) before and after the assessment of creative potential at the pre- and the post-test. Participants were presented with pictorial five-point scales (1 = high happiness and excitement; 5 = low happiness and excitement) and asked to indicate their current level of happiness and excitement.

Moreover, we examined whether the two types of creativity training are comparable in terms of fun and effort. For this training evaluation, students rated the perceived levels of fun and effort at the end of each training day on a pictorial six-point rating scale (1 = very funny/not effortful; 6 = not funny at all/very effortful), adapted from the Wong-Baker Faces Pain Rating Scale (Wong & Baker, 1988). In addition, at the post-test, an overall rating for the entire training was requested.

STUDY PROCEDURE

The entire test and training phase comprised four consecutive days: pre- and post-test of creative potential (about 2 hours) on the first and fourth day, and one training session each (about 1 hour) on the second and third day. All sessions took place in the students’ familiar classroom setting with the class teacher in the room. One author of this manuscript (TR) administered the tests and trainings.

The procedure in the pre- and the post-test was similar except for the first task. The pre-test started with the sociodemographic questionnaire, whereas in the post-test the overall rating of fun and effort for the training was requested. This was followed by the mood assessment, the two well-established creative potential tests (Alternate Uses and Cued Drawings), a 5-minute break, and the two school-related creative potential tasks (story completion and picture painting). At the end of the pre- and the post-test, the mood assessment was repeated.

The six creativity training games were assigned to the two training days, so that the setting (individual, group, classroom) and time sequence were as comparable between the training variants as possible. Specifically, the verbal training group worked on Dice-Words, Mysterious Bag, and Lonely Island (verbal version) on the first training day, and on Visiting Aliens, Bathtub (verbal version) and Initial Letters on the second training day. For the figural training group, the sequence was Living Shapes, Divided Drawing, Lonely Island (figural version) on the first training day, and Dressing Up Friends, Bathtub (figural version) and We Draw A Picture on the second training day. At the beginning of each training day and between the games, a toy figure called Ideefix was shown to the students (cf. Fasswald-Magnet et al., 2014). This figure was made of plasticine and varied in shape and color. Students were repeatedly encouraged to discuss Ideefix’ appearance (e.g., how could he move around, could the colors have a certain purpose etc.). This was done to increase students’ motivation to produce original ideas on the training days.

DATA ANALYSIS

Creative potential in the Alternate Uses and Cued Drawing tests was quantified in terms of ideational fluency, flexibility, and originality. Fluency scores represent the number of ideas; flexibility scores the number of semantic categories used in the generated ideas based on the taxonomy of a well-established creativity test (Krampen et al., 1996). Ideational originality scores were based on ratings from three independent raters. In the Alternate Uses test, each idea was rated on a scale ranging from 1 (“not original”) to 6 (“very original”). Subsequently, the average rating score across all ideas and raters was calculated. In the Cued Drawing test, the three raters were asked to provide a snapshot scoring (Silvia, Martin & Nusbaum, 2009) for the entire page of drawings. The intraclass correlations (ICC) of the three independent raters were 0.709 for the Alternate Uses test and 0.714 for the Cued Drawings test. For further analyses, we computed composite measures of verbal and figural divergent thinking performance for each time point of assessment (pre- and post-test) by aggregating the z-standardized scores for fluency, flexibility, and originality in each task.

A snapshot scoring was also used for determining the originality scores of the story completion and picture painting tasks. Again, the ratings were averaged over the three independent raters. ICCs were 0.722 and 0.739 for the two tasks, respectively.

For the investigation of training effects of the verbal and the figural creativity training, separate ANOVAs for repeated measures were conducted for the four measures of creative potential (verbal divergent thinking, figural divergent thinking, story completion, picture painting). In each ANOVA, the factors TRAINING GROUP (verbal vs. figural) and TIME point of assessment (pre-test vs. post-test) were considered. Posthoc
tests for significant interaction effects were computed by subsequent paired t-tests separately for both training groups. For the analysis of potential differences between the training groups in happiness, excitement, fun, and effort, we computed two MANOVAs (one for the two mood variables, and one for the two training evaluation variables).

RESULTS

TRAINING EFFECTS ON DIFFERENT FACETS OF CREATIVE POTENTIAL

The ANOVA for verbal divergent thinking (Alternate Uses test) revealed a significant main effect of TRAINING GROUP \( (F(1,74) = 5.19, p = .03, \eta^2_p = 0.07) \), along with a significant interaction between TIME and TRAINING GROUP, \( F(1,74) = 4.53, p = .04, \eta^2_p = 0.06 \). As shown in Figure 1, the verbal training group showed increases in verbal divergent thinking from the pre- to the post-test, while the figural training group showed decreases. However, subsequent paired t-tests separately for both training groups revealed no significant changes for neither group (verbal group: \( p = .19 \); figural group: \( p = .09 \)).

The interaction between TIME and TRAINING GROUP was also significant for figural divergent thinking (Cued Drawing task; \( F(1,75) = 9.64, p = .003, \eta^2_p = 0.11 \) ), along with a significant TRAINING GROUP effect \( (F(1,75) = 6.07, p = .02, \eta^2_p = 0.07) \). Quite similar to verbal divergent thinking, the verbal training group exhibited performance gains also in figural divergent thinking \( (t(37) = -2.69, p = .01) \), while the figural training group again tended to show decreases \( (t(38) = 1.90, p = .06) \).

The ANOVA for the story completion task yielded no significant results. Interestingly, the relevant TIME by TRAINING GROUP interaction was significant for the picture painting task \( (F(1,75) = 8.44, p = .005, \eta^2_p = 0.10) \). As shown in Figure 1, the figural training group showed significant performance increases \( (t(38) = -2.28, p = .03) \), while the verbal training tended to show decreases \( (t(37) = 1.96, p = .06) \).

![Figure 1](image-url)  
**FIGURE 1.** Changes in different facets of creative potential (verbal divergent thinking, figural divergent thinking, story completion, picture painting) from the pre-test (t1) to the post-test (t2), separately for the verbal and the figural training group.
CONTROL ANALYSES OF TRAINING EFFECTS

An alternative way of analyzing the data is to compute analyses of covariance (ANCOVAs) with the post-test scores as dependent variables and the respective pre-test scores as covariate. This analysis approach controls for pre-existing group differences at the pre-test (baseline) and might be favorable in light of the apparent group differences in figural divergent thinking at the pre-test (see Figure 1). These analyses yielded significant group effects at the post-test for verbal divergent thinking (F(1,73) = 9.45, p = .003, η² = 0.11; M ± SE verbal training: 0.24 ± 0.11; figural training: −0.23 ± 0.11), and for the picture painting task (F(1,74) = 8.09, p = .006, η² = 0.10; M ± SE verbal training: 2.85 ± 0.10; figural training: 3.27 ± 0.10). Regarding figural divergent thinking (Cued Drawing task), there was a trend toward significance (F(1,74) = 2.91, p = .09, η² = 0.04), with higher creativity scores in the verbal (M ± SE: 0.13 ± 0.10) than the figural training group (−0.12 ± 0.10). No significant effects were found for the story completion task. Taken together, these supplemental analyses confirm the overall pattern of findings obtained in the original analyses by controlling for pre-existing group differences at baseline.

CONTROL ANALYSES OF MOOD AND TRAINING FEEDBACK

For testing potential changes in mood during the trainings and differences between the two groups, we conducted a MANOVA for the ratings of happiness and excitement. The MANOVA included day (first and second training day) and assessment time (pre-training vs. post-training) as within-subjects variables and creativity training group (verbal vs. figural) as between-subjects variable. None of the multivariate effects reached significance. Only one interaction (assessment time × training group) was marginally significant, F (2,62) = 2.89, p = .06; the other main effects and interactions had ps > .18. In subsequent univariate ANCOVAs, assessment time × training group reached significance only for happiness, F(1,63) = 5.01, p = .03. This interaction consisted of a slight decrease in happiness ratings over the training in the figural group (1.22 vs. 1.35), while in the verbal group a slight increase was observed (1.47 vs. 1.27, for pre-training and post-training, respectively). Please note that scores were between 1 and 5 with lower values reflecting higher happiness.

The average scores (6-point rating scale) from the training evaluation revealed that students perceived both trainings as very funny (5.69 and 5.85) and little effortful (5.59 and 5.78, for the verbal and figural training, respectively). To test for potential differences between the trainings and changes over time, we computed a MANOVA on both scores (fun and effort) with day (first training day, second training day, post-training) as within-subjects factor and creativity training group (verbal vs. figural) as between-subjects factor. None of the multivariate effects were close to significance (all ps > .15), suggesting that the trainings were perceived as comparably funny and effortful.

DISCUSSION

The overall picture of results obtained in this study adds further evidence to the common finding that the engagement in creativity exercises generally unfolds beneficial effects on various measures of creative potential (Benedek et al., 2006; Kleibeuker et al., 2017; Ma, 2006; Scott et al., 2004a,b; Stevenson et al., 2014). Specifically, already a brief intervention comprising two school lessons over two consecutive days was successful in stimulating student’s creative performance. An important new finding, however, is the demonstration of domain-specific training and transfer effects. The verbal training tended to increase divergent thinking in both the verbal and the figural domain, but did not show transfer to the more realistic story completion task. The figural training, in contrast, did not improve performance in the divergent thinking tasks, but affected the more realistic picture painting task. Thus, we found a highly distinct pattern of performance changes depending on the content of the training.

Overall, training effects thus appear to be rather specific to the content of the training, as suggested by relevant literature (e.g., Baer, 1996). This especially applies for the figural creativity training. As itemized in Table 1, this training involved a broad variety of drawing tasks requiring children to extend complex fictive stimulus scenarios in an original way. Exercising with these manifold drawing scenarios improved performance in the picture painting task only, and not in the more basic figural divergent thinking task (Cued Drawing task), which included geometrical objects (triangles or squares) as stimuli. Notably, compared with the picture painting task, which required students to paint a single picture on a given topic, the figural divergent thinking task (Cued Drawing task) required them to complete and extend as many as possible from the given 16 geometrical objects in a new and original way. The
focus of this task was clearly set on fluency and flexibility (i.e., generate as many and as different geometrical objects as possible), which may have operated at the expense of quality or originality. In fact, there is evidence that when people are instructed to be creative vs. fluent in a divergent thinking task they exhibit more creative but fewer ideas, clearly indicating that task instruction impacts quality and quantity of ideas (Forthmann et al., 2016; Nusbaum, Silvia & Beaty, 2014). The stronger focus on quantity (fluency, flexibility) rather than quality (originality) in the figural divergent thinking task (i.e., Cued Drawing task) in this study, coupled with the stronger focus on originality/quality in the figural training, could thus be considered as possible reason why the figural training did not affect performance in the figural divergent thinking (Cued Drawing) task. In this particular context, it would be interesting to examine training effects separately for the fluency, flexibility, and originality facets of creative potential. However, given that these performance indicators were based only on the Cued Drawing task (with only one aggregated snapshot rating for originality), such analyses would suffer from restricted reliability and are therefore in need to be addressed in future research.

In contrast, the verbal creativity training was found to improve creative potential regarding verbal and figural divergent thinking. While the former was very likely to be expected, the latter could, at least partly, be linked with the fact that the figural divergent task (Cued Drawing) also involves verbal demands, since students were required to entitle their drawings in this task. Alternatively, this finding could also point to an interesting domain-generality of the verbal training. As shown in Table 1, the verbal training was more strongly concerned with strategies relevant to more domain-general creative thought processes involving the fluent and flexible generation of new and original ideas to open-ended problems, rather than enhancing “verbal” abilities per se (cf. Benedek et al., 2006). These domain-general creative thought processes are implicated in both verbal and figural divergent thinking performance (Alternative Uses and Cued Drawing task). But notably, stimulation of these core processes of divergent thinking in the verbal training had no impact on creative potential in the more real-life verbal story completion task, and on the picture painting task neither. It hence seems that, as evident by the specific effect of the figural training on the picture painting task, these more school-related (or realistic) types of creative potential require a specific training that is more closely aligned with the creativity domain at hand.

Among the most important strengths of this study is the uncovering of a specific pattern of domain-dependent training effects in a comparatively young sample of participants (fourth grade children with a mean age of about nine years). Strikingly, only two school lessons of structured creativity exercises unfolded beneficial effects on student’s creative performance, but not uniformly across all tasks of creative potential. Future training studies in the creativity domain should hence carefully consider the specific training content and the psychometric outcome measures in their designs. In this context, it would be exciting to examine training effects not only on divergent thinking ability, but also in tasks involving more ecologically valid, real-life creativity demands, as it was attempted with the more school-related creativity tasks in this study. The findings of this study may also contribute to a rethinking of “verbal” and “figural” creative task demands. This dichotomous task characterization is commonly used in psychometric and neuroscientific creativity research, but appears imprecise as it does not properly reflect tasks with cross-modal demands such as when participants are asked to find original titles for drawings (see also Benedek, Christensen, Fink & Beaty, in press). Moreover, the findings of this study suggest that verbal and figural divergent thinking tasks share substantial domain-general cognitive processes, since the “verbal” training did not enhance “verbal” abilities per se, but rather stimulated general creative thought processes involving the fluent and flexible generation of new and original ideas that are characteristics of divergent thinking tasks across different domains.

There are also some limitations of this study that we need to pay attention to. First, there were two active experimental (i.e., training) groups and no non-treatment control group. Due to the highly specific pattern of training effects found in this study, general test–retest effects (e.g., test familiarity, practice effects) should be less an issue, but the inclusion of a non-treatment group would increase the quality of the design as it also allows to control for other potentially relevant effects (e.g., mere interaction of the children with the experimenter, possible effects related to school routine, time-related changes of cognitive functioning of the children that are not due to the training, etc.). This study also took a novel step ahead to investigate training effects not only regarding divergent thinking tasks but also in tasks involving more school-related creativity task demands. In future studies, it would be exciting to examine whether different types of creativity interventions have an impact on even more complex academic performances such as writing essays or articles or solving arithmetic problems, or on overall achievements (grades) in subjects such as language.
education or mathematics. In general, we feel that the comparatively short training period of only two school lessons may be sufficient to stimulate rather basic aspects of age-appropriate school-related behavior (story generation and picture painting), while more complex creative achievements and academic performances would certainly require more extended intervention periods. And finally, future studies should also involve larger samples of children which would also allow to study the role of potential moderator variables (e.g., personality, motivation, trait creativity, etc.).

Taken together, the trainings developed and tested in this study constitute effective creativity tools that could easily be implemented in everyday school life. On a more general level, this study also entails important practical implications for the educational domain. The findings indicate that exercises drawing on ideational fluency, flexibility, and originality are likely to affect divergent thinking abilities across different domains, while enhancement of creative potential in more school-related types of creative behavior requires exercises specific to these domains. In this vein, the current study findings support Baer and Kaufman’s (2005) notion that the issue of domain specificity very much matters for the educational domain, especially in view of the choice of appropriate interventions.

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