Motivation and Emotion (2024) 48:531–548
https://doi.org/10.1007/s11031-024-10070-5

ORIGINAL PAPER

Intergroup threat stimulates malevolent creative idea generation

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Accepted: 5 April 2024 / Published online: 6 May 2024
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Abstract
In response to intergroup threats, group members typically exhibit aggressive behaviors. These aggressive behaviors include malevolent creativity (MC), which refers to the application of novel ideas to intentionally harm others. However, whether and how intergroup threats affect MC remains unclear. This study comprehensively examines the impact of intergroup threats on MC, along with its underlying mechanisms, across three experiments. Study 1 investigated the effects of intergroup threats on MC performance. The results revealed that while intergroup threat improved MC originality, it had no significant impact on general creativity, which indicates that intergroup threat enables individuals to invest more resources in generating original malevolent ideas. Building on these findings, Study 2 focused on how the target directivity of MC influences the relationship between intergroup threat and MC performance. The results demonstrated that MC originality was higher when the MC target was directed at threatening outgroup members rather than at irrelevant persons. These findings imply that threatened individuals tend to retaliate vicariously against out-group members using original malevolent methods. Study 3 explored whether realistic and symbolic threats exerted distinct effects on MC performance. Their results showed that only symbolic threats promoted originality and fluency in MC. This indicates that only symbolic threats compelled the incentives to promote the generation of malevolent ideas. In conclusion, these findings suggested that intergroup threats significantly amplify MC, particularly when directed at perceived threatening outgroup members, while symbolic threats appear more conducive to fostering the generation of malevolent ideas.

Keywords Intergroup threat · Malevolent creativity · Threat mobilization hypothesis · Deterrence theory

Introduction

Malevolent creativity and intergroup threats

Creativity is defined as the ability to generate novel and useful ideas (Runco & Acar, 2012; Sternberg & Lubart, 1996). It is often celebrated as a positive trait that fosters unique accomplishments. However, each coin has two sides. Creativity can also be used for evil purposes. For instance, the Ponzi scheme, as highlighted by Garber (1990), and the 9/11 attacks, analyzed by Cropley et al. (2008), are stark examples of creativity applied in malevolent contexts. To fully understand the different aspects of creativity, researchers have proposed the concept of malevolent creativity (MC), which is characterized as the ability to innovate ideas intentionally designed to cause harm to others, primarily for self-serving objectives (Cropley et al., 2008, 2010; Hao et al., 2020; Harris et al., 2013).

Recognizing the dual nature of creativity prompts a closer examination of what drives MC, particularly how internal and external factors intertwine to influence its manifestation. Previous studies have suggested that several internal factors affect MC performance, including trait aggression (Harris & Reiter-Palmon, 2015; Lee & Dow, 2011), the Dark Triad (Gao et al., 2022b; Jonason et al., 2017), antagonism (Perchtold-Stefan et al., 2020), and anger (Cheng et al., 2021a, b). Beyond these internal factors, researchers have attached importance to the effects of external factors on MC performance, such as threat (e.g., Cheng et al., 2018; De Dreu et al., 2008; Van Leeuwen & Baas, 2017). Considering this,

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it's recognized that threats elicit a spectrum of individual responses, ranging from defensive actions like escaping and attacking to more constructive strategies (Baas et al., 2019; Bracha, 2004; Dixon, 1998), such as the utilization of creativity to navigate challenges (e.g., Cheng et al., 2018). This breadth of responses highlights the pathway for exploring the threat mobilization hypothesis, which primarily posits a positive connection between threat and creativity (e.g., Walton & Kemmelmeier, 2012). Threatened individuals are motivated to find creative coping approaches (Walton & Kemmelmeier, 2012) because original and practical responses can be more effective in solving threats than conventional responses (Cheng et al., 2018). In line with these hypotheses, several studies have demonstrated that creativity is enhanced in threatening situations, including business negotiations (De Dreu et al., 2008), attack/defense competition games (Van Leeuwen & Baas, 2017), and viewing self-directed threatening images (e.g., being pointed at by a gun; Cheng et al., 2018).

Moreover, external threats provoke aggressive cognition and a readiness to either fight or defend (Baas et al., 2019; Johnson et al., 2019). Since MC is characterized as deliberately hurting others and being original, it can be more influenced by external threats than general creativity. Baas et al. (2019) revealed that participants under high-threat conditions (i.e., participants might suffer a substantial loss due to the opponents' decision) tended to generate more malevolent creative ideas than general creative ideas (i.e., referring to novel brick uses and negotiation tactics). Perchtold-Stefan et al. (2022) demonstrated that social exclusion, which is a robust social threat, increased the number of malevolent ideas that are also more original in a malevolent creativity task (i.e., generating original approaches to hurt others). Thus, when facing pressing threats, individuals might lean towards addressing these challenges through MC rather than general creativity. While cooperative and prosocial actions are alternatives, in threatening circumstances, destructive and antisocial behaviors tend to be more prevalent (i.e., as the interests of all parties are conflicting; De Dreu & Nijstad, 2008; Deutsch, 1973). Additionally, MC behaviors are more unpredictable and easier to escape from punishment than normal malevolent behaviors (Wang, 2019; Wiltermuth et al., 2017). To illustrate, terrorists often choose innovative attack methods that have never been previously executed, making them challenging for both victims and law enforcement to anticipate and prevent. Among the various ways of responding to threats, the enhanced MC behaviors can pose a significant danger to society.

Building on the understanding of external threats at the individual level, it's imperative to explore how these dynamics operate when threats extend beyond personal conflicts to encompass entire groups. Existing studies on MC and intergroup threat have mainly been restricted to the individual level, directly linked to specific conflicts or competitive scenarios involving personal interest. For example, the threats in the context of economic losses resulting from others' decisions (Baas et al., 2019). However, external threats may also emerge at the group level, manifesting as intergroup threats. This occurs when one group's actions, beliefs, or characteristics challenge the goal attainment or well-being of another (Riek et al., 2006). For now, no study has directly explored the effect of intergroup on MC. The definition of intergroup threat implies that it is directed towards an entire out-group, such as a specific country or community. Consequently, unlike individual-level threats, intergroup threats are heavily contingent upon group categorization (Chang et al., 2016). Furthermore, the responses to intergroup threats also manifest at the group level, giving rise to phenomena like intergroup conflicts (Stephan & Stephan, 2017). In summary, intergroup threat and its subsequent responses are rooted in group categorization.

Several previous studies have revealed that individuals perceiving intergroup threat often exhibit heightened malevolence, evidenced by aggressive intergroup actions (Schmid et al., 2014) and opposition to policies favoring threatening out-groups (Yang & Zhao, 2013). When competitive out-group members encounter adverse events, in-group members experience heightened positive emotions (Cikara & Fiske, 2011) and a reduced level of negative emotions (Cikara & Fiske, 2012). Additionally, perceived intergroup threats can diminish benevolence, lessen prosocial behaviors, and impair empathy towards out-group members (Cikara et al., 2011; Jackson & Esses, 2000; Li & Zhao, 2012). The AMORAL (i.e., antecedents, mechanisms, operants, realization, aftereffects, and legacy) model proposes that malevolent ideas can be stimulated by social cues when individuals have a shared social identity within a group (Kapoor & Kaufman, 2022). Intergroup threats, occurring at the group level, can accentuate group identity and thereby serve as a strong potent social cue that enhances subsequent malevolent creation. Taking into account these findings and the threat mobilization hypothesis (Baas et al., 2019; De Dreu et al., 2008; Walton & Kemmelmeier, 2012), we propose that intergroup threats would facilitate malevolent creative idea generation. Therefore, the primary question that the current study aims to answer is: Can perceived intergroup threat promote individuals' MC performance?

The potential influencing factors

Intergroup threat elicits a response from the threatened group member to seek retaliation. Any member of a threatening group can be the target of retaliation, even if they were not directly involved in the initial intergroup provocation

(Stenstrom et al., 2008). According to deterrence theory, individuals are inclined to vicariously retaliate against out-group members as a means to deter potential aggressors from future offenses (McCullough et al., 2013; Sjöström & Gollwitzer, 2015). Chen and Zhao (2015) found that individuals pay great attention to the faces of threatening out-group members. The attention of threatened individuals was narrowed to dangerous stimuli and is shifted away from irrelevant information (Ferguson & Bargh, 2004; Johnson et al., 2019; Lipp & Waters, 2007). Therefore, in the face of threatening out-group members, threatened individuals may mobilize more cognitive resources to prepare for the potential harm. The threat mobilization hypothesis proposes that this mobilization should enhance creative idea generation (Baas et al., 2019; Chajut & Algom, 2003; Johnson et al., 2019). Thus, the performance of malevolent creation may be higher when directed toward a threatening out-group member than when directed toward an irrelevant person. The current study aimed to answer the second question: Will the target directivity (i.e., whether MC is directed towards threatening out-group members) affect individuals' MC performance under intergroup threats?

Building on the exploration of MC's target directivity, the forms of intergroup threats were delved into. Intergroup threat theory identifies two distinct forms of intergroup threat: realistic threat (i.e., threats to a group's general welfare, power, and resources) and symbolic threat (i.e., threats to a group's values, morals, religion, ideology, worldview, belief system, or philosophy) (Bizman & Yinon, 2001; Chen et al., 2019; Stephan et al., 2009, 2015). According to the threat-based hate model, hatred is rooted in prolonged threats that are oriented toward individuals' deeply-held values (Martínez et al., 2022). The definition of symbolic threat indicates that it is closely related to the values of a specific group, thereby making it a more effective predictor of hatred than realistic threat, which in turn, hatred serves as an indicator of aggressive behavior. Additionally, symbolic threats induce deep and enduring negative emotions (Glaser et al., 2002; Halperin, 2008), potentially leading to hate-driven intergroup behaviors (e.g., Sternberg, 2003). These findings suggest that symbolic threats have a higher likelihood of triggering harmful behaviors compared to realistic threats. Thus, the current study will further target at the third question: Do the two forms of intergroup threats (realistic threats vs. symbolic threats) exert distinct effects on individuals' MC performance?

Moving from the forms of threats to their psychological impacts, the factors contributing to the intergroup threat-MC dynamic are examined. Emotional states have been linked to both intergroup threats and subsequent behaviors (Cikara & Fiske, 2011, 2012; Glaser et al., 2002; Halperin, 2008; Sternberg, 2003). The dual pathway to creativity model suggests that an increase in negative emotions compel individuals to sharpen their focus on idea generation, leading to a more in-depth and sustained exploration and analysis of various potential solutions (De Dreu et al., 2008; Nijstad et al., 2010). Previous findings indicate that under social threats, a persistent pathway can enhance malevolent creativity (Baas et al., 2019). Therefore, intergroup threats may influence MC performance by altering emotional states. Moreover, ingroup identity affects the strength of perceived intergroup threat (Riek et al., 2010). For example, individuals with a strong ingroup social identity are more likely to exhibit prejudice when under threat (Bizman & Yinon, 2001; Schmid & Muldoon, 2015). The degree of ingroup identity may moderate the intergroup threat-MC relation. In the current study, the abovementioned factors will be examined as mediating or moderating variables to explore their impact on the intergroup threat-MC relation.

The current study

In summary, the relationship between intergroup threats and MC remains unclear. The current study aimed to determine whether the threat mobilization hypothesis applies to intergroup threats and MC. It addresses several hypotheses: (H1) intergroup threat enhances MC performance (e.g., the fluency, originality, and harmfulness of the generated malevolent ideas); (H2) MC performance is promoted when the MC target is directed to threatening out-group members rather than irrelevant persons; (H3) symbolic threat promotes MC performance more significantly than realistic threat; (H4) intergroup threat increases MC performance by altering emotional states (i.e., increased negative emotion, decreased positive emotion, and changes in the overall arousal and pleasure levels of emotion); (H5) ingroup identity moderates the relations between intergroup threat and MC.

Three studies were conducted to empirically test these hypotheses. Different levels of intergroup threat were manipulated by reading the corresponding articles. The Malevolent Creativity Task (MCT) was utilized to assess the temporary behavioral performance in generating malevolent creative ideas, as indicated by fluency, originality, and harmfulness (e.g., Perchtold-Stefan et al., 2020; Perchtold-Stefan et al., 2022; Qiao et al., 2022). For general creativity, the Realistically Presented Problem (RPP) was applied to measure temporary behavioral performance in generating general creative ideas, based on fluency and originality (e.g., Batey et al., 2022; Gao et al., 2022a; Hao et al., 2020). Previous studies have revealed that MC potential, general creativity potential, and aggression (explicit and implicit aggression) are related to enhanced MC performance (Hao et al., 2016, 2020; Harris et al., 2015; Lee & Dow, 2011;

Perchtold-Stefan et al., 2020). The perceived difficulty and pleasure of creativity tasks (i.e., MCT and RPP) were regarded as potential factors that might affect the creativity-related outcomes (Gao et al., 2022a; Qiao et al., 2022). To exclude their potential effects, these variables were controlled for as covariates. Specifically, MC potential, general creativity potential, aggression (both explicit and implicit), group identity, and task difficulty/pleasure were used as covariates.

This study was approved by the University Committee on Human Research Protection of the East China Normal University (HR2-1067-2020). In these studies, we report all measures, manipulations and exclusions.

Study 1

In Study 1, a between-subjects design (intergroup threat group vs. control group) was used to test whether intergroup threats could enhance MC performance, and to explore possible mediating and moderating variables (i.e., examining H1, H4 and H5). Participants were randomly assigned to either the intergroup threat or control condition and then asked to complete malevolent and general creativity tasks. General creativity performance was measured to check whether the effect of intergroup threats was specific to MC rather than affecting general creativity.

Method

Participants and procedure

Sixty college students were recruited (42 women; $M = 19.34$ years old, $SD = 2.21$). None of the participants reported a history of psychiatric disorders. They were randomly assigned to either the intergroup threat condition (30 participants) or the control condition (30 participants). The sex ratio was balanced (with 21 women per condition). The post-hoc power analysis showed that the sample size was sufficient ($\alpha = 0.05$; $1\text{-}\beta = 0.99$; Chow et al., 2017) to achieve the purposes of our study. All participants signed an informed consent form before the experiment and received ₹30 for participation upon completing the entire procedure.

Upon arrival, participants were randomly assigned to either the intergroup threat or control conditions. Participants first completed a pre-test, including Runco Ideational Behavior Scale (RIBS), Malevolent Creativity Behavior Scale (MCBS), Buss-Perry Aggression Questionnaire (BPAQ), and Group Identity Scale (GIS) (4 min). Then, participants completed the Self-Assessment Manikin (SAM) and Positive and Negative Affect Scale (PANAS) to measure their pre-emotional states (1 min). Next, participants were asked to read the corresponding articles (5 min) and complete the manipulation check (1 min) and the assessment of post-emotional states (SAM and PANAS, 1 min). Next, the participants completed the Realistic Presented Problem (RPP) (5 min) and Malevolent Creativity Task (MCT) (5 min) on the computer (with the sequence counterbalanced). Finally, in the post-test, participants rated the levels of pleasure and difficulty before completing the Implicit Association Test (IAT). The experiment duration was approximately 30 min. The experimental procedure is shown in Fig. 1.

Experimental tasks

The article reading task was used to manipulate intergroup threats (Costello & Hodson, 2011; Morrison & Ybarra, 2009; Rios et al., 2018) (Supplementary Material, S1). Participants in the intergroup threat condition were asked to read an article about the discrimination against Chinese people by foreigners after the outbreak of COVID-19 (S1. 1). Participants in the control condition were asked to read an article on different English learning methods (S1. 2). After reading the article, a single item was used to check whether intergroup threat was successfully manipulated in the intergroup threat condition. That is, "to what extent do you feel that foreigners threaten Chinese people?" (1 = very low to 7 = very high) (Chen & Zhao, 2015; Chen et al., 2017; Costello & Hodson, 2011; Stephan et al., 2000).

The Realistic Presented Problem (RPP) was used to evaluate the performance of general creativity. Participants were required to generate as many original solutions as possible for a specific problem in a realistic situation within 5 min (Agnoli et al., 2016; e.g., You are going to a concert with your friend, but you forgot the ID card and wallet. The ticket inspector insists on seeing something that proves your identity before letting you pass. The concert has already begun, and your friends have already seated. Please generate the novel solutions as many as possible). The neutrality of the RPP used in this study was tested and confirmed (Gao et al., 2022a). The RPP content was neither malevolent nor benevolent. Two experienced researchers reached a consensus to consolidate the ideas. The RPP performance was assessed based on originality and fluency (Agnoli et al., 2016; Runco et al., 2016). Specifically, subjective method was used to evaluate originality: five trained raters with at least two years of research experience in the field of creativity scored each idea on a 5-point scale according to its level of originality (0 = not original, 4 = very original; internal consistency coefficient [ICC] = 0.87). The originality score for each idea was calculated by averaging the scores from the five raters (Baas et al., 2019; Perchtold-Stefan et al., 2022). The final originality scores for each participant were

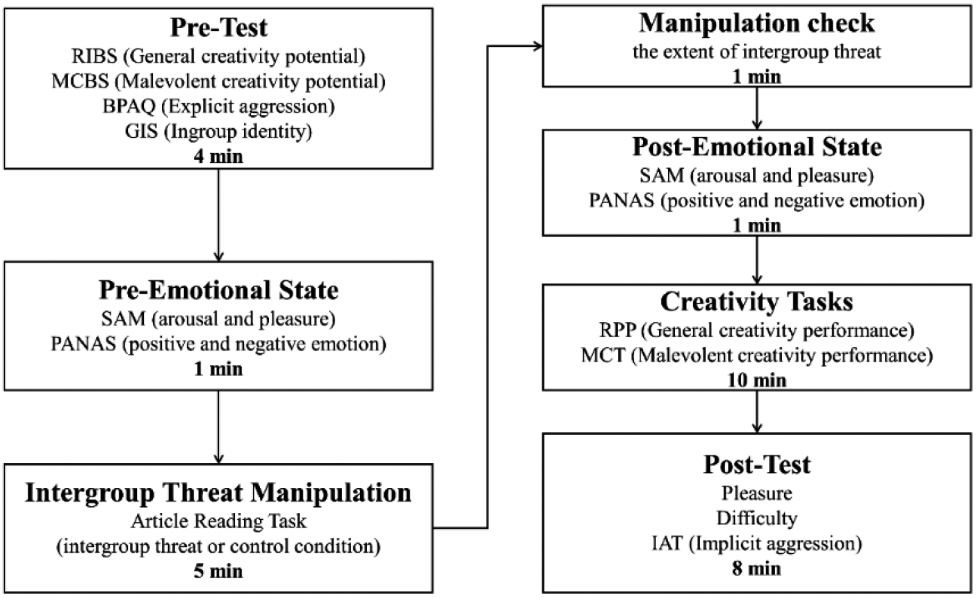

Fig. 1 Flow chart for experimental procedure in study 1

calculated by averaging the scores for all ideas. The fluency score was calculated as the number of appropriate solutions generated by participants for the RPP.

The Malevolent Creativity Task (MCT) was used to evaluate malevolent creativity. Participants were asked to provide as many original and harmful solutions as possible for a specific problem within 5 min (Cheng et a., 2021a, 2021b; Gao et al., 2022a; Hao et al., 2020; Qiao et al., 2022; e.g., Ming will be your opponent in the tennis final, but you are impossible to defeat Ming right now. Please generate novel methods to make Ming injured 'accidentally' and win the tennis final). The MCT performance was assessed based on originality, fluency, and harmfulness (Harris et al., 2013; Harris & Reiter-Palmon, 2015; Perchtold-Stefan et al., 2020). The originality (ICC = 0.82) and fluency scoring procedures were the same as those used for the RPP. For harmfulness, five trained raters with at least two years of research experience in the field of creativity scored each solution on a 5-point scale according to its severity of harm (0 for 'no harm', 4 for 'severe harm'; internal consistency coefficient [ICC] = 0.88). The harmfulness score for each idea was calculated by averaging the scores from five raters. The final harmfulness scores of each participant were calculated by averaging the scores of all their ideas. All the MCTs used in Studies 1, 2 and 3 do not significantly differ in the aspects of difficulty, fatigue, involvement and familiarity (Cheng et al., 2021a, b; Qiao et al., 2023).

Instruments

The Self-Assessment Manikin (SAM) was used to measure levels of pleasure and arousal (Bradley & Lang, 1994). Participants rated their pleasure (1 = very sad, 9 = very happy) and arousal (1 = very calm, 9 = very excited) on a 9-point scale.

The Positive and Negative Affect Scale-Short Form (PANAS) was used to evaluate the intensity of ten positive and negative emotional states (Bradley & Lang, 1994; Cheng et al., 2021b). Participants needed to rate their emotional intensity on a 9-point scale (1 = not at all, 9 = very) for (1) positive emotion (PA): calmness, happiness, satisfaction, and relaxation; and (2) negative emotion (NA): worry, disappointment, anger, anxiety, sadness, and tension (Pre-Emotional State: PA Cronbach's α = 0.65; NA Cronbach's α = 0.88; Post-Emotional State: PA Cronbach's α = 0.80, NA Cronbach's α = 0.89).

The Runco Ideational Behavior Scale (RIBS) was used to measure general creativity potential (Runco et al., 2001). Participants were asked to score 19 items on a 5-point scale (0 = never, 4 = almost every day, sometimes more than once a day; Cronbach's α = 0.86). A sample item is, "At home, I have ideas to arrange or rearrange furniture."

The Malevolent Creativity Behavior Scale (MCBS) was used to measure the malevolent creativity potential (Hao et al., 2016). Participants were asked to score 13 items on a 5-point scale (1 = never, 5 = always; Cronbach's α = 0.85). A sample item is, "How often do you have ideas about how to pull pranks on others?"

The Buss-Perry Aggression Questionnaire (BPAQ) was used to assess explicit aggression (Buss & Perry, 1992). Participants were asked to score 22 items on a 5-point scale (1 = extremely uncharacteristic of me, 5 = extremely characteristic of me, Cronbach's α = 0.84). A sample item is, "If somebody hits me, I hit back."

An adapted Group Identity Scale (GIS) was used to evaluate in-group identity (Mael & Tetrick, 1992). Participants

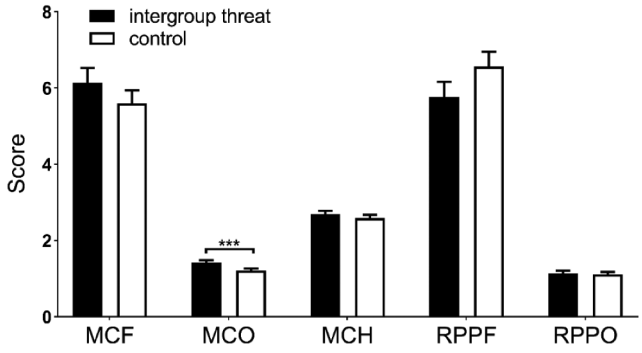

Fig. 2 Results of T-tests on MCT and RPP Performances. MCF = MCT fluency; MCO = MCT originality; MCH = MCT harmfulness; RPPF = RPP fluency; RPPO = RPP originality. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

were asked to score 10 items on a 5-point scale (1 = strongly disagree, 5 = strongly agree; Cronbach's α = 0.77). A sample item is, "Being Chinese is an important aspect of my identity."

The Implicit Association Test (IAT) was used to measure implicit aggression, which was adapted from a previous task (Dai et al., 2005). Participants were required to respond to positive, negative, and aggressive words by pressing buttons. The difference (i.e., D value) between the response time of the incompatible condition (press the same button when aggressive or negative words appear) and the compatible condition (press the same button when aggressive or positive words appear) indicates the level of implicit aggression. The quicker participants respond to the compatible task compared with the incompatible task, the higher their implicit aggression would be.

Result

Manipulation check of intergroup threat

A t-test was used to examine the manipulation of intergroup threats. The results showed that participants in the intergroup threat condition ($M = 5.47$, $SD = 0.86$) reported higher feelings of intergroup threat than those in the control condition ($M = 3.78$, $SD = 1.38$; t (58) = 5.69, $p < .001$, 95% confidence interval [95% CI] = [1.09, 2.28], Cohen's $d = 1.47$).

The differences of MCT and RPP performances between the two conditions

Several t-tests with threat (intergroup threat vs. control) as a between-subjects independent variable were conducted on MCT originality/fluency/harmfulness and RPP originality/fluency. All the p values were corrected by the false discovery rate (fdr) method. The results revealed that MCT originality in threat condition ($M = 1.43$, $SD = 0.33$) was significantly higher than that in the control condition ($M = 1.21$, $SD = 0.30$, t (58) = 2.62, $p_{(fdr)} = 0.022$, 95%CI = [0.05, 0.37], Cohen's $d = 0.70$) (Fig. 2). Additionally, threat had no significant effect on MCT fluency (t (58) = 1.02, $p_{(fdr)} = 0.311$, 95%CI = [-0.52, 1.58], Cohen's $d = 0.26$)/ hamfulness (t (58) = 0.88, $p_{(fdr)} = 0.385$, 95%CI = [-0.14 0.36], Cohen's $d = 0.23$) and RPP fluency (t (58) = 1.45, $p_{(fdr)} = 0.305$, 95%CI = [-1.90, 0.30], Cohen's $d = 0.37$)/ originality (t (58) = 0.31, $p_{(fdr)} = 0.761$, 95%CI = [-0.16, 0.22], Cohen's $d = 0.32$).

After controlling for several covariates (i.e., MC potential, general creativity potential, explicit aggression, implicit

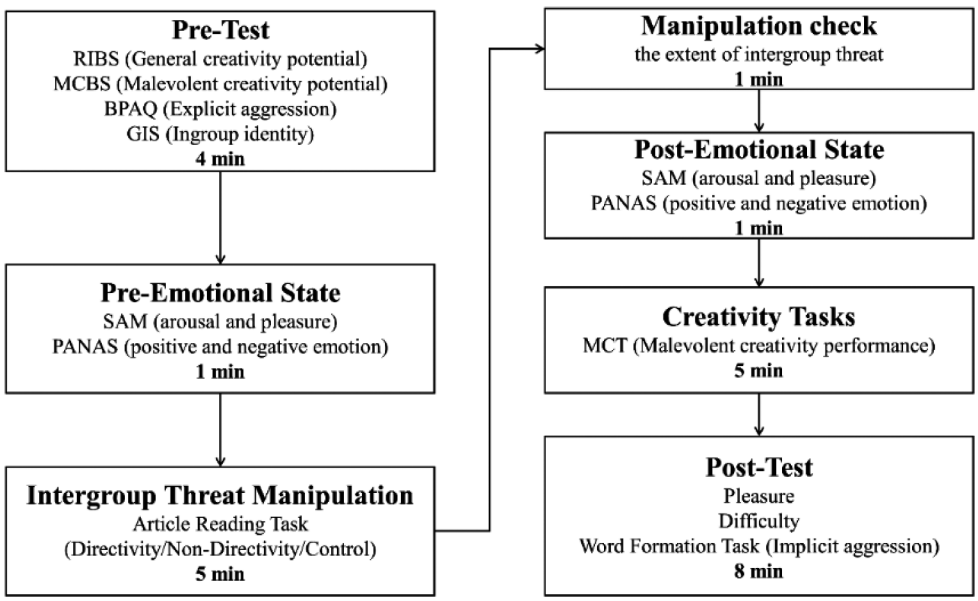

Fig. 3 Flow chart for experimental procedure in study 2

aggression, task difficulty, and task pleasure), the effect of intergroup threat on MCT originality remained significant (ANOVA; MCT originality, F (1, 52) = 8.23, p = .006, 95%CI = [0.07,0.40], η_p^2 = 0.14).

Correlation between MCT performances, RPP performances, and other variables

Several Pearson correlation analyses were used to examine the relationships between MCT performance, RPP performance, and variables in the pre-test, pre-emotional state, and post-test (Table S1). MCT fluency was significantly correlated with MC potential (MCBS score: r = .38, p = .003). MCT harmfulness was significantly correlated with explicit aggression (BPAQ score: r = .26, p = .045) and MC potential (r = .29, p = .023).

Mediation analysis

A non-parametric percentile method of mediation analysis based on bootstrap bias correction was conducted using PROCESS (Hayes, 2013; model 4) with 5000 Bootstrap samples. MCT originality was used as the dependent variable, CONDITION (1 = intergroup threat condition, 0 = control condition) as the independent variable, post-emotional states (i.e., the PANAS and SAM scores in the post-emotional state) as mediating variables, and pre-emotional states as covariates. None of the variables were significant in mediating CONDITION-MCT originality relationship (positive emotion: b = 0.03, 95% CI = [-0.05, 0.15]; negative emotion: b = − 0.01, 95% CI = [-0.11, 0.08]; arousal: b = 0.01, 95% CI = [-0.02, 0.05]; pleasure: b = − 0.05, 95% CI = [-0.16, 0.05]).

Exploratory moderation analysis

The moderation analyses were conducted post hoc to exploratively investigate the potential moderating effects of in-group identity on the intergroup threat-MC relationship. A non-parametric percentile method of moderation analysis based on bootstrap bias correction was conducted using PROCESS (Hayes, 2013; model 1) with 5000 Bootstrap samples. MCT performances (i.e., fluency, originality and harmfulness) were used as the dependent variable, CONDITION (1 = intergroup threat condition, 0 = control condition) as the independent variable and the score of ingroup identity was used as a moderators. Results revealed that ingroup identity was not significant in moderating the effect of CONDITION on all performance measures (fluency: b = − 0.03, 95% CI = [-2.22, 2.16]; originality: b = − 0.04, 95% CI = [-0.37, 0.29]; harmfulness: b = 0.13, 95% CI = [-0.26, 0.52]).

Interim discussion

Partially consistent with H1, the results indicate that intergroup threats only enhanced MCT originality but did not affect MCT fluency, harmfulness, or RPP performance. These results may be showing that the intergroup threat effect may be specific to malevolent creativity rather than general creativity. Such findings suggest that individuals who feel threatened may mobilize their resources to generate novel malevolent ideas to handle threats effectively (Baas et al., 2019; De Dreu et al., 2008; Walton & Kemmelmeier, 2012). In addition, MCT fluency and harmfulness were positively correlated with MC potential. This suggests that individuals with a higher MC potential tend to turn their potential into practice (Hao et al., 2016). However, the emotional states were not found to significantly mediate the relationship between intergroup threat and MC performances, thereby not supporting H4. Additionally, ingroup identity did not significantly moderate the intergroup threat-MC performance connection, which is inconsistent with H5.

Study 2

Study 1 demonstrated the promotional effect of intergroup threats on MC performance, particularly in terms of MC originality. In Study 2, we used a two-factor between-subjects design (intergroup threat vs. directivity; threat-directivity, threat-non directivity, control-directivity and control-non directivity conditions) to investigate whether MC performance could be enhanced when MC targets were directed toward threatening outgroup members (i.e., examining H1 and H2). The targets of MCT differed between the directivity (threatening out-group members) and non directivity (irrelevant persons) conditions. The potential mediating effects of various emotions and potential moderating effects of group identity were also examined (i.e., examining H4 and H5).

Method

Participants and procedure

One hundred and twenty-one college students were recruited (105 women; M = 20.13 years old, SD = 2.51). None of the participants reported a history of psychiatric disorders. The participants were randomly assigned to the threat-directivity condition (30 participants completed the MCT using threatening out-group members as the target following threat manipulation), threat-non directivity condition (30 participants completed the MCT using an irrelevant person as the target following threat manipulation),

control-directivity condition (30 participants completed the MCT using threatening group members as the target without threat manipulation), or control-non directivity condition (31 participants completed the MCT using an irrelevant person as the target without threat manipulation). A post hoc power analysis showed that the sample size was sufficient ($\alpha = 0.05$; $1\text{-}\beta = 0.99$; Chow et al., 2017). The sex ratio of the participants was balanced. All participants signed an informed consent form before the experiment and received ¥20 for participation upon completing the entire procedure.

Upon arrival, the participants were randomly assigned to either the threat-directivity, threat-non directivity, control-directivity, and control-non directivity conditions. Participants first completed the pre-test, including RIBS, MCBS, BPAQ, and the Internal GIS (4 min). Then, participants completed SAM and PANAS to measure their pre-emotional state (1 min). Next, participants were asked to read the corresponding article (5 min), followed by completing the manipulation check (1 min) and assessing their post-emotional state (SAM and PANAS, 1 min). Next, the participants completed the MCT on the computer (5 min). Finally, in the post-test, participants rated the levels of pleasure and difficulty of MCT before completing the Word Formation Task (3 min). The experiment duration was approximately 20 min. The experimental procedure is shown in Fig. 2.

Experimental tasks

Similar to Study 1, the article reading task was used to manipulate intergroup threats. The materials in the threat condition (i.e., threat-directivity and threat-non directivity conditions) of Study 2 were the same as the intergroup threat condition of Study 1 (S1.1), while the material in the control condition (i.e., control-directivity and control-non directivity conditions) of Study 2 was the same as the control condition in Study 1 (S1.2). The MCT was used in Study 2 to evaluate the performance of malevolent creativity (Gao et al., 2022a; Hao et al., 2020; Qiao et al., 2022). In the directivity condition (i.e., threat-directivity and control-directivity conditions), the target of the MC was threatening foreigners (i.e., Suppose you and Jack are in the same class and Jack is a foreigner. You want to rank ahead of him in the final exam, think of novel ways that can interfere with his review as much as possible). In the non directivity condition (i.e., threat-non directivity and control-non directivity conditions), the target of MC was not specified as a foreigner (the task situation was the same as in the directivity condition). Every participant completed the same MCT in both the directivity and non directivity conditions. The scoring procedures for the MCT performance were the same as in Study 1 ($ICC_{[originality]} = 0.80$; $ICC_{[harmfulness]} = 0.88$).

Instruments

Participants were required to complete the RIBS (Cronbach's $\alpha = 0.84$), MCBS (Cronbach's $\alpha = 0.90$), SAM, PANAS (Pre-Emotional State: PA Cronbach's $\alpha = 0.73$; NA Cronbach's $\alpha = 0.88$; Post-Emotional State: PA Cronbach's $\alpha = 0.81$, NA Cronbach's $\alpha = 0.91$), BPAQ (Cronbach's $\alpha = 0.94$), and GIS (Cronbach's $\alpha = 0.85$).

A Word Formation Task was used to measure implicit aggression (Zhu et al., 2006). It contained 25 trials, each consisting of one probe Chinese character and three target Chinese characters. Participants were asked to form a two-character Chinese word using a probe character and one of the target characters. They could form aggressive words (e.g., kill), neutral words (e.g., wrap), or interfering words (meaningless words). For each trial, the participants scored 1 if they formed an aggressive word while scoring 0 for other situations. The sum scores of all trials indicated the level of implicit aggression.

Result

Manipulation check of intergroup threat

A one-way ANOVA with threat (intergroup threat vs. control) and directivity (directivity vs. non directivity) as between-subjects independent variables was performed on the self-reported feeling of intergroup threat after manipulation. The main effect of threat on feelings of intergroup threat after manipulation was significant (F (1, 117) = 185.57, $p < .001$, $\eta_p^2 = 0.61$), whereas that of directivity (F (1, 117) = 0.42, $p = .517$, $\eta_p^2 = 0.00$) and interaction (F (1, 117) = 0.10, $p = .751$, $\eta_p^2 = 0.00$) were not.

Specifically, the feeling of intergroup threat after manipulation in the intergroup threat condition ($M = 5.54$, $SD = 0.95$) was higher than in the control condition (Bonferroni corrected; $M = 3.26$, $SD = 0.88$; $p < .001$; 95%CI = [1.94, 2.61]).

Effect of intergroup threat and directivity on MCT performance

Several ANOVAs with threat (intergroup threat vs. control) and directivity (directivity vs. non directivity) as between-subject independent variables were conducted on MCT originality, fluency, and harmfulness respectively. The p values were fdr corrected.

Results revealed that the main effects of threat (F (1,117) = 18.57, $p_{(fdr)} = 0.001$, $\eta_p^2 = 0.14$) and directivity (F (1,117) = 6.45, $p_{(fdr)} = 0.037$, $\eta_p^2 = 0.05$) were significant on MCT originality. Specifically, MCT originality in the intergroup threat condition ($M = 1.35$, $SD = 0.32$) was

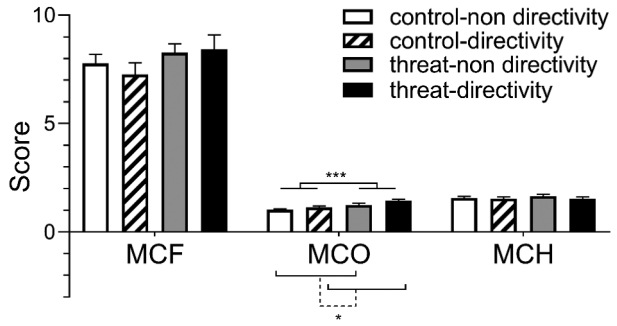

Fig. 4 Results of MANOVA on MCT Performances. MCF = MCT fluency; MCO = MCT originality; MCH = MCT harmfulness. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

significantly higher than in the control condition (Bonferroni corrected; $M = 1.08$, $SD = 0.30$, 95%CI = [0.14, 0.39]); MCT originality in the directivity condition ($M = 1.29$, $SD = 0.38$) was significantly higher than non directivity condition (Bonferroni corrected; $M = 1.14$, $SD = 0.35$, 95%CI = [0.04, 0.28]). The interaction effect between threat and directivity on MCT originality was not significant (F (1,117) = 0.65, $p_{(fdr)} = 1.000$, $\eta_p^2 = 0.01$) (Fig. 4).

The main effects of threat (F (1,117) = 2.57, $p_{(fdr)} = 0.167$, $\eta_p^2 = 0.02$) and directivity (F (1,117) = 0.109, $p_{(fdr)} = 0.742$, $\eta_p^2 = 0.00$) and their interaction effects (F (1,117) = 0.43, $p_{(fdr)} = 0.774$, $\eta_p^2 = 0.00$) were not significant on MCT fluency; the main effects of threat (F (1,117) = 0.36, $p_{(fdr)} = 0.549$, $\eta_p^2 = 0.00$) and directivity (F (1,117) = 0.93, $p_{(fdr)} = 0.507$, $\eta_p^2 = 0.01$) and their interaction effects (F (1,117) = 0.209, $p_{(fdr)} = 0.648$, $\eta_p^2 = 0.00$) were not significant on MCT harmfulness.

After controlling several covariates (i.e., MC potential, general creativity potential, explicit aggression, implicit aggression, task difficulty, and task pleasure), the main effects of intergroup threat (F (1, 111) = 13.87, $p < .001$, $\eta_p^2 = 0.11$, 95%CI = [0.11, 0.36]) and directivity (F (1, 111) = 4.82, $p = .030$, $\eta_p^2 = 0.04$, 95%CI = [0.14, 0.26]) on MCT originality were still significant.

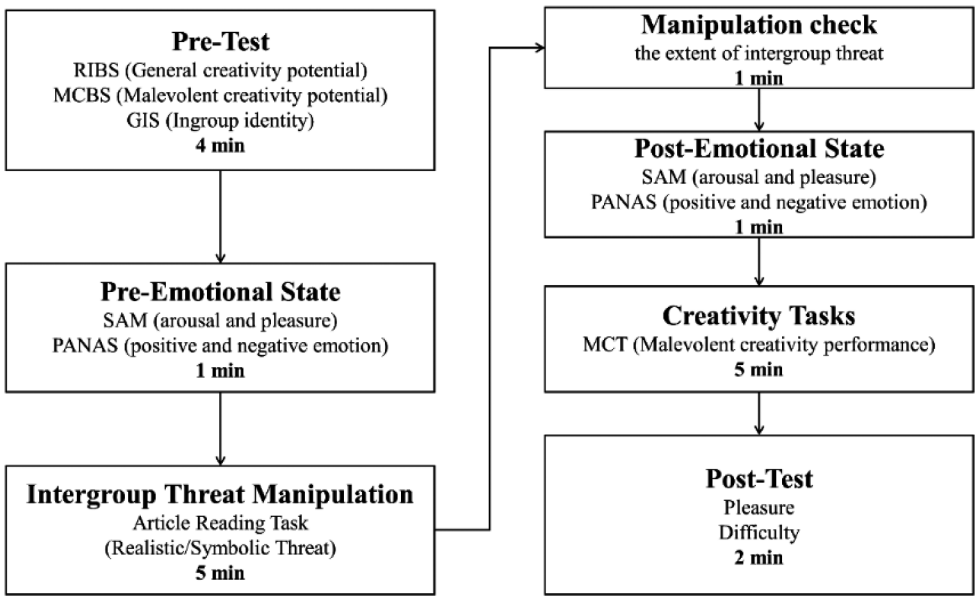

Fig. 5 Flow chart for experimental procedure in study 3

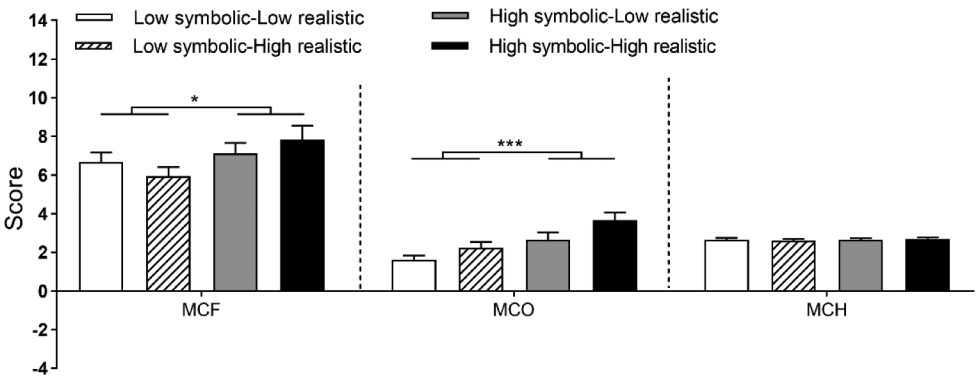

Fig. 6 Results of MANOVA on MCT Performances. MCF = MCT fluency; MCO = MCT originality; MCH = MCT harmfulness. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Correlation between MCT performances and other variables

Pearson's correlation analysis was used to test the correlations between MCT performance and the variables in the pre-test, pre-emotional state, and post-test (Table S2). MCT harmfulness was significantly correlated with MC potential (MCBS score; $r = .22$, $p = .014$).

Mediation analysis

A non-parametric percentile method of mediation analysis based on bootstrap bias correction was conducted using PROCESS (Hayes, 2013; model 4) with 5000 Bootstrap samples. MCT originality was chosen as the dependent variable, CONDITION (i.e., control-non directivity, control-directivity, threat-non directivity, and threat-directivity; converted into dummy variables; the control-non directivity condition as the baseline) was selected as the independent variable, post-emotional states were used as mediating variables, and pre-emotional states were used as covariates.

Results showed that pleasure mediated the relation between CONDITION and MCT originality (omnibus effect: $b = -0.01$, 95%CI = [-0.03, −0.01]). Specifically, pleasure completely mediated the relationship between threat-non directivity and MCT originality (indirect effect: $b = 0.07$, 95%CI = [0.01, 0.17]; direct effect: $b = 0.16$, 95%CI = [-0.04, 0.36]); pleasure partly mediated the relationship between threat-directivity and MCT originality (indirect effect: $b = 0.07$, 95%CI = [0.01, 0.17]; direct effect: $b = 0.35$, 95%CI = [0.15, 0.55]) (Table S3).

Other variables were not significant in mediating CONDITION-MCT originality relationship (arousal: $b = 0.01$, 95% CI = [-0.01, 0.01]; positive emotion: $b = -0.02$, 95% CI = [-0.03, 0.01]; negative emotion: $b = 0.01$, 95% CI = [-0.01, 0.02]).

Exploratory moderation analysis

The moderation analyses were conducted post hoc to exploratively investigate the potential moderating effects of in-group identity on the intergroup threat-MC relationship.

A non-parametric percentile method of moderation analysis based on bootstrap bias correction was conducted using PROCESS (Hayes, 2013; model 1) with 5000 Bootstrap samples. MCT performances (i.e., fluency, originality and harmfulness) were used as the dependent variable, THREAT (1 = intergroup threat condition [i.e., threat-non directivity and threat-directivity], 0 = control condition [i.e., control-non directivity and control-directivity]) as the independent variable and the score of ingroup identity was used as a moderators. Results revealed that ingroup identity significantly moderated the relation between intergroup threat and MCT originality ($b = 0.30$, 95% CI = [0.09, 0.52]). Specifically, intergroup threat positively predicted MCT originality when the level of ingroup identity was 1SD higher than the mean ($b = 0.44$, 95% CI = [0.27, 0.62]) or equal to the mean ($b = 0.27$ 95% CI = [0.14, 0.39]). However, the moderating effects of ingroup identity were not significant on fluency ($b = -0.35$, 95% CI = [-2.18, 1.47]) and harmfulness ($b = 0.23$, 95% CI = [-0.06, 0.51]).

Interim discussion

The results of Study 2 indicated that MCT originality was promoted more significantly in the threat directivity condition. These findings partially support H2, revealing that threatened individuals generated more original ideas that caused damage specifically to threatening out-group members rather than to irrelevant persons. This suggests that threatened individuals deter potential aggressors by retaliating against threatening outgroup members (McCullough et al., 2013; Sjöström & Gollwitzer, 2015). Correlation analyses showed that MCT harmfulness was positively related to MC potential, implying that a higher MC potential might impel individuals to perform MC behaviors (Hao et al., 2016). Moreover, a reduction in pleasure mediated the relationship between intergroup threat and MCT originality, which partially supports H4. Besides, intergroup threat only positively predicted MCT originality when individuals with average or high ingroup identity (partially consistent with H5).

Study 3

Our findings indicated that intergroup threats enhanced the originality of MC performance (Study 1) and found that MC target directivity promoted the originality of MC performance when individuals faced intergroup threats (Study 2). In Study 3, we used a two-factor between-subjects design to examine whether the forms of intergroup threat (realistic threat vs. symbolic threat) would exert distinct effects on MC performance (i.e., examining H3). Participants were randomly assigned to one of four groups: high realistic-high symbolic, high realistic-low symbolic, low realistic-high symbolic, and low realistic-low symbolic, each characterized by reading two distinct articles followed by completing the identical malevolent creativity task.

Method

Participants and procedure

A total of 96 college students were recruited (72 women; $M = 24.5$ years old, $SD = 2.02$). None of the participants reported a history of psychiatric disorders. One participant was excluded because the MCT answers did not match the task requirements. Finally, 95 partcipants were randomly assigned to the high realistic-high symbolic threat condition (23 participants), high realistic-low symbolic threat condition (24 participants), low realistic-low symbolic threat condition (24 participants), or low realistic-high symbolic threat condition (24 participants). The sex ratio was balanced (ratio of women:65.2%, 67.7%, 67.7%, and 67.7%, respectively). A post hoc power analysis showed that the sample size was sufficient ($\alpha = 0.05$; $1\text{-}\beta = 0.99$; Chow et al., 2017). All participants signed an informed consent form before the experiment and received ¥25 for participation upon completing the entire procedure.

Upon arrival, participants were randomly assigned to the high realistic-high symbolic threat, high realistic threat-low symbolic threat, low realistic-high symbolic threat, or low realistic-low symbolic threat conditions. Participants first completed the pre-test, including RIBS, MCBS, and GIS (4 min). Then, participants completed SAM and PANAS to measure their pre-emotional state (1 min). Next, participants were asked to read the corresponding articles (5 min; the order had been counterbalanced), and to complete a manipulation check (1 min) and assess post-emotional state (SAM and PANAS, 1 min). Next, the participants completed the MCT (5 min) on the computer. Finally, in the post-test, participants rated the levels of pleasure and difficulty of MCT (2 min). The experiment duration was 19 min. The experimental procedure is shown in Fig. 4.

Experimental tasks

The article reading task has been used to manipulate realistic and symbolic threats (Costello & Hodson, 2011; Morrison & Ybarra, 2009; Rios et al., 2018). Descriptions of tariff policies and military power have been used in realistic threat manipulation (Kamans et al., 2011). In the highly realistic condition (i.e., high realistic-high/low symbolic condition), the participants read an article referring to a foreign country increasing tariffs toward China and showing enormous military advantages over China (359 words) (S2.1), while the low realistic condition (i.e., low realistic-high/low symbolic condition) used an article describing the decreased tariffs toward China and the narrowing gap in military power between China and this foreign country (356 words) (S2.2). After reading the article, a single item was used to check whether the realistic threat was successfully manipulated: How unfavorable are the economic and military situations mentioned in the article for China's future interests? (1 = very unfavorable and 5 = very favorable) (Kamans et al., 2011). For symbolic threat manipulation, discrimination and prejudice toward the Chinese were selected as the content of the article. In the high-symbolic condition (i.e., high/low realistic-high symbolic condition), participants read an article about a foreign journalist who acted aggressively and disrespectfully toward Chinese tourists during an interview on negative descriptions of Chinese people (285 words) (S2.3), while the low-symbolic condition (i.e., high/low realistic-low symbolic condition) used an article about a foreign journalist acting calmly and respectfully toward Chinese tourists during an interview on culture differences (299 words) (S2.4). After reading the article, a single item was used to check whether the symbolic threat was successfully manipulated: What do you think about the status of foreign journalists during interviews with Chinese tourists? (1 = very low and 5 = very high) (Tajfel & Turner, 1986).

The MCT was used in Study 3 to evaluate the performance of malevolent creativity (Gao et al., 2022a; Hao et al., 2020; Qiao et al., 2022; i.e., Ming's roommate is very active in class, which makes Ming afraid of losing the limelight. Please help Ming generate as many novel ways as possible to secretly hurt his roommate so that he can't attend class). The scoring procedure was the same as in Studies 1 and 2 ($ICC_{[originality]} = 0.77$; $ICC_{[harmfulness]} = 0.87$).

Instruments

Participants were required to complete the RIBS (Cronbach's $\alpha = 0.88$), MCBS (Cronbach's $\alpha = 0.86$), SAM, PANAS (Pre-Emotional State: PA Cronbach's $\alpha = 0.68$, NA Cronbach's $\alpha = 0.87$; Post-Emotional State: PA Cronbach's $\alpha = 0.71$, NA Cronbach's $\alpha = 0.90$), and GIS (Cronbach's $\alpha = 0.85$). These scales were the same as those used in Studies 1 and 2.

Result

Manipulation check of intergroup threat

ANOVAs with realistic threat (high vs. low) and symbolic threat (high vs. low) as between-subjects independent variables were conducted on feelings of realistic threat and symbolic threat after manipulation, respectively. The results showed that realistic threat manipulation exerted a main effect on self-reported feelings of realistic threat, $F(1,91) = 97.63$, $p < .001$, $\eta_p^2 = 0.51$, similar to symbolic threat manipulation on feelings of symbolic threat, $F(1,91) = 51.56$, $p < .001$, $\eta_p^2 = 0.36$. Specifically, the feeling

of realistic threat in the high realistic condition ($M = 4.38$, $SD = 0.64$) was significantly higher than that in the low realistic condition (Bonferroni corrected; $M = 2.83$, $SD = 0.88$, $p < .001$; 95%CI = [1.23, 1.87]), while the feeling of symbolic threat in the high symbolic threat condition ($M = 4.45$, $SD = 0.88$) was significantly higher than that in the low symbolic threat condition (Bonferroni corrected; $M = 3.33$, $SD = 0.60$, $p < .001$; 95%CI = [0.80, 1.42]).

Additionally, the realistic threat manipulation did not change feelings of symbolic threat ($F(1,91) = 0.07$, $p = .722$, $\eta_p^2 = 0.00$), whereas the symbolic threat manipulation did not change feelings of realistic threat ($F(1,91) = 0.22$, $p = .642$, $\eta_p^2 = 0.00$).

Differences of MCT performance among four conditions

Several ANOVAs with realistic threat (high vs. low) and symbolic threat (high vs. low) as between-subject independent variables were conducted on MCT originality, fluency, and harmfulness respectively. The p values were fdr corrected.

Results revealed that the main effects of symbolic threat were significant on MCT fluency ($F(1,91) = 6.03$, $p_{(fdr)} = 0.048$, $\eta_p^2 = 0.06$) and originality ($F(1,91) = 4.68$, $p_{(fdr)} = 0.050$, $\eta_p^2 = 0.05$). Specifically, MCT fluency in the high symbolic threat condition ($M = 7.64$, $SD = 2.94$) was significantly higher than in the low symbolic threat condition (Bonferroni corrected; $M = 6.31$, $SD = 2.35$, 95%CI = [0.26, 2.42]); MCT originality in the high symbolic threat condition ($M = 1.32$, $SD = 0.24$) was significantly higher than in the low symbolic threat condition (Bonferroni corrected; $M = 1.21$, $SD = 0.27$, 95%CI = [0.01, 0.22]).The main effect of symbolic threat on MCT harmfulness was not significant ($F(1,91) = 0.25$, $p_{(fdr)} = 0.619$, $\eta_p^2 = 0.00$). The main effects of realistic threat on MCT fluency ($F(1,91) = 0.10$, $p_{(fdr)} = 1.000$, $\eta_p^2 = 0.00$), originality ($F(1,91) = 3.17$, $p_{(fdr)} = 0.235$, $\eta_p^2 = 0.03$) and harmfulness ($F(1,91) = 0.01$, $p_{(fdr)} = 0.929$, $\eta_p^2 = 0.00$) were not significant. The interaction effects between symbolic and realistic threat on MCT fluency ($F(1,91) = 2.61$, $p_{(fdr)} = 0.330$, $\eta_p^2 = 0.03$), originality ($F(1,91) = 0.27$, $p_{(fdr)} = 0.906$, $\eta_p^2 = 0.0$) and harmfulness ($F(1,91) = 0.25$, $p_{(fdr)} = 0.619$, $\eta_p^2 = 0.00$) were not significant.

After controlling several covariates (i.e., gender, MC potential, general creativity potential, task difficulty, and task pleasure), the effect of symbolic threat on MCT performances was still significant (ANOVA; symbolic threat-MCT fluency: $F(1, 85) = 5.63$, $p = .020$, $\eta_p^2 = 0.06$, 95%CI = [0.21, 2.43]; symbolic threat-MCT originality: $F(1, 86) = 4.04$, $p = .048$, $\eta_p^2 = 0.05$, 95%CI = [0.00, 0.20]).

Correlation analysis

Pearson's correlation analysis was used to test the correlations between the MCT performance and variables in the pre-test and pre-emotional states (Table S4). The MCT performance was not significantly correlated with any of the pretest variables.

Mediation analysis

Several non-parametric percentile methods of mediation analyses based on bootstrap bias correction were conducted using PROCESS (Hayes, 2013; model 4) with 5000 Bootstrap samples. MCT originality and fluency were used as dependent variables, symbolic threat (1 = high symbolic threat condition, 0 = low symbolic threat condition) as the independent variable, post-emotional states (i.e., the PANAS and SAM scores) as mediating variables, and pre-emotional states as covariates. Results showed that none of the post-emotional states were significant in mediating the symbolic threat-MCT originality relationship (pleasure: $b = -0.01$, 95%CI = [-0.05, 0.01]; arousal: $b = 0.01$, 95%CI = [-0.01, 0.03]; positive emotion: $b = -0.01$ 95%CI = [-0.04 0.01]; negative emotion: $b = -0.01$, 95%CI = [-0.05, 0.01]) and symbolic threat-MCT fluency (pleasure: $b = 0.01$, 95%CI = [-0.24, 0.34]; arousal: $b = -0.07$, 95%CI = [-0.53, 0.07]; positive emotion: $b = 0.06$, 95%CI = [-0.06, 0.42]; negative emotion: $b = -0.09$, 95%CI = [-0.59, 0.20]).

Exploratory moderation analysis

The following moderation analyses were conducted post hoc to exploratively investigate the potential moderating effects of in-group identity on the intergroup threat-MC relationship.

A non-parametric percentile method of moderation analysis based on bootstrap bias correction was conducted using PROCESS (Hayes, 2013; model 1) with 5000 Bootstrap samples. MCT performances (i.e., fluency, originality and harmfulness) were used as the dependent variable, symbolic threat (1 = high symbolic threat condition, 0 = low symbolic threat condition) as the independent variable and the score of ingroup identity was used as moderators. Results revealed that ingroup identity was not significant in moderating the effect of symbolic threat on all performance measures (fluency: $b = 0.44$, 95% CI = [-1.50, 2.37]; originality: $b = -0.01$, 95% CI = [-0.20, 0.17]; harmfulness: $b = -0.15$, 95% CI = [-0.49, 0.20]).

A non-parametric percentile method of moderation analysis based on bootstrap bias correction was conducted using PROCESS (Hayes, 2013; model 1) with 5000 Bootstrap samples. MCT performances (i.e., fluency, originality and

harmfulness) were used as the dependent variable, realistic threat (1 = high realistic threat condition, 0 = low realistic threat condition) as the independent variable and the score of ingroup identity was used as moderators. Results revealed that ingroup identity was not significant in moderating the effect of realistic threat on all performance measures (fluency: $b = 1.05$, 95% CI = [-0.86, 2.96]; originality: $b = 0.06$, 95% CI = [-0.12, 0.24]; harmfulness: $b = -0.06$, 95% CI = [-0.34, 0.22]).

Interim discussion

The results of Study 3 showed that only symbolic threats enhanced MCT originality and fluency, partially aligning with H3. This suggests that symbolic threats serve as a more compelling incentive for malevolent creative plans. Previous studies have found that these threats evoke high-arousal emotions (Martínez et al., 2022; Wirtz et al., 2016; Cottrell & Neuberg, 2005), potentially inducing individuals to generate malevolent solutions.

General discussion

The present study explored the effects of intergroup threats on MC and their underlying mechanisms using three experiments. Study 1 examined the promoting effect of intergroup threats on MC. The results showed that intergroup threats enhanced MCT originality, but did not affect general creativity. Next, we explored whether the MC target directivity (Study 2) promoted MC performance. The results revealed that MCT originality was higher when the MC was directed to the threatening out-group members than to the irrelevant persons. In Study 3, we investigated whether the promoting effect of intergroup threat on MC fluctuated with different intergroup threats (i.e., realistic and symbolic threats). The results demonstrated that only symbolic threats enhanced the fluency and originality of the generated malevolent ideas. Study 2 revealed that emotions were a significant path for intergroup threats to promote MCT originality, while ingroup identity moderated the relation between intergroup threat and MCT originality.

Study 1 revealed that only MCT originality was enhanced by intergroup threats, which is partially consistent with H1. Intergroup threats could activate destructive responses, such as malevolent creative plans, rather than constructive ones (De Dreu & Nijstad, 2008; Deutsch, 1973). Additionally, original approaches prove more effective and less detectable than common approaches when addressing intergroup threats, as evidenced by prior research (Cropley et al., 2008; Wang, 2019; Wiltermuth et al., 2017). Aligned with the threat mobilization hypothesis, individuals may mobilize more cognitive resources to generate original and useful malevolent approaches than regular aggressive approaches to effectively address intergroup threats (Baas et al., 2019; De Dreu et al., 2008; Walton & Kemmelmeier, 2012). Moreover, from the perspective of the threat identification model, intergroup threats give rise to positive identification with the ingroup (Schmid & Muldoon, 2015), enhancing hostile behavioral intentions and negative emotions (Guerra et al., 2022). This negative intergroup response tendency may cultivate malevolent ideas used to harm threatening outgroup members, manifested as an increase in the originality of malevolent ideas.

However, the results indicate that intergroup threat did not enhance MCT fluency and harmfulness in Study 1. According to the dual pathway to creativity model, individuals facing threats are expected to adopt a persistent pathway, wherein they remain focused and persistent on their target to generate creative ideas, narrowing their focus to a limited set of malevolent categories (De Dreu et al., 2008; Nijstad et al., 2010). Consequently, this narrowed focus restricts the total number of malevolent ideas. Perchtold-Stefan et al. (2022) observed that threat-induced persistence motivates individuals to invest more effort into each malevolent idea but does not necessarily increase idea fluency. In threatening situations, individuals' primary goal is to solve their current problems using all available resources (Baas et al., 2019; De Dreu et al., 2008; Walton & Kemmelmeier, 2012). Therefore, highly harmful yet relatively unrealistic solutions may be discarded, ultimately limiting the overall harmfulness of the generated ideas. Furthermore, general creativity was not affected by intergroup threats in Study 1. This aligns with previous findings indicating that social threats result in fewer ideas in general creativity tasks (Baas et al., 2019). It is suggested that individuals may lean more on MCT than on general creativity to cope with intergroup threats.

In Study 2, the originality of malevolent ideas was found to be higher when the MC target was directed at threatening out-group members than at irrelevant persons, partially supporting H2. This finding aligns with the deterrence theory, suggesting that threatened individuals may vicariously retaliate against threatening out-group members to intimidate potential aggressors from the same out-group (McCullough et al., 2013; Sjöström & Gollwitzer, 2015). It is noteworthy that threatening stimuli, such as faces of threatening out-group members, can capture individuals' attention (Chen & Zhao, 2015; Ferguson & Bargh, 2004; Johnson et al., 2019; Lipp & Waters, 2007). This heightened attention may further motivate threatened individuals to mobilize more resources for generating original malevolent methods specifically targeting threatening out-group members (Baas et al., 2019; Chajut & Algom, 2003; Johnson et al., 2019). Expanding on the threat mobilization hypothesis, the combined results

of Studies 1 and 2 illustrate that individuals tend to allocate more resources to effectively address the threat, as evidenced by their generation of malevolent ideas against the threatening target, compared to engaging in other actions unrelated to the threat.

It is noteworthy that the heightened impact of intergroup threats on MC performance persisted even when the MC target was not specified, as evidenced in the results of Studies 1 and 3. In the face of intergroup threats, individuals tend to allocate additional cognitive resources for processing threat-related information (Ferguson & Bargh, 2004; Johnson et al., 2019; Lipp & Waters, 2007). This increased allocation of resources to threat-related information not only amplifies MC directed toward threatening entities but also extends to MC directed at the general population. While MC directed at irrelevant individuals may not be as effective as that directed at a threatening out-group member, it can still function as a defense strategy against potential threats from another outgroup (McCullough et al., 2013; Sjöström & Gollwitzer, 2015).

The findings from Study 3 demonstrated that only symbolic threats had a positive impact on MCT originality, thus providing support for H3. Symbolic threats, being more strongly linked to hatred than realistic threats (Martínez et al., 2022), may further incite intergroup conflict behaviors (e.g., Sternberg, 2003). Considering that the central characteristic of MC involves intentional harm to others (Hao et al., 2016, 2020), it appears to be more responsive to symbolic threats than to realistic threats.

Moreover, the results of Study 3 revealed a positive effect of symbolic threats on MC fluency. This observation can be attributed to the impact of symbolic threats on high-arousal emotions (Martínez et al., 2022). Intense and high-arousal emotions may prompt an unconventional and irrational selection of solutions, thereby contributing to increased fluency in creativity tasks (Pham, 2007; Sohn et al., 2015). For instance, when individuals confront a symbolic threat, they may generate solutions that are more extreme and malevolent, even if these are difficult to be practically implemented.

The results indicated that pleasure significantly mediated the impact of intergroup threats on MCT originality, but this pattern was observed only in Study 2. While prior research has consistently underscored the crucial role of emotional states in MC, the emphasis has predominantly been on negative emotions. Specifically, researchers have established that anger boosts MC by elevating emotional arousal and aggression (Cheng et al., 2021a, b). When faced with intergroup threats, the alteration in overall pleasure levels may particularly predicted enhanced MC. According to the dual pathway to creativity model, the increase in negative emotion are linked to cognitive persistency in idea generation (Nijstad et al., 2010). This cognitive persistency can further enhance MC under external threats (Baas et al., 2019). Although reduced positive emotion is not directly linked to persistent pathway, the level of pleasure is inversely associated with intergroup threat-related negative emotion like disgust (e.g., García-Rodríguez et al., 2021). The decrease in pleasure could reflect an increase in these emotions, which may serve as an effective mediator. However, Studies 1 and 3 did not reveal the same mediation results as Study 2. The differences in study design and potential effects of other moderators could be possible reasons for this inconsistency. Additionally, the findings from Study 2 revealed that intergroup threat significantly predicted MCT originality only among individuals with average or high ingroup identity. Those with a pronounced ingroup identity tend to be more attuned to intergroup threats and are likely to exhibit more negative intergroup attitudes (Bizman & Yinon, 2001; Riek et al., 2010; Schmid & Muldoon, 2015). Consequently, it appears that intergroup threat may exclusively impact the MC in individuals who strongly identify with their group. However, these analyses were exploratory, and future empirical research is required to specifically investigate the effects of in-group identity on the relationship between intergroup threat and malevolent creativity.

Several limitations should be mentioned. First, this study relied solely on an article reading task to manipulate intergroup threats. Future research should consider diverse paradigms for manipulating such threats. Moreover, the content structure of the reading materials in the experimental and control conditions of Studies 1 and 2 showed inconsistencies. It should be rectified by using identical texts with modifications only to the ethnicities of the characters portrayed in future studies. Second, caution is necessary when extending these findings to other societies, as social groups with positive outgroup views may react differently to threats (Danbold & Huo et al., 2022). Third, the role of ingroup identity in moderating the intergroup threat-MC relationship also requires further investigation. For instance, various forms of group identities may differently influence the impact of intergroup threats on MC (Guerra et al., 2022). Fourth, given the high proportion of female participants, generalizing these findings to males should be cautious. Studies show gender differences in MC (Lee & Dow, 2011; Zhao et al., 2022; Harris & Reiter-Palmon, 2015), but recent research suggested similar MC levels across genders with different brain processes (Perchtold-Stefan et al., 2023). Women may have stronger reactions to social threats (Benenson et al., 2011, 2013; Perchtold-Stefan et al., 2022). In this study, threatening out-group members in task materials were predominantly male. It may have led to cross-categorization for female participants, who perceive these members in terms of both gender and nationality (Mullen et al., 2001), potentially heightening perceived threats and

involvement in MC compared to male participants. Future studies should ensure a gender balance in task characters or consider disguising the gender information of victims and perpetrators in the materials. Fifth, future research should explore specific emotions like hatred, humiliation, and disgust in greater depth, as these may mediate the impact of intergroup threats, particularly symbolic threats, on MC (Martínez et al., 2022; Halperin, 2008). More enduring and intense negative emotions could be key mediators. Sixth, cultural and individual variations in emotional regulation (Mesquita & Frijda, 2011) also warrant examination for their effects on MC under intergroup threats. Seventh, considering MC's characteristic of breaking moral norms (Qiao et al., 2022), investigating individual differences in moral identity is important. Lastly, MCT results may be influenced by cumulative effects from manipulation checks and emotional measures (SAM and PANAS). Regarding the analysis methodology, the effects of post-hoc analysis may be limited in testing novel hypotheses (Heinsberg & Weeks, 2022). Future research could reference this study's effect sizes when investigating intergroup threat and MC. The current study focuses on exploring novel, aggressive behaviors under threat. However, responses to threats are diverse. For instance, future research could attempt to explore whether and how threatened individuals might transfer the crisis to others in novel ways.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11031-024-10070-5.

Acknowledgements This work was supported by the STI 2030-Major Projects 2021ZD0200500.

Data availability The data of current study is available from the corresponding author upon request.

Declarations

Competing interests There is no conflict of interest in the present study.

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