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The action-dynamics of dark creativity

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Abstract

Creative ideation can be driven by honorable objectives, but also by nefarious intentions. Even though this dark side of creativity gained scientific attention recently, the underlying cognitive processes remain poorly understood. In a preregistered experiment, we applied the process-tracing method of mouse tracking to precisely assess the cognitive underpinnings of malevolent creativity. Participants (N = 67 adults) chose between either a creative or a traditional use for a visually presented item while the creative use was either positive or negative. Consistent with prior research, choice frequencies and movement trajectories indicated a strong preference for traditional over creative responses. This bias, however, was not affected by the valence of the more creative alternative. Moreover, exploratory analyses suggest that negative creative ideas might be retrieved easier for actors who are prone to antisocial rule-violation. We conclude that traditional beliefs and procedures hamper positive and negative creativity alike, attesting to a pervasive impact of traditional ideas on creative behavior.

Keywords: malevolent creativity; action-dynamics; creativity; motion-tracking; rule-breaking

1. Introduction

Scientific discoveries, artistic excellence or repurposing of everyday objects: creative behavior, characterized by novelty and usefulness (Runco & Jaeger, 2012), comes in many different ways (Sternberg, 2006). Despite this striking diversity within the creative spectrum, these behaviors usually share an inherently positive connotation (James et al., 1999). In line with such reasoning, most people associate creativity with positive characteristics like societal growth (Hennessey & Amabile, 2010) or pronounced well-being (Smith et al., 2022).

This narrative, however, has been slowly changing for the last years. Terrorists have caused great suffering with sophisticated attacks which could not be foreseen by police or secret services. Criminal hackers displayed an enormous amount of creative energy when circumventing the security measures of financial institutions or government agencies. This list of indisputably negative outcomes, fueled by creative ideation, could be continued endlessly. Consequently, the realization that creativity cannot be seen as an exclusively positive characteristic has taken hold within the scientific community (Kapoor, 2023). This dark side of creativity is characterized by the use of original means leading to harmful consequences for other agents (McLaren, 1993). These negative consequences can be deliberately intended ("malevolent creativity"; Cropley et al., 2008) or constitute an unintended byproduct of the creative action ("negative creativity"; James et al., 1999).

This paper will focus on malevolent creativity, which has been at the heart of an increasing amount of research in the last years, examining individual, situational and societal factors that influence when and how such dark creativity emerges (e.g., Baas et al., 2019; Harris et al., 2013; for an overview see Kapoor, 2023). As a first theoretical framework within this field, the *AMORAL* model (Kapoor & Kaufman, 2022) has been proposed recently. This model covers the whole timeline of dark creativity, starting with its antecedents and individual mechanisms, up to its implementation as well as possible aftereffects. The present study aims to extend this model by precisely targeting the cognitive underpinnings of dark creativity, which have been mainly neglected so far.

While malevolent and benevolent creativity share underlying divergent thinking processes, as also indicated by similar EEG alpha patterns (Perchtold-Stefan et al., 2023), previous research also found some remarkable differences between both kinds of creativity. For instance, evidence from neuroimaging suggests different neural correlates for malevolent and benevolent creative ideation (Gao et al., 2022, Qiao et al., 2022). In particular, for dark creativity, there might be a stronger interplay of affective and cognitive processes (see for an overview Perchtold-Stefan et al., 2022). Furthermore, while openness-to-experience predicts benevolent but not malevolent creativity, the opposite relation was found for psychopathy (Batey et al., 2022). Such findings raise the question whether dark creativity relies on the same cognitive processes as its positive counterpart. As the relation of morality and creativity is a “key theme regarding individual differences in creativity” (Shen et al., 2019, p. 469), we further asked how these processes might interact with morality, in particular with moral judgements. Previous research within this field found highly diverging results (e.g., Scigala et al., 2022; Shen et al., 2019; Reis et al., 2023a), showcasing a need for further investigations.

To address these research questions, we adapted a recently proposed response-dynamics paradigm of creative idea selection to the context of negative creativity (Reis et al., 2023b; Reis & Kunde, under revision). This paradigm relies on tracking hand movements while participants choose between either a creative or a traditional use for a visually presented object. Such trajectories provide profound insights into the cognitive underpinnings of complex decision processes (e.g., Freeman & Ambady, 2009; Song & Nakayama, 2008; Spivey et al., 2005). This previous research (Reis et al., 2023b) revealed a marked bias towards traditional uses, even when opting for the unconventional use eventually. Thus, this observation suggests that beyond generating creative solutions, a lingering bias toward the traditional approach is a major obstacle to creativity. In the present study, we assessed possible differences of this process between positive and negative creativity. Thereby, this work further extends earlier studies on malevolent creativity, which mainly investigated idea generation, by focusing on the evaluation and selection of malevolent original ideas.

To this means, we had participants choose between traditional and creative uses, while the latter ones were either positive or negative. As earlier research indicates an attraction towards response options with relatively more positive valence (Koop & Johnson, 2013), we hypothesized that this bias towards traditional uses might be more pronounced when pitted against negative as compared to positive creative uses.

2. Method

2.1 Participants

The comparison of traditional and (rather neutral) creative behavior (Reis et al., 2023b) yielded effect sizes of $d_z = 0.42$ to $d_z = 0.75$ across different measures. We, therefore, based our sample size calculations on an effect size of $d_z = 0.40$, resulting in a sample size of 51 participants for a power of 1-β = 80% (α = .05, two-tailed testing; calculated with the power.t.test function in the *statistics* package of R, version 4.0.3). To account for potential dropout, we increased sample size by 30% and thus collected data of 67 participants. Data of participants with less than ten observations per condition were excluded ($n = 14$), resulting in a final sample size of 53 participants (self-reported gender identity: 1 diverse, 21 females, 31 males; age: $M = 28.9$, $SD = 12.3$ years). This effective sample size provided a power of 1-β = 80% for effect sizes of $d_z \geq 0.39$. We recruited our sample via Prolific and participants reported 22 different nationalities with Portugal ($n = 9$), Poland ($n = 7$), and the UK ($n = 6$) as the most common responses. Informed consent was obtained from each individual participant. All procedures performed in this study were approved by the local ethics committee.

2.2 Materials and Procedure

2.2.1 Creativity task

Our item pool consisted of 12 objects with three uses each (traditional, positive creative, negative creative; see Table S1), which were validated in terms of creativity and valence beforehand (see supplement for details).

This online experiment was programmed with lab.js (Henninger et al., 2022) as well as the mouse-tracking plugin mousetrap (Kieslich & Henninger, 2017). Before the start of the study, participants were instructed regarding the task and had to explicitly agree to the experimental terms. Due to the online setup and varying screen sizes, all stimuli and text were scaled according to the individual display resolution of each participant, and full screen mode was enforced when starting the experiment. Figure S1 shows the procedure of a single trial. Note that all distances mentioned below apply to a reference screen size of 800 x 600 px.

At the start of each trial, participants indicated their intention for the upcoming response (selecting the traditional or the creative use) by clicking on one of two boxes, labelled “Traditional task” and “Creative task”, respectively. Both boxes were presented in random order, but this mapping was constant across trials for each individual. Afterwards, we centred the mouse cursor position by asking participants to click on a small black square in the middle of the screen. The next screen featured three areas: Two target areas (230 px x 30 px) in the upper left and upper right side of the screen and a home area (60 px x 60 px) in the bottom center. To remind participants of their prior task choice (traditional or creative task), we presented a bold uppercase letter in the center of the home area (“C” for creative use, “T” for traditional use). The target object was presented as an image between both target areas (bounding box: 100 px x 100 px), each of which displayed one use in written form. The order of the traditional and the creative use was determined randomly for each trial. Both uses and the target object appeared after participants had clicked on the home area. In response to this target stimulus, participants should select the chosen use as fast as possible. From this point onward, we sampled the x- and y-coordinates of the mouse cursor. Moreover, we measured the time from target onset until the mouse cursor had left the home area (Initiation Time, IT) and the time from leaving the home area until approaching the center of one of both target areas to less than 20 px (Movement Time, IT). We did not provide any feedback and objects were shown in random order. In total, there were four blocks, and each object was presented twice per block (traditional + positive creative use and traditional + negative creative use).

2.2.2 Prosocial and antisocial rule-breaking scale

At the end of the study, we administered the *prosocial and antisocial rule-breaking scale* (*PARB* scale; Hennigan & Cohn, 2022). Within this task, participants were asked to indicate how likely they would break certain rules or social norm in sixteen hypothetical situations. Responses were collected on a seven-point Likert scale going from “Very unlikely” to “Very likely”. Half of the items refer to antisocial rule-breaking (e.g., stealing money for your personal gain) while the other half describes prosocial rule-violation (e.g., lying to your insurance company so a sick relative receives medical coverage). Accordingly, this scale allows to calculate two different scores, not only describing attitudes towards antisocial but also regarding prosocial rule-breaking. Thereby, this measure enables differentiated insights into the relation of moral judgements and creativity.

2.3 Data analysis

Raw data, analysis code and all materials are available on the OSF (https://osf.io/3pj9v/?view_only=e14a3a60c41f425e9af52b8fa1d029f1). The sampling strategy, all hypotheses, as well as the experimental design and analysis plans were preregistered (https://osf.io/u7njm/?view_only=6134317ffcda4211924cda3fb9d8437d).

We preprocessed trajectory data with custom R scripts (for detailed background information on how to analyse mouse-tracking data see e.g., Hehman et al, 2015; Kieslich et al., 2019). First, all trajectories were scaled to a uniform display resolution so the distance from the center of the home area and each target area was 100 x-units (xu) on the x-axis and 200 xu on the y-axis. Next, movements to the left were mirrored at a vertical midline and trajectories were time-normalized from movement onset to reaching the target area to 101 points by linear interpolation. To compensate for varying click times, we appended the last coordinate of the movement after time normalization. The Area Under the Curve (AUC) was computed as the signed area between these points and a straight line from start- to endpoint of the scaled movement (in xu^2).

We excluded error trials (i.e., opting for the creative task when indicated to go for the traditional one and vice versa) and trials in which IT, MT or AUC deviated more than 2.5 *SD*s from their corresponding cell mean. In addition to these preregistered exclusion criteria, we decided on additionally excluding extreme outliers (IT > 3,000 ms, MT > 5,000 ms, AUC > 30,000 xu^2, and AUC < -20,000 xu^2) beforehand. This was done to prevent a distortion of the ± 2.5 *SD*s cut-off criterion (cut-off values were based on prior investigations using a similar paradigm, Reis et al., 2023b; see also Van Selst & Jolicoeur, 1994). Results without exclusion of these extreme values are reported in the supplement, with conceptually similar results for each measure. Please note that analyses of choice frequencies were calculated before any data exclusions (corresponding results for these analyses based on the final sample size are reported in the supplement).

To test our hypotheses, we calculated a rmANOVA for each dependent variable (IT, MT, AUC) using item use (traditional, positive creative, negative creative) as a within-subject factor. Significant main effects were further investigated by two-tailed *t*-tests comparing the respective measure between each item use condition. For choice frequencies we conducted two separate two-tailed t-tests comparing traditional and creative (positive + negative) responses as well as positive creative and negative creative responses.

As an exploratory analysis, we calculated the difference between positive creative and traditional as well as between negative creative and traditional responses for each measure (IT, MT, AUC). This difference was correlated with the prosocial and the antisocial rule-breaking score obtained in the *PARB* scale.

3. Results

Figure 1 displays movement trajectories and choice frequencies for each item use condition. Traditional uses were selected significantly more often than creative ones (creative: M = 40.47%, SD = 15.68%; traditional: M = 59.53%, SD = 15.68%), $t(66) = 4.98$, $p < .001$, $d_z = 0.61$, 95%-CI_{SM} [0.35, 0.87]. Among the creative responses, positive uses were selected descriptively more often than negative uses, however, this effect did not approach statistical significance (positive: M = 53.67%, SD = 14.83%; negative: M = 46.33%, SD = 14.83%), $t(64) = 1.86$, $p = .067$, $d_z = 0.23$, 95%-CI_{SM} [-0.02, 0.47].[1]

Crucially, this bias towards the traditional use was still present even when going for the creative option. Table S2 shows means and standard deviations for each measure (IT, MT, AUC) and item use condition. Movement initiation (IT) was descriptively, however not statistically significantly, more time consuming for creative than for traditional responses, $F(2,104) = 1.69$, $p = .189$, $\eta_p^2 = .03$. Moreover, movement execution (MT) was significantly slower for creative compared to traditional responses, $F(2,104) = 7.78$, $p = .001$, $\eta_p^2 = .13$. In detail, MT was significantly higher for positive, $t(52) = 3.88$, $p < .001$, $d_z = 0.53$, 95%-CI_{SM} [0.24, 0.82], and negative creative trials compared to traditional ones, $t(52) = 2.94$, $p = .005$, $d_z = 0.40$, 95%-CI_{SM} [0.12, 0.68]. However, MT did not differ between positive and negative creative trials, $t(52) = 1.24$, $p = .219$, $d_z = 0.17$, 95%-CI_{SM} [-0.10, 0.44]. Similarly, there was a

[1] Reduced degrees of freedom because two participants never chose the creative option.

main effect of item use for AUC, $F(2,104) = 3.17$, $p = .046$, $\eta_p^2 = .06$. That is, AUC was larger when going for positive, $t(52) = 2.40$, $p = .020$, $d_z = 0.33$, 95%-CI_{SM} [0.05, 0.60], and for negative creative uses than for traditional solutions, $t(52) = 2.24$, $p = .029$, $d_z = 0.31$, 95%-CI_{SM} [0.03, 0.58], whereas there was no difference between both kinds of creative responses, $|t| < 1$.

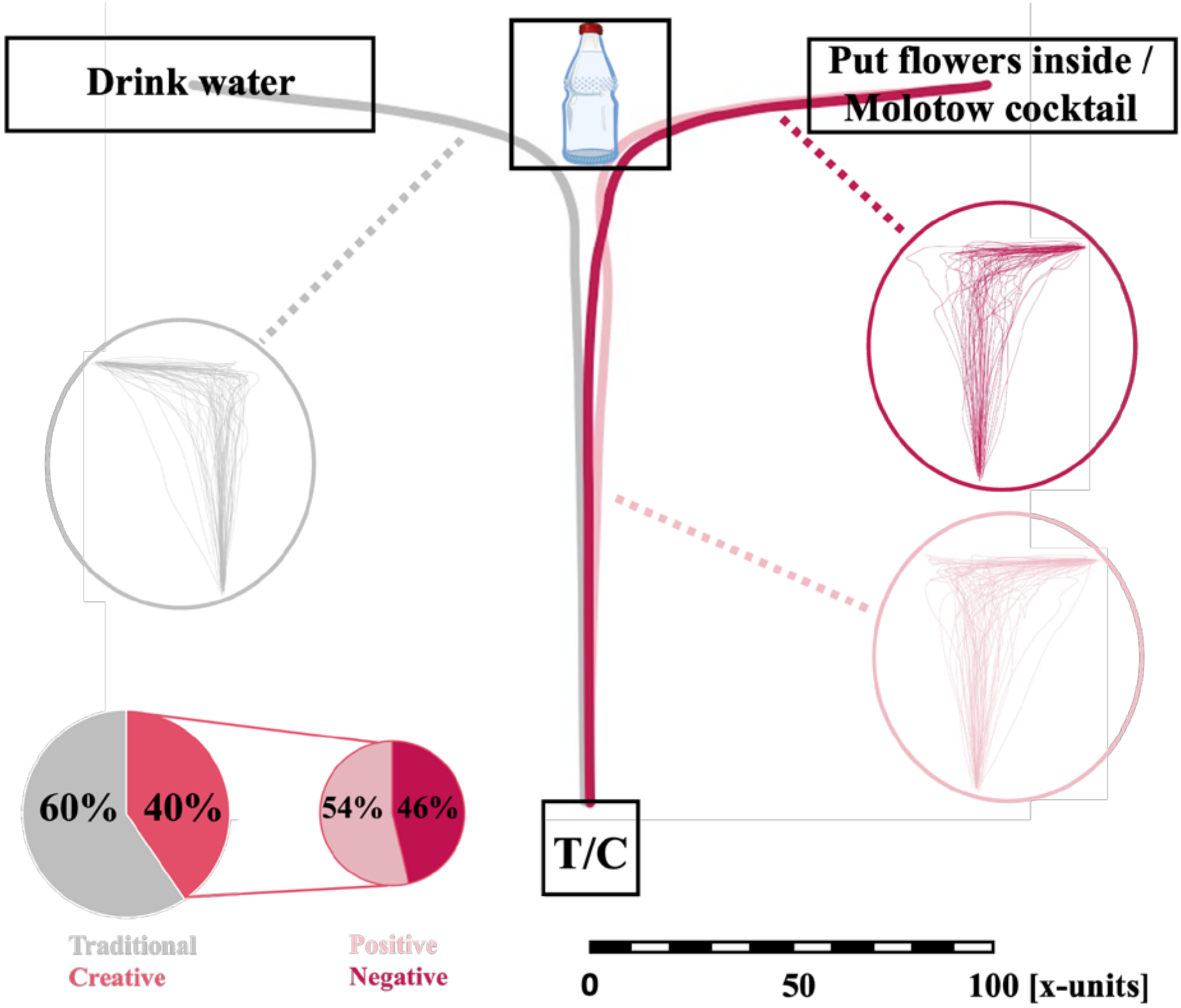

Fig. 1. Choice frequencies (pie charts) and time normalized movement trajectories for traditional (here: "Drink water"; grey line) as well as positive (here: "Put flowers inside"; pink line) and negative (here: "Molotow cocktail"; red line) creative responses. Each trial featured the traditional option but only one of both creative conditions. Thin lines show average trajectories of individual participants for each item use condition.

Cronbach's alpha indicates good internal reliability for both *PARB* subscales (Antisocial rule-breaking: $\alpha = .76$; prosocial rule-breaking: $\alpha = .78$). There was no statistically significant correlation between the prosocial or the antisocial rule-breaking score and the differences between traditional and positive creative responses for any measure, $|rs| \leq .19$, $|ts| \leq 1.35$, $ps \geq .182$. Similar results were found for the correlation of both rule-breaking scores and the differences between traditional and negative creative responses for IT and MT, $|rs| \leq .21$, $|ts| \leq 1.54$, $ps \geq .129$. However, regarding AUC there was a significant relation to the antisocial (see Fig. 2), $r = -.38$, $t(51) = 2.97$, $p = .005$, but not to the prosocial rule-breaking score, $r = -.25$, $t(51) = 1.83$, $p = .073$.

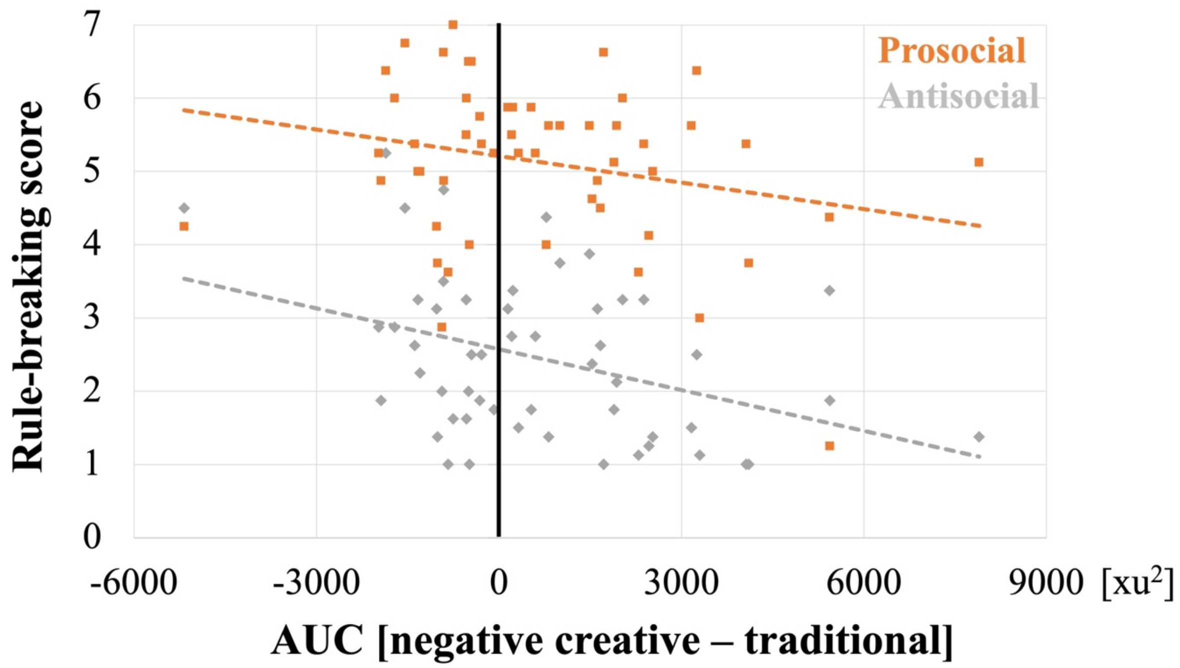

Fig. 2. Correlation of the individual score on the *PARB* scale and the difference of “negative creative use” and “traditional use” trials for the Area Under the Curve (AUC). Scores on the prosocial rule-breaking dimension are shown as orange squares and scores on the antisocial rule-breaking dimension are presented as grey diamonds. Each shape represents one participant. Vertical, solid line represents zero and dashed lines show linear regression lines for prosocial (upper, orange line) and antisocial (lower, grey line) rule-breaking scores.

4. Discussion

Depending on the actor´s intention, creative ideas can benefit society (Hennessy & Amabile, 2010) or cause tremendous harm (McLaren, 1993; Kapoor, 2023). While this dark side of creativity has been at the heart of an increasing amount of research in the last years, the underlying cognitive processes are yet to be documented, in particular regarding the evaluation and selection of malevolent creative ideas. To this end, we took advantage of a recently proposed motion-tracking paradigm from creative idea selection (Reis et al., 2023b). Participants could freely choose between traditional and creative uses for given objects by moving the mouse cursor to a corresponding target area. To precisely address the action-dynamics of negative creativity, creative uses were additionally manipulated regarding their valence (positive or negative).

Corroborating previous findings (Reis et al., 2023b; Rietzschel et al., 2010), we observed a clear preference for choosing traditional over creative solutions. Moreover, movement-trajectories indicated a much stronger bias towards the opposing response option when going for the creative instead of to the traditional solution. Contrary to our hypothesis, the valence of the creative task, however, did neither affect choice rates, nor temporal or spatial measures of participant´s hand movements. This outcome implies that the bias against creativity is universal, or at least independent of the valence of the creative solution. Overcoming attraction towards the standard option seems to be cognitively challenging, even when the creative task has a strong positive connotation.

Exploratory analyses further suggest that for negative, but not for positive creativity the strength of this bias interacts with moral dispositions. We used the *PARB* scale (Hennigan & Cohn, 2022) to assess participants` disposition to commit rule-violations for either personal gain (antisocial) or helping others (prosocial). The more likely they indicated to engage in antisocial rule-breaking, the more their movement trajectories were pulled towards the negative creative use. For attitudes towards prosocial rule-violation a descriptively similar, however statistically non-significant effect was found. This outcome is in line with recent findings, indicating that malevolent creativity is associated with unsuccessful coping with anger-eliciting events and through that might promote antagonistic problem-solving strategies (Perchtold-Stefan et al., 2021).

Our findings bear direct implications for theorizing on dark creativity. A widespread model of creative cognition suggests a two-step process, consisting of blind variation and selective retention (BVSR; Campbell, 1960; Simonton, 2011). Most research has focused on the variation phase, reducing the relevance of the selection phase to a simple “quality control” (Simonton, 2011, p. 159). An increasing amount of evidence, however, indicates that generating original ideas is necessary but not sufficient for successful creative ideation (Faure, 2004; Rietzschel et al., 2010). Even after an innovative idea has been generated, the selection and implementation of this idea might still fail, for example due to a lasting pull towards the traditional approach (Reis et al., 2023b). Our results lend further support to this claim. Exploratory analyses further suggest that individual dispositions, especially in the moral domain, affect this pull process. While lower moral standards seem to facilitate the selection of negative creative ideas, high moral standards might buffer against it (reliability for such correlational findings, however, is limited due the present sample size and as we only used a single self-report measure to capture moral dispositions). Whether similar is true for the blind variation phase of creative ideation is subject to future investigations.

Moreover, our research adds further nuance to the AMORAL model (Kapoor & Kaufman, 2022) by addressing the underlying cognitive processes of dark creativity. Our findings did not yield any evidence that positive and negative instances of creative idea selection differ in terms of how they interfere with the presence of the standard option. This is worrisome news as there is no indication that deriving at negative creative solutions is any harder than deriving at positive creative solutions.

A limitation of our results might be that the valence manipulation was not of maximal strength. We took great care to come up with item uses which were explicitly positive or negative, respectively (see Table S1) and validated our item pool in a corresponding pilot study (see supplement). Accordingly, we only included items, for which the positive use was rated as more positive than its negative counterpart, without however requiring these differences to be extreme (some uses like "Squish mosquitos" might be slightly ambiguous regarding their valence). It could, thus, be that the action-dynamics of creative idea selection differ when it comes to even more pronounced instances of either positive or negative creativity. Finally, the present online setup comes with reduced experimental control compared to a traditional lab experiment. Thus, future studies should aim for a replication of our findings in a more controlled setting.

5. Conclusions

The present experiment used mouse-tracking methodology to study the cognitive underpinnings of malevolent creativity. We provide further evidence that the selection of creative ideas is markedly hampered by the presence of the traditional option. Importantly, this is true for malevolent and benevolent creativity alike.

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