Inspired by art:

**Higher aesthetic appeal elicits increased felt inspiration in a
creative writing task**

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Abstract

Moments of creative inspiration – an evoked state of motivation for creative activity – form a distinct step in creative processes. We hypothesize that the psychological state of being creatively inspired is similar to the state of being aesthetically moved, and that aesthetically moving experiences can serve as prompts for creative inspiration. We tested this hypothesis in a creative writing task: In Experiment 1, 25 participants from the general public were asked to write 12 short creative vignettes (repeated measures) in response to either “aesthetic” prompts (visual artworks they had rated highly aesthetically moving in a preceding task) or “non-aesthetic” prompts (triads of unrelated words). People then rated how inspired they had felt during idea generation. Ratings of inspiration were significantly higher for aesthetic vs. non-aesthetic prompts. In Experiment 2, 34 participants performed the same task with prompts consisting of highly-moving artworks, non-moving artworks (rated in a preceding task), or novel artworks not seen in advance. While pre-exposure to the stimuli had no significant effect, felt inspiration was significantly higher for moving vs. non-moving prompts, and post-test aesthetic ratings of novel artworks were positively correlated with felt inspiration. Furthermore, inspiration ratings correlated positively with the amount of produced text. Being aesthetically moved increases the likelihood of creative inspiration, a finding with implications both for the study of creative and aesthetic processes and also for the potential role of the arts in educational settings.

Keywords: felt inspiration, aesthetic appreciation, creativity, visual art, creative writing

Introduction

While the concept of an artistic muse dates to antiquity, modern cognitive psychology has much to learn about the mental processes that support the generation of original or creative ideas. Given the high cultural and economic relevance attached to creative ideas and achievements, it is no surprise that the past two decades have seen intense work on the psychological mechanisms supporting creative thought at a number of levels of analysis, from inter-personal traits down to moment-to-moment mental operations (for reviews see Batey & Furnham, 2006; Dietrich & Kanso, 2010; Scott, Leritz, & Mumford, 2004a).

At the level of character traits, it is known that individual abilities, such as the capacity for divergent and convergent thinking (introduced by Guilford, 1950), general intelligence, and openness (or open-mindedness; Jauk, Benedek, & Neubauer, 2014) are all linked to creativity (see Batey & Furnham, 2006 for a review). Trait-level creativity is often assessed by standardized tools like the Alternative-Uses Task (AUT; Guilford, Christensen, Merrifield, & Wilson, 1978) but also via quantitative or qualitative ratings of the creativity of outputs, and recent efforts have linked trait-level creativity to neural systems such as the dopaminergic system (Boot, Nevicka, & Baas, 2017), the default-mode network (Boccia, Piccardi, Palermo, Nori, & Palmiero, 2015; Gonen-Yaacovi et al., 2013), the executive-control network (Santarnecchi, Emmendorfer, & Pascual-Leone, 2017), and to functional connectivity across brain systems (Beaty et al., 2018); see Jauk (2019) for a recent review.

Beyond inter-personal differences in creative ability, it is also the case that a persons' creativity can vary – not only over one's lifetime (Baer, 1994; Scott, Leritz, & Mumford, 2004b; Torrance, 1968) but also over the course of days, hours, or even minutes (Amabile, 1985; Zenasni & Lubart, 2002). This likely holds true for all individuals, not just those that exhibit high trait-level creativity — nearly everyone has the capacity to engage in some form of creative thought. Influential models of creativity take this into account, recognizing that

while culturally relevant creative achievements (Carson, Peterson, & Higgins, 2005) are only produced by a small subset of the population (Eysenck, 1995), everyday creative activity is rather commonplace and not confined to a subset of the population (Jauk et al., 2014). Rather, the capacity for creative and artistic activity is likely a core skill of humankind that plays a role in learning, personal development and professional activities (see e.g. the 4C model by Kaufman and Beghetto 2009).

Understanding the psychological mechanisms of creative thought on a moment-to-moment basis requires process models. A creative process is a series of mental operations and actions that lead to the generation of ideas or solutions, as well as to novel artifacts, products, or performance (Lubart, 2001). Process models have a long history in the field of creativity. For example, Graham Wallas (1926) proposed that creative processes, consist of four distinct stages that can be separated in time: preparation, incubation, illumination, and verification. Current models of the creative process tend to move away from such distinct stages, and rather emphasize a set of important subprocesses such as 1) problem finding, formulation, and redefinition, 2) divergent thinking, 3) combination and reorganization of information, and 4) analytic-evaluative processes (for a review see Lubart, 2001). One additional benefit of studying creative thought as a process is that it might lead to identification of certain mental operations that could be subject to intervention, such as by improving the efficacy of one stage or the transition from one operation to the next.

Recent work by Oleynick, Thrash and colleagues (2014) highlight an alternative way to segment the creative process: they propose that moments of inspiration are critical pivot points from creative ideation to actualization of an idea. As defined by Thrash and Elliot (2003), creative inspiration is a state of increased motivation for creative activity that has three main characteristics: evocation, meaning that it is often evoked by a stimulus, either an external object or internal thought processes; transcendence, characterized by the feeling of possibilities beyond concrete reality; and approach motivation, a desire to put the evoked

ideas into the form of a concrete object or action. We note that inspiration shares similarities with insight, the phenomenon of instantaneously “seeing” the solution for a problem rather than solving it analytically: both are related to ideation, and can feel pleasurable. Yet unlike inspiration, insight functions within the context of solving problems with a closed solution (Sternberg & Davidson, 1995). Moments of inspiration may be elements of the creative process that are amenable to isolation and intervention. Furthermore, as the motivational state and subjective feeling of inspiration arguably result from “illumination” with a highly creative idea (Thrash, Maruskin, Cassidy, Fryer, & Ryan, 2010), measures of felt inspiration can be taken as an index of the subjective creativity of an idea.

While virtually any object or stimulus could potentially trigger creative inspiration, we propose that intense aesthetic experiences may serve as particularly effective prompts. Many artists and musicians anecdotally cite the creative works of others or the beauty of nature as a source of inspiration for their own creative achievements. For example, art historians note a prominent role of Japanese woodblock prints for the French impressionist movement (e.g. Ives & Metropolitan Museum of Art, 1974), and a recent study with art students found that both copying and thorough observation of artworks with unfamiliar styles can facilitate creativity in drawing (Okada & Ishibashi, 2017). Various other studies point at similarities between aesthetic appreciation and creative thought processes. Tinio’s “mirror model of art” (2013) proposed that during perception and comprehension of an artwork, an observer engages in similar (though not identical) thought processes as the artist’s original creative process, in reversed order. Artistic compositions can trigger strong emotional and physiological reactions (Gerger, Pelowski, & Leder, 2018; Goldstein, 1980; Schindler et al., 2017; Silvia, 2009; Wassiliwizky, Wagner, Jacobsen, & Menninghaus, 2015; Zentner, Grandjean, & Scherer, 2008) similar to those attributed to moments of inspiration (e.g. Doyle, 1998). The occurrence of intense aesthetic experiences can be well characterized by assessing the state of “being aesthetically moved,” an exemplary aesthetic emotion (Menninghaus et al.,

2019) sometimes associated with art-elicited chills (Wassiliwizky et al., 2015) that can reflect aesthetic responses derived from differently valenced, or even mixed affective states (Menninghaus et al., 2015). At the neural level, being aesthetically moved by artwork engages the brain's default-mode network (DMN; Belfi et al., 2019; Vessel, Starr, & Rubin, 2012, 2013) which has also been associated with trait-level (Beaty et al., 2018; Boccia et al., 2015; Gonen-Yaacovi et al., 2013) and state creativity (Limb & Braun, 2008).

To test the hypothesis that being aesthetically moved can trigger creative inspiration, we designed an experimental paradigm in which participants wrote short pieces of creative text in response to prompts that varied in their degree of subjective aesthetic appeal. Following each writing phase, people rated how inspired they felt when beginning their writing (see Figure 1) – our main measure of interest. This task mimics a prompted writing exercise that is used in creative writing workshops, where it is intended to help novice writers learn to generate text with minimal preparation. Our participants were sampled from the general public, and we chose this output modality expecting that a non-artist population would be most comfortable with writing as compared to other possible modes of creative output. Our primary objectives were to 1) operationalize inspiration in an experimental context in a manner that reflected participants' subjective feeling, could be measured on each trial, and could be (at least roughly) isolated in time, and 2) to test whether aesthetically appealing materials are effective primes for creative inspiration. Note that we deliberately focused on a subjective measure of inspiration rather than an objective outcome measure, as we aimed to develop a measure that was more closely linked to a psychological state, unmediated by a participant's ability to translate an inspiring idea into a text that an external judge would rate as creative.

In Experiment 1, we sought to test the ability of an aesthetic prompt (in the most general sense) to trigger creative inspiration compared to a non-aesthetic prompt. Prompts were either highly aesthetically moving paintings (aesthetic prompts), or triads of unrelated

words constructed with no aesthetic intent and expected to have lower aesthetic appeal, but which still contained information that could serve to stimulate writing (non-aesthetic prompts). As aesthetic appeal for artworks is known to be highly idiosyncratic (Vessel, Maurer, Denker, & Starr, 2018), painting prompts were custom selected for each participant based on their aesthetic ratings from a separate pre-test. We hypothesized that aesthetically moving paintings would lead to higher feelings of inspiration during the writing task than the word prompts.

In Experiment 2, prompts consisted only of paintings: paintings that the person previously rated as highly aesthetically moving, paintings they previously rated as non-moving, and novel paintings which were not presented in advance. Here we tested the hypothesis that high-rated paintings would lead to higher feelings of inspiration than low-rated ones, and that there would be no effect of prompt familiarity, resulting in intermediate ratings of inspiration (on average) for the novel paintings. Participants in both experiments also performed an alternative-uses-test (AUT), a common measure of trait-level creativity (Benedek, Könen, & Neubauer, 2012; Runco & Acar, 2012) and the amount of produced text was quantified for each trial. Due to logistical reasons, Experiment 1 was conducted in the United States, while Experiment 2 was conducted in Germany; although not intentional, these two populations allow for some degree of generalization across two different cultures.

Figure 1. Creative writing task for assessing felt inspiration in response to aesthetic prompts. On each trial, a fixation point (not shown) was followed by presentation of a prompt for 10 s. In Exp. 1, these prompts consisted of artworks rated as aesthetically pleasing or of three unrelated-words. In Exp. 2, stimuli consisted of paintings the person previously rated as highly-moving, paintings they previously rated as non-moving, and paintings which were not presented in advance. Participants then had 180 s to generate an original creative writing sample in response to the prompt. A warning indicated when only 30 seconds remained. Following the writing period, people rated how inspired they felt at the start of the writing period. See Acknowledgments for image credit.

Experiment 1

Methods

Participants

30 participants took part in the study. Due to an error in the script for artwork selection from the aesthetic pre-rating task that resulted in repeated presentation of the same stimulus in the creative writing task for some participants, four participants had to be excluded from the analysis (reconstruction was not possible), and two have one missing data-point each but were not removed from the analysis. One other participant was excluded due to non-compliance, leaving data from 25 participants for analysis (15 female, 10 male; age 18-55 years, median = 25 years, mean = 26.6 years, std = 7.8 years). Our final sample provided

sensitivity to detect effects of size $d = 0.584$ for the main effect of prompt category on inspiration ratings (two-sided, one-sample t-test, with alpha of 0.05 and power of 0.8).

We applied convenience sampling: participants were recruited using flyers posted on the campuses of New York University and received monetary compensation. Participation was limited to persons fluent in written English. The study was run in a group testing room in groups of two to four people. The experimenter was present in the room during the experiment. Besides the participants and the experimenter, no one was present during data collection. The experimenter supervising the data collection was aware of the experimental conditions and study hypothesis during data collection. Each participant provided informed written consent before the beginning of the experiment. The study was approved by the New York University Committee on Human Subjects and adhered to the ethical standards of the Declaration of Helsinki. Data were collected from Apr. 2015 to Dec. 2015.

Stimuli

Paintings – the stimuli consisted of twenty paintings selected from a larger stimulus set of 109 paintings collected for an earlier study (Vessel et al., 2012). The set contained selected works from the Catalog of Art Museum Images Online (CAMIO; note that this database was closed Dec. 2018 and cannot be accessed anymore) and included paintings from a variety of cultural traditions and historical periods; images that are commonly reproduced were not included in order to minimize the possibility of recognition. We subselected paintings for the present study based on data from a previous aesthetic rating study of the larger stimulus set ($N = 20$ raters; data published in Vessel et al., 2018) for having an average aesthetic rating (“how strongly does this painting move you,” see below) of at least 4 on a 7-point Likert scale and were rated 5.5 or higher by at least 30% of the 20 raters; see

Table A2 for a list of the selected paintings. Images were scaled not to exceed 20° of visual angle, and the area on screen did not exceed 75% of a 20° box.

Word Triads - Six triads of unrelated word were selected from a stimulus set used in a Remote Associates Test (Bowers, Regehr, Balthazard, & Parker, 1990). We took the six word triads reported as being the least coherent in the original study; An incoherent word triad is defined as a set of three words that has no common remote associate (Bolte, Goschke, & Kuhl, 2003); e.g. “trumpet, bathtub, grant”. Word triads have been successfully used as prompts for creative writing in past experiments (Howard-Jones, Blakemore, Samuel, Summers, & Claxton, 2005). The full set used in the present study is enclosed in **Table A1**. Participants were not exposed to the word triads prior to the creative writing task.

Procedure

Exp. 1 was conducted in English at New York University in New York, NY. At the start of the experiment, each participant completed a set of questionnaires: a demographic background questionnaire, an abbreviated version of the Positive and Negative Affect Schedule (PANAS-X; Watson & Clark, 1999), the State-Trait Anxiety Inventory (STAI-Y; Grös et al., 2007; Julian, 2011; Spielberger, 1983), and the Aesthetic Responsiveness and Engagement Assessment (AReA; Schlotz et al., 2020), in their English version using pen and paper. The AReA questionnaire is a tool developed by our group to measure participants’ general aesthetic responsiveness with items assessing the frequency with which people experience three relevant states: aesthetic appreciation, intense aesthetic experiences, and creative engagement. The remainder of the experimental session consisted of four phases: 1) an alternative-uses task (AUT) to measure trait creativity, 2) an aesthetic rating pre-test, 3) the main creative writing task to measure felt inspiration (see Figure 1), and 4) an aesthetic rating post-test. Both aesthetic rating tasks required the participants to rate all twenty artwork stimuli. All tasks (except questionnaires) were implemented and run using MATLAB 2013b

(The MathWorks) and the PsychToolbox v3 (Brainard, 1997) on Microsoft-Windows PC's (Microsoft Corporation). Instructions, text-stimuli and images of paintings were presented on calibrated Dell P190S computer monitors. Participants were placed at a distance of 16'' (approx. 41 cm) from the monitors. Before each task, people were shown a series of instruction screens explaining the task and the measure used. The experimenter read the full set of instructions to the group as a whole, and participants could ask questions before the beginning of each task (see *Online Supplementary* for full instructions). A full debriefing was performed at the end of the experiment. Overall, the session took about 90 – 120 minutes depending on each participant's individual speed.

AUT Ideational Fluency - The Alternative-Uses Task (AUT; Guilford et al., 1978) is a divergent thinking task that is frequently used as a measure for trait-level creativity (Cousijn, Zanolie, Munsters, Kleibeuker, & Crone, 2014; Friedman & Forster, 2001). We implemented the AUT “brick“ paradigm and scored for ideational fluency, a reliable and robust method for scoring the AUT (Martindale, Hines, Mitchell, & Covello, 1984). Participants had three minutes to come up with as many unusual uses as possible for the prompt “a single brick“, which were typed on a computer keyboard into a simple text editing interface. Responses were evaluated by the experimenter – ordinary, impossible, or nonsense replies were not counted. Fluency was scored as the total number of valid responses.

Aesthetic Rating Tasks (Pre-/Post) - Participants rated a set of 20 paintings on the question “How strongly does this painting move you?“ using a continuous response scale. Prompts were presented in pseudo-randomized order to counterbalance image order effects. People were instructed by the experimenter to make ratings based on their feelings at the moment, without regard to ratings made on earlier trials. Being *aesthetically moved* is a description of aesthetic experience that is often used by researchers in the field of empirical aesthetics (Armstrong & Detweiler-Bedell, 2008; Menninghaus et al., 2015; Silvia, 2009; Vessel et al., 2012). It is a term that accounts for the possibility that artworks which are not

stereotypically beautiful can also evoke powerful and emotionally moving responses. Participants were given two practice trials to gain familiarity with the types of stimuli used and the rating scale. These practice stimuli were not used in the main experiment. After having finished the following writing task (see below) they repeated the aesthetic rating task of the same 20 stimuli in a different order. Each trial began with a blank screen (1 s) followed by a fixation point (0.5 s), an image of an artwork (6 s), a blank screen, and a rating scale. Participants were asked to indicate their ratings on a continuous scale by positioning a visual slider moving the mouse up and down; responses were locked in by clicking the mouse button. Participants were instructed “If the image was highly moving, then use the mouse to position the slider cursor towards the high end of the scale (marked “H”) and click the mouse to lock in your response. If the painting did not move you at all, move the slider to the low end of the scale (marked “L”) and lock in your response. If you did not feel strongly one way or the other, use the middle of the scale” (see *Online Supplementary* for full instructions). Responses were saved as numerical values ranging from 0 (low) to 1 (high). The continuous rating scale had a response precision of 0.001, technically limited by the number of pixels on the scale. Movement direction of the mouse corresponding to the respective ends of the scale was randomized between participants. Participants were instructed to use the entire scale. Image order was randomized across participants, with pairs of participants receiving mirror reversed orders of each other to counteract any order effects. Different random orders were used for the pre- and post- aesthetic rating tasks.

Creative Writing Task - Participants were asked to produce short pieces of creative writing in response to 12 prompts (see Figure 1). The response variable of interest was the self-reported felt inspiration in each writing period. The prompts belonged to two conditions: “aesthetic” prompts consisting of the six paintings rated highest by the participant in the preceding aesthetic rating task, and “non-aesthetic” prompts consisting of six unrelated word triads. Prompts were presented in pseudo-randomized order with condition alternating by trial

(half of the participants starting with art prompts, half of them starting with text prompts). On each trial, a fixation cross was presented for 0.5 s, followed by the prompt for 10 s. After stimulus presentation, people had 180 s to produce text in response to the prompt using a basic text editor interface that allowed for typing, deletion and addition of line breaks. Participants were asked to not simply describe the prompt or their reaction to it but to produce a series of “independent, short creative writing samples.” (For full instructions see *Online Supplementary*. At the beginning of the session there was a practice trial with a separate stimulus to practice using the text-editor.) After the end of each writing period, participants were asked to answer the question “How strongly were you inspired?” on a continuous scale with the ends marked “H” or “L” (instruction: “Use the far right of the scale if you felt highly inspired, the far left if you were not inspired at all, and the middle if you didn't feel strongly one way or the other.”). Participants were asked to judge the feeling of inspiration they had while starting their creative process, and were told not to judge the prompt itself, nor to judge their final product (see *Online Supplementary* for full instructions). A similar self-report measure was used in Thrash and Elliot’s Inspiration Scale, who let their participants assess the statement “I feel inspired” in terms of Frequency and Intensity, using a 7-point Likert scale. They found the scale to be internally consistent, with an average Cronbach’s α of 0.92 (Thrash & Elliot, 2003). After a rating was provided, there was a 30 s break before the next prompt was shown. After six trials participants were offered a longer, self-paced break.

Data analysis

Data analysis and visualization was done using MATLAB 2018a (The MathWorks) and R (R Core Team, 2018) on a Macintosh PC (Apple Inc.). For visualization of mean ratings we used a customized version of the *boxPlot* function from the IoSR MatlabToolbox (<https://github.com/IoSR-Surrey/MatlabToolbox>). Descriptive statistics were computed using R with built-in functionality, t-tests were generally two-sided, computed with R’s *t.test* function, effect sizes were computed using *cohen.d* function from R’s *effsize* package. The

main hypotheses (effect of prompt category) were tested using linear mixed effects regressions with the *lmer* function from *lme4* package in R (Bates, Mächler, Bolker, & Walker, 2015). Participants' rated inspiration was modelled as the dependent variable, with a fixed effect of prompt category and two random effects of participant and stimulus. To assess the overall significance of all reported linear models, Likelihood Ratio Tests were performed: LMM-coefficients were compared to reduced intercept-only models (no fixed effect, random effects of participant and stimuli) using R's *anova* function. Power analysis was performed using G*Power v3.1 (Faul, Erdfelder, Lang, & Buchner, 2007).

Results and Discussion

Previous research has shown that different people have highly idiosyncratic aesthetic tastes for visual artworks (Vessel et al., 2018, 2012), making it impossible to identify a single set of artworks that all observers would find aesthetically moving. We therefore included an aesthetic rating pre-test before the creative writing task. Our participants viewed 20 paintings and rated them for how strongly the paintings moved them aesthetically (see *Methods* and *Online Supplementary*). The six top-rated paintings for each observer were used as prompts in the subsequent writing task. All 20 stimuli were among the top six for at least two participants. On average, each painting was selected by 7.4 (SD = 2.66) of the 25 observers and the overall count of the stimuli followed a normal distribution (a Shapiro-Wilk normality test on frequency counts of the paintings did not reject the null hypothesis: $W = 0.94791, p = 0.3365$). The paintings selected for the writing task had an average aesthetic rating of $M = 0.79$, 95% CI [.774, .813] across participants (0 to 1 response interval). The word triads were not rated by the participants.

Consistent with our hypothesis, inspiration ratings in the writing task were significantly higher for trials with aesthetically moving paintings (aesthetic prompts) than for trials with word triads (non-aesthetic prompts; Figure 2). The grand mean inspiration rating in aesthetic trials ($M = 0.63$, 95% CI [.591, .675]) was higher than the grand mean rating in non-

aesthetic trials ($M = 0.48$, 95% CI [.438, .532]). All individual ratings of inspiration were used to fit a linear mixed effect regression model with fixed effect of stimulus category and random effects of participant and stimulus (see *Methods*). Prompt category affected inspiration rating (slope = 0.150, SE = 0.026), and a Likelihood Ratio Test (see *Methods*) against an intercept-only model with the same random effects was significant ($\chi^2(1) = 10.29$, $p < 0.002$).

Figure 2. Higher felt inspiration ratings in Exp. 1 when participants wrote in response to aesthetically moving prompts. Each dot represents the mean inspiration rating of one participant for writing trials with either unrelated word triads (non-aesthetic) or paintings rated as aesthetically moving (aesthetic). $n = 25$. White dot and black bar indicate grand mean with 95% confidence interval. *** $p < 0.001$ (significance level from linear model). Gray shaded area represents the data density computed using a gaussian kernel with a width that is optimal for normal data.

To investigate the role of trait-level creativity, AUT-fluency scores were added as a second fixed effect with interactions to a new model otherwise identical to the LMM described above. AUT score had no significant effect on inspiration rating (slope = 0.013, SE = 0.013, $p = 0.311$ using Satterthwaite's degrees-of-freedom method), but there was a significant interaction between AUT score and category (slope = -.023, SE = 0.009, $p < 0.02$

using Satterthwaite's degrees-of-freedom method): people with lower AUT scores tended to show a larger effect of category on inspiration ratings. A Likelihood Ratio Test against the previously described model without fixed effect of AUT was significant ($\chi^2(2) = 6.27, p < 0.05$).

Experiment 2

The “aesthetic” and “non-aesthetic” prompts of Exp. 1 differed in several ways. Most importantly, the aesthetic prompts consisted of visual artworks, while the non-aesthetic prompts consisted of written stimuli - the two conditions thus differed on a variety of other dimensions besides their aesthetic properties that may also have accounted for the observed behavioral differences. In addition, the artworks were rated during the aesthetic pre-test and were thus familiar to the participants, whereas the word triads were novel. To address these potential confounding factors, we conducted a second experiment in which the potential effect of stimulus modality (visual art vs. text) was eliminated by only using visual art, and the effects of aesthetic appeal and familiarity were directly examined. Exp. 2 thus contained three prompt categories: aesthetically moving visual artworks, non-moving visual artworks (both determined via an aesthetic rating task that preceded the writing task), and a set of novel artworks that had not been previously shown to the participants.

Methods

Participants

41 participants took part in the study. Sample size was powered for detection of a moderate effect size ($d = 0.5$) for the main effect of prompt category on inspiration ratings using a two-sided, one-sample t-test, alpha of 0.05 and power of 0.8. Two participants did not finish data collection due to software failures and were excluded from analysis, one was

excluded because their distribution of ratings in the aesthetic pre-test did not allow for the identification of 4 non-moving stimuli, and four because they gave zero valid responses in the AUT task, leaving 34 participants for analysis (21 female, 13 male; age 19-53 years, median = 24.5 years, mean = 27.3 years, std = 8.7 years). Our final sample provided sensitivity to detect effects of size $d = 0.495$ or larger (two-sided, one-sample t-test, with alpha of 0.05 and power of 0.8).

We applied convenience sampling: participants were recruited via flyers posted on the campuses of Goethe University (Frankfurt, Germany) and Johannes-Gutenberg University (Mainz, Germany), as well as direct mailings to subscribers of an institute-hosted participant database (>1500 members, open to everybody to subscribe) and received monetary compensation. Participation was limited to persons fluent in written German, age 18-55 years, with normal or corrected vision. Participants performed the experiment individually in an acoustically and visually shielded cabin. The experimenter was present outside the cabin and could be contacted via intercom. Besides the participants and the experimenter, no one was present during data collection. Two different experimenters collected the data. The experimenters supervising the data collection were aware of the experimental conditions and study hypothesis during data collection. Each participant provided informed written consent before the beginning of the experiment. The study was approved by the Ethics Committee of the Max Planck Society and adhered to the ethical standards of the Declaration of Helsinki. Data were collected from Nov. 2017 to Feb. 2018.

Stimuli

Twenty-four paintings were selected as stimuli: Twenty of the paintings were identical to those used in Exp. 1 and were presented in the aesthetic rating pre test. An additional 4 paintings were selected from the larger set of 109 painting to be used as “novel” (i.e. not previously presented) paintings only in the creative writing task (and the aesthetic rating post-

368 test). As for the 20 other paintings (described above), selection was based on the rating
369 dataset from Vessel et al. (2018), choosing the 4 paintings with the highest variance across
370 participants among the twenty paintings with aesthetic ratings closest to the grand mean rating
371 (3.6 on a 7-point scale). A full list of the paintings used in this experiment is available in

Table A2.***Procedure***

The overall procedure was almost identical to that of Exp. 1; however, Exp. 2 was conducted in German at the Max Planck Institute for Empirical Aesthetics in Frankfurt, Germany and all task instructions required translation to German. Participants read through the instructions at their own pace. In addition to the questionnaires from Exp. 1 (PANAS, STAI, AReA), each participant completed the Snaith-Hamilton-Pleasure-Scale (SHAPS; Snaith et al., 1995). Questionnaires were presented in their German version. All tasks (except questionnaires) were run using MATLAB 2017a (The MathWorks) and the PsychToolbox v3 (Brainard, 1997) on Microsoft-Windows PC's (Microsoft Corporation). Instructions, text-stimuli, and images of paintings were presented on a Benq XL2420Z computer monitor. Participants were placed at a distance of 60 cm from the monitors. Overall, the session took about 90 – 120 minutes depending on the speed of the participants.

AUT Ideational Fluency - The task and analysis was identical to that described in Exp. 1, using the German version of the “brick” paradigm (prompt: “ein einzelner Ziegelstein“).

Aesthetic Rating Tasks (Pre-/Post) - For the pre-rating task, participants rated the aesthetic appeal of 20 artworks using the exact same task described in Exp. 1. Since participants were German the question “Wie ansprechend finden Sie dieses Gemaelde?“ (“How appealing was this painting to you“) was displayed. This translation was chosen over the literal German translation of “moving” – “bewegend” – since this was flagged as potentially problematic for application with a continuous scale. The ends of the rating scale were marked with “+“ (high) and “-“ (low). In contrast to Exp. 1, the aesthetic rating post-test (after the writing task) required participants to rate the twelve pictures used as writing prompts (see below). For half of the participants presentation order was the same as in the writing-task, for the other half it was reversed.

Creative Writing Task - The procedure was identical to Exp. 1, but prompts consisted exclusively of paintings. The twelve writing prompts were from three conditions: the four paintings rated highest by the participant in the aesthetic rating pre-test (“moving”), the four paintings rated lowest in the pre-test (“non-moving”), and four paintings that were not rated in advance (“novel”, the same for all participants). Prompt-order followed a predefined scheme which balanced transitions between the different categories. This scheme was reversed for half of the participants. After writing, participants answered the question “Wie inspiriert haben Sie sich beim Schreiben gefuehlt?” (“How inspired did you feel during writing”) using the same slider used in the aesthetic pre-rating (ends marked “+” / “-” for “high” and “low” inspiration) with the instruction: “If you have felt very inspired position the slider cursor at the high end of the scale (marked “+”). If you have felt uninspired, position the slider at the low end of the scale (marked “-”). If you do not have a strong tendency one way or the other, use the middle of the scale” (see *Online Supplementary* for full German instructions). Participants were presented with two practice-prompts (novel paintings) to practice using the editor and rating scale (30 seconds writing each).

Data analysis

Data analysis was largely analogous to Exp. 1. Due to the slightly different experimental design, the main linear model was adapted: participants’ rated inspiration was still modelled as the dependent variable, with a fixed effect of prompt category and two random effects of participant and stimulus. Yet, to directly test effects of aesthetic appeal and pre-exposure on felt inspiration, linear contrasts were computed for the conditions novel vs. familiar (collapsing across moving and non-moving prompts) and for moving vs. non-moving (ignoring novel prompts) using R’s *MASS* package. Specific significance values for the two linear contrasts were estimated using Satterthwaite's degrees-of-freedom method implemented in R’s *lmerTest* package (Kuznetsova, Brockhoff, & Christensen, 2017). A second model of

inspiration ratings for only the novel stimuli was fitted with fixed effect of post-test aesthetic ratings and random effects of participant and stimulus.

Results

Of the 20 stimuli presented in the aesthetic rating pre-test, only one was not among the top four (aesthetically moving) stimuli for any participant. All others were selected by at least two participants. On average, each painting was selected by 6.8 (SD = 4.37) of the 34 observers. A Shapiro-Wilk normality test on frequency counts of all aesthetically moving paintings did not reject the null hypothesis ($W = 0.93452, p = 0.1885$), indicating that the overall count for moving stimuli followed a normal distribution. All 20 were among the bottom four (non-moving) stimuli for at least one participant. On average, each painting was selected by 6.8 (SD = 5.96) of the 34 observers. Yet for non-moving paintings the Shapiro-Wilk normality test on frequency counts of the paintings did reject the null hypothesis ($W = 0.8038, p < 0.001$). The distribution appears skewed to the left – most paintings (12 out of 20) were selected by only 5 or fewer participants. The moving paintings had an average aesthetic rating of $M = 0.86$, 95% CI [.838, .876], while the non-moving paintings had an average aesthetic rating of $M = 0.20$, 95% CI [.180, .226]. For comparison, the novel paintings, assessed only after the writing task in a post-test rating task, had an average aesthetic rating of $M = 0.50$, 95% CI [.455, .551]. A two-sample independent t-test (two-sided) comparing aesthetic ratings of moving and non-moving conditions was significant, $t(260.4) = 43.24, p < 2 \times 10^{-16}$, 95% CI [.624, .683], Cohen's $d = 5.24$, 95% CI [4.740, 5.746].

Participants reported higher felt inspiration during writing trials prompted by aesthetically moving artworks than by trials prompted by non-moving artworks (Figure 3a), while ratings following novel paintings did not significantly differ from the ratings following pre-exposed paintings (i.e. both moving and non-moving conditions). The mean inspiration rating for moving paintings ($M = 0.64$, 95% CI [.596, .683]) was higher than the mean rating for non-moving paintings ($M = 0.49$, 95% CI [.441, .530]), while mean inspiration ratings for

novel paintings ($M = 0.58$, 95% CI [.533, .624]) lay in between. Individual ratings of inspiration were fit using a linear mixed effect regression model with fixed effect of stimulus category and random effects of participant and stimulus (see *Methods*). A linear contrast of moving vs. non-moving was significant (slope = 0.126, $SE = 0.033$, $p < 0.0002$ using Satterthwaite's degrees-of-freedom method) but the contrast of familiar (moving and non-moving) vs. novel was not (slope = 0.018, $SE = 0.045$, $p = 0.705$). A Likelihood Ratio Test of the full model against an intercept-only model with the same random effects was significant ($\chi^2(2) = 13.31$, $p < 0.002$).

Figure 3. Aesthetic appeal but not stimulus familiarity influenced felt inspiration in Exp. 2. **a)** Mean inspiration ratings were higher when participants wrote about aesthetically moving paintings than when they wrote about non-moving paintings. Writing trials with novel paintings as prompts produced intermediate ratings of inspiration; a linear contrast of familiar (moving and non-moving) vs. novel was not significant. Each open circle represents the mean inspiration rating per category of one participant ($n = 34$). White dot and black bar indicate grand mean and 95% confidence interval. *** $p < 0.001$; n.s. indicates $p > 0.05$ (significance level from linear model). Gray shaded area represents the data density computed using a gaussian kernel with a width that is optimal for normal data. **b)** Even for novel paintings, there was a positive linear relation between rated inspiration and rated aesthetic appeal in the aesthetic post-test. Each dot represents a single trial (four per

participant, 136 observations total). Regression line computed using linear modelling with fixed effect of post-test aesthetic rating and random effects of participant and stimulus (slope = 0.398, intercept = 0.378).

While average inspiration ratings for novel stimuli did not significantly differ from the average ratings following the pre-exposed (familiar) artworks, we did observe a linear relationship between inspiration ratings following novel stimuli and subsequent (*post-test*) ratings of aesthetic appeal (Figure 3b). We fit a linear mixed effect regression model with fixed effect of post-test aesthetic ratings and random effects of participant and stimulus on inspiration ratings for all novel stimuli (see *Methods*) and found a significant positive relationship between aesthetic ratings and rated inspiration (slope = 0.398, SE = 0.074, intercept = 0.378, SE = 0.052, Likelihood Ratio Test against an intercept-only model with the same random effects, $\chi^2(1) = 23.8$ $p < 0.000002$).

To investigate the role of trait-level creativity, AUT-fluency scores were added as a second fixed effect with interactions to a new model otherwise identical to the above described LMM. The model yielded a negative effect of AUT score on inspiration rating (Slope = -0.011, SE = 0.005, $p < 0.04$ using Satterthwaite's degrees-of-freedom method), and none of the interactions with the category contrasts reached significance (interaction with aesthetic appeal: Slope = -.011, SE = 0.009, $p = 0.231$ using Satterthwaite's degrees-of-freedom method; interaction with preexposure: Slope = -.0002, SE = 0.008, $p = 0.983$ using Satterthwaite's degrees-of-freedom method). A Likelihood Ratio Test against the previously described model without AUT was not significant ($\chi^2(3) = 5.73$, $p = 0.125$).

Correlation of participant-level and single-trial-level measures in pooled data

We performed exploratory analyses to investigate the connections between inspiration, aesthetic appeal and text length on a trial-by-trial basis, and to assess potential links between participant states and traits (like mood, or hedonic and aesthetic responsiveness) and the observed behavior. We characterized the relationships between inspiration, aesthetic appeal and a number of additional measures by computing a series of pairwise correlations. Correlated measures were either attributes of a participant (participant level: age, AUT score, questionnaire scores, average number of typed characters) or corresponding responses to a stimulus by one participant (single-trial level: aesthetic ratings from pre- and post-sessions, inspiration rating, number of typed characters). To increase the statistical sensitivity for this analysis we decided to pool data from both experiments together, but only those trials collected under largely identical conditions – i.e. trials with painting stimuli that were rated for aesthetic appeal before and after the writing session (thereby excluding word prompts from Exp. 1 and novel paintings from Exp. 2.)

Data pooling

We statistically compared the population characteristics and the distributions of ratings for the set of paintings designated as aesthetically moving in the two studies (identical tasks) and decided that observed differences should not preclude a pooling of the data (see *Appendix B – Across study comparison* for additional information). The partial pooling (“moving artworks” from Exp. 1, “moving” and “non-moving artworks” from Exp. 2) resulted in a total of 420 trials from $n = 59$ participants (36 female, 23 male; age 18-55 years, median = 25 years, mean = 27.0 years, std = 8.3 years). The pooled sample provided sensitivity to detect effect sizes of $r = \pm 0.355$ or bigger on the subject level, and $r = \pm 0.136$ or

bigger on the single-trial level (two-sided, Pearson correlation, with alpha of 0.05 and power of 0.8). Note that correction for multiple testing raised the individual significance thresholds above this value.

Data analysis

Pearson's R for all possible combinations of participant-level factors were computed using R's *rcorr* function from *Hmisc* package (Harrell, n.d.). Participant-level factors included the participant's age, AUT-fluency score, scores on mood and personality trait measures (PANAS, STAI, AReA, SHAPS; see Exp. 1 *Methods*), and each participant's average text length, computed as the total number of typed characters of each short response (averaged over all 12 trials). Correlation coefficients for all possible combinations of single-trial-level variables were computed using the repeated measures correlation algorithm implemented in R's *rmcorr* package (Bakdash & Marusich, 2017) to take into account that individual observations were clustered by participant. Single-trial-level measures included aesthetic pre-rating, inspiration rating, text count (total number of typed characters in the trial), and aesthetic post-rating.

Correction for multiple comparisons was performed after Holm's method implemented in *p.adjust* function from the *stats* package. Visualization of correlation matrices was implemented using R's *corrplot* function from the *corrplot* package (Wei & Simko, 2017). In the General Discussion, correlation coefficients were statistically compared using Hotelling's (dependent groups) and Fischer's (independent groups) method implemented in R's *cocor* package (Diedenhofen, 2016).

Additionally, we performed a mediation analysis to test whether a potential effect of aesthetic appeal on amount of text produced was a direct effect, or rather an indirect effect mediated by rated inspiration. A full mediation model was constructed from a simplified model for the dependent variable (main effects of rated inspiration and aesthetic rating on amount of text produced) and mediator model (main effect of aesthetic rating on rated

inspiration) using R's *mediation* package (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014). Significance of the indirect effect was tested using bootstrapping procedures. Unstandardized indirect effects were computed for each of 10,000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2.5th and 97.5th percentiles.

Results and discussion

Results of the pairwise correlation of participant-level factors are shown in Figure 4a: Only two correlations were found to be significant at the $p < 0.05$ level (Holm corrected): State and trait anxiety measures were highly positively correlated ($r = 0.63$); Positive affect (PA) was negatively correlated with state anxiety measures ($r = -.47$). The full set of correlation coefficients is reported in Table C1.

Results of the pairwise repeated measures correlation of all single-trial-level responses are shown in Figure 4b: All measures were positively correlated with each other, yet to different degrees and not always significantly (Holm corrected $p < 0.05$). The highest correlation was observed between pre- and post-test aesthetic ratings ($r = 0.78$). Inspiration ratings were significantly correlated with pre- and post-test aesthetic ratings, though to a higher degree with the post rating (pre: $r = 0.31$, post: $r = 0.45$). Text count was positively correlated with the other measures, but only the relationship to inspiration rating reached significance ($r = 0.42$). The full set of correlation coefficients is reported in

Table C2.

A mediation analysis indicates that the relationship between aesthetic rating (pre) and amount of text produced was fully mediated via rated inspiration. Results are shown in Figure 5. The standardized regression coefficient between aesthetic rating and inspiration rating was statistically significant (standardized beta = 0.319, $p < 0.001$), as was the standardized regression coefficient between inspiration rating and amount of text produced (standardized beta = 0.213, $p < 0.001$). According to bootstrapping results the standardized indirect effect was statistically significant (standardized beta = 0.068, $p < 0.001$). The standardized total effect of being aesthetically moved on amount of text produced was not significant (standardized beta = 0.082, $p = 0.093$) and the remaining direct effect was 0.014.

Figure 4. Associations between (a) participant-level factors and (b) single-trial-level response parameters in pooled data (painting prompts only). a) Pairwise correlations of participant-level data for all participants (n = 59) from Exp. 1 and 2, including AGE, AUT-score, questionnaire scores (AReA; PA, NA – PANAS subscores; STAI_s, STAI_t – STAI subscores; SHAPS), mean text count over all 12 trials (mTXT). Correlation

coefficients (Pearson R) are color and size coded; red - positive, blue - negative, larger and more saturated circles indicate higher values. Significant correlations ($p < 0.05$, Holm-corrected) marked with *. Note that SHAPS data was only collected in Exp. 2. **b)** Pairwise repeated-measures correlations of single-trial-level measures ($n = 420$ trials from 59 participants): inspiration ratings (INSP), text count (TXT), and corresponding aesthetic ratings from pre- and post-tests (AE-PRE/AE-POS). Only data from trials with all four measures were included: moving paintings from Exp. 1 and moving and non-moving (familiar) paintings from Exp. 2.

Figure 5. mediation analysis. The mediation model suggests that the relationship between aesthetic rating and amount of text produced was fully mediated by rated inspiration. a - standardized effect of aesthetic rating on the mediator, b - standardized effect of the mediator on amount of text produced, c - standardized total effect of aesthetic rating on amount of text produced, ab - standardized indirect effect of aesthetic rating on amount of text produced, c' - standardized direct effect of aesthetic rating on amount of text produced (total effect minus indirect effect). $*** p < 0.001$

General Discussion

Moments of inspiration represent elements of the creative process that may be particularly amenable to intervention. Using a creative writing paradigm, we found that aesthetically appealing artworks induced higher felt inspiration than non-aesthetic word triads and non-appealing artworks. In Exp. 1, writing about aesthetically appealing artworks resulted in higher ratings of felt inspiration than writing about prompts consisting of three non-related words, which still contained information that could serve to stimulate writing, but had no

artistic intent. Exp. 2 found that high versus low aesthetic appeal, and not preexposure to the specific prompts, was the factor associated with higher ratings of felt inspiration. Writing about aesthetically appealing (moving) artworks resulted in higher inspiration ratings than writing about non-moving artworks, while novel artwork prompts led to intermediate ratings of felt inspiration that were not different from the average of the familiar (moving plus non-moving) artworks. This experiment also ruled out potential confounds due to the different stimulus modalities, and replicated the general effect in a different country, with instructions in a different language. Together, these experiments demonstrate that aesthetically moving stimuli can act as prompts for creative inspiration and provide initial evidence that the mental state of being aesthetically moved may prime a state of being creatively inspired. Our results suggest that moments of inspiration can be operationalized and that the incidence of highly inspirational episodes can be increased by priming with aesthetic stimuli.

Felt Inspiration and the Creative Process

Moments of inspiration mark a step in the creative process, and can be characterized as a motivational state that marks the transition from creative ideation to actualization of an idea. Inspiration is evoked by a creative idea and is an “intentional (i.e. object-focused) state, which has the creative idea as its content and actualization of the idea as its aim” (Thrash et al., 2010, p. 470). According to this view, inspiration is separate from ideation and could be seen as a form of idea selection informed by subjective feelings of elevation, pleasure, and motivation. Measuring the strength of inspirational episodes can thus serve as a measure for the subjective quality of an idea (e.g. Oleynick et al., 2014; Thrash, 2020). However, it should be noted that the extent to which creative ideas evoke inspiration may be modified by individual approach temperament (Thrash et al., 2010) and degree to which a person sees themselves as the source of an idea (Thrash, Maruskin, Moldovan, Oleynick, & Belzak, 2017). We also note that during ongoing creative activity, there may be multiple cycles of

ideation, inspiration and actualization, and inspiration could potentially occur several times during successive steps. Thus, creative acts may not always entail a single strong moment of inspiration. Yet, given their status as a link between cycles — their evocation follows from the previous content of thought (in this case, an artwork), but also motivates the next cycle of activity — inspiration is a promising window into idea generation and selection during creative activity and a promising component for process models of creativity,

In our data, inspiration ratings were positively correlated with the amount of text produced, on the single-trial level ($r = 0.42$, $p < 0.05$), suggesting a relationship between felt inspiration and writing fluency in this task. Similar results have been reported previously (see Thrash et al., 2010). On the other hand, the participants' average amount of produced text were positively correlated with their AUT-fluency scores ($r = 0.39$, not significant). This is not particularly surprising, since the writing task bears certain similarities with the AUT test (both being time-limited text production tasks). Thus, the observed correlational structure suggests a link between felt inspiration and more traditional measures of ideational fluency. One possibility is that felt inspiration is a subjective response to one *specific* idea, and interacts with the idea generation process: under many circumstances (but not in the AUT), idea generation proceeds until a single idea evokes strong feelings of inspiration (e.g. a “good idea”), at which point idea generation stops.

We defined self-reported feeling of inspiration as our main measure of interest, rather than a third-party assessment of the novelty or usefulness of a specific outcome. This measure reflects our interest in isolating the intensity of the subjective psychological state of creative inspiration. More objective qualities of the produced texts could be included in future studies. Ratings by experts and/or naïve judges (e.g. Baer & McKool, 2009) or measures of semantic distance (Heinen & Johnson, 2018) could be compared to self-reports of the participants. In fact, a similar study has already been conducted (using a scientific writing exercise) suggesting a link between a writers rated inspiration and externally judged quality of the

outcome (Thrash et al., 2010). In such a framework one could further investigate the relationship between externally rated creativity of the output with subjective aesthetic appeal for the prompt, or various objective stimulus properties. However, we would urge caution: in our study, participants had only three minutes to type starting directly after the prompt, which may not be sufficient to fully convey all their ideas in writing. This would mark a substantial confound for external ratings of the output. More generally, this study follows in the tradition of characterizing subjective psychological states independent of external measures, an approach that has been used successfully in many cognitive domains such as memory ('remember/forgotten' judgments; e.g. Brewer, 1998), visual perception (analysis of false detections and misses; e.g. Ress & Heeger, 2003), and aesthetics (subjective aesthetic appeal; e.g. (Vessel et al., 2012)). We believe this to be a fruitful future direction for understanding the psychological and neural processes underlying creative cognition.

From Being Moved to Being Inspired

Participants reported higher feelings of inspiration when writing about aesthetically moving artworks than when writing about either non-moving art or non-art prompts — as discussed above this rating likely reflects the subjective quality of their idea. While the precise temporal and logical relations of aesthetic response, idea generation, and idea selection remain to be addressed, the reported findings are consistent with our conjecture that the psychological state of being aesthetically moved may share certain features with the state of creative inspiration.

Similar to the definition of creative inspiration put forth by Thrash and Elliot (2003), moving aesthetic experiences are also evoked (often by an external object), involve feelings of transcendence beyond concrete reality (Menninghaus et al., 2015), and can motivate behavior (e.g. to repeatedly visit a gallery). Furthermore, states of strong aesthetic pleasure have been shown to require the allocation of cognitive resources (Brielmann & Pelli, 2017),

while such flexible cognitive control is also known to play a critical role in creative thinking (Zabelina & Robinson, 2010). Armstrong and Detweiler-Bedell (2008) theorized that in order to experience beauty, an object (e.g. a painting) has to capture an observers attention in a way that evokes imaginative processes in order to better understand the object; sustained, inwardly directed imagery and prospection is also a hallmark of inspired creative thought (Benedek, 2018). This similarity is even alluded to in the literature on inspiration: Thrash & Elliot (2004) outline a subconstruct of inspiration that they refer to as being inspired “by,” using the example of appreciating the beauty of the Grand Canyon. While it is debatable whether such an experience should be considered inspiration or aesthetic appeal, it is clear that these two constructs overlap considerably, and may also share similarities with the construct of being inspired “to” create something.

Several other findings indicate that being aesthetically moved and being creatively inspired may engage partly overlapping neural systems. Brain imaging studies of strongly moving aesthetic experiences reveal activation patterns consistent with a potential role for prospection and imagery: in addition to activation of externally oriented sensory pathways (e.g. the ventral visual stream), aesthetically appealing artworks also engage the DMN (Vessel et al., 2012), an inwardly-focused brain network that has been shown to play a role in prospection (Andrews-Hanna, Reidler, Sepulcre, Poulin, & Buckner, 2010) and mental scene construction (Axelrod, Rees, & Bar, 2017). While the DMN is typically suppressed when a person engages with external stimuli, including non-appealing artworks, aesthetically appealing artworks engage the DMN, resulting in a change in the large-scale network dynamics of the brain (Belfi et al., 2019; Vessel et al., 2013). Differences in DMN connectivity have also been associated with trait-level creativity (Beaty et al., 2018) and there is evidence that certain creative acts directly engage the DMN. For example, in a study of jazz musicians, improvisation was accompanied by greater activation of cortical midline regions of the DMN and less activation of lateral prefrontal regions, when compared to production of

well-learned sequences (Limb & Braun, 2008). A potential explanation for the observed effect of aesthetic appeal on felt inspiration is that aesthetically appealing artworks engage top-down imagery processes to a greater extent than other prompts, and that this promotes generation of more divergent and remote ideas, or improves the elaboration process.

While we posit that the states of being aesthetically moved and of feeling creatively inspired are similar, they are not the same. For example, a recent study that observed contagion of felt inspiration from the writer of a poem to a reader identified a reader's rating of pleasantness of the poem as a mediator of the contagion effect (Thrash et al., 2017), consistent with our hypothesis that the states can be linked but are not identical. In the context of the present study, it is important to note that it is unlikely that participants were implicitly rating aesthetic appeal of a prompt when they should in fact rate felt inspiration. First, participants were not asked to rate aesthetic appeal during the writing task ("We are asking you to judge the feeling of inspiration you had while starting your creative process – do not judge the prompt itself, and do not judge what you produced;" see *Online Supplementary* for full instructions). Furthermore, many of the stimuli (word triads in Exp. 1, novel paintings in Exp. 2) were not presented and rated for aesthetic appeal in advance; a participant would thus have had to rate aesthetic appeal of a visual memory, or recall implicit judgments during image presentation. Inspiration was rated after a three-minute writing period; the writing period and the generated idea were therefore more recent, and likely more salient in memory than the original prompt. While it is the case that aesthetic ratings and inspiration ratings were positively correlated (see Figure 4b), this correlation was significantly smaller than the correlation of repeated aesthetic ratings of the same stimuli (Hotelling's $t(419) = 14.59$, $p < 0.001$, two-sided) and there are numerous individual trials with artworks rated as highly moving corresponding to low ratings of felt inspiration, and vice versa (see for example Figure 3b).

For similar reasons, it is also unlikely that other judgments or feelings generated when viewing the prompts are misattributed or transferred to the subsequent rating of felt inspiration, similar to what is known as sensation transference in the marketing literature (Cheskin, 1957). In addition to the arguments mentioned above, we found that the amount of text produced, a separate behavioral measure that was not a rating (and hence unlikely to be affected by misattribution or transference) was significantly correlated with inspiration ratings, but not with aesthetic ratings (see Figure 4b). A mediation model confirmed that even this small relationship between aesthetic ratings and text length was fully mediated by inspiration ratings (see Figure 5). These findings are more consistent with the notion that ratings of felt inspiration reflect the intervening mental process of idea generation, and are not a direct misattribution of feelings generated when viewing the prompt. We would note, however, that a potential role for other intrapsychic effects cannot be ruled out at this time.

Given the potential similarity of being moved and feeling inspired, it is also conceivable that feeling inspiration when writing about a prompt might, in turn, influence subsequent ratings of aesthetic appeal. Such an effect might be caused by either increased attention to certain features of the stimulus during writing which then influence subsequent calculation of aesthetic value, or by a more specific influence of inspiration on aesthetic appeal: those stimuli that resonate with intrapsychic creative processes (causing inspiration) become more relevant to us and are subsequently experienced as more aesthetically moving.

Interestingly, the correlation between inspiration ratings and post-test aesthetic judgments was significantly higher than with pre-test aesthetic judgments (Hotelling's $t(419) = -4.17, p < 0.001$, two-sided, see Figure 4b), and in Exp. 1 the correlation between pre- and post- aesthetic ratings in the six chosen paintings ($n = 150, r = 0.44, p < 0.001$) was significantly lower than in the fourteen non-chosen ones ($n = 350, r = 0.61, p < 0.001$; Fisher's $z = -2.41, p < 0.05$). Further work will be needed to determine whether the observed

pattern was spurious, or truly reflects an effect of the writing task on subsequent aesthetic judgments.

Although our study was not powered to investigate individual differences in the relationship between being moved and being creatively inspired, we did find a mild positive relationship between PA and an observers' average text count (0.20) and a mild negative relationship between state anxiety and average text count (-0.20). Future work could explore whether certain aspects of personality, mood or context might mediate or moderate the likelihood that being moved would be successfully channeled into inspiration to write.

Our findings have potential implications for other settings in which similar cycles of prompting and creative production take place, such as educational settings in which students are presented with material they should write about. Although further study would be required to see if the observed effects truly translate to educational settings, and what influence increased inspiration might have on educational success, our findings are suggestive that if students are asked to work with materials that they find aesthetically pleasing, they too might experience increased instances of creative inspiration. We would caution, though, that the setting utilized in this experiment—the open-ended creation of a short vignette in response to a prompt—might prompt a specific type of writing and may not reflect factors that are important in other types of writing. Thus, while free association creative writing is a good fit for studying the open-ended nature of ideation and inspiration, it may be less appropriate for modeling sources of inspiration and idea selection when the problem domain puts tighter constraints on the content and form.

Cross-Modality Effects

It is notable that being aesthetically moved by non-text visual stimuli (paintings) carried over and influenced inspiration in a different output modality (text), as this suggests that the underlying mechanism is at least partially independent of modality. With the

exception of the word triads in Exp. 1, the prompts in these experiments were all visual artworks, while the requested output was text. We chose this output modality expecting that a non-artist population of participants would be most comfortable with writing as compared to any other type of creative output such as drawing, painting, singing, movement etc. Future work might specifically focus on potential modality-specific effects of prompt and output modality, such as whether a visual stimulus is better for inducing inspiration for visual output than for text. Yet our data shows that simply matching prompt and output modalities is not likely to induce higher inspiration ratings: in Exp. 1, the three-word prompts led to significantly lower ratings of felt inspiration than appealing visual artworks. We note that since aesthetic ratings were not collected for the word triads and only aesthetically appealing paintings were selected for the writing task, the effects of aesthetic appeal and stimulus modality in Exp. 1 cannot be statistically separated. Yet when considered alongside the results of Exp. 2, it seems more likely that aesthetic appeal was the driving factor for whether a prompt led to higher felt inspiration.

On the other hand, the fact that AUT fluency scores interacted with prompt category in one experiment but not in the other may speak for a modulating effect of prompt modality. In Exp. 1 (text vs. visual artworks) the effect of prompt type on felt inspiration was stronger for people with lower AUT scores (a commonly used measure of trait creativity). However, this effect was not seen in Exp. 2 (visual artworks only). One possibility is that the interaction observed in Exp. 1 was spurious. Another possibility is that the word triads were indeed particularly bad prompts for people who scored low on the AUT, and that this deficit was eliminated in Exp. 2 by the use of image prompts. Given that AUT-fluency scores are a measure of divergent thinking in response to word prompts, it is sensible to expect that low-scoring participants may also perform worse at creative writing prompted by non-associated words. Further research is needed to better understand the nature and source of such an interaction.

Finally, it is important to emphasize that the results of Exp. 2 rule out a number of alternative explanations for the observed effects of prompt type on ratings of felt inspiration that could be raised in Exp. 1. The visual artworks differed from the three-word triads in many other aspects than just their aesthetic properties. Artworks contain a variety of low- and high- level visual features such as color and shape that were absent in the word triads, and while both artworks and words may convey semantic information, most of the artworks were more semantically rich than the word lists. These factors could potentially affect the performance in creative tasks directly – for example, color has been proposed to influence creativity in an anagram solving task (see Mehta & Zhu, 2009; but also Steele, 2014 who failed to replicate the findings) – or might affect inspiration indirectly by causing differences in other potentially relevant psychological states such as arousal. However, the persistence of the effect in Exp. 2, in which a homogenous stimulus set composed only of artworks was used, largely rules out such potential confounds. In addition, participants showed very low agreement in which paintings they found aesthetically moving, meaning that almost all paintings appeared as both moving and non-moving prompts in Exp. 2 (for different participants. This suggests that neither the aesthetic ratings nor the inspiration ratings were primarily driven by differences in objective stimulus properties such as the presence of specific colors (see also Vessel et al., 2018).

Conclusion

We show that aesthetic appeal represents a potential mechanism to boost subjectively felt inspiration in a creative writing task. While the correlation between felt inspiration and externally judged creativity or utility of an outcome needs further investigation, such a behavioral intervention has high potential for both scientific and educational settings. For education, one could develop targeted methods to elicit inspiring moments by interaction with aesthetic material that include individual choice of what materials to engage with. Likewise, the ability to increase the incidence of inspiring moments and creative states can be valuable

for increasing statistical power in empirical studies of creativity. Furthermore, the paradigm presented here also allows for temporal isolation of moments of creative inspiration, a necessary step for examination using the tools of cognitive neuroscience. We believe that this work improves our understanding of the elevated mental states of creative inspiration and aesthetic appreciation, and will aid the development of better process models of creative thought.

Additional Information

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Code and Data availability

The manuscript was uploaded on a preprint server - <https://psyarxiv.com/rdsby>. The full dataset used for analysis, as well as R and MATLAB scripts replicating the results, and MATLAB scripts used in data collection were made available in a public online repository - <https://osf.io/53w6b/>

References

- Amabile, T. M. (1985). Motivation and creativity: Effects of motivational orientation on creative writers. *Journal of Personality and Social Psychology*, 48(2), 393–399. doi: 10.1037/0022-3514.48.2.393
- Andrews-Hanna, J. R., Reidler, J. S., Sepulcre, J., Poulin, R., & Buckner, R. L. (2010). Functional-anatomic fractionation of the brain's default network. *Neuron*, 65(4), 550–562. doi: 10.1016/j.neuron.2010.02.005
- Armstrong, T., & Detweiler-Bedell, B. (2008). Beauty as an emotion: The exhilarating prospect of mastering a challenging world. *Review of General Psychology*, 12(4), 305–329. doi: 10.1037/a0012558
- Axelrod, V., Rees, G., & Bar, M. (2017). The default network and the combination of cognitive processes that mediate self-generated thought. *Nature Human Behaviour*, 1(12), 896–910. doi: 10.1038/s41562-017-0244-9
- Baer, J. (1994). Divergent thinking is not a general trait: A multidomain training experiment. *Creativity Research Journal*, 7(1), 35–46. doi: 10.1080/10400419409534507
- Baer, J., & McKool, S. S. (2009). Assessing creativity using the consensual assessment technique. In C. Schreiner (Ed.), *Handbook of Research on Assessment Technologies, Methods, and Applications in Higher Education* (pp. 65–77). Hershey, PA: IGI Global. doi: 10.4018/978-1-60566-667-9.ch004
- Bakdash, J. Z., & Marusich, L. R. (2017). Repeated Measures Correlation. *Frontiers in Psychology*, 8. doi: 10.3389/fpsyg.2017.00456
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1). doi: 10.18637/jss.v067.i01
- Batey, M., & Furnham, A. (2006). Creativity, intelligence, and personality: A critical review of the scattered literature. *Genetic, Social, and General Psychology Monographs*, 132(4), 355–429. doi: 10.3200/MONO.132.4.355-430

- 876 Beaty, R. E., Kenett, Y. N., Christensen, A. P., Rosenberg, M. D., Benedek, M., Chen, Q., ...
877 Silvia, P. J. (2018). Robust prediction of individual creative ability from brain
878 functional connectivity. *Proceedings of the National Academy of Sciences*, 115(5),
879 1087–1092. doi: 10.1073/pnas.1713532115
- 880 Belfi, A. M., Vessel, E. A., Brielmann, A., Isik, A. I., Chatterjee, A., Leder, H., ... Starr, G.
881 G. (2019). Dynamics of aesthetic experience are reflected in the default-mode
882 network. *NeuroImage*, 188, 584–597. doi: 10.1016/j.neuroimage.2018.12.017
- 883 Benedek, M. (2018). Internally directed attention in creative cognition. In R. E. Jung & O.
884 Vartanian (Eds.), *The Cambridge Handbook of the Neuroscience of Creativity* (1st ed.,
885 pp. 180–194). Cambridge, UK: Cambridge University Press. doi:
886 10.1017/9781316556238.011
- 887 Benedek, M., Könen, T., & Neubauer, A. C. (2012). Associative abilities underlying
888 creativity. *Psychology of Aesthetics, Creativity, and the Arts*, 6(3), 273–281. doi:
889 10.1037/a0027059
- 890 Boccia, M., Piccardi, L., Palermo, L., Nori, R., & Palmiero, M. (2015). Where do bright ideas
891 occur in our brain? Meta-analytic evidence from neuroimaging studies of domain-
892 specific creativity. *Frontiers in Psychology*, 6. doi: 10.3389/fpsyg.2015.01195
- 893 Bolte, A., Goschke, T., & Kuhl, J. (2003). Emotion and intuition: Effects of positive and
894 negative mood on implicit judgments of semantic coherence. *Psychological Science*,
895 14(5), 416–421. doi: 10.1111/1467-9280.01456
- 896 Boot, N., Nevicka, B., & Baas, M. (2017). Creativity in ADHD: Goal-directed motivation and
897 domain specificity. *Journal of Attention Disorders*, 108705471772735. doi:
898 10.1177/1087054717727352
- 899 Bowers, K. S., Regehr, G., Balthazard, C., & Parker, K. (1990). Intuition in the context of
900 discovery. *Cognitive Psychology*, 22, 72–110. doi: 10.1016/0010-0285(90)90004-N

- 901 Brainard, D. H. (1997). The psychophysics toolbox. *Spatial Vision*, 10(4), 433–436. doi:
902 10.1163/156856897X00357
- 903 Brewer, J. B., Zhao, Z., Desmond, J. E., Glover, G. H., & Gabrieli, J. D. E. (1998). Making
904 memories: Brain activity that predicts how well visual experience will be remembered.
905 *Science*, 281(5380), 1185–1187. doi: 10.1126/science.281.5380.1185
- 906 Briellmann, A. A., & Pelli, D. G. (2017). Beauty requires thought. *Current Biology*, 27(10),
907 1506-1513.e3. doi: 10.1016/j.cub.2017.04.018
- 908 Carson, S. H., Peterson, J. B., & Higgins, D. M. (2005). Reliability, validity, and factor
909 structure of the creative achievement questionnaire. *Creativity Research Journal*,
910 17(1), 37–50. doi: 10.1207/s15326934crj1701_4
- 911 Cheskin, L. (1957). *How to predict what people will buy*. New York: Liveright Pub. Corp.
- 912 Coupé, C., Oh, Y., Dediu, D., & Pellegrino, F. (2019). Different languages, similar encoding
913 efficiency: Comparable information rates across the human communicative niche.
914 *Science Advances*, 5(9), eaaw2594. doi: 10.1126/sciadv.aaw2594
- 915 Cousijn, J., Zanolie, K., Munsters, R. J. M., Kleibeuker, S. W., & Crone, E. A. (2014). The
916 relation between resting state connectivity and creativity in adolescents before and
917 after training. *PloS One*, 9(9), e105780. doi: 10.1371/journal.pone.0105780
- 918 Diedenhofen, B. (2016). R package “cocor”: Comparing correlations (Version 1.1-3).
919 Retrieved from <http://comparingcorrelations.org/>
- 920 Dietrich, A., & Kanso, R. (2010). A review of EEG, ERP, and neuroimaging studies of
921 creativity and insight. *Psychological Bulletin*, 136(5), 822–848. doi:
922 10.1037/a0019749
- 923 Doyle, C. L. (1998). The writer tells: The creative process in the writing of literary fiction.
924 *Creativity Research Journal*, 11(1), 29–37. doi: 10.1207/s15326934crj1101_4
- 925 Eysenck, H. J. (1995). *Genius: The natural history of creativity* (Reprinted). Cambridge, UK:
926 Cambridge Univ. Press.

- 927 Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical
928 power analysis program for the social, behavioral, and biomedical sciences. *Behavior*
929 *Research Methods*, 39(2), 175–191. doi: 10.3758/BF03193146
- 930 Friedman, R. S., & Forster, J. (2001). The effects of promotion and prevention cues on
931 creativity. *Journal of Personality and Social Psychology*, 81(6), 1001–1013. doi:
932 10.1037/0022-3514.81.6.1001
- 933 Gerger, G., Pelowski, M., & Leder, H. (2018). Empathy, Einfühlung, and aesthetic
934 experience: The effect of emotion contagion on appreciation of representational and
935 abstract art using fEMG and SCR. *Cognitive Processing*, 19(2), 147–165. doi:
936 10.1007/s10339-017-0800-2
- 937 Goldstein, A. (1980). Thrills in response to music and other stimuli. *Physiological*
938 *Psychology*, 8(1), 126–129. doi: 10.3758/BF03326460
- 939 Gonen-Yaacovi, G., de Souza, L. C., Levy, R., Urbanski, M., Josse, G., & Volle, E. (2013).
940 Rostral and caudal prefrontal contribution to creativity: A meta-analysis of functional
941 imaging data. *Frontiers in Human Neuroscience*, 7. doi: 10.3389/fnhum.2013.00465
- 942 Grös, D. F., Antony, M. M., Simms, L. J., & McCabe, R. E. (2007). Psychometric properties
943 of the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA):
944 Comparison to the State-Trait Anxiety Inventory (STAI). *Psychological Assessment*,
945 19(4), 369–381. doi: 10.1037/1040-3590.19.4.369
- 946 Guilford, J. P. (1950). Creativity. *American Psychologist*, 5(9), 444–454. doi:
947 10.1037/h0063487
- 948 Guilford, J. P., Christensen, P. R., Merrifield, P. R., & Wilson, R. C. (1978). *Alternate uses:*
949 *Manual of instructions and interpretation*. Orange, CA: Sheridan Psychological
950 Services.
- 951 Harrell, F. E. (n.d.). *R package “Hmisc”: Harrell miscellaneous*. Retrieved from
952 <http://biostat.mc.vanderbilt.edu/Hmisc>

- 953 Heinen, D. J. P., & Johnson, D. R. (2018). Semantic distance: An automated measure of
954 creativity that is novel and appropriate. *Psychology of Aesthetics, Creativity, and the*
955 *Arts*, 12(2), 144–156. doi: 10.1037/aca0000125
- 956 Howard-Jones, P. A., Blakemore, S.-J., Samuel, E. A., Summers, I. R., & Claxton, G. (2005).
957 Semantic divergence and creative story generation: An fMRI investigation. *Cognitive*
958 *Brain Research*, 25(1), 240–250. doi: 10.1016/j.cogbrainres.2005.05.013
- 959 Ives, C. F., & Metropolitan Museum of Art. (1974). *The Great Wave: The Influence of*
960 *Japanese Woodcuts on French Prints*. New York, N.Y.: Metropolitan Museum of Art.
961 Retrieved from <https://books.google.de/books?id=JYgeaV1w9SIC>
- 962 Jauk, E. (2019). A bio-psycho-behavioral model of creativity. *Current Opinion in Behavioral*
963 *Sciences*, 27, 1–6. doi: 10.1016/j.cobeha.2018.08.012
- 964 Jauk, E., Benedek, M., & Neubauer, A. C. (2014). The road to creative achievement: A latent
965 variable model of ability and personality predictors: The road to creative achievement.
966 *European Journal of Personality*, 28(1), 95–105. doi: 10.1002/per.1941
- 967 Julian, L. J. (2011). Measures of anxiety: State-Trait Anxiety Inventory (STAI), Beck Anxiety
968 Inventory (BAI), and Hospital Anxiety and Depression Scale-Anxiety (HADS-A).
969 *Arthritis Care & Research*, 63(S11), S467–S472. doi: 10.1002/acr.20561
- 970 Kaufman, J. C., & Beghetto, R. A. (2009). Beyond Big and Little: The Four C Model of
971 Creativity. *Review of General Psychology*, 13(1), 1–12. doi: 10.1037/a0013688
- 972 Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in
973 linear mixed effects models. *Journal of Statistical Software*, 82(13). doi:
974 10.18637/jss.v082.i13
- 975 Limb, C. J., & Braun, A. R. (2008). Neural substrates of spontaneous musical performance:
976 An fMRI study of jazz improvisation. *PLoS ONE*, 3(2), e1679. doi:
977 10.1371/journal.pone.0001679

- 978 Lubart, T. I. (2001). Models of the Creative Process: Past, Present and Future. *Creativity*
979 *Research Journal*, 13(3–4), 295–308. doi: 10.1207/S15326934CRJ1334_07
- 980 Martindale, C., Hines, D., Mitchell, L., & Covello, E. (1984). EEG alpha asymmetry and
981 creativity. *Personality and Individual Differences*, 5(1), 77–86. doi: 10.1016/0191-
982 8869(84)90140-5
- 983 Mehta, R., & Zhu, R. (2009). Blue or Red? Exploring the Effect of Color on Cognitive Task
984 Performances. *Science*, 323(5918), 1226–1229. doi: 10.1126/science.1169144
- 985 Menninghaus, W., Wagner, V., Hanich, J., Wassiliwizky, E., Kuehnast, M., & Jacobsen, T.
986 (2015). Towards a psychological construct of being moved. *PLOS ONE*, 10(6),
987 e0128451. doi: 10.1371/journal.pone.0128451
- 988 Menninghaus, W., Wagner, V., Wassiliwizky, E., Schindler, I., Hanich, J., Jacobsen, T., &
989 Koelsch, S. (2019). What are aesthetic emotions? *Psychological Review*, 126(2), 171–
990 195. doi: 10.1037/rev0000135
- 991 Okada, T., & Ishibashi, K. (2017). Imitation, Inspiration, and Creation: Cognitive Process of
992 Creative Drawing by Copying Others' Artworks. *Cognitive Science*, 41(7), 1804–
993 1837. doi: 10.1111/cogs.12442
- 994 Oleynick, V. C., Thrash, T. M., LeFev, M. C., Moldovan, E. G., & Kieffaber, P. D. (2014).
995 The scientific study of inspiration in the creative process: Challenges and
996 opportunities. *Frontiers in Human Neuroscience*, 8. doi: 10.3389/fnhum.2014.00436
- 997 R Core Team. (2018). *R: A language and environment for statistical computing*. Vienna,
998 Austria: R Foundation for Statistical Computing. Retrieved from [https://www.R-](https://www.R-project.org/)
999 [project.org/](https://www.R-project.org/)
- 1000 Ress, D., & Heeger, D. J. (2003). Neuronal correlates of perception in early visual cortex.
1001 *Nature Neuroscience*, 6(4), 414–420. doi: 10.1038/nn1024
- 1002 Runco, M. A., & Acar, S. (2012). Divergent thinking as an indicator of creative potential.
1003 *Creativity Research Journal*, 24(1), 66–75. doi: 10.1080/10400419.2012.652929

- 1004 Santarnecchi, E., Emmendorfer, A., & Pascual-Leone, A. (2017). Dissecting the parieto-
1005 frontal correlates of fluid intelligence: A comprehensive ALE meta-analysis study.
1006 *Intelligence*, 63, 9–28. doi: 10.1016/j.intell.2017.04.008
- 1007 Schindler, I., Hosoya, G., Menninghaus, W., Beermann, U., Wagner, V., Eid, M., & Scherer,
1008 K. R. (2017). Measuring aesthetic emotions: A review of the literature and a new
1009 assessment tool. *PLOS ONE*, 12(6), e0178899. doi: 10.1371/journal.pone.0178899
- 1010 Schlotz, W., Wallot, S., Omigie, D., Masucci, M. D., Hoelzmann, S. C., & Vessel, E. A.
1011 (2020). The Aesthetic Responsiveness Assessment (AReA): A screening tool to assess
1012 individual differences in responsiveness to art in English and German. *Psychology of*
1013 *Aesthetics, Creativity, and the Arts*. doi: 10.1037/aca0000348
- 1014 Scott, G., Leritz, L. E., & Mumford, M. D. (2004a). The effectiveness of creativity training: A
1015 quantitative review. *Creativity Research Journal*, 16(4), 361–388. doi:
1016 10.1080/10400410409534549
- 1017 Scott, G., Leritz, L. E., & Mumford, M. D. (2004b). Types of creativity training: Approaches
1018 and their effectiveness. *The Journal of Creative Behavior*, 38(3), 149–179. doi:
1019 10.1002/j.2162-6057.2004.tb01238.x
- 1020 Silvia, P. J. (2009). Looking past pleasure: Anger, confusion, disgust, pride, surprise, and
1021 other unusual aesthetic emotions. *Psychology of Aesthetics, Creativity, and the Arts*,
1022 3(1), 48–51. doi: 10.1037/a0014632
- 1023 Snaith, R. P., Hamilton, M., Morley, S., Humayan, A., Hargreaves, D., & Trigwell, P. (1995).
1024 A scale for the assessment of hedonic tone the Snaith–Hamilton Pleasure Scale.
1025 *British Journal of Psychiatry*, 167(1), 99–103. doi: 10.1192/bjp.167.1.99
- 1026 Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory (Form Y)*. Palo Alto
1027 CA: Consulting Psychologists Press.

- 1028 Steele, K. M. (2014). Failure to replicate the Mehta and Zhu (2009) color-priming effect on
1029 anagram solution times. *Psychonomic Bulletin & Review*, 21(3), 771–776. doi:
1030 10.3758/s13423-013-0548-3
- 1031 Sternberg, R. J., & Davidson, J. E. (Eds.). (1995). *The nature of insight*. Cambridge, MA:
1032 MIT Press.
- 1033 Thrash, T. M. (2020). The creation and curation of all things worthy: Inspiration as vital force
1034 in persons and cultures. In *Advances in Motivation Science*. Elsevier. doi:
1035 10.1016/bs.adms.2020.01.002
- 1036 Thrash, T. M., & Elliot, A. J. (2003). Inspiration as a psychological construct. *Journal of*
1037 *Personality and Social Psychology*, 84(4), 871–889. doi: 10.1037/0022-3514.84.4.871
- 1038 Thrash, T. M., Maruskin, L. A., Cassidy, S. E., Fryer, J. W., & Ryan, R. M. (2010). Mediating
1039 between the muse and the masses: Inspiration and the actualization of creative ideas.
1040 *Journal of Personality and Social Psychology*, 98(3), 469–487. doi:
1041 10.1037/a0017907
- 1042 Thrash, T. M., Maruskin, L. A., Moldovan, E. G., Oleynick, V. C., & Belzak, W. C. (2017).
1043 Writer–reader contagion of inspiration and related states: Conditional process analyses
1044 within a cross-classified writer $\times$ reader framework. *Journal of Personality and Social*
1045 *Psychology*, 113(3), 466–491. doi: 10.1037/pspp0000094
- 1046 Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). mediation: R Package
1047 for Causal Mediation Analysis. *Journal of Statistical Software*, 59(5). doi:
1048 10.18637/jss.v059.i05
- 1049 Tinio, P. P. L. (2013). From artistic creation to aesthetic reception: The mirror model of art.
1050 *Psychology of Aesthetics, Creativity, and the Arts*, 7(3), 265–275. doi:
1051 10.1037/a0030872
- 1052 Torrance, E. P. (1968). A longitudinal examination of the fourth grade slump in creativity.
1053 *Gifted Child Quarterly*, 12(4), 195–199. doi: 10.1177/001698626801200401

- 1054 Vessel, E. A., Maurer, N., Denker, A. H., & Starr, G. G. (2018). Stronger shared taste for
1055 natural aesthetic domains than for artifacts of human culture. *Cognition*, 179, 121–
1056 131. doi: 10.1016/j.cognition.2018.06.009
- 1057 Vessel, E. A., Starr, G. G., & Rubin, N. (2012). The brain on art: Intense aesthetic experience
1058 activates the default mode network. *Frontiers in Human Neuroscience*, 6. doi:
1059 10.3389/fnhum.2012.00066
- 1060 Vessel, E. A., Starr, G. G., & Rubin, N. (2013). Art reaches within: Aesthetic experience, the
1061 self and the default mode network. *Frontiers in Neuroscience*, 7. doi:
1062 10.3389/fnins.2013.00258
- 1063 Wallas, G. (1926). *The art of thought*. London, UK: Jonathan Cape.
- 1064 Wassiliwizky, E., Wagner, V., Jacobsen, T., & Menninghaus, W. (2015). Art-elicited chills
1065 indicate states of being moved. *Psychology of Aesthetics, Creativity, and the Arts*,
1066 9(4), 405–416. doi: 10.1037/aca0000023
- 1067 Watson, D., & Clark, L. A. (1999). *The PANAS-X: Manual for the positive and negative*
1068 *affect schedule - expanded form*. doi: 10.17077/48vt-m4t2
- 1069 Wei, T., & Simko, V. (2017). R package “corrplot”: Visualization of a correlation matrix
1070 (Version 0.84). Retrieved from <https://github.com/taiyun/corrplot>
- 1071 Zabelina, D. L., & Robinson, M. D. (2010). Creativity as flexible cognitive control.
1072 *Psychology of Aesthetics, Creativity, and the Arts*, 4(3), 136–143. doi:
1073 10.1037/a0017379
- 1074 Zenasni, F., & Lubart, T. (2002). Effects of mood states on creativity. *Current Psychology*
1075 *Letters [Online]*, 2002/2(8), 33–50.
- 1076 Zentner, M., Grandjean, D., & Scherer, K. R. (2008). Emotions evoked by the sound of
1077 music: Characterization, classification, and measurement. *Emotion*, 8(4), 494–521.
1078 doi: 10.1037/1528-3542.8.4.494
1079

Appendix A

Full list of Stimuli

Table A1

List of word triads used in Experiment 1

Hard	Bang	Fountain
Colors	Salt	Sum
Poke	Lettuce	Molasses
Trumpet	Big	Gold
Bathtub	Hair	Cracker
Grant	Scotch	Wheel

Note. Word triads taken from Bowers et al. (1990)

1086 **Table A2**1087 *List of painting stimuli*

Title	Artist	Year
Paintings used in Experiment 1 and 2		
<i>Classical Landscape</i>	Joshua Shaw	1830
<i>Death on the Pale Horse</i>	Benjamin West	1796
<i>Die Junge Morgenländerin (The Young Eastern Woman)</i>	Friedrich von Amerling	1838
<i>Fellah Women Drawing Water (Medinet-el-Fayoum)</i>	Jean Leon Gerome	19 th century
<i>Girl In Glitz</i>	Mary Pratt	2002
<i>Greek Slave</i>	Jean Leon Gerome	1870
<i>Head of a Damned Soul from Dante's "Inferno"</i>	Johann Heinrich Füssli	1770-1778
<i>Lady Seated</i>	Jules Adolphe Goupil	19 th century
<i>Medusa</i>	Alice Pice Barney	1892
<i>Niagara Falls from Table Rock</i>	Samuel Finley Breese Morse	1835
<i>On The Beach</i>	Alfred Pellán	1845
<i>Portrait of Madame X</i>	Giovanni Boldini	1907
<i>Prometheus Bound</i>	Thomas Cole	1846-1847
<i>The Beeches</i>	Asher B. Durand	1845
<i>The Bouquet</i>	Raimundo Madrazo y Garreta	1870s
<i>The Nightmare</i>	Henry Fuseli	1781
<i>The Questioner of the Sphinx</i>	Elihu Vedder	1863
<i>The Wreck</i>	Eugene-Louis-Gabriel Isabey	1854
<i>Turning Point of Thirst</i>	Victor Brauner	1934
<i>Watson and the Shark</i>	John Singleton Copley	1782
Additional paintings used as novel prompts in Experiment 2		
<i>Leisure Hours</i>	John Everett Millais	1864

<i>An Ecclesiastic</i>	Mariano Fortuny y Marsal	1874
<i>Hercules as Heroic Virtue Overcoming Discord</i>	Peter Paul Rubens	1632-1633
<i>Cloud Study</i>	John Constable	c. 1822

- 1088 *Note.* Painting titles and artist names taken from the Catalog of Art Museum Images Online (CAMIO) - this
- 1089 database was closed Dec. 2018 and cannot be accessed anymore.

Appendix B

Across study comparison of responses

We aimed to test whether there were significant differences in the participants rating behavior across the two experiments using a series of two-sided t-tests. In both Exp. 1 and Exp. 2, moving artworks were chosen by means of an aesthetic judgment pre-test, worked on in the aesthetic writing task, and rated again for aesthetic appeal in a post-test session. Comparison of responses was hence restricted to this subset of data collected under almost identical conditions. The average aesthetic rating in the pre-test session was significantly lower in Exp. 1 ($M = 0.79$, 95% CI [.774, .813]) than in Exp. 2 ($M = 0.86$, 95% CI [.838, .876]; two-tailed paired $t(281.96) = -4.59$, $p < 0.01$, 95% CI [-.091, -.036], Cohen's $d = -0.54$, 95% CI [-.782, -.306]). This is not surprising, since in Exp. 1 the top 6 highest rated paintings were selected for the writing task, while in Exp. 2 only the top 4 were taken. The average aesthetic rating in the post-hoc session, however was not significantly different in Exp. 1 ($M = 0.73$, 95% CI [.698, .76]) than in Exp. 2 ($M = 0.76$, 95% CI [.721, .797], two-tailed paired $t(266.39) = -1.19$, $p = 0.237$, 95% CI [-.078, .019], Cohen's $d = -0.14$, 95% CI [-.376, .092]). The average inspiration rating in the writing session of Exp. 1 ($M = 0.63$, 95% CI [.591, .675]) was also not significantly different from Exp. 2 ($M = 0.64$, 95% CI [.596, .683]; two-tailed paired $t(279.64) = -0.20$, $p = 0.838$, 95% CI [-.067, .054], Cohen's $d = -0.02$, 95% CI [-.258, .210]). Finally, average text count in the writing session was significantly higher in Exp. 1 ($M = 481.9$, 95% CI [455.65, 508.15]) than in Exp. 2 ($M = 419.5$, 95% CI [387.79, 451.20], two-tailed paired $t(268) = 3.0$, $p < 0.01$, 95% CI [21.41, 103.40], Cohen's $d = 0.36$, 95% CI [.123, .594]). The mean difference in typed characters per trial equals roughly 5-15 words. AUT-fluency scores, however, were not significantly different across the two samples (Exp. 1: $M = 8.36$, 95% CI [7.16, 9.54]; Exp. 2: $M = 7.65$, 95% CI [6.45, 8.84]; two-tailed paired $t(55.92) = 0.87$, $p = 0.389$, 95% CI [-0.93, 2.36], Cohen's $d = 0.22$, 95% CI [-.306,

1115 .752]). As Exp. 1 was conducted in English with fluent English speakers while Exp. 2 was
1116 conducted in German with fluent German speakers, language may have systematically
1117 influenced typing speed (as has been shown for spoken language (e.g. Coupé, Oh, Dediu, &
1118 Pellegrino, 2019)).

Appendix C

Correlation tables

Table C1

Pairwise correlation coefficients for participant-level covariates.

Variable	n	M	SD	1	2	3	4	5	6	7	8	9
1. AGE	59	26.98	8.264	-								
2. AUT	59	7.95	3.192	-0.05	-							
3. AReA	59	48.85	17.565	0.22	0.05	-						
4. PA	59	17.25	3.924	0.19	0.09	0.15	-					
5. NA	59	8.00	3.179	0.32	-0.18	0.30	0.08	-				
6. STAI _s	59	37.53	9.573	0.04	-0.04	0.06	-0.47*	0.42	-			
7. STAI _{It}	59	41.31	11.627	0.04	0.04	0.27	-0.41	0.24	0.63*	-		
8. SHAPS ^a	34	12.85	1.395	0.15	0.11	-0.11	0.20	0.07	-0.17	-0.46	-	
9. mTXT	59	447.5	162.37	-0.21	0.39	0.20	0.20	-0.05	-0.20	0.11	-0.18	-

Note. Combined data from Exp. 1 and 2 (n=59): AGE; AUT-score; questionnaire scores (AReA; PA, NA –

PANAS subscores; STAI_s, STAI_{It} – STAI subscores; SHAPS); and mean text count over all 12 trials (mTXT).

^a SHAPS data was only collected in Exp. 2.

* $p < 0.05$, Holm-corrected.

Table C2*Pairwise correlation coefficients for single-trial-level responses.*

Variable	n	M	SD	1	2	3	4
1. AE-PRE	420	0.62	0.317	-			
2. AE-POS	420	0.59	0.307	0.78*	-		
3. INSP	420	0.59	0.268	0.31*	0.45*	-	
4. TXT	420	440.0	183.50	0.06	0.16	0.42*	-

Note. Combined data from Exp. 1 and 2 (n=420 trials from 59 participants). Inspiration ratings (INSP); text count (TXT); and corresponding aesthetic ratings from pre- and post-tests (AE-PRE, AE-POS). Only data from trials with all four measures were included, i.e. moving paintings from Exp. 1 and moving and non-moving (familiar) paintings from Exp. 2. Correlation coefficients and p values obtained via repeated measures correlation (Bakdash & Marusich, 2017).

* $p < 0.05$, Holm-corrected.