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Priming Creativity as a Strategy to Increase Creative Performance by Facilitating the Activation and Use of Remote Associations

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Abstract

Attempts at idea generation often produce outputs that are marked by restricted creativity. This lack of originality is often due to responses being tethered to recently activated knowledge and salient examples. The current research tested the hypothesis that implicitly priming creativity results in more creativity (i.e., flexibility). Experiment 1 addressed the potential underlying mechanisms that might lead to such an effect and demonstrated that creativity priming leads to the activation of remote, as opposed to close, associations to a target item. Experiments 2a, 2b, 3, and 4 showed that priming creativity (using two different procedures) leads to more original ideas in a generative task as well as better performance in the remote association task (RAT). These effects occurred independently of the conscious intention to be creative as well as motivational and mood states. Across these studies, the activation of a creative mindset undermined the sources of inflexible and uncreative responding.

Keywords: creativity, mindset priming, idea generation, remote associations

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Extensive domain-specific knowledge is required for idea generation and creative performance more generally (e.g., Kulkarni & Simon, 1988; Weisberg, 1999). The more potential building blocks that are available for a new idea, the more the idea can stand out from the usual. Nonetheless, even early theorists saw a tension between prior knowledge in the domain in question and creativity (e.g., DeBono, 1968; Wertheimer, 1925). Indeed, prior knowledge has an impact on idea generation. In order for ideas to be new and original, they must go beyond the usual associations activated through prior knowledge. As Campbell (1960) put it: "Real gains must have been the products of explorations going beyond the limits of foresight and prescience, and in this sense blind. In the instances of such real gains, the successful explorations were in origin as blind as those which failed." (p. 381, see also Simonton, 1999). In the current experiments, we suggest that one way to promote creativity and overcome the limits of prior knowledge in the task domain is by activating a creative mindset; one that provides access to remote as opposed to close associations.

How prior knowledge contributes to low creativity

Research on performance in generative tasks has demonstrated that new ideas heavily rely on prior knowledge about the category to which they belong (e.g., Jansson & Smith, 1991; Rubin, Stoltzfus, & Wall, 1991; Ward, 1994) and on provided examples (Smith, Ward, & Schumacher, 1993; Marsh, Landau, & Hicks, 1996). For instance, Rubin et al. (1991) had participants generate new names for several new products. They found that the generated names were very likely to resemble the names of existing products of the same category, with similar word endings and numbers of syllables (e.g., using Italian sounding word endings when creating a name for a new pasta). Thus, the creativity of the generated ideas was limited by prior knowledge about the targeted categories. Similarly, Smith and Blankenship (1991) found that presenting items from the Remote Association Test (RAT, Mednick, Mednick, & Mednick, 1964) together with associations unrelated to the solution leads to lower performance. Adding to these findings, Marsh, Bink, and Hicks (1999a) demonstrated that unconsciously activated knowledge influenced idea generation. Hence, the activation of prior knowledge most likely accounts for the fact that individuals generating ideas have a hard time going beyond given examples and the usual associations. These processes, then, seem to promote the unintended copying of ideas, or parts of them (Brown & Murphy, 1989).

Although it may seem easy to avoid conforming to existing examples that are stored in memory (or given as part of explicit instructions), research findings suggest the opposite: Smith, Ward, and Schumacher (1993; see also Marsh, Landau, & Hicks, 1997) instructed participants to “not copy” any features of a set of given examples, but this instruction led to *more* rather than less conformity (as did the explicit instruction to copy). For instance, participants copied the word endings of the given existing examples (e.g., “-ini” or “-etti” when generating new names for a pasta). Hence, participants tried to follow the instructions, but were not able to do so because they seemingly could not generate something ‘new’ while monitoring the ‘old’. This suggests that a conscious intention neither helps in avoiding conventional thinking[1] nor leads to the overcoming of the influence of typical associations (“stepping outside the box”; Duncker & Lees, 1945), which is required for creative performance. Therefore, the current research sought to test whether there is an unintentional route *around* conventional thinking that may help to increase creativity, by studying the impact of a creative mindset on these processes.

Activating a creative mindset

Previous research has investigated the activation of different mindsets in order to influence cognitive processing, such as implemental versus deliberative mindsets (Gollwitzer, Heckhausen, & Steller, 1990; for other mindset manipulations see Chen, Shechter, & Chaiken, 1996; Higgins & Chaires, 1980; Sassenberg, Moskowitz, Jacoby, & Hansen, 2007).

Galinsky, Moskowitz, and Skurnik (2000) used a mindset prime related to the current research by priming a counterfactual-based mindset (a readiness to consider alternatives). This priming procedure exposed participants to situations in which alternative events could have easily unfolded. This primed mindset had a positive impact on creative problem-solving because participants spontaneously saw alternative functions for items that they then utilized to solve the problem. However, this counterfactual mindset has a *detrimental* effect when it comes to idea generation since it focuses one's mind on the existing items and does not promote avoiding the copying of those items and their features (Kray, Galinsky, & Wong, 2006). In other words, the counter-factual mindset seems to facilitate creative fluency—the quantity of ideation within a given cognitive frame (e.g., a category). However, it does not assert a positive influence on cognitive flexibility—the unconstrained information processing required for thinking outside the box and getting beyond the prior knowledge (e.g., activated categories). Therefore, we aimed at identifying a truly creative mindset that we predicted would have the ability to simultaneously prevent the copying of existing ideas and promote seeing alternatives to typical associations, thus promoting novelty in idea generation.

Such a mindset would need to reduce the activation of common thoughts related to the task, or domain at hand, as well as limit the activation of provided or known examples. One of the mental operations facilitating such flexibility is the activation of remote associations (Mednick, 1962). Research has identified the specific process underlying the heightened flexibility resulting in the triggering of remote associations. According to the dual pathway model of creativity (De Dreu, Baas, & Nijstad, 2008) unconstrained and flexible information processing is particularly likely when a global processing style—a tendency to perceive global rather than local structures and general rather than specific features (Förster &

Dannenberg, 2010)—occurs together with behavioral activation—a state of strong engagement in action usually accompanied by positive and activating mood (Carver & White, 1994; Gray, 1990). Behavioral activation asserts a positive impact because it increases working memory capacity (De Dreu et al., 2008) and thus more resources for information processing. In line with the dual pathway model, the generation of remote associations is facilitated by this pairing of 1) changes in processing style (global rather than local) that impacts the focus of one's information processing (affecting all steps of information processing from perceptual to higher order cognition), and 2) changes in behavioral activation that elevates the amount of resources for the information processing (De Dreu et al, 2011).

We assume that these changes in the focus of and the resources for information processing that are essential to creativity can be implicitly triggered. In other words, because people lack awareness of what precisely allows them to be creative, asking them to be creative may fail. In contrast, triggering the processes that actually underlie creative performance may heighten creativity, even if it is not consciously willed. We suggest that these mental operations that facilitate creativity can be activated through a priming procedure (e.g., Galinsky et al., 2000) that makes accessible a creative mindset. We hypothesized that a set of information processing procedures including (but not necessarily limited to) the one's suggested in the dual pathway model of creativity may be activated by memories of one's own past creative performance. This priming of a "creative mindset" should facilitate the processing of remote rather than close associations, and thus increase cognitive flexibility, helping to avoid the influence of prior knowledge linked to a given domain.

The processing of remote and close associations

There is some evidence that priming a creative mindset via the recollection of previous creative performance affects the processing of close associations: Sassenberg and

Moskowitz (2005) demonstrated that priming creativity by asking participants to remember three situations in which they had behaved creatively reduced the semantic priming effect in a lexical decision task (e.g., fire is less likely to activate flame; summer less likely to activate warm). In other words, it hindered the processing of close associations.

There are reasons to predict that these *semantic priming effects in a lexical decision task* result from the processes that underlie flexibility in *idea generation* that are specified by the dual pathway model of creativity (De Dreu et al., 2008, 2011). Semantic priming effects in lexical decision tasks can be explained based on the retrieval theory of priming (Ratcliff & McKoon, 1988), which assumes that the items in working memory and the targets of the lexical decision form a compound cue. The familiarity of this cue determines the response time. According to the diffusion model (Ratcliff, 1978; Ratcliff, Smith, & McKoon, 2015) individuals accumulate evidence until the set criterion for familiarity is reached before they categorize a target as word. This evidence can stem from the processing of information from (a) the cue or the environment, (b) from working memory, and (c) from long term memory. Based on the dual pathway model of creativity (De Dreu et al., 2008), when in a creative mindset, evidence should be processed with more attention to global structures and less attention to local structures. Hence, familiarity judgments will rely on different (more global) features (a) of the prime and (b) of information retrieved from working as well as from long term memory while searching for evidence.

In other words, in a creative mindset the familiarity of the compound cue will be higher when the prime and the target share global perceptual features and characteristics than when they share local features such as temporal or special proximity. The adjective “green”, for instance, is usually primed by the closely associated substantive “grass”, because one is the locally and immediately associated characteristic of the other—they are usually perceived and imagined together. Their common occurrence leads to the experience of familiarity. If a creative mindset limits the processing of such immediate and local characteristics, then such processing cannot affect familiarity, and the priming effect should not occur—which is what Sassenberg and Moskowitz (2005) found.

Crucially for the current research, this would also have implications for remote associations. The focus on global features in a creative mindset should ease the processing of remote associations, because the focus on global rather than local characteristics should lead to the experience of familiarity for globally matching stimuli. In the example of the color "green", the concept of "nature" might share communalities at that global level; even though it lacks the immediacy "grass" shares with green, "nature" is generally associated with "green" (e.g., badges for organic products use the color green).

Extending the findings by Sassenberg and Moskowitz (2005), we therefore predict that priming creativity alters information processing towards the preferred processing of remote associations. This implicit alteration to the contents of working memory should then facilitate creative performance. To be more precise, we expect that activating a creative mindset will hinder the processing of close associations and encourage the processing of remote associations (Experiment 1), reduce the copying of given examples (Experiments 2a, 2b, & 4) and elevate performance in the Remote Association Task (RAT; Mednick, Mednick, & Mednick, 1964; Experiment 3).

Experiment 1

The findings of Sassenberg and Moskowitz (2005) show that priming a creative mindset undermined the sequential priming effect for close associations in a lexical decision task. The current experiment aimed at (1) replicating this finding and (2) demonstrating that a creative mindset will lead to stronger sequential priming effects of remote association in a lexical decision task with sequential priming. To this end, we manipulated the activation of a creative mindset between participants using the same procedure as Sassenberg and

Moskowitz (2005). In addition, we varied within participants whether primes were closely associated or remotely associated to the targets (for a similar procedure see McKoon & Ratcliff, 1992).

Method

Design and Participants

Twenty-five female and 16 male undergraduate-students with a mean age of 22 years (range 19-30) took part in an experiment with a mixed 2 (Mindset: creativity vs. no prime) x 2 (Prime: related vs. unrelated) x 2 (Target: close vs. remote) design. The first factor was manipulated between subjects whereas the other two factors were manipulated within subjects. The two mindset conditions were run in separate sessions, due to the mindset priming lasting twice as long as the no prime condition. Participants received € 5 as compensation. We aimed at 20 participants per cell. This sample size was determined by an outdated lab rule that was common at the time the data was collected. However, an a priori power analysis based on the mean effect size from the studies by Sassenberg and Moskowitz (2005) (*partial* $\eta^2 = .121$), $\alpha = .05$ and $(1-\beta) = .80$ using G * Power (Faul, Erdfelder, Lang, & Buchner, 2007) indicated a minimum cell size of 15 for the test of the between within interaction effect. Hence, the sample size is satisfactory according to these criteria.

In this and all other studies reported here, we aimed to exclude psychology students from participation, because they are unlikely to believe that two experiments conducted together are unrelated after having learned in their studies that this is a standard experimental procedure. Psychology students who nonetheless participated in one of the experiments reported here were excluded from the data analysis.

Procedure

Participants were seated in front of a computer. In the creativity condition, they were informed that they would take part in two separate studies consisting of a short questionnaire and then the main experiment. The questionnaire included the following instruction: “As a pretest for a study on *innovation* we need to know what people associate with *creativity*. Hence, we would like you to describe three creative activities or ideas of your own, briefly. All that matters to us is to know how *you* evaluate these situations, not what others think”. On the same page, three separate blocks of five lines provided room for participants to write down their descriptions. Finally, demographics were requested to signal the ostensible end of that study.

After participants finished the questionnaire the experimenter asked them to work on the computer task. Participants in the control condition started right away with the computer task. The computer task was a lexical decision task with sequential priming. The stimuli were presented in the center of the screen. Each trial consisted of a fixation cross that was presented for 400ms then the prime that was presented for 100 ms, which was immediately afterwards overwritten by the target. After participants’ responses the screen turned blank for 750 ms before the next trial started. After reading the instructions participants went through 10 practice trials before the main task began. It consisted of 72 trials, half of which had words as target and the other half non-words. The trials were presented in random order. Each of the nine target words was shown four times, preceded by different primes: a closely associated prime, a remotely associated prime, a randomly chosen closely related prime of another target word, and a randomly chosen remotely associated prime of another target word (see Appendix for an overview of primes and targets). The prime and target word were pretested concerning the perceived closeness of their association on a scale ranging from 1 not related at all to 9 closely related. Control primes had a similarly low relatedness with both targets that are closely and remotely related to other primes (M = 2.06, SD = 1.29 and M = 2.01, SD = .86, respectively), $t(36)$ = .26, d = .09. Related primes had a stronger relation to closely related targets (M = 8.50, SD = .060) than to remotely related targets (M = 6.29, SD = 1.17),

$t(36) = 14.55$, $p < .001$, $d = 4.85$. Based on these four types of prime-target pairs, four indices were computed that were entered into the data analyses. Response times from wrong responses and values lower than 300 ms or higher than 1500 ms (3.7%) were deleted.

Results and Discussion

A mixed ANOVA with Mindset (between subjects), Prime, and Target (both within subjects) was computed. The predicted Mindset x Prime x Target interaction was found, $F(1, 39) = 9.15$, $p = .004$, $\eta^2_{part} = .190$, all other $F < 1$. To gain a better understanding of this interaction (see Figure 1 and Table 1), separate ANOVAs with Prime and Target as factors were computed within each mindset condition. In the control condition a marginal Prime x Target interaction was found, $F(1, 18) = 3.58$, $p = .075$, $\eta^2_{part} = 166$. Even though simple comparisons were not significant, both *F*s < 1.5, both *p*s > .2, $\eta^2_{part} < .08$, the data pattern indicated that the marginal interaction occurred due to faster responses following closely associated primes than following control primes, and slower responses following remotely associated primes compared to following the respective control primes. In the creativity condition, a Prime x Target interaction was found, $F(1,21) = 5.93$, $p = .024$, $\eta^2_{part} = .220$. Simple comparisons indicated that the data pattern was clearly in line with the predictions. Participants responded faster to remote associations following related than following control primes, $F(1,21) = 6.43$, $p = .019$, $\eta^2_{part} = 234$. No effect was found for close associations, $F < 1$.

Experiment 1 provides evidence for the assumption that priming a creative mindset facilitates the processing of remote associations. In the creativity condition no semantic priming effect was found for close associations, whereas in the control condition results pointed in this direction. However, in the creativity condition (but not in the control condition) a priming effect was found for remote associations. Hence, a creative mindset changes the processing of incoming information from the usual preference for close associations towards a preference for remote associations. In the next experiment, we explored whether such altered processing helps one to reach novelty and attain more creativity.

The current finding rules out an alternative explanation that applied to the findings of Sassenberg and Moskowitz (2005). Those experiments only examined close associations to a prime versus control words and did not provide any evidence for a priming effect for the close associations in the creativity condition. Hence, one might object that participants in the creativity condition failed to show the activation of close associations because they paid less attention to the entire task rather than having engaged in a different set of processes. The priming effect for the remote associations in the creativity condition of the current experiment clearly indicates that participants do not process the primes less intensely, but *differently*. Information is being activated, just not the information that is typically activated due to its close association to the category.

Experiment 2a and 2b

The previous experiment points to an altered processing of close and remote associations when a creative mindset is activated. However, we have yet to show that priming a creative mindset reduces the copying of given examples, and thereby, facilitates creative processes. While the heightened processing of remote associations in a creative mindset by itself may be sufficient to facilitate creativity, the specific processes that were hypothesized to guide semantic priming in a creative mindset should affect not only working memory, but also search and retrieval processes from long term memory (De Dreu et al., 2011). Idea generation is based on knowledge retrieved in long-term memory and transferred to working memory as well as on the problem definition stored in working memory (Nijstad & Stroebe, 2006). Because the creative mindset should impact the retrieval process as well as the increased processing of remote associations, the question whether an individual communicates an idea that comes to mind should be determined by similar factors as the response in the lexical decision task. Ideas will be communicated as soon as sufficient evidence has been accumulated that they are in line with the problem definition. This evidence will be guided by more global and less local features and their relation to the problem definition in a creative mindset. Based on these alterations resulting from a creative mindset, the generation of ideas higher in flexibility should be more likely.

We expected that after priming a creative mindset, idea generation is less influenced by given examples than in a control condition without such priming. To test this prediction we conducted an experiment in which a creative mindset was activated, as in Experiment 1. In an ostensibly unrelated task, participants worked through one of the core paradigms from research on copying examples (so-called inadvertent plagiarism) in idea generation (e.g., Marsh, Ward, & Landau, 1999b). They were asked to generate alternatives names for a new product, with examples provided (i.e., to test the copying effect). This measure was used because it is optimally tailored to assess whether participants manage to go beyond the given examples in name generation. In Experiments 2a and 2b, it was predicted that participants would be more likely to generate alternatives that differ from the given examples after being primed with creativity compared to after being primed with preciseness and a no priming control condition.

In addition, Experiment 2b sought to test whether the impact of creativity priming relies on conscious intentions (rather than the activation of a mindset). Moreover, the role of two other alterative processes was tested. First, according to the dual pathway model of creativity (De Dreu et al., 2008), positive activating mood leads to more flexibility and negative activating mood leads to more fluency. Since the copying of examples should be mitigated by cognitive flexibility, one might assume that rather than a mindset being activated, it could be that positive activating mood is what underlies this priming effect (e.g., resulting from pride about past own creative performance). Second, research has shown that a promotion focus leads to greater flexibility, including the overcoming of activated knowledge (Friedman and Förster, 2001, 2005). Hence, one might assume that a promotion focus mediates the impact of the activation of the creative mindset on creative performance in the name generation task. Experiment 2b aimed to rule out that these two known predictors of flexibility mediate the impact of priming a creative mindset on creative performance.

Method

Participants and Design

In Experiment 2a, 22 female and 24 male undergraduate students with a mean age of 19 years (range 18 to 22) participated in exchange for course credits in an experiment with a mixed 3 (Priming: creativity vs. preciseness vs. no prime) x 3 (Task: pasta product vs. nuclear element vs. analgesics) design. Three additional participants did not complete all measures and were thus excluded from the analysis. The Priming factor was manipulated between subjects whereas the Task factor was manipulated within subjects. In Experiment 2b, participants were 57 female and 15 male undergraduate students with a mean age of 25 years (range 19 to 50) taking part in a one-hour lab session in exchange for 8 Euros. Two additional participants were omitted from the analysis due to missing values on the main dependent variable. Experiment 2b had the same design as Experiment 2a. Again we aimed at 20 participants per cell, while the actual sample size was determined by availability of participants—in line with an outdated lab-rule. Based on the mean effect size of the studies reported by Sassenberg and Moskowitz (2005) (*partial* $\eta^2 = .121$) a cell size of 26 would be required for $\alpha = .05$ and $(1-\beta) = .80$ for the test of the predicted between subject main effect in the current mixed design, according to G * Power (Faul et al, 2007).

Procedure

Experiment 2a was conducted in English and Experiment 2b in German. In both experiments, participants received two questionnaires that were ostensible pretests for two different studies. The first questionnaire constituted the priming manipulation. In the creativity condition, participants were asked to describe three creative activities or ideas of their own using the procedure applied in Experiment 1. In the preciseness condition, we replaced creativity by preciseness in the instructions: Participants in Experiment 2a were asked to describe three situations in which they considered the preciseness of their own behavior to be important. In Experiment 2b, we altered this text to render it even more similar to the creativity condition and asked for situations in which participants demonstrated preciseness via their action or behavior. Participants in the no prime condition only received the second questionnaire.

After finishing the first questionnaire, participants were asked to work through the second one. It was designed similar to the one used in Experiment 2 by Rubin et al. (1991; see also Marsh et al., 1999b), one of the first studies that demonstrated the influence of provided knowledge in generation tasks. Participants were asked to imagine themselves taking part in a job interview for a position in a marketing firm:

> Please try to imagine the following situation:
>
> You are interviewing with a top marketing firm. In order to test your aptitude for business, you have been given a short test. Your task is to create a brand new label for a new product. Following the conventions commonly used, please make up reasonable one-word names for each of the three items requested on the following pages. For each of the three categories we will show you six existing examples to give you a better understanding what kind of product is meant. Keep in mind, however, that you should not use or copy any aspects of the examples that we show to you. Also please avoid using words from a foreign language when creating your new words.

Thus, the participants were explicitly asked not to copy the examples and to give one-word answers. On the following pages, participants were asked to generate names for a new pasta product, a new nuclear element (2a) or chemical element (2b), and a new analgesic.

Word endings of German names of nuclear elements are very heterogeneous and thus did not have the requisite familiarity to serve as a dependent measure in Experiment 2b. Therefore, nuclear elements from Experiment 2a, which was conducted in English, were replaced by chemical elements for Experiment 2b, which was conducted in German. Participants received six examples for each task. The examples were taken from Marsh et al. (1999b) and used in order to define the critical features of each category. The examples for pasta products were “Spaghetti, Lasagna, Fettucini, Rotini, Pastina, Rigatoni”, suggesting that names for pasta usually end with an “i” or an “a”. The examples for the nuclear elements were “radon, plutonium, argon, carbon, radium, uranium” indicating that such names usually end with “-on” or “-ium”. Finally, the examples for the analgesics were “Tylenol, Anacin, Aspirin, Bufferin, Panadol, Midol” suggesting that the names of members of this category end with “-ol” or “-in”. Differing from Marsh et al. (1999b), examples were given as part of the questionnaire and not just presented for 5 seconds each. Participants were requested to write up to three new product labels per category, but they were not required to write more than one label. Participants were not forced to generate (exactly) three ideas in order to avoid participants copying the examples after running out of ideas.

In Experiment 2b, there were 3 additional questionnaires taken at the end of the study.

Dependent Measures

Following the procedure of Marsh et al. (1999b) the *generation of original alternatives* was assessed by counting the frequency of created words with endings that differed from the given examples. In the instructions, participants were asked to restrict their answers to one-word names. Hence, answers with two or more words were not included in the analyses (see Marsh et al., 1999b, for a similar procedure). Because the number of answers can differ between individuals, relative frequencies based on the overall number of answers per item were computed to control for different base rates.

Intentions and related measures (2b): Two items assessed *the goal to be creative* in relation to the idea generation task (e.g., "How important was it for you to be creative?", *r(72)* = .87, *p* < .001). In addition, the *intentions to avoid copying the examples and their word endings* ("Did you spend attention on not copying the examples / word endings?") and the *intention to follow rules* ("How important was it to you to follow the instructions?") were assessed with a single item each. Furthermore, a single item assessed the *perception* of one's own creativity ("How creative do you think your ideas are?") and the *effort* put in the task ("How hard did you try to perform well"). Finally, three items were adapted from Bearden, Hardesty, and Rose (2001) to measure *self-confidence* ("Did you trust in your abilities while working on the task?", α = .48[2]).

Regulatory focus (2b): Unfortunately, there is no well-established measure of situational regulatory focus or standard manipulation check. Therefore, we developed our own three item scales of promotion and prevention focus (e.g., "Were you eager to complete the idea generation task as good as possible?" – promotion; "Were you cautious while working on the idea generation task?" – prevention; both αs = .63).

Mood (2b) was assessed using the four subscales suggested by de Dreu et al. (2008) with three items each: Positive activating mood (elated, excited, happy, α = .68), positive deactivating mood (at ease, calm, relaxed, α = .73), negative activating mood (ashamed, fearful, worried, α = .60), and negative deactivating mood (depressed, fatigued, sad, α = .62). Participants answered all items on a 7-point scale (1 = *not at all* to 7 = *very much*).

Results and Discussion

Experiment 2a

A mixed ANOVA with Priming (between subjects) and Task (within subjects) as factors and relative frequency of generated original alternatives as dependent measure was computed. This analysis tests the prediction that after priming creativity the generated alternatives will differ more from provided examples than those generated in the other two conditions. A main effect of Priming was found, $F(2, 43) = 6.43$, $p = .004$, $\eta^2_{part} = .230$[3], see Table 2. As predicted, the proportion of generated alternatives that differed from the provided examples was larger after priming creativity than after priming preciseness or without any priming (both *p*s < .01). No difference was found between the latter two conditions (p = .636). Additionally, a theoretically uninteresting main effect of Task occurred, $F(2, 42)$ = 6.59, $p = .002$, $\eta^2_{part} = .133$. For analgesics more original alternatives were generated than for pasta products ($p = .085$) and nuclear elements ($p = .002$), whereas no difference was found between pasta products and analgesics ($p = .479$)[4]. No Task x Prime interaction was observed, $F(4, 86) = 1.19$, $p = .320$, $\eta^2_{part} = .053$.

A second ANOVA with Prime and Task as factors and frequency of ideas as the dependent variable was computed. The number of ideas did not differ significantly between conditions, $F(2, 43) = 1.81$, $p = .175$, $\eta^2_{part} = .073$. Thus, an alternative explanation in terms of differing amounts of ideas can be ruled out.

Taken together, the results support the prediction that priming a creative mindset results in less copying of features from given examples. Participants generated more alternatives that differ from previously activated knowledge about the respective category after being primed with creativity than without priming or after being primed with preciseness. Priming creativity seems to lead to the activation of a mindset that allows one to overcome the restrictions of examples in working memory during generative tasks.

Experiment 2b

Idea generation. As in Experiment 2a a mixed ANOVA with Priming (between subjects) and Task (within subject) as factors and relative frequency of generated original alternatives as dependent measure was computed. Replicating the findings of Experiment 2a, a main effect of Priming occurred, $F(2, 69) = 5.44$, $p = .006$, $\eta^2_{part} = .136$ (for descriptive statistics of all measures in this study see Table 3). The proportion of generated ideas that differed from the provided examples was higher in the creativity condition than in the preciseness condition (p = .033) and the control condition (p = .002), whereas the latter two conditions did not differ (p = .295). There was again the theoretically unimportant main effect of Task, $F(2, 68) = 13.91$, $p < .001$, $\eta^2_{part} = .290$. For analgesics more original alternatives were generated than for chemical elements ($p < .001$) and for pasta product names ($p < .001$), whereas the originality for the latter two categories did not differ (p = .935). The Task x Prime interaction was not significant, $F < 1.7$.

Intentions and related measures. To provide evidence that the effect of priming creativity is not due to altered intentions, the impact of the priming on the goal to be creative, intentions to avoid copying the examples and their word endings, the intention to follow rules, the perception of creativity, the effort put into the task, and self-confidence were tested in separate ANOVAs (for descriptive statistics see Table 3). While the intention to avoid making use of features from the examples was stronger among participants in the preciseness condition than in the control condition (p = .023), there were no differences between these two conditions and the creativity condition (ps > .15), $F(2, 69) = 4.00$, $p = .023$, $\eta^2_{part} = .104$. Moreover, while the intention to follow rules was somewhat stronger in the creativity condition than in the no priming condition (p = .073), there were no differences between these two conditions and the preciseness condition (both ps > .3), $F(2, 69) = 2.75$, $p = .071$, $\eta^2_{part} = .074$. The effect of priming on all other variables was not significant, all Fs < 1.1.

In addition, we tested for indirect effects of the creativity priming (compared to the other two conditions) via each of these mediators on creative performance using the PROCESS macro provided by Hayes (2013). There was no evidence for indirect effects via goal to be creative ($CI_{95\%}$ [-.019;.007]), intentions to avoid copying the examples ($CI_{95\%}$ [-.009;.020]) and their word endings ($CI_{95\%}$ [-.003;.003]), the intention to follow rules ($CI_{95\%}$ [-

.008;.014]), the perception of creativity ($CI_{95\%}$ [-.021;.010]), the effort put in the task ($CI_{95\%}$ [-.005;.013]) , and self-confidence ($CI_{95\%}$ [-.007;.007]). In sum, these analyses do not provide evidence that the effect of the creativity priming on idea generation is based on conscious intentions. The findings should, however, be interpreted with caution, given the low internal consistency of some of the scales.

Mood and motivation. The impact of priming on mood was tested in separate ANOVAs, with Priming as a between subject factor and the four mood measures as dependent variables. These analyses yielded no effect on the mood measures, all other *F*s < 2, all *p*s > .15 (see Table 3). In addition, we tested for indirect priming effects via mood on creative performance. All four tests failed to provide evidence for an indirect effect (positive activating $CI_{95\%}$ [-.019;.005]); negative activating ($CI_{95\%}$ [-.018;.008]); positive non-activating ($CI_{95\%}$ [-.012;.004]); negative non-activating ($CI_{95\%}$ [-.009;.008]).

Moreover, there was no effect of the priming on the promotion scale, $F(2, 69) = 1.35$, $p = .266$, $\eta^2_{part} = .038$, but there was an effect on the prevention scale, $F(2, 69) = 4.23$, $p = .019$, $\eta^2_{part} = .109$ (see Table 3). Participants were less prevention focused in the control condition, than in the creativity priming and the preciseness priming conditions ($p = .072$ and $p = .028$ respectively). There was no difference in prevention focus between the latter two conditions ($p = .982$). Additionally, there was no evidence for an indirect priming effect on creative performance via promotion focus ($CI_{95\%}$ [-.008;.011]), or via prevention focus ($CI_{95\%}$ [-.003;.016]).

Taken together, the current findings provide evidence for the mitigating impact of creativity priming on copying features of given examples during idea generation. Moreover, they suggest that the effect of creativity priming is not based on processes related to mood, regulatory focus, or intentions. It should, however, be noted that the internal consistency of some of the scales we used to test the impact of mood, regulatory focus, and intentions did not live up to conventional standards and the statistical power was too low to draw strong conclusions about a null hypothesis.

Another limitation of Experiments 2a and 2b is that the impact of the creativity mindset was tested among participants being instructed to avoid any features of the given examples. Hence, one might criticize that the impact of the creative mindset was tested in the presence of, but not in the absence of, the goal to be creative. In other words, the effect of the mindset priming might – based on the results of Experiment 2a and 2b – require the goal to be creative. To rule out that this additional precondition is necessary, we sought to demonstrate that the creative mindset also elicits creative behavior when neither a goal to be creative nor any other related goal is formed.

Experiment 3

To test the impact of a creative mindset on creative performance without the measure itself instigating a goal to be creative, a dependent measure that does not require instructions requesting to form the intention to be creative explicitly or implicitly is necessary. This criterion is fulfilled by the RAT (Mednick et al., 1964), a classic creativity measure, and it was, therefore, employed in the current study. The RAT was presented as part of an intelligence test either with or without the instruction to be creative to address the limitation mentioned above. Before working on this task participants either completed the creativity priming or the preciseness priming procedure used in the preceding experiments. A no priming control condition was not included in the design as neither Experiment 2a and 2b nor Sassenberg and Moskowitz (2005, Experiment 2) found a difference between a no priming and a preciseness priming control condition.

Furthermore, we aimed to replicate the finding that the creativity priming does not impact mood, intentions, or regulatory focus. It was predicted that the creativity priming would lead to higher RAT scores. Moreover, this effect was expected not to be dependent on the intention to be creative, because it is assumed that the priming effect works based on unconscious rather than intentional processes.

Method

Participants and Design

Seventy-four undergraduate students (57 female, 16 male and 1 who did not provide socio-demographics) with a mean age of 25 years (range 19 to 44) took part in a one-hour lab session in exchange for 8 Euros. In addition, six psychology students took part in the study, we aimed not to recruit psychology majors. They were excluded from the analysis, because they should have learned about the RAT in class. The experiment had a 2 (Priming: creativity vs. preciseness) x 2 (Intention: creativity vs. no creativity) between subjects design. As in the preceding studies, we again aimed at 20 participants per cell and the actual sample size was determined by the availability of participants. According to a power analysis using G * Power (Faul et al., 2007) following the same logic as in the preceding experiments (*partial* η^2 = .121, α = .05 and (1-β) = .80), we should have aimed for 21 participants per cell for a test with 3 degrees of freedom and for 15 per cell for a test with 1 degree of freedom.

Procedure

Participants received a package that was announced as two separate studies. In what was presented as the first study, creativity vs. preciseness priming was varied using the same procedure and instruction as in Experiment 2b. The ostensible second study included 20 items of the German translation of the RAT (Bolte, Goschke, & Kuhl, 2003) that were said to be a subtest of an intelligence test. Each item consisted of three words. Participants were requested to respond with a fourth word that indicated what the three words have in common (e.g., barrel, garden, belly – correct response beer). To manipulate the Intention, half of the participants received the instruction to be as creative as possible while solving this task, whereas the other half only received the standard RAT instruction. Finally, participants completed a questionnaire including measures of intentions, regulatory focus, and mood.

Dependent Measure

RAT performance: Responses were coded as correct if participants wrote down the exact or a closely related solution. The number of correct solutions served as the dependent measure.

All additional measures were assessed using the same items as in Experiment 2b. The internal consistencies were as follows: manipulation check for goal to be creative, $r(74) = .76$, $p < .001$; self-confidence, $\alpha = .57$; promotion focus, $\alpha = .67$; prevention focus, $\alpha = .74$; positive activating mood, $\alpha = .77$; positive deactivating mood, $\alpha = .75$; negative activating mood, $\alpha = .66$, and negative deactivating mood, $\alpha = .72$. In addition, effort and perception of creativity were assessed with single items. Participants answered all items on a 7-point scale (1 = *not at all* to 7 = *very much*).

Results and Discussion

Manipulation check

An ANOVA with Priming and Intention as independent variables tested the impact of the manipulation on the goal to be creative. In the creative intention condition, participants were found to have a stronger goal to be creative ($M = 5.38$, $SD = 1.20$) than in the no creative intention condition ($M = 4.50$, $SD = 1.48$), suggesting that the intention manipulation was successful, $F(1, 70) = 7.73$, $p = .007$, $\eta^2_{part} = .099$. Neither a main effect of Priming nor a Priming x Intention interaction was found, both Fs < .1 (for descriptive statistics see Table 4), replicating the finding of Experiment 2b that the creativity priming does not lead to a conscious intention to be creative.

Creative performance

To test the prediction that the creativity priming would lead to higher RAT scores independent of the intention to be creative, we ran an ANOVA with Priming and Intention as factors and RAT score as dependent measure. In line with the hypothesis, participants performed better on the RAT after being primed with creativity than after being primed with preciseness, $F(1, 70) = 4.99$, $p = .029$, $\eta^2_{part} = .066$ (for descriptive statistics of all measures in this study, see Table 4). Neither a main effect of Intention nor an Intention x Priming interaction occurred, both Fs < .5. The main effect of Priming was also significant when considering trials in which the exact solution (as opposed to close alternatives) of the original RAT were considered, $F(1, 70) = 7.03$, $p = .009$, $\eta^2_{part} = .094$. Overall, in line with our expectations, the creativity priming procedure had an impact independent of the intention to be creative.

Intentions and related measures

To provide additional evidence for the impact of priming creativity beyond intentions, the impact of the priming on the perception of creativity, the effort put in the task, the intention to follow rules, and self-confidence were tested in separate ANOVAs. There was not a main effect of Priming on any of the dependent variables, all Fs < .5. In addition, mediation analysis did not yield any evidence for an indirect effect of priming via the three potential mediations on RAT performance (effort $CI_{95\%}$[-.11;.31], intention to follow rules $CI_{95\%}$ [-.11;.38], self-confidence $CI_{95\%}$ [-.33;.11]). Hence, replicating the results of Experiment 2b, there was no evidence that priming creativity affected intentions or awareness related to creative performance. The fact that the internal consistency of some these scales was suboptimal limits the conclusion that should be drawn from these findings.

Mood and motivation

To provide additional evidence that the effects of the creativity priming are not rooted in known processes based on mood or regulatory focus, the impact of the priming on mood was tested in separate ANOVAs with Priming and Intention as between subject factors and the four mood measures as dependent variables. In line with our expectations, there was no effect of Priming on any of the four mood measures, all *F* (1, 69) < 2, all *p*s > .15, all η^2_{part} < .03. In addition, no evidence was found for an indirect effect of priming on creative performance via the mood measures (positive non-activating $CI_{95\%}$[-.20;.16], positive activating $CI_{95\%}$[-.41;.11], negative non-activating $CI_{95\%}$ [-.49;.18], negative activating $CI_{95\%}$ [-.11;.31]). Irrelevant to the question of alternative explanations for the main effect of Priming, there were main effects of Instruction on negative activating and non-activating mood, both *F*s (1, 69) > 5, both *p*s < .03, both η^2_{part} > .06, that were qualified by Priming x Instruction interactions, negative activating *F*(1, 69) = 6.84, *p* = .011, η^2_{part} = .090, negative non-activating, *F*(1, 69) = 3.06, *p* = .085, η^2_{part} = .043 (for details see Table 4).

Analogous tests were again performed concerning the role of regulatory focus. Again, no main effects of Priming were significant, all *Fs* < 1. Furthermore, mediation analysis did not provide evidence for an indirect effect of priming via promotion ($CI_{95\%}$[-.50;.10]) or prevention focus ($CI_{95\%}$[-.29;.11]) on creative performance. Irrelevant to the question of alternative explanations, the instruction to be creative resulted in a stronger promotion (*M* = 5.40, *SD* = 0.99) and prevention focus (*M* = 5.18, *SD* = 1.18), than the no creativity instruction (promotion *M* = 4.94, *SD* = 1.08; prevention: *M* = 4.56, *SD* = 1.21), promotion: *F*(1, 70) = 3.59, *p* = .062, η^2_{part} = .049, prevention: *F*(1, 70) = 4.92, *p* = .030, η^2_{part} = .066.

Overall, the results supported our prediction that the creative mindset facilitates creative performance independent of the goal to be creative, because the impact of the mindset was not moderated by the goal manipulation. In addition, the findings concerning intentions, mood, and regulatory focus indicate (just as the results from Experiment 2b) that the impact of priming creativity on creative performance does not rely on the known mechanisms (i.e., risky strategies resulting from a promotion focus or activation resulting from specific forms of mood). Even though these effects have been found consistently across two studies, the internal consistency of some of the scales is lower than one would wish.

Moreover, one would ideally aim for a higher statistical power to provide evidence for a null hypothesis. Therefore, the current findings can only provide a first indication, in this respect.

Experiment 4

The induction of the creative mindset applied in Experiments 1-3 relied on the recall of past *success* in being creative. This is in line with the idea of mindset priming, because participants thought back to a situation in which they were in the mental state that facilitated creative performance and thereby should have reactivated this state. At the same time, thinking back to past success in being creative might have bolstered participants' confidence or created a feeling of ease, either of which might in turn facilitate creative performance (although the tests for indirect effects in Experiments 2b and 3 suggest that this is not the case).

To rule out these alternative explanations, we decided to use a more minimal priming procedure, namely conceptual priming. The priming of the mere concept of creativity does not activate the mental state allowing for cognitive flexibility via going through one's own experience to be creative again. However, the *recall* of own past creative performances in the preceding experiments was based on instructions asking for exactly that: one's own creative performances. Thus, participants accessed these experiences via the concept of creativity. Hence, the concept of creativity and the experiences seem to be closely associated in long term memory and thus the mere activation of this concept should also active the creative mindset. In sum, we expected that after priming the concept of creativity, generated words would differ more from the given examples (using the paradigm applied in Experiments 2a and 2b) than in the control condition.

Method

Participants and Design

Thirty-one female and 20 male undergraduate students with a mean age of 22 years (range 19 to 28) took part in exchange for a chocolate bar in an experiment with a mixed 2 (Priming: creativity vs. activity) x 3 (Task: pasta vs. analgesics vs. element) design. The priming was manipulated between subjects whereas the task was varied within subjects. We again aimed at 20 participants per cell. According to a power analysis using G * Power (Faul et al., 2007), following the same logic as in the preceding experiments (*partial* $\eta^2 = .121$, $\alpha = .05$ and $(1-\beta) = .80$), we should have aimed for 31 participants per cell for the between subjects main effect.

Procedure

The materials, methods, and procedure were identical to those in Experiment 2b, except for the priming procedure and the fact that no measures of intentions, motivation, mood etc. were taken. The Priming manipulation asked participants to complete the 23 word fragments in which one or two letters were replaced by a dash. In the creativity condition, 12 words were related to creativity (anders - different, spontan - spontaneous, ungewöhnlich - exceptional, ideenreich - imaginative, innovative - innovative, originell - original, schöpferisch - inventive, flexible -flexible, experimentierfreudig - keen to experiment, Vorstellungskraft - imagination, Malerei - painting, Design - design). In the control condition, we decided to present words related to action and goal achievement, because we aimed at avoiding the activation of a specific content that could restrict the ideas generated by either having an impact on the content or on the procedure used. In the activity condition, these words were replaced by words related to action and goal achievement (aufnehmen - start, loslegen - get started, handeln - act, vervollständigen - to complete, Zielerreichung - target achievement, Anfang - beginning, Beginnen - begin, Aktion - action, angehen - approach, umsetzen - implement, funktional –functional, Implementierung - implementation). Words were similar in length and had the same amount of missing letters (in total 19). The 11 distractors were the same in both conditions. All participants completed at least 21 words correctly.

Dependent Measure

As in Experiments 2a and 2b, the frequency of created words with endings that differed from the provided examples was the dependent measure. In the instructions, participants were again asked to restrict their answers to one-word names. Hence, as in the preceding experiments, answers composed of two or more words were not included in the analyses.

Results and Discussion

A mixed ANOVA with Priming (between subjects) and Task (within subject) as factors and relative frequency of generated original alternatives as dependent measure was computed. It was predicted that after priming creativity the generated alternatives would differ more from the provided examples than after priming activity. Indeed, a main effect of Priming was found, $F(1, 49) = 7.51$, $p = .009$, $\eta^2_{part} = .133$ (see Table 5). The proportion of generated ideas that differed from the provided examples was higher in the creativity condition than in the activity condition. Additionally, the theoretically unimportant main effect of Task was found again, $F(2, 48) = 6.68$, $p = .001$, $\eta^2_{part} = .248$. For chemical elements, less original alternatives were generated than for analgesics ($p = .001$). The originality of the pasta product names did not differ from the other two products (both $ps > .10$). The Task x Prime interaction was not significant, $F < 1$.

As in Experiments 2a and 2b, a second ANOVA with Prime and Task as factors and frequency of ideas as the dependent variable was computed. Again, the number of ideas did not differ significantly between conditions and tasks, all Fs < 1. Thus, an alternative explanation in terms of differing amounts of ideas can also be ruled out in this experiment.

The results clearly support the prediction. The current experiment shows that activating the *concept* of creativity is sufficient to initiate the generation of original alternatives. A priming procedure that is even less likely to affect the motivation to behave creatively than the one applied in Experiment 2a, b and 3 likewise increased the originality of ideas.

General Discussion

The current research sought to demonstrate that a creative mindset can reduce the drawbacks resulting from activated knowledge in creative performance by facilitating flexibility and the processing of remote (rather than close) associations. Earlier research found that generated ideas are restricted by activated knowledge and given examples and that these influences cannot be controlled intentionally. This research was the first to show that the activation of a creative mindset – via the recollection of creative performance or by merely activating the concept of creativity – reduces the copying of given examples and their features and, thus, increases creative performance. More precisely, Experiment 1 provided insights about the processes that may underlie such an effect. The study demonstrates that a creative mindset facilitates the processing of remote compared to close associations. Thereby, Experiment 1 advances earlier work (Sassenberg & Moskowitz, 2005) that had only shown that close associations are less swiftly processed in a creative mindset than usual. With these processes evidenced, we then focused on showing that activating a creative mindset actually increases creative performance. Experiments 2a, 2b and 4 provided evidence that the activation of a creative mindset reduced the similarity of generated ideas to provided examples. Experiment 3 added that the creative mindset facilitates performance in the RAT. In sum, these studies demonstrate that a creative mindset reduces the impact of previously activated knowledge and thereby increases the flexibility in idea generation.

In addition, Experiment 2b and 3 provides no evidence for an impact of the creative mindset on creative performance is based on intentions, self-confidence, mood, or a promotion focus (but using scales that had in part limited internal consistency). Hence, the creative mindset does not seem to assert its influence via one of the processes that have been well documented in earlier research. Experiment 3 added that the impact of the creative mindset is not limited to situations where individuals hold the intention to be creative, but unfolds its effects independent of the absence or presence of such an intention. This heightens the plausibility of our assumption that the preferred processing of remote associations in a creative mindset, as demonstrated in Experiment 1, is driving this effect. Future research might aim at providing direct evidence for that mechanism.

The question remains about the underlying effect of this creative mindset priming on remote associative processing. Based on the experiments reported here, one could only speculate about whether the primed differences between remote and close processing results from more global processing of information. It could also be resulting from alterations of information processing in working memory and/or changes in access to information in long term memory. These explanations on this even more fine grained level (for a detailed discussion see the introduction) require empirical investigation.

A limitation of the current research is that the sample sizes of the studies are smaller than one would aim for by today's standards. This is partly due to the fact that most of the data reported here was collected before 2012. At the same time, the sample size come—due to the mixed designs in most studies and due to the large effects sizes—close to what a priori power analysis would have suggested based on the effects of earlier studies. In addition, according to the *p-checker* (http://shinyapps.org/apps/p-checker/) the median observed power of the main statistical tests (i.e., the key interactions) across all five reported studies is .778 and can, thus, be classified as acceptable. Nonetheless, a replication of the current findings with a larger sample size is desirable.

The current research contributes to earlier research on creativity and cognitive flexibility. The dual pathway model of creativity (De Dreu et al., 2008, 2011) suggests that flexibility results from activating positive affect. One might speculate that thinking back to situations when one was successful in being creative might also result in this affective state. There are, however, two reason, why we believe this is not the case. First, most of the experiments reported here include a control condition in which participants likewise thought about past success (regarding preciseness), which could also have elicited positive affect. In all cases, the evidence for cognitive flexibility was higher in the creativity condition. Second, in Experiments 2b and 3, there were no differences in affect between the creativity and the control conditions. Taken together, the current research points to a different source of cognitive flexibility beyond the one mentioned in the dual pathway model of creativity, namely the activation of the relevant procedural knowledge.

The results of Experiments 2a, 2b, 3, and 4 suggest that mindset priming has the power to elicit thoughts and potentially behavior that—according to research by Marsh, Smtih and colleagues (Marsh et al., 1996, 1997, 1999a/b; Smith et al., 1993)—individuals cannot show based merely on conscious intentions. Hence, although the conscious intention to be creative is not effective, there seems to be an unintentional route to cognitive flexibility. This is most likely the case because the information participants have to respond to does not reach conscious awareness. The idea that individuals can overcome the boundaries of activated concepts unintentionally, but not intentionally makes sense. Activating a creative mindset does not operate via an intention to suppress a certain thought (cf. Experiments 2b & 3) that has the potential to result in rebound effects (Wenzlaff & Wegner, 2000). The suppression takes place unintentionally. In fact, Moskowitz and colleagues (Moskowitz, 2014; Moskowitz, Gollwitzer, Wasel, & Schaal, 1999; Moskowitz & Li, 2011; Moskowitz, Li, Ignarri, & Stone, 2011; Moskowitz & Stone, 2012) report similar findings regarding the implicit suppression of stereotypes prior to the activation of, and without the subsequent activation of, the stereotype.

One can conclude from the present research that unintentional processes can work against the bias resulting from automatic effects of activated knowledge. A creative mindset reduces the (unwanted) impact of activated knowledge. A task for further research would be to identify similar mechanisms and mindsets that reduce other biases (e.g., resulting from the inadequate application of heuristics).

The current set of experiments focused, as is often the case in early stages of research, on an effect or mechanism, and on repeatedly demonstrating the effect. However, one of the next steps would be to also determine the boundary conditions of the impact of priming a creative mindset. A set of boundary conditions might center on the processes that are assumed to make mindset priming work. First, a mindset is in essence activating procedural knowledge (Gollwitzer et al., 1990). If the *activation* fails, because an individual does not manage to recall a situation in which the knowledge structure allowing for cognitive flexibility was activated, the mindset priming is likely to fail. This could happen 1) if the instruction asks one to recall too many situations (cf., Schwarz et al., 1991) or 2) among individuals holding an uncreative self-concept (as only knowledge stored in long term memory can be activated via priming; Bargh, Lombardi, & Higgins, 1988). Somewhat related, it would be interesting to test whether the mindset priming asserts differentially strong effects depending on inter-individual differences in creativity. This would imply that individuals differ in extent or accessibility of the relevant procedural knowledge.

Second, the procedural knowledge needs to be *applicable* to the subsequent task (Higgins & Brendl, 1995). This applicability varies depending on the similarity of the content of the recalled situations, in the mindset priming, and the content of the flexibility measure. If the recalled situation was mostly language based (e.g., writing story) and the task, intended to measure flexibility, is based on visual materials (e.g., painting a picture), the applicability might be lower than if both tasks are structurally more similar. Finally, one might speculate how *resource demanding* the application of the procedural knowledge is. It might be the case that the effect of the creative mindset becomes weaker under high cognitive load, because it is resource demanding—the opposite would be true if it was automatic.

Conclusion

Earlier research demonstrated that generated ideas are restricted by boundaries set by the unconscious impact of activated concepts and given examples. Priming creativity is suitable to foster the generation of alternatives that overcome these restrictions and, in turn, enhance creative performance. It enables individuals to overcome the restrictions of activated knowledge – an outcome that is not typically achieved by means of conscious intentions. The results indicate that the cognitive mechanism underlying this pattern of results is the altered processing of remote and close associations. The three conclusions resulting from these experiments are: (1) under certain conditions, implicit processing (priming a creative mindset) has the power to overcome restrictions that cannot be overcome by conscious intentions focused on a specific outcome, (2) activating creativity facilitates the processing of remote and undermines the processing of close associations, and (3) mindset priming can put the brakes on biases resulting from other automatic effects.

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Table 1:

Mean response times in ms (*SD* in brackets) to word targets as a function of mindset and prime (Experiment 1, *N* = 41).

Mindset	**Creativity**	**Control**
close target		
related prime	615 (113)	598 (71)
unrelated prime	605 (101)	613 (87)
remote target		
related prime	601 (108)	617 (67)
unrelated prime	633 (149)	604 (59)

Table 2:

Relative frequency of generated ideas with word endings that differed from the given examples—in total across all task and separately for each task (*M* and *SD* in brackets) from Experiment 2a (*N* = 46).

Prime	**Creativity**	**Preciseness**	**Control**	**Mean**
Total [1]	.53 (.24)	.22 (.26)	.27 (.25)	.34 (.28)
Pasta	.58 (.39)	.22 (.33)	.17 (.34)	.32 (.39)
Nuclear	.36 (.29)	.17 (.27)	.19 (.26)	.24 (.28)
Analgetics	.64 (.39)	.28 (.40)	.44 (.40)	.46 (.41)

Note: [1] The *M*s and *SD*s reported in this row are reported to facilitated readability. Analysis reported in the text rely on separate scores for each task rather than these averages.

Table 3:

Relative frequency of generated ideas with word endings that differed from the given examples—in total across all task (estimated mean and *SE* in brackets) and separately for each task (*M* and *SD* in brackets) as well as intentions, self-perception, mood and regulatory focus (*M* and *SD* in brackets) from Experiment 2b (*N* = 72).

Prime	**Creativity**	**Preciseness**	**Control**	**Mean**
Idea generation				
Total [1]	.46 (.20)	.32 (.24)	.26 (.22)	.35 (.23)
Pasta	.43 (.38)	.22 (.26)	.15 (.27)	.26 (.33)
Chemical element	.28 (.36)	.33 (.39)	.19 (.26)	.27 (.34)
Analgetics	.68 (.37)	.42 (.36)	.44 (.41)	.51 (.39)
Intentions				
Goal to be creative	5.11 (1.50)	5.29 (1.35)	5.10 (1.49)	5.17 (1.43)
Avoid copying examples	4.70 (1.52)	5.04 (1.63)	3.80 (1.61)	4.50 (1.65)
Avoid copying word endings	5.30 (1.36)	4.75 (2.07)	5.20 (2.02)	5.08 (1.84)
Intention to follow rules	6.48 (0.73)	6.25 (0.79)	5.80 (1.38)	6.17 (1.05)
Judgment of own creativity	4.17 (1.56)	3.63 (1.28)	3.96 (1.49)	3.92 (1.44)
Effort	5.48 (1.16)	5.75 (0.99)	5.60 (1.08)	5.61 (1.07)
Self-confidence	4.42 (0.84)	4.51 (1.19)	4.23 (1.15)	4.38 (1.07)
Mood				
Positive activating	4.17 (1.08)	3.90 (1.36)	4.29 (0.86)	4.13 (1.11)
Positive non-activating	4.29 (1.17)	4.17 (1.16)	4.39 (1.31)	4.28 (1.21)
Negative activating	2.09 (0.86)	2.15 (1.04)	1.83 (0.86)	2.02 (0.92)
Negative non-activating	2.57 (1.17)	2.72 (1.13)	2.13 (0.99)	2.47 (1.11)
Regulatory focus				
Promotion	4.35 (1.24)	4.13 (0.96)	3.80 (1.27)	4.08 (1.16)
Prevention	5.42 (0.73)	5.51 (0.90)	4.79 (1.16)	5.23 (1.00)

Note: [1] The *M*s and *SD*s reported in this row are reported to facilitated readability. Analysis reported in the text rely on separate scores for each task rather than these averages.

Table 4:

Mean (SD) of RAT-score, intentions, self-perception, mood and regulatory focus from Experiment 3 (N = 74).

Priming		**Creativity**			**Preciseness**	
Intention	**Be creative**	**Non**	**Total**	**Be creative**	**Non**	**Total**
RAT Score	9.53 (2.34)	9.78 (2.69)	9.65 (2.49)	7.84 (2.97)	8.44 (3.52)	8.14 (3.22)
Intentions						
Goal to be creative	5.34 (1.38)	4.44 (1.60)	4.91 (1.54)	5.42 (1.02)	4.56 (1.46)	4.95 (1.41)
Effort	6.11 (1.29)	5.61 (1.04)	5.86 (1.19)	5.89 (1.37)	5.44 (0.98)	5.68 (1.20)
Intention to follow rules	5.95 (1.35)	5.33 (1.76)	5.65 (1.55)	5.84 (1.34)	5.72 (0.96)	5.78 (1.16)
Self-confidence	4.77 (1.26)	4.85 (1.14)	4.81 (1.19)	4.81 (1.17)	4.57 (0.77)	4.69 (0.99)
Mood						
Positive activating	3.67 (1.03)	3.94 (1.21)	3.81 (1.11)	4.01 (1.27)	3.81 (1.16)	3.91 (1.20)
Postive non-activating	3.81 (1.42)	4.69 (1.20)	4.25 (1.37)	4.25 (1.36)	4.37 (1.03)	4.31 (1.20)
Negative activating	3.04 (1.20)	1.67 (0.83)	2.35 (1.23)	2.14 (1.15)	2.00 (0.75)	2.07 (0.97)
Negative non-activating	3.74 (1.28)	2.52 (1.12)	3.13 (1.24)	2.81 (1.60)	2.65 (1.11)	2.73 (1.37)
Regulatory focus						
Promotion	5.40 (1.00)	5.15 (1.10)	5.28 (1.05)	5.40 (1.00)	4.74 (1.06)	5.08 (1.07)
Prevention	5.35 (1.14)	4.56 (1.35)	4.96 (1.30)	5.00 (1.22)	4.56 (1.08)	4.78 (1.16)

Table 5:

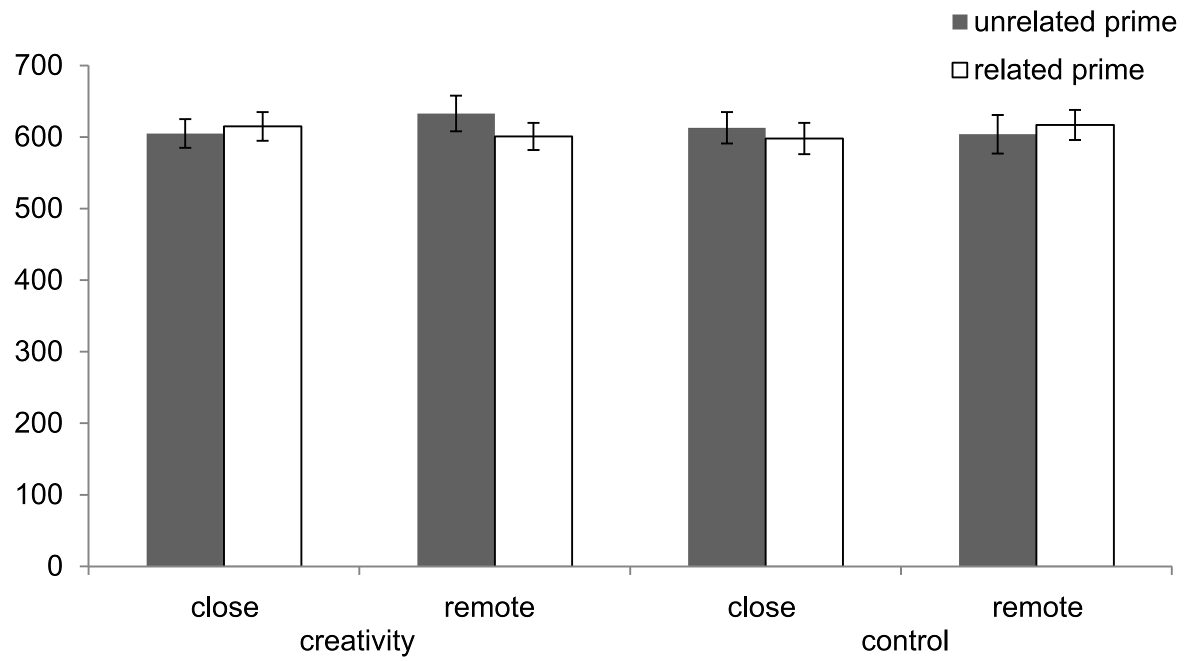
Relative frequency of generated ideas with word endings that differed from the given examples—in total across all task (estimated mean and *SE* in brackets) and separately for each task (*M* and *SD* in brackets) from Experiment 4 ($N = 51$).

Prime	**Creativity**	**Control**	**Mean**
Total[1]	.48 (.20)	.33 (.20)	.41 (.22)
Pasta	.49 (.40)	.35 (.33)	.42 (.37)
Chemical element	.35 (.30)	.22 (.28)	.28 (.29)
Analgetics	.61 (.34)	.42 (.31)	.51 (.34)

Note: [1] The *M*s and *SD*s reported in this row are reported to facilitated readability. Analysis reported in the text rely on separate scores for each task rather than these averages.

Figure Caption

Figure 1. Response latencies by activated mindset and prime (Experiment 1). Error bars mark standard errors.


unrelated prime
related prime
700
600
500
400
300
200
100
0
close
remote
close
remote
creativity
control

Appendix

Materials used in Experiment 1. The German expression is given in brackets.

closely associated primes	*remotely associated primes*	*targets*
sugar (Zucker)	tea (Tee)	sweet (süß)
circle (Kreis)	tart (Torte)	round (rund)
light (Licht)	window (Fenster)	bright (hell)
sun (Sonne)	wool (Wolle)	warm (warm)
night (Nacht)	forest (Wald)	dark (dunkel)
silence (Stille)	sea (Meer)	quiet (ruhig)
grass (Gras)	nature (Natur)	green (grün)
winter (Winter)	scarf (Schal)	cold (kalt)
butter (Butter)	sheep (Schaf)	soft (weich)

Footnotes

[1]Certainly, for a limited amount of elements, the copying can be reduced when intentions related to source monitoring of the ideas are formed, but intentions related to source memory only help to reduce the impact of a limited number of criteria as processing capacity is limited. Moreover, intentions can only be formed for knowledge for which source memory as a clue to avoid copying exists. Hence, the success of any intention-based strategy is very limited.

[2]The internal consistency of this scale is insufficient, because the scale comprised three items that are sometimes attributed to different sub-aspects of self-confidence (e.g. Baerden et al. (2001). They were included in the scale to capture the concept broadly, which comes with the downside of lower internal consistency.

[3]Degrees of freedom vary because of missing answers.

[4]The overall high level of conformity compared to earlier studies using the same paradigm (e.g., Marsh et al., 1999b) can be explained based on the fact that examples in the current research were available throughout the whole generation task, whereas they were only shown for 5 seconds each prior to idea generation in earlier research.