Regulating Emotion by Imagining the Reverse: Evidence for Reversal Imagery

Abstract

People cope with distress not only by reinterpreting what happened or looking away from it, but also by imagining the scene reversed—becoming the rejecter rather than the rejected, or picturing a lost object safely restored. We term this process reversal imagery (RI): generating a reversed second scene alongside the original distressing one and using the affect it supplies to counter the original emotion. Across one pilot study and five main studies comprising eleven experiments, RI emerged as an effective and distinctive emotion-regulation strategy. Participants spontaneously gravitated toward RI-consistent coping, and when instructed, RI reduced negative affect more than distancing, distraction, and cognitive reappraisal, without requiring greater time or subjective effort. Mechanistically, RI worked not by changing an event's meaning, but by generating a vivid reversed scene that produced counter-valent affect online; positive-affect gain statistically accounted for much of RI's regulatory effect, and converging task-switching and individual-differences evidence indicated that RI was anchored more strongly in visual imagery than in semantic reinterpretation. Crucially, RI's immediate relief was broadly context-general—emerging across interpersonal and event-based scenes and remaining intact under monetary loss—whereas its durability depended on two separable boundary conditions. Relief was more sustained when an interpersonal target allowed a symbolically satisfying reversal, but it was more likely to rebound when the original loss was concrete and unresolved: monetary deductions left in-the-moment relief largely intact yet increased negative affect after regulation stopped. RI thus identifies a scene-generating route to emotion regulation: the mind can reduce distress not only by changing reality's meaning, but by constructing a reversed alternative that makes the original hurt less emotionally dominant.

Introduction

"Man is nothing else but what he makes of himself." — Jean-Paul Sartre

At the core of human experience lies a stubborn paradox: we are thrown into a world not of our choosing, yet we relentlessly imagine how it might be otherwise. Thus, our resistance to adversity often unfolds not through overt action but through reversals in imagination (Cocquyt & Palombo, 2023): A person who has lost a wallet may suddenly picture it safely lying at home; a person who feels rejected may imagine becoming the one who rejects others. Such imagined reversals do not erase what actually happened. Rather, they create a brief alternative scene that may reduce the emotional weight of the original one, consistent with the affective function of counterfactual thinking (Roese, 1994). By reversing roles, outcomes, or power relations, people may momentarily reduce distress and recover a sense of control over an otherwise unwanted event (Nasco & Marsh, 1999). Yet this common experience has received little direct attention in emotion regulation (ER) research. Is this merely escapist fantasy, or does it represent a distinct regulatory strategy with its own mechanisms and boundary conditions?

Several established constructs partly overlap with this phenomenon, but none fully captures it. *Counterfactual thinking* examines imagined alternatives to reality—what might have happened instead (Epstude & Roese, 2008; Roese, 1997; Van Hoeck, 2015), but it is usually studied as a reflective process that supports causal learning and future behavior change. *Mental simulation* also involves imagining alternative scenarios (Addis et al., 2007; D'Argembeau & Van der Linden, 2004; Taylor & Schneider, 1989), but it is typically prospective, helping individuals prepare for future events. Defensive processes such as *projection* (Freud, 1961), *catharsis*, or *compensation* (Bushman et al., 1999) may redistribute emotion across targets or channels, but they do not center on the structured reversal of the distressing episode itself. What remains underexplored is a more immediate process: using an imagined reversed scene to reduce the emotional dominance of an actual negative scene.

ER research provides a more direct lens, but it still leaves an important gap. *Cognitive reappraisal* (CR) changes how a negative event is interpreted, whereas *distraction* and *distancing* reduce attention to, or psychological involvement with, the event (Ochsner & Gross, 2005; Webb et al., 2012a). These strategies differ in their operations, but they share a common assumption: the original distressing scene remains the main object of regulation. Reappraisal changes its meaning, distancing changes the vantage point from which it is viewed, and distraction reduces engagement with it. Emerging evidence suggests that persistent distress may stem precisely from this singular reliance on the original representation (Kross & Ayduk, 2017) , pointing to an overlooked regulatory possibility: a process that does not operate on the distressing scene at all, but generates a second, reversed scene to stand alongside the original and competes with its emotional impact. This overlooked possibility is the focus of the present work.

This distinction is theoretically important. If a strategy works by modifying the original scene, then its mechanism should depend on the type of operation being performed: semantic reinterpretation for reappraisal, attentional disengagement for distraction, or changes in self-distance for distancing. By contrast, a strategy that generates a second scene should depend on the systems that support scene generation, especially visual imagery. It should also show a different pattern of success and failure: it may work well when the reversed scene can provide a satisfying emotional counterweight, but it may be less durable when the original event involves tangible and irreversible loss. Thus, treating this phenomenon as merely another form of reappraisal, distancing, or counterfactual thinking would obscure the predictions that follow from its core feature: regulation through scene generation rather than modification of the original scene.

With this framing in place, three substantive questions become tractable. First, does regulation through a reversed counter-scene differ, mechanistically and functionally, from established strategies that operate on the original scene? Second, through what cognitive-affective operations does it produce relief, and what processing systems support these operations? Third, what determines its boundary conditions—when does a reversed counter-scene produce durable relief, and when does the original distress re-emerge once regulation ends?

We term this phenomenon *reversal imagery* (RI). RI refers to an ER strategy in which individuals construct an imagined scene that reverses a key element of a distressing event—such as the role, outcome, or power relation—and use this reversed scene to reduce the affective dominance of the original one. RI thereby occupies a functional niche that the established families do not: rather than modifying the meaning of, attention to, or vantage on the original scene (Gross, 1998a), it introduces a second scene-level representation whose reversed configuration provides the counter-valent affect that regulation exploits. It also diverges from neighboring scene-generating constructs—counterfactual thinking (Roese, 1997) and mental simulation (Taylor & Schneider, 1989)—whose generated scenes serve analytic or preparatory purposes; RI's generated scene, by contrast, is immediate, spontaneous, and explicitly reparative in function. The functional niche of RI within the broader landscape of regulation strategies is illustrated in **Figure 1**.

Specifically, we posit that RI involves three core components: (1) *scene deconstruction*, that is, the identification of a reversible element of the distressing episode, such as a role, action, or outcome; (2) *scene reversal*, the construction of an imagined scenario in which that element is reversed; and (3) *positive-emotion counteraction*, the reversed image elicits counter-valent affect—such as relief, control, satisfaction, or restored dignity—that partly counterbalances the original negative emotion. We describe these components as a sequence for analytic clarity, but they need not unfold as strictly separate stages. In actual experience, constructing the reversed scene and feeling the counter-emotion may occur in a tightly coupled manner.

Building on this process view, we distinguish two primary forms of RI. In interpersonal contexts, such as exclusion or humiliation, the most salient reversible element is often who holds power in the scene. Here, RI takes the form of *role reversal*: the harmed person imagines becoming the agent rather than the victim (Abeditehrani et al., 2021; Yaniv, 2012). This reversal may restore a sense of control and may also elicit symbolic retaliation or imagined revenge (Richman & Leary, 2009). Importantly, RI is defined as an imagined and symbolic reversal, not as endorsement of real-world retaliation or aggression. The present work therefore examines "an eye for an eye" as a virtual affect-regulatory phenomenon rather than as a behavioral prescription. In event-based contexts, such as losing an item, failing an exam, or experiencing an accident, there is often no clear interpersonal target. The most salient reversible element is therefore what happened. Here, RI takes the form of *outcome reversal*: the person imagines that the loss did not occur, the failure was avoided, or the negative outcome was undone (Gavanski & Wells, 1989). This can also restore a sense of control (Epstude & Roese, 2008; Thompson, 1981), but it lacks the interpersonal satisfaction that comes from reversing roles with a harm-doer. We therefore predict that interpersonal and event-based RI may produce similar immediate relief, but differ in durability. Taken together, we hypothesize that role reversal and outcome reversal share a common control-restoration channel, while differing in whether a context-specific retaliatory experience is recruited alongside it—an asymmetry that should have few consequences for immediate regulatory efficacy, but important consequences for its durability, given that control over tangible, irreversible outcomes cannot be genuinely secured through imagination alone (Rothbaum et al., 1982).

The present research tested three questions across one pilot and five empirical studies comprising eleven experiments.

First, **is RI an effective and distinctive ER strategy?** We tested whether RI reduces negative affect, whether its effect depends specifically on reversal rather than generic perspective change, and whether it outperforms established strategies such as reappraisal and distraction without requiring greater time or effort.

Second, **how does RI work?** We tested whether RI operates through an imagery-based counter-emotion pathway, and whether this pathway differs from the semantic reinterpretation pathway that characterizes CR. We further examined whether RI depends more strongly on visual-imagery processing than on semantic-conceptual processing.

Third, **when is RI's relief lasting versus transient?** We examined RI in interpersonal and event-based contexts, using emotional rebound—the re-emergence or persistence of negative affect after an initial decrease during regulation—as an index of regulatory durability. We tested whether RI produces comparable immediate relief across contexts but stronger rebound in event-based contexts, and whether tangible loss independently amplifies this rebound beyond interpersonal target availability.

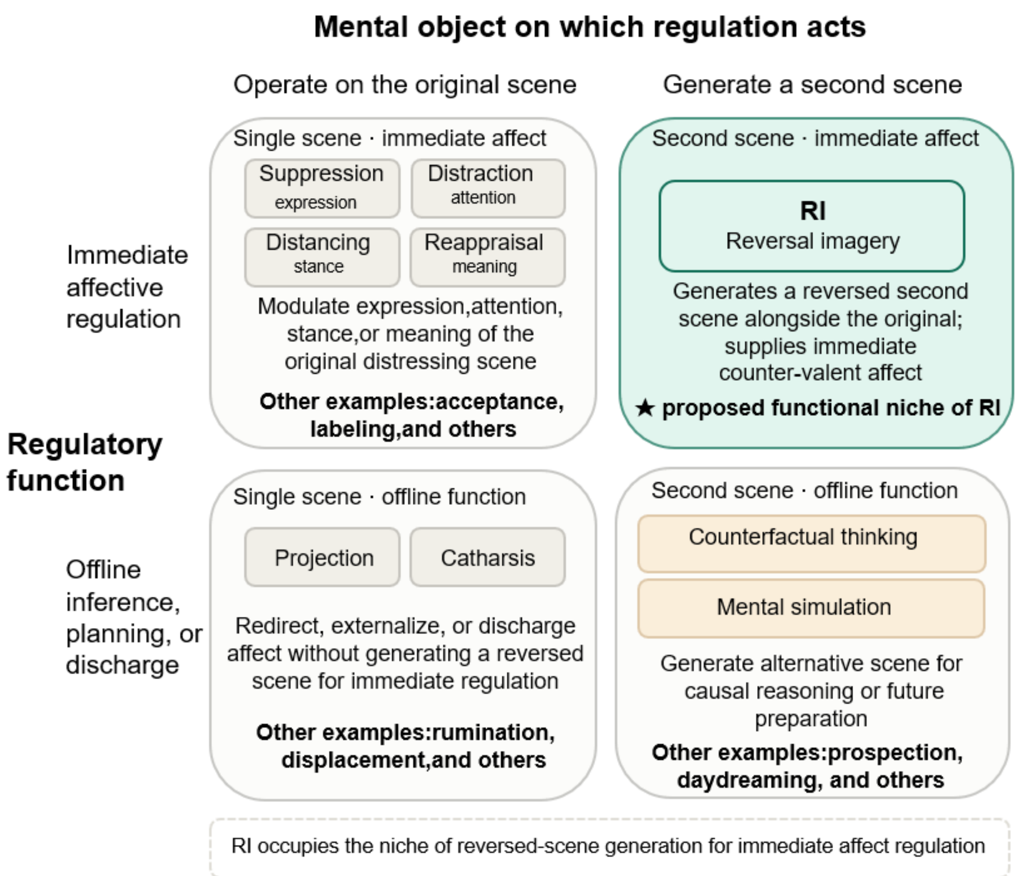

Figure 1: Functional niche of reversal imagery within emotion regulation and neighboring imagination-based constructs. Established ER strategies can be organized by the operation they perform on the distressing episode. Suppression, distraction, distancing, and reappraisal primarily operate on the original scene by modulating expression, attention, stance, or meaning. Other constructs may redirect or discharge affect without generating a reversed scene for immediate regulation. By contrast, counterfactual thinking and mental simulation generate alternative scenes, but these scenes are typically used for causal reasoning or future preparation. RI occupies a distinct niche: it generates a reversed second scene alongside the original and uses the counter-valent affect supplied by that scene for immediate affective repair.

Study Overview

The present research comprises one pilot and five main studies, encompassing eleven experiments in total (see **Table 1** for an overview of the purpose, key comparisons, and main measures of each study). **The pilot** established the foundation for the program—validating the experimental stimuli and measures and documenting spontaneous RI preference before the three research questions were tested. It provided preliminary evidence that instructed RI reliably engaged the hypothesized three core components of deconstruction, reversal, and emotional counteraction. Crucially, the pilot additionally established that RI-consistent coping is spontaneously preferred by participants even without explicit instruction—role reversal for interpersonal scenarios, outcome reversal for event-based scenarios—suggesting that RI captures an intuitive regulatory tendency rather than an artificial laboratory imposition.

Studies 1 and 2 addressed **Research Question 1—whether RI is an effective and distinctive ER strategy**—by evaluating its efficacy, the specificity of reversal, and its efficiency relative to established strategies. **Study 1** provided an initial validation in a social exclusion scenario, comparing RI (adopting the excluder's perspective) with passive viewing (PV) of the victim perspective. **Study 2a** asked whether RI's advantage derives from the reversed directionality of the generated counter-scene per se, by contrasting three replacement-based perspectives along a "you–me–other" axis: direct immersion (DI) into the victim's perspective ("me"), role reversal into the excluder's perspective ("you"), and distanced observation from a bystander's perspective ("other"), all applied to social-exclusion scenes. **Study 2b** extended the comparison to classic ER strategies from different regulatory families—CR (meaning modification) and distraction (attentional redirection)—across both interpersonal and event-based contexts, and additionally assessed regulation duration and subjective effort to quantify cognitive efficiency.

Studies 3 and 4 addressed **Research Question 2—how RI works**—by examining its imagery-based counter-emotion pathway and the visual-versus-semantic processing systems supporting it. **Study 3a** used retrospective feature ratings and causal mediation analyses to identify RI-specific cognitive features (scene generation and emotional opposition) and to quantify how much of RI's regulatory effect is transmitted through these features relative to shared features (appraisal change, meaning reconstruction). **Study 3b** complemented this by tracking positive and negative affect in real time during regulation, testing whether counter-affective responses emerge during strategy implementation rather than being reconstructed post-hoc, and whether online positive-emotion gain mediates RI's advantage. **Study 4a** employed a task-switching paradigm to test for selective interference from preceding visual versus semantic tasks, predicting a crossover interaction in which RI would be disproportionately impaired after visual tasks and CR after semantic tasks. **Study 4b** adopted a complementary individual-differences approach, asking whether stable cognitive styles—visual versus verbal preference measured by the Visualizer-Verbalizer Questionnaire—differentially predict success with RI versus CR.

Study 5 addressed **Research Question 3—when RI's relief is lasting versus transient**—by mapping emotional rebound across interpersonal and event-based contexts and the role of tangible loss. **Study 5a** dissociated a context-general control-restoration channel from a context-specific retaliation experience, using motivational ratings combined with hierarchical regression to test whether control predicts regulation success across contexts while revenge predicts success specifically in interpersonal settings. **Study 5b** tested whether this motivational dissociation produces distinct behavioral signatures by tracking V-shaped emotional trajectories (before, during, and after regulation) in interpersonal versus event-based contexts. **Study 5c** provided a causal test of the tangibility hypothesis by experimentally manipulating monetary-loss magnitude (¥0, ¥1, ¥5) on a trial-by-trial basis, examining whether larger tangible losses monotonically amplify post-regulation rebound without affecting immediate efficacy, and whether this amplification operates similarly in both contexts.

Table 1. Summary of the pilot and five studies, organized by the three research questions: the distinctiveness and efficacy of RI (Studies 1–2), its cognitive-affective mechanism (Studies 3–4), and its contextual boundaries (Study 5).

Study	Purpose	Comparison	Method / Main measures
Foundation — Stimulus validation and spontaneous RI preference			
Pilot	1) Validate stimuli; 2) Test participants' spontaneous RI preferences; 3) Establish preliminary evidence for the RI components	RI in interpersonal vs event-based scenes	1) Preliminary questionnaire + main task; 2) Trial-level affect ratings, block-level cognitive features and counter-emotions
1	Establish basic efficacy of RI	PV vs RI in social exclusion	1) Within-subject picture task; 2) Negative-emotion ratings
Research Question 1 — Is RI an effective and distinctive ER strategy?			
2a	Test whether reversed directionality (not perspective change per se) drives RI's efficacy	PV vs DI ("me") vs RI ("you") vs distancing ("other") in social exclusion	1) Block design; 2) Negative-emotion ratings during-regulation and 20-min post-task re-ratings
2b	1) Compare RI against classic ER families; 2) Assess cognitive efficiency	PV vs RI vs CR vs distraction; both interpersonal and event contexts	1) Self-paced trials; 2) Negative-emotion + regulation-duration + subjective-effort ratings
Research Question 2 — How does RI work?			
3a	Identify RI-specific cognitive features and their mediating role	PV vs RI vs CR	1) Mini-block design; 2) Trial-level ER success + block-level feature ratings (scene generation, emotional opposition, appraisal change, meaning reconstruction); 3) Causal mediation with each feature
3b	1) Track real-time emergence of counter-affect; 2) Test whether it mediates RI's advantage	PV vs RI vs CR	1) Extended 16-s windows; 2) Pre/post positive and negative affect; 3) Emotional Counteraction Index; 4) Mediation via online positive-emotion gain
4a	Test processing-system dissociation at the state level via task-switching interference	2 (RI vs CR) × 2 (visual vs semantic preceding task)	1) Task-switching paradigm; 2) Trial-level ER success; 3) Block-level task difficulty and switch difficulty
4b	Test the same dissociation at the trait level via individual differences in cognitive style	RI vs CR moderated by visual and verbal preference (Richardson's VVQ) as continuous covariates	1) Repeated-measures ANCOVA; 2) Simple-slope analysis
Research Question 3 — When is RI's relief lasting versus transient?			

Study	Purpose	Comparison	Method / Main measures
5a	Dissociate context-specific retaliation from context-general control	1) 2 (RI vs CR) × 2 (interpersonal vs event); 2) Motivational ratings	1) Revenge and control ratings; 2) Hierarchical regression testing context-specific vs context-general pathways
5b	Test whether the motivational dissociation produces distinct behavioral signatures (emotional rebound)	2 (interpersonal vs event-based) × 3 (before, during, after regulation)	1) V-shaped trajectory analysis; 2) Context × time interaction
5c	Causal test of the tangibility hypothesis	2 (interpersonal vs event) × 3 (¥0 vs ¥1 vs ¥5) × 3 (before, during, after)	1) Monetary-deduction manipulation; 2) Dose-response rebound analysis

Note. RI = reversal imagery; PV = passive viewing; CR = cognitive reappraisal; DI = direct immersion; ER = emotion regulation; VVQ = Visualizer-Verbalizer Questionnaire.

Pilot Study —Validation of Materials and RI Procedure

Before testing RI's efficacy and mechanisms in the main studies, we conducted a pilot study with three objectives. First, we examined whether participants could distinguish interpersonal from event-based contexts and whether they spontaneously preferred RI-consistent coping strategies within a structured choice format—role reversal for interpersonal harm and outcome reversal for event-based setbacks—before receiving any explicit RI instructions. This tested whether RI reflects an intuitive regulatory tendency rather than an artificial laboratory demand.

Second, we validated the stimulus materials by obtaining item-level ratings of negative intensity, arousal, and scene vividness. These ratings allowed us to confirm that both stimulus categories reliably induced negative affect and were broadly matched in baseline affective properties, while also supporting balanced stimulus assignment in later experiments.

Third, we tested whether the RI procedure engaged the proposed cognitive–affective components. Participants rated their emotional change after imagining a reversed scenario, as well as block-level indices of scene deconstruction, scene reversal, emotional counteraction, and context-specific counter-emotions. These measures provided preliminary evidence that the RI instructions elicited the core processes and affective outputs specified by the model.

Methods

Participants

Thirty participants (15 men, 15 women; $M = 21.07$, $SD = 1.40$) took part in the study. All provided informed consent and received compensation for their participation.

Materials

The experimental stimuli were organized into two primary categories: interpersonal context and event-based context, with 50 images in each category (100 images in total; **Figure 2A**).

The interpersonal context consisted of social exclusion scenarios, providing a concrete instantiation of interpersonal negative experiences. Images were selected from the Social Inclusion and Exclusion in Asian Young Adult database (Zheng et al., 2022) and typically depicted one rejected individual with sad or upset facial and bodily expressions and three or four rejecters talking and/or laughing together. Such scenes reliably elicit negative affect associated with rejection, inferiority, and interpersonal threat (He et al., 2023).

The event-based context included negative situations unrelated or less related to social interaction, representing common adverse life events such as loss of personal belongings, academic failure, accidental injury, pest infestation, and financial or material loss. Images for this category were obtained from public online sources as well as standardized affective image sets, including the International Affective Picture System (IAPS; Lang et al., 2008) and the Chinese Affective Picture System (CAPS； Lu et al., 2005). These stimuli were chosen to capture adverse experiences unrelated to social interaction and to ensure a broad range of affective intensity.

All images were resized to a common resolution, and luminance and contrast were checked and matched as closely as possible across stimulus categories. They were pre-rated by an independent sample on three 9-point scales: negative intensity, arousal, and vividness. These ratings confirmed that the stimuli reliably induced negative affect and were suitable for use across experimental conditions.

Preliminary questionnaire

Prior to the main RI task, participants completed a brief preliminary questionnaire designed to (a) verify that they could reliably distinguish interpersonal from event-based scenes and (b) assess whether they spontaneously gravitated toward RI-consistent coping strategies in each context (role reversal for interpersonal scenarios and outcome reversal for event-based scenarios). All 100 images (50 interpersonal, 50 event-based) were used.

Responses were collected at two levels. At the trial level, participants classified each scenario as *interpersonal*, *non-interpersonal/event-based*, or *mixed*. At the block level (every five consecutive trials), participants indicated how they would typically cope with the types of situations they had just viewed. Because the goal was to assess whether participants preferentially selected RI-consistent coping when it was available, coping preference was measured using a forced-choice format rather than an open-ended free-response format. For interpersonal images, the options were: (a) *imagining yourself fighting back, gaining the upper hand, or being the one doing the excluding* (role-reversal tendency), (b) *imagining the rejection or exclusion never happened, or that you were actually accepted* (outcome-reversal tendency), or (c) *using other coping methods*. For event-based images, the options were: (a) *imagining the event never happened* *or that the outcome was better than in reality* (outcome-reversal tendency), (b) *imagining yourself as having caused or controlled the situation rather than being the victim* (role-reversal tendency), or (c) *using other coping methods*. Participants' scene-classification accuracy and coping preferences are summarized in **Figure 2B**.

Main task procedure

Prior to the main task, participants received standardized training (approximately 5 minutes) to ensure accurate understanding and implementation of RI. During training, participants viewed sample negative images from both interpersonal and event-based contexts and practiced applying RI under supervision—imagining role reversal for interpersonal scenarios and outcome reversal for event-based scenarios. They were also introduced to the trial-level rating dimensions (negative intensity, arousal, vividness, emotional change) and block-level assessments of RI components and context-specific counter-emotional responses, with examples provided to ensure comprehension. Training continued until participants demonstrated adequate familiarity with the strategy instructions and the meaning of each rating item.

As shown in **Figure 2C**, each trial began with the presentation of a negative image from either the interpersonal context (e.g., social exclusion) or the event-based context (e.g., losing personal belongings). Participants first passively viewed the image and rated their immediate emotional response on three 9-point scales (1 = not at all, 9 = extremely): negative-emotion intensity, arousal, and scene vividness. Next, participants were instructed to implement the RI strategy, that is, to imagine a reversed version of the scenario (e.g., imagining themselves as the excluder rather than the excluded, or imagining that the lost item was recovered or the failure averted; detailed RI instructions are provided in **SI-Text 2**). They then rated their overall emotional change on a scale from −3 (much worse) to +3 (much better).

Emotional and cognitive responses were assessed at two levels: trial-level (after each stimulus) and block-level (every five trials).

Trial-level measures. After each picture stimulus, participants provided three immediate ratings on 9-point scales (1 = not at all, 9 = extremely): negative emotion intensity, arousal, and scene vividness. They then rated their overall emotional change after imagining the reversed scenario on a scale from −3 (much worse) to +3 (much better).

Block-level measures. Every five trials, participants were first asked to recall the image that evoked the strongest emotional response and briefly describe the reversed scenario they had imagined. They then completed two retrospective assessments.

The first assessment targeted the cognitive mechanisms of RI and was identical across the two stimulus contexts. Participants were instructed to reflect on their imagination process and rate the clarity of each cognitive step on 9-point scales (1 = not at all clear, 9 = extremely clear). Three subscales corresponded to the proposed RI components: (1) *scene deconstruction* (extent to which participants identified the key replaceable element of the distressing scene), (2) *scene reversal* (extent to which an alternative, reversed scenario was vividly constructed), and (3) *emotional counteraction* (extent to which they were aware of opposing emotions emerging and counterbalancing the initial negative affect).

The second assessment measured the actual intensity of specific counter-emotions elicited by the reversed scenario (1 = not at all, 9 = extremely). We use the term *counter-emotion items* to refer to context-specific positive or retaliatory emotional states (and perceived control) that emerge after RI and functionally counterbalance the initial negative affect. This measure is conceptually distinct from the *emotional counteraction* rating above: whereas emotional counteraction assesses metacognitive awareness of the counterbalancing process, counter-emotion items assess the actual intensity of specific emotional experiences elicited by the reversed scenario.

Counter-emotion items differed by context to capture the qualitatively distinct affective consequences of RI. In interpersonal contexts, In interpersonal contexts, social exclusion and rejection can elicit retaliatory motivation and revenge-related positive affect, partly as a response to threatened belonging and social standing (Chester & DeWall, 2017; Richman & Leary, 2009); accordingly, participants rated senses of *revenge*, *superiority*, and *satisfaction*—emotions reflecting the imagined redress of social harm and reassertion of relational standing. In event-based contexts, adverse events such as material loss or failure typically threaten perceived control and security (Rothbaum et al., 1982; Thompson, 1981); accordingly, participants rated senses of *safety*, *relaxation*, and *release*—emotions reflecting the restoration of psychological security and relief from uncontrollable circumstances. Both contexts included a shared item—perceived control—because restoring perceived control is a central function of coping with aversive or uncontrollable events (Heckhausen & Schulz, 1995; Rothbaum et al., 1982; Thompson, 1981b). This design enabled consistent measurement of cognitive processes across contexts while capturing context-specific counter-emotions elicited by the imagined reversal.

Statistics

Preliminary questionnaire. For scene classification (trial level), classification accuracy was computed as the proportion of responses correctly identifying each image's normed category (interpersonal or event-based). For coping preference (block level), we calculated the proportion of responses selecting each option (role reversal, outcome reversal, or other methods) separately for interpersonal and event-based blocks. To evaluate whether recognition of the intended context exceeded chance and whether RI-consistent tendencies predominated, one-sample *t*-tests were conducted against a theoretical proportion of 1/3, with Cohen's *d* as the effect size. Multiple comparisons were corrected using the False Discovery Rate (FDR) method.

Main task. Item-based analyses were conducted at two levels to accommodate the hierarchical structure of the stimuli.

-At the trial level, each picture served as a unit of analysis (50 interpersonal vs. 50 event-based images), appropriate for attributes assessed per individual image, including *negative intensity*, *arousal*, *vividness*, and *emotional change after RI*.

-At the block level, each block served as a unit of analysis (10 interpersonal vs. 10 event-based blocks), appropriate for attributes defined at the block level, including *scene deconstruction*, *scenario reversal*, *emotional counteraction*, and *counter-affective responses*.

For each item, mean ratings were first computed across participants. To verify that stimuli were perceived as intended, one-sample *t*-tests were conducted against the scale minimum or midpoint to confirm that ratings fell within the expected range. Multiple comparisons were corrected using the FDR method. Differences between interpersonal and event-based stimuli were examined using paired-sample *t*-tests, with Cohen's *d* as the effect size.

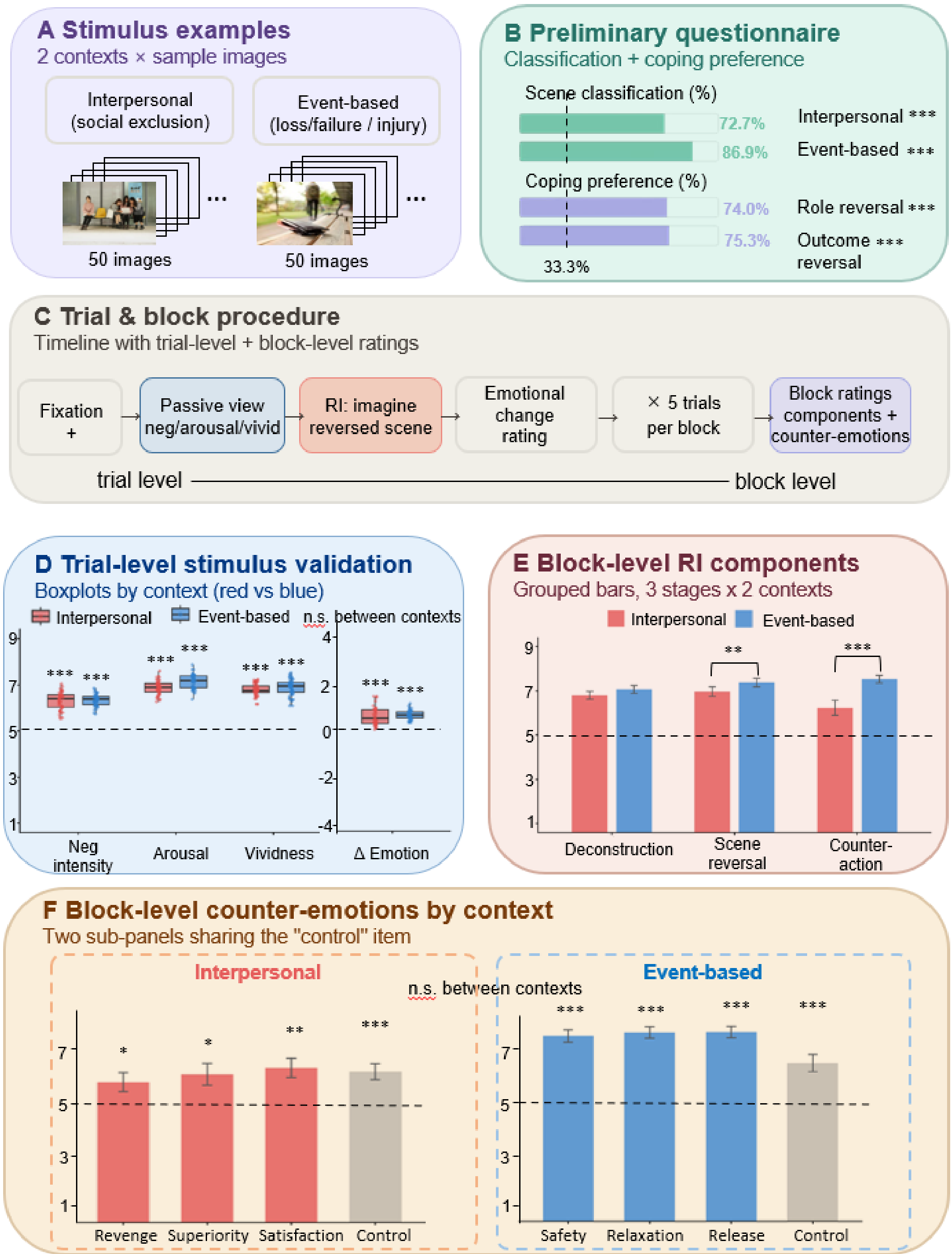
A Stimulus examples
2 contexts × sample images
Interpersonal (social exclusion)
Event-based (loss/failure / injury)
50 images
50 images
B Preliminary questionnaire
Classification + coping preference
Scene classification (%)
72.7%
86.9%
Interpersonal ***
Event-based ***
Coping preference (%)
74.0%
75.3%
Role reversal ***
Outcome reversal ***
33.3%
C Trial & block procedure
Timeline with trial-level + block-level ratings
Fixation +
Passive view neg/arousal/vivid
RI: imagine reversed scene
Emotional change rating
× 5 trials per block
Block ratings components + counter-emotions
trial level
block level
D Trial-level stimulus validation
Boxplots by context (red vs blue)
Interpersonal
Event-based
n.s. between contexts
Neg intensity
Arousal
Vividness
Δ Emotion
E Block-level RI components
Grouped bars, 3 stages x 2 contexts
Interpersonal
Event-based
Deconstruction
Scene reversal
Counter-action
F Block-level counter-emotions by context
Two sub-panels sharing the "control" item
Interpersonal
n.s. between contexts
Revenge
Superiority
Satisfaction
Control
Event-based
Safety
Relaxation
Release
Control

Figure 2. Pilot study design and validation results. (A) Example stimuli from the two context categories used in the pilot study: interpersonal social-exclusion scenes and event-based negative scenes, with 50 images in each category. **(B)** Preliminary questionnaire results. Participants classified each image as interpersonal, event-based, or mixed, and selected how they would typically cope with the scenarios in a structured choice format. Classification accuracy exceeded the chance level of 33.3% for both interpersonal and event-based images. Participants also preferentially selected RI-consistent coping strategies: role reversal for interpersonal scenarios and outcome reversal for event-based scenarios. **(C)** Trial and block procedure. On each trial, participants passively viewed a negative image and rated negative affect, arousal, and vividness. They then implemented RI by imagining a reversed version of the scenario and rated their emotional change. Every five trials, participants completed block-level ratings of RI components and context-specific counter-emotions. **(D)** Trial-level stimulus validation. Boxplots show negative intensity, arousal, vividness, and emotional change after RI for interpersonal and event-based images. Negative intensity was tested against the scale minimum (1 = not negative), arousal and vividness were tested against the scale midpoint (5), and emotional change was tested against zero. Both contexts showed reliable negative affect, moderate-to-high arousal and vividness, and positive emotional change after RI, with no significant differences between contexts. Dashed horizontal lines indicate the relevant reference values for arousal/vividness and emotional change. **(E)** Block-level ratings of RI components. Both contexts showed clear engagement of scene deconstruction, scene reversal, and emotional counteraction. Event-based blocks showed higher ratings than interpersonal blocks for scene reversal and emotional counteraction, whereas scene deconstruction did not differ significantly between contexts. **(F)** Context-specific counter-emotions. Interpersonal blocks elicited revenge, superiority, satisfaction, and perceived control, whereas event-based blocks elicited safety, relaxation, release, and perceived control. Perceived control was included as a shared item across contexts and did not differ significantly between interpersonal and event-based blocks. Error bars indicate standard errors of the mean. The dashed horizontal line indicates the scale midpoint. The dashed vertical line in Panel B indicates chance-level responding. *$p < .05$, **$p < .01$, ***$p < .001$; n.s. = not significant.

Results

To keep the main text concise and reader-friendly, the full descriptive statistics ($M \pm SD$) for each condition are provided in **SI Text 1**. The pilot design and main validation results are summarized in **Figure 2**.

Preliminary questionnaire

The preliminary questionnaire results are shown in **Figure 2B**.

Scene classification: Participants reliably distinguished between interpersonal and event-based scenarios. For images normed as interpersonal, the proportion of *correct classifications* (72.7%) significantly exceeded the chance level of 33.3% [$t(29) = 9.02$, $p < 0.001$, $d = 1.65$], while *misclassifications* as event-based (16.0%) and *mixed* (11.3%) fell significantly below chance (all ps < 0.001, ds ≥ -1.42). For images normed as event-based, the proportion of *correct classifications* (86.9%) similarly exceeded chance [$t(29) = 20.45$, $p < 0.001$, $d = 3.73$], while *misclassifications* as interpersonal (2.2%) and *mixed* (10.9%) fell significantly below chance (all ps < 0.001, ds ≥ −7.92).

Coping preference: Participants favored RI-consistent coping—role reversal in interpersonal contexts and outcome reversal in event-based contexts. For interpersonal blocks, the proportion selecting *role reversal* (74.0%) significantly exceeded chance [$t(29) = 6.61$, $p < 0.001$, $d = 1.21$], while *outcome reversal* (12.7%) and *other methods* (13.3%) fell significantly below chance (both ps < 0.001, ds ≥ −0.94). For event-based blocks, the proportion selecting *outcome reversal* (75.3%) significantly exceeded chance [$t(29) = 6.70$, $p < 0.001$, $d = 1.22$], while *role reversal* (11.3%) and *other methods* (13.3%) fell significantly below chance (both ps < 0.001, ds ≥ −0.92).

Trial-level stimulus validation

Trial-level validation results are shown in **Figure 2D**.

Both the interpersonal and event-based contexts elicited reliable negative emotional responses. Across images, negative-intensity ratings were significantly above the scale minimum (1 = not negative; all ps < 0.001, ds ≥ 1.09), indicating that the stimuli elicited negative affect. Arousal and vividness ratings were significantly above the scale midpoint (5; all ps < 0.001, ds ≥ 2.03), indicating moderate-to-high subjective arousal and perceptual clarity. *Emotional change after RI* was significantly above zero (all ps < 0.001, ds ≥ 1.38), indicating measurable emotional improvement following RI. Importantly, no reliable differences emerged between contexts on any of these measures (all ps ≥ .099), confirming that the two stimulus sets were matched on general affective properties.

Block-level cognitive processes

Block-level RI component ratings are shown in **Figure 2E**.

Both contexts showed clear engagement of the proposed RI components. Ratings were significantly above the scale midpoint (5) for *scene deconstruction* (all ps < 0.001, ds ≥ 1.82), *scene reversal* (all ps < 0.001, ds > 1.64), and *emotional counteraction* (all ps ≤ 0.001, ds ≥ 0.66). However, context differences emerged on two of the three stages: compared with the event-based context, the interpersonal context received lower ratings on *scene reversal* [$t(29) = -2.97$, $p = 0.006$, $d = -0.54$] and *emotional counteraction* [$t(29) = -4.51$, $p < 0.001$, $d = -0.82$], while *scene deconstruction* did not differ ($p = 0.056$).

Block-level counter-emotions

Context-specific counter-emotion ratings are shown in **Figure 2F**.

Both contexts elicited counter-emotions above the scale midpoint, though with context-specific profiles. In the interpersonal context, participants reported elevated senses of *revenge* [$t(29) = 2.14$, $p = 0.041$, $d = 0.39$], *superiority* [$t(29) = 2.59$, $p = 0.015$, $d = 0.47$], *satisfaction* [$t(29) = 3.65$, $p = 0.001$, $d = 0.67$], and *control* [$t(29) = 3.91$, $p < 0.001$, $d = 0.71$]. In the event-based context, participants reported elevated senses of *safety* [$t(29) = 11.98$, $p < 0.001$, $d = 2.19$], *relaxation* [$t(29) = 11.83$, $p < 0.001$, $d = 2.16$], *release* [$t(29) = 10.75$, $p < 0.001$, $d = 1.96$], and *control* [$t(29) = 4.55$, $p < 0.001$, $d = 0.83$]. Notably, perceived control—the shared item across contexts—did not differ between conditions ($p = 0.323$), suggesting that both forms of RI restore a sense of control despite engaging qualitatively different counter-emotions.

Discussion

The pilot study provided the empirical foundation for the main experiments in two ways. First, it validated the interpersonal and event-based stimulus sets by showing that both categories elicited robust negative affect, arousal, and vividness while remaining broadly comparable in baseline emotional properties. Second, and more importantly, it provided preliminary support for the core assumptions of RI. Participants were able to identify the reversible element of a scene, construct a reversed version of it, and report counter-emotional experiences after doing so. Thus, the pilot did not merely screen stimuli; it also verified that the proposed RI procedure could reliably engage the cognitive–affective components specified in the theoretical model.

Preliminary questionnaire. Beyond validating the stimuli, the preliminary questionnaire showed that participants reliably distinguished interpersonal from event-based scenes and displayed predicted coping preferences. For interpersonal scenarios, they predominantly endorsed role-reversal responses (e.g., "fighting back" or "gaining the upper hand"), whereas for event-based scenarios they predominantly endorsed outcome-reversal responses (e.g., imagining that the event did not happen or turned out better). These findings indicate that participants not only classified scene types accurately but also preferentially selected RI-consistent coping within a structured choice format—role reversal in interpersonal contexts and outcome reversal in event-based contexts—even before receiving any explicit RI instructions.

Stimulus validation. At the trial level, both interpersonal and event-based images elicited reliable negative responses. Negative intensity ratings were significantly above the scale minimum 1, confirming the presence of negative affect. More importantly, ratings of arousal and vividness were significantly above the scale midpoint 5, indicating moderate-to-high subjective arousal and perceptual clarity. Emotional change ratings were significantly above zero, confirming measurable emotional improvement following RI.

At the block level, the cognitive indices preliminary support for the proposed RI component structure: in both contexts, ratings of scene deconstruction, scenario reversal, and emotional counteraction were all well above the scale midpoint (5), indicating moderate-to-strong engagement with each cognitive stage. Similarly, block-level counter-emotion ratings were significantly above the midpoint in both contexts, confirming that RI reliably produced robust self-reported counter-emotional experiences. In interpersonal blocks, RI was associated with elevated revenge, superiority, and satisfaction, consistent with motives for status restoration and symbolic retaliation in response to rejection (Chester & DeWall, 2017; Richman & Leary, 2009). In event-based blocks, RI primarily enhanced safety, relaxation, and release, consistent with the restoration of psychological security after non-social setbacks (Rothbaum et al., 1982; Thompson, 1981). Together, these findings validate the stimuli and measures as suitable tools for probing RI in the main studies.

Cross-context comparability. Before RI implementation, the two stimulus sets were well matched on baseline affective properties. At the trial level, none of the pre-regulation measures (negative intensity, arousal, vividness) differed reliably between contexts, minimizing the risk that later differences could be attributed to initial stimulus characteristics rather than regulatory processes.

After RI implementation, the two contexts also showed comparable regulatory outcomes on key indices: emotional change ratings did not differ between contexts, and perceived control—the shared counter-emotion item—was equally elevated in both, suggesting that restoring a sense of control may be a common regulatory outcome of RI regardless of context, consistent with theories emphasizing perceived control as a central resource in coping with aversive or uncontrollable events (Rothbaum et al., 1982; Thompson, 1981; Heckhausen & Schulz, 1995). However, the cognitive sequence showed notable differences. Event-based blocks received higher ratings than interpersonal blocks for scenario reversal and emotional counteraction, whereas scene deconstruction did not differ between contexts. This pattern suggests that participants found outcome reversal in event-based scenes somewhat easier to construct and more strongly counter-emotional than role reversal in interpersonal scenes. Whether this greater reported engagement translates into more durable relief is a separate question examined in **Study 5**.

Taken together, these findings indicate that the interpersonal and event-based image sets form two conceptually distinct yet affectively balanced categories. They reliably evoke strong negative affect, engage the core cognitive steps of RI, and produce context-appropriate counter-emotional profiles without introducing unintended baseline confounds. This provides a solid foundation for the main studies, in which any observed differences can be more confidently attributed to regulation strategies and contextual manipulations rather than artifacts of the stimulus sets.

Study 1 — Initial Validation: Role Reversal in Social Exclusion

Study 1 aimed to provide an initial test of whether RI effectively alleviates negative emotional responses. We focused on social exclusion because this context provides a structurally clear role division between the excluded individual and the excluder. This made it possible to operationalize interpersonal RI in its most direct form: generating a reversed counter-scene in which the participant no longer occupies the harmed role but instead imagines occupying the agentic role within the scene. Participants were asked either to naturally view the exclusion scene (PV condition) or to imagine themselves as the one doing the excluding (RI condition). By comparing these two conditions, this study provided an initial test of whether generating a role-reversed counter-scene can reduce negative affect in response to social exclusion.

Methods

Participants

Sixty-eight participants (35 men, 33 women; *M* = 21.37, *SD* = 1.44) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a paired *t*-test. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.50), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 34 participants would be required. Our sample of 68 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

Fifty social exclusion pictures were selected from our validated stimulus set. Each picture was presented twice—once in the PV condition and once in the RI condition—with assignment order randomized across participants. Because identical images were used across both conditions, baseline affective properties were inherently matched, ensuring that any observed differences reflected regulation effects rather than stimulus characteristics.

Procedure

The training procedure was similar to that used in the pilot study: participants received standardized instructions for each regulation condition (PV, RI) and completed a brief supervised practice phase to familiarize themselves with the timing, strategy implementation, and rating procedure.

The experiment used a two-condition within-subjects design (PV vs. RI). The role-reversal logic and trial procedure are illustrated in **Figure 3A–B**. In each trial, participants first viewed a fixation cross (2 s), followed by an 8 s presentation of a social exclusion image. During this viewing period, participants either viewed the pictures naturally (PV) or implemented the RI strategy by imagining a reversed version of the scene. Detailed PV and RI instructions are provided in **SI-Text 2**. After each image, participants rated the intensity of negative emotion on a 9-point scale (1 = not negative, 9 = very negative). Ratings were made within 4.5 s using a cursor that initially appeared in the midpoint of the scale (5) and could be adjusted left or right with two buttons on the response box. The final cursor position was recorded as the participant's rating.

Statistics

Statistical analyses were performed using the R statistical computing environment. A paired-samples *t*-test was conducted to compare the negative emotion ratings between the PV and RI conditions during the regulation phase. Effect sizes for the pairwise comparisons were reported as *Cohen's d* to indicate the magnitude of the differences. The significance level was set at $\alpha = 0.05$ for all tests.

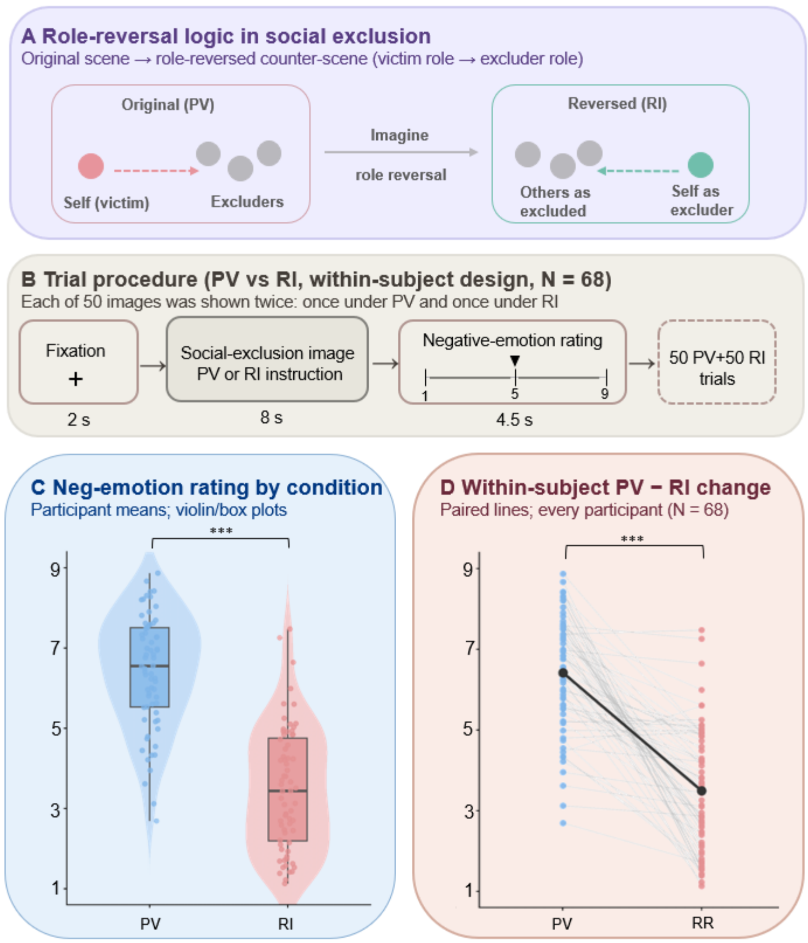

Figure 3. Study 1 design and r

victim standpoint, whereas RI required participants to imagine a role-reversed counter-scene in which the self occupied the excluder role. **(B)** Trial procedure. Each of the 50 social-exclusion images was presented twice, once under PV and once under RI. Participants viewed each image for 8 s and then rated negative emotion within 4.5 s. **(C)** Negative-emotion ratings by condition. **(D)** Within-subject PV − RI change. Thin gray lines represent individual participants; the thick black line represents the group mean. RI significantly reduced negative emotion relative to PV. ***$p < .001$.

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1**.

Negative-affect ratings were significantly lower in the RI condition than in the PV condition. A paired-samples t-test on the difference score (PV − RI) confirmed this effect [$t(67) = 11.42$, $p < 0.001$, $d = 1.39$], indicating a large reduction in negative affect during RI (**Figure 4C–D**).

Discussion

The results provide initial evidence for the effectiveness of RI in regulating negative affect elicited by social exclusion. Compared with passive viewing, RI significantly reduced participants' subjective experience of negative emotion, with a large effect size. Because this study used a simple PV baseline, however, it establishes only the basic efficacy of RI, not its specificity. In particular, it remains unclear whether the observed benefit reflects the reversed structure of the imagined scene, or merely the fact that participants shifted away from the victim's original standpoint. Study 2 addressed these questions through two complementary experiments.

Study 2 — Comparative Efficacy and Efficiency of RI

Study 2 was designed to locate RI within the broader landscape of ER strategies by testing its specificity and efficiency at two levels. At the first level (Study 2a), we asked whether RI's efficacy derives from the reversed structure of the generated counter-scene rather than from perspective change in general. To address this, we held the scenario constant (social exclusion) and compared three ways of relating to the same scene along a "you–me–other" axis: direct immersion into the victim's standpoint ("me"), role reversal into the excluder's standpoint ("you"), and distanced observation from a bystander's standpoint ("other"). At the second level (Study 2b), we asked whether RI's advantage extends beyond this perspective-based comparison to outperform regulatory strategies from different families—CR (meaning modification) and distraction (attentional redirection). Study 2b also incorporated efficiency indicators (regulation duration and subjective effort) to determine whether RI achieves its effects without greater time or cognitive cost. Together, these experiments evaluated both the specificity and efficiency of RI's regulatory advantage.

Study 2a — "You–Me–Other" Comparison of Regulatory Perspectives

Although RI may involve imagining oneself in a different position within the scene, its defining feature is not perspective change per se. Rather, RI requires the generation of a reversed counter-scene in which the original role configuration or power relation is inverted. Other strategies may also move the self away from the originally encoded victim standpoint without producing such reversal. For example, distancing asks individuals to view the scene from a detached third-person perspective, thereby increasing psychological distance while leaving the original role structure intact (Ochsner & Gross, 2008; Powers & LaBar, 2019).

To isolate the specific contribution of reversal, Study 2a held the social exclusion scenario constant and varied how participants related to the same scene along a "you–me–other" axis. Direct immersion (DI) required participants to re-enter the episode from the excluded victim's standpoint ("me"), preserving the original role configuration. RI required participants to imagine the scene from the excluder's standpoint ("you"), thereby generating a role-reversed counter-scene. Distancing required participants to observe the exclusion as an uninvolved third party ("other"), changing vantage point without reversing the underlying social relation. This design allowed us to test whether RI's regulatory benefit depends on reversed scene generation over and above generic perspective change or self–other distance.

Methods

Participants

Fifty-two participants (27 men, 25 women; M = 20.06, SD = 1.84) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a one-way repeated-measures ANOVA with four levels. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.25), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 24 participants would be required. Our sample of 52 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

Forty-eight social exclusion images were selected from the pilot-validated interpersonal stimulus set. Each image was presented twice across the experiment, yielding 96 trials in total. Trials were assigned to four regulation blocks (PV, DI, RI, distancing), with each block containing 24 trials.

To confirm that stimulus assignment was balanced across blocks, we used the pre-rating data obtained in the pilot study. For each pilot participant, ratings were averaged across the images assigned to each Study 2a block set, and one-way repeated-measures ANOVAs were conducted to compare negative intensity, arousal, and vividness across the four block sets. Results showed no significant differences in negative intensity [$F(3, 87) = 1.58$, $p = 0.20$, $\eta^2 = 0.05$; PV = 2.64 ± 0.91; DI = 2.76 ± 1.01; RI = 2.52 ± 0.91; distancing = 2.72 ± 1.01], arousal [$F(3, 87) = 1.27$, $p = 0.291$, $\eta^2 = 0.04$; PV = 6.84 ± 0.98; DI = 6.81 ± 0.95; RI = 6.89 ± 0.94; distancing = 6.92 ± 0.99] or vividness [$F(3, 87) = 0.12$, $p = 0.948$, $\eta^2 < 0.01$; PV = 6.82 ± 0.81; DI = 6.81 ± 0.86; RI = 6.80 ± 0.91; distancing = 6.84 ± 0.88].

Procedure

The training procedure was similar to that used in the pilot study: participants received standardized instructions for each regulation condition (PV, DI, RI, and distancing) and completed a brief supervised practice phase to familiarize themselves with the timing, strategy implementation, and rating procedure.

The experiment followed a 4 (*regulation type*: PV, DI, RI, distancing) block design. Block order was randomized. The "you–me–other" comparison and block procedure are illustrated in **Figure 4A–B**. Each trial within a block began with a 2 s fixation, followed by an 8 s viewing of a social exclusion image. During this viewing period, participants either viewed naturally (PV) or followed one of three instructions: DI required adopting the victim's perspective ("me"), RI required adopting the excluder's perspective ("you"), and distancing required adopting an uninvolved bystander's perspective ("other"). Detailed instructions of these strategies are provided in **SI-Text 2**. Subsequently, they rated the negativity they felt from the picture on a scale of 1 (not negative) to 9 (very negative) within 4.5 s. The rating interface and response procedure were identical to those used in Study 1.

After completing the main task, participants had a 20-minute break and then performed a post-rating task. In this task, all 48 images used in the main regulation task were re-presented once without any regulation instruction. Participants rated how negative each image felt at that moment on a 9-point scale (9-point scale; 1 = minimum negativity, 5 = neutral, 9 = maximum negativity; **Figure 5B**). This task was used to examine whether the regulation condition previously associated with each image influenced participants' subsequent emotional responses to the same images.

Statistics

One-way repeated-measures ANOVAs were conducted separately for regulation-phase negative-emotion ratings and post-task picture ratings, with regulation condition (PV, DI, RI, distancing) as the within-subject factor. Post-hoc pairwise comparisons were corrected using the FDR method. To directly compare RI with distancing, ER success scores were computed as PV minus strategy rating, such that higher values indicated greater reduction in negative affect relative to passive viewing. Paired-samples t-tests compared ER success between the RI and distancing conditions. Effect sizes were reported as partial eta-squared (η^2) for ANOVA effects and Cohen's d for paired comparisons.

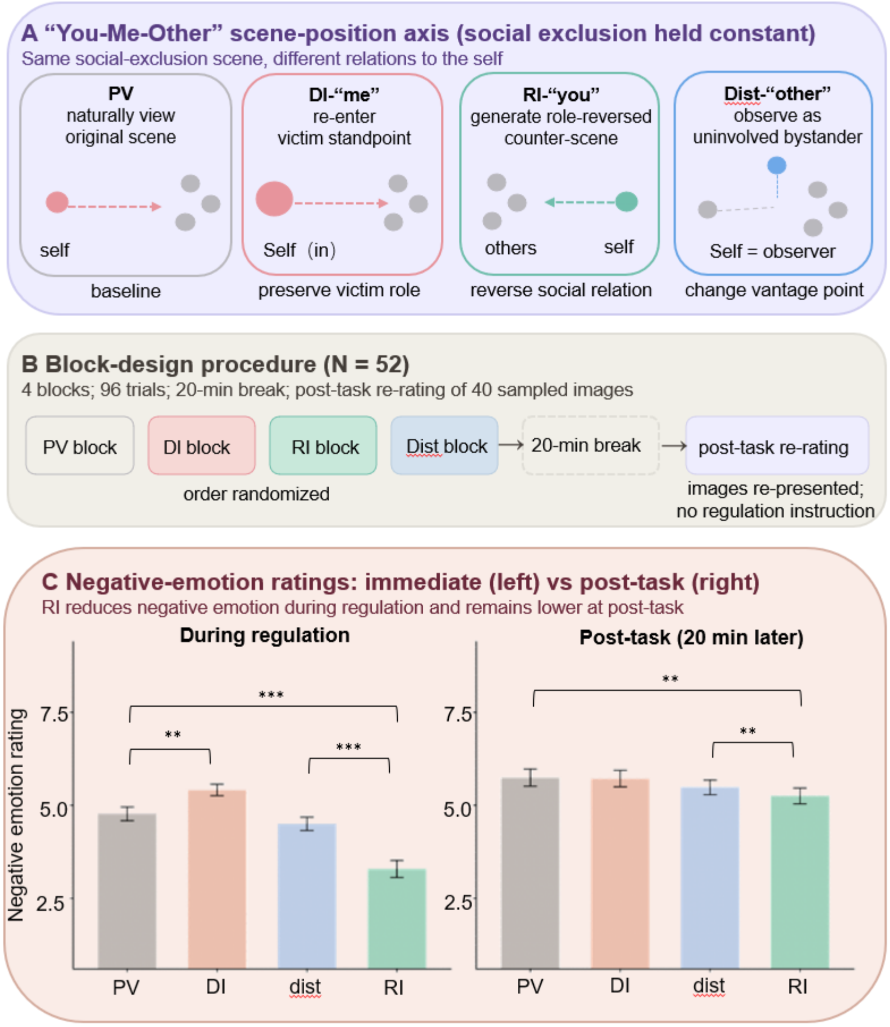

Figure 4. Study 2a design and results: the "you–me–other" comparison in social exclusion. (A) Conceptual illustration of the four conditions used to isolate the role of reversal. In the passive-viewing condition (PV), participants viewed the original social-exclusion scene naturally. In direct immersion (DI, "me"), participants re-entered the excluded victim's standpoint, preserving the original victim role. In reversal imagery (RI, "you"), participants imagined the scene from the excluder's standpoint, thereby generating a role-reversed counter-scene. In distancing ("other"), participants observed the scene as an uninvolved bystander, changing vantage point without reversing the underlying social relation. **(B)** Block-design procedure. Participants completed four regulation blocks corresponding to PV, DI, RI, and distancing, with block order randomized/counterbalanced across participants. After the main regulation task, participants completed a 20-min break followed by a post-task re-rating task in which images were re-presented, and rated without any regulation instruction. **(C)** Negative-emotion ratings during regulation and at post-task. During regulation, DI produced higher negative-emotion ratings than PV, whereas RI produced lower negative-emotion ratings than PV and greater ER success than distancing. At post-task, images previously regulated with RI were rated as less negative than images from the PV block, and RI showed greater post-task ER success than distancing. Error bars indicate standard errors of the mean. $^{**}p < .01$, $^{***}p < .001$

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1**.

Ratings of negative emotions

Subjective negative emotion ratings were examined using one-way repeated measures ANOVA (*regulation condition*: PV/DI/RI/distancing). The main effect of *regulation condition* was significant [$F(3, 153) = 34.52$, $p < 0.001$, $\eta^2 = 0.40$]. Pairwise comparison (FDR corrected) indicated that compared with PV, DI produced higher negative ratings [$t(51) = 3.90$, $p = 0.002$, $d = 0.42$], whereas RI produced lower negative ratings [$t(51) = -6.08$, $p < 0.001$, $d = -0.96$]. Negative-emotion ratings did not differ significantly between the distancing and PV blocks ($p = 0.681$; **Figure 4C, left**).

To directly compare the effectiveness of RI and distancing, we calculated ER success as PV minus strategy rating, such that higher values indicated greater reduction relative to PV (Wager et al., 2008) for the RI and distancing blocks. Paired sample *t*-tests (two-tailed) revealed greater ER success for RI versus distancing [$t(51) = 4.87$, $p < 0.001$, $d = 0.79$].

Post-task picture ratings

Negative emotion ratings of the post-task pictures were analyzed using one-way repeated measures ANOVA (*regulation condition*: PV/DI/RI/distancing). The main effect of *regulation condition* was significant [$F(3, 153) = 7.97$, $p < 0.001$, $\eta^2 = 0.14$]. Pairwise comparison (FDR corrected) indicated that post-task negative ratings did not differ from PV for pictures previously assigned to the DI or distancing blocks (all ps ≥ 0.201), but were significantly lower for pictures previously assigned to the RI block than for pictures previously assigned to the PV block [$t(51) = -3.82$, $p = 0.002$, $d = -0.59$].

To directly compare the prolonged effectiveness of RI and distancing, we calculated and compared the participant's "post-task ER success (difference between ratings of pictures from the passive viewing and each ER block)" for the RI and distancing blocks. According to paired sample *t*-test (two-tailed), RI showed greater post-task ER success than distancing [$t(51) = 3.34$, $p = 0.009$, $d = 0.28$; **Figure 4C, right**).

Discussion

Study 2a examined whether RI's regulatory advantage depends on reversed scene generation rather than perspective change in general. Holding the social exclusion scenario constant, we compared three ways of relating to the same scene: re-entering the victim's standpoint (DI), generating a role-reversed counter-scene from the excluder's standpoint (RI), and observing the scene from an uninvolved third-person standpoint (distancing).

The results revealed a clear pattern. RI produced the strongest reduction in negative emotion and also showed the most persistent benefit in the post-task rating. DI tended to maintain or even heighten negative affect, suggesting that returning to the victim's standpoint preserves the original sense of vulnerability. Distancing, by contrast, did not show the same reliable advantage over PV in the present design. This is theoretically informative: Distancing increases psychological distance from the original scene (Powers & LaBar, 2019), but in the present context this may be insufficient because the underlying victim–excluder relation remains unchanged. RI appears to be more potent because it does not merely relocate the self outside the scene; it constructs a second scene in which the original relation is reversed.

Study 2b — RI versus Reappraisal and Distraction: Efficiency Analysis

Whereas Study 2a provided evidence that RI's advantage depends on reversed scene generation rather than generic perspective change, Study 2b asked whether this advantage extends to comparisons with established ER strategies that do not generate a reversed second scene. Specifically, we contrasted RI with two widely studied strategies—CR and distraction—which regulate emotion through meaning modification and attentional redirection, respectively (Gross, 1998; Kanske et al., 2011). We tested these strategies across both interpersonal social exclusion and event-based negative scenarios. Beyond *efficacy*, Study 2b examined regulatory *efficiency* by measuring regulation duration and subjective effort (Troy et al., 2018). If RI produces stronger relief without requiring more time or effort, this would suggest that its advantage reflects the operation of reversed imagery rather than greater regulatory investment.

Methods

Participants

Sixty-eight participants (35 men, 33 women; $M = 21.37$, $SD = 1.44$) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7). Because the primary planned comparisons concerned differences among the four regulation conditions, power was estimated for a one-way repeated-measures ANOVA with four within-subject conditions. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.25), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 24 participants would be required. Our sample of 68 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

All 100 images (50 interpersonal, 50 event-based) were selected from the pilot-validated stimulus set. Each image was presented twice across the experiment, yielding 200 trials in total. Trials were assigned to four regulation blocks (PV, RI, CR, distraction), with each block containing 50 trials: 25 interpersonal and 25 event-based image presentations.

To confirm that stimulus assignment was balanced across blocks, we used the pre-rating data obtained in the pilot study. For each pilot participant, ratings were averaged across the images assigned to each Study 2b block set, and one-way repeated-measures ANOVAs were conducted to compare negative intensity, arousal, and vividness across the four block sets. No significant block differences were observed for negative intensity [$F(3, 87) = 1.66$, $p = 0.183$, $\eta^2 = 0.05$; PV = 2.64 ± 1.21; RI = 2.62 ± 1.22; CR = 2.63 ± 1.17; distraction = 2.60 ± 1.16], arousal [$F(3, 87) = 1.97$, $p = 0.124$, $\eta^2 = 0.06$; PV = 7.03 ± 0.79; RI = 7.03 ± 0.80; CR = 6.99 ± 0.81; distraction = 7.01 ± 0.81], or vividness [$F(3, 87) = 2.57$, $p = 0.060$, $\eta^2 = 0.08$; PV = 6.89 ± 0.82; RI = 6.89 ± 0.82; CR = 6.87 ± 0.82; distraction = 6.85 ± 0.84].

Procedure

The training procedure was similar to that used in the pilot study: participants received standardized instructions for each regulation condition (PV, RI, CR, distraction) and completed a brief supervised practice phase to familiarize themselves with the timing, strategy implementation, and rating procedure.

Study 2b largely followed the procedure established in Study 2a, employing a within-subjects design that included four ER conditions: PV, RI, CR, and distraction. All participants completed the four blocks in randomized order. Detailed instructions for each strategy are provided in **SI-Text 2**. The strategy comparison and self-paced trial procedure are illustrated in **Figure 5A–B**.

In contrast to Study 2a, participants in Study 2b were not required to complete their emotional ratings within a fixed time limit. Instead, in active regulation trials, participants pressed a key when they felt that they had successfully implemented the assigned strategy and achieved emotional relief. In PV trials, participants pressed the key when they had finished viewing the image naturally and were ready to rate their emotional response. In all conditions, the key press was allowed only after a minimum viewing period of 6 s to ensure a minimum duration of engagement with the task. The latency from image onset to key press was recorded as implementation duration. For active regulation trials, this measure indexed regulation duration; for PV trials, it indexed viewing duration. Analyses of regulatory efficiency focused primarily on the three active regulation strategies. Following the key press, participants rated both the intensity of their negative emotions and the subjective effort required to implement the strategy, each on a 9-point Likert scale (negative emotion: 1 = *not at all negative*, 9 = *extremely negative*; effort: 1 = *not at all effortful*, 9 = *extremely effortful*). These additional measures—regulation duration and subjective effort—were introduced to provide a more refined understanding of the efficiency of RI, particularly with respect to its cognitive demand and the time required for effective implementation.

Statistics

For each dependent variable (negative-emotion rating, implementation duration, and subjective effort), we first conducted a 4 (*regulation condition*: PV, RI, CR, distraction) × 2 (*context*: interpersonal, event-based) repeated-measures ANOVA. When neither the main effect of context nor the regulation condition × context interaction was significant, data were collapsed across context and analyzed using one-way repeated-measures ANOVAs with regulation condition as the within-subject factor. All other statistical procedures and requirements were identical to those used in Study 2a.

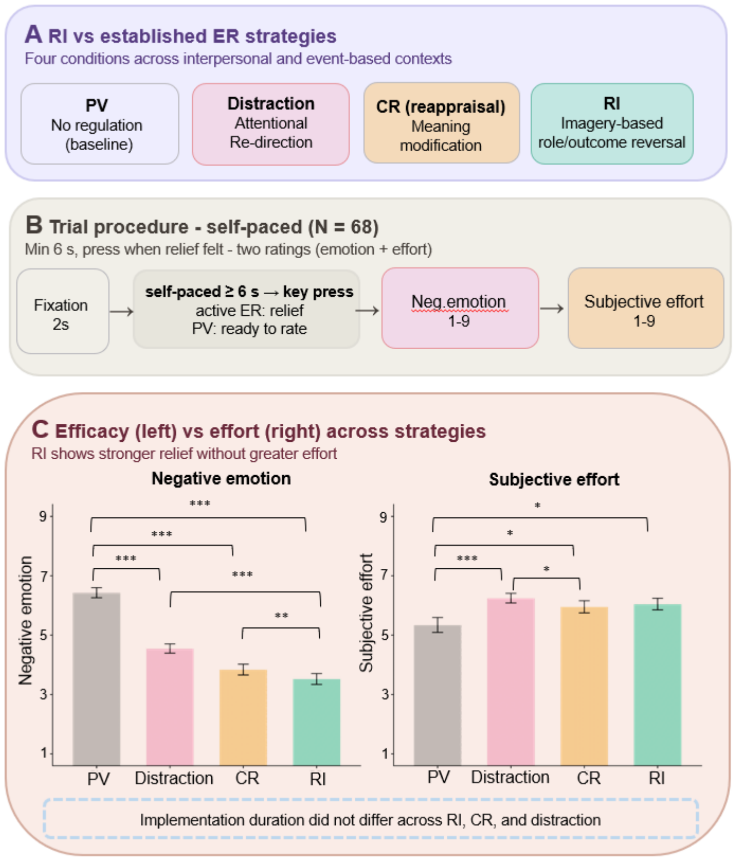

Figure 5. Study 2b design and results: RI versus established emotion-regulation strategies. (A) Strategy comparison. Study 2b compared passive viewing (PV) with three active regulation strategies: distraction, cognitive reappraisal (CR), and reversal imagery (RI). Distraction regulates emotion through attentional redirection, CR through meaning modification, and RI through imagery-based role or outcome reversal. Strategies were tested across interpersonal social-exclusion scenes and event-based negative scenes. **(B)** Self-paced trial procedure. Each trial began with a 2-s fixation, followed by image presentation with a strategy cue. Participants viewed or regulated for at least 6 s and then pressed a key when they were ready to rate. In active regulation trials, the key press indicated that participants had implemented the assigned strategy and achieved subjective relief; in PV trials, it indicated that participants had finished viewing naturally and were ready to rate. Participants then rated negative emotion and subjective effort on 9-point scales. **(C)** Efficacy and effort across strategies. RI produced lower negative-emotion ratings than PV, distraction, and CR, indicating stronger immediate regulatory efficacy. Subjective effort was higher for active strategies than for PV; critically, RI did not require greater effort than either CR or distraction. Implementation duration did not differ across the three active strategies. Error bars indicate standard errors of the mean. *$p < .05$, **$p < .01$, ***$p < .001$.

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1**. The main efficacy and effort results are summarized in **Figure 5C**.

A preliminary *regulation condition* × *context* repeated-measures ANOVA revealed neither a main effect of context nor a context × regulation interaction (all *p*s > .05). Therefore, data were collapsed across context, and a one-way repeated-measures ANOVA was conducted with regulation condition as the sole factor.

Ratings of negative emotions

A one-way repeated-measures ANOVA on negative emotion ratings revealed a significant main effect of regulation condition [$F(3, 201) = 88.96$, $p < 0.001$, $\eta^2 = 0.39$].

Pairwise comparisons (FDR-corrected) indicated that all three regulation strategies significantly reduced negative affect relative to PV [RI, $t(67) = -11.18$, $p < 0.001$, $d = -1.36$; CR, $t(67) = -10.01$, $p < 0.001$, $d = -1.21$; distraction, $t(67) = -10.19$, $p < 0.001$, $d = -1.24$]. Furthermore, RI was significantly more effective than distraction [$t(67) = -6.62$, $p < 0.001$, $d = -0.80$], and also more effective than CR [$t(67) = -2.86$, $p = 0.006$, $d = -0.35$] (lower ratings in the RI condition; **Figure 5C, left**).

Implementation Duration

No significant differences were found in implementation duration across the four task conditions ($p \geq 0.06$).

Subjective effort ratings

A one-way repeated-measures ANOVA showed a significant main effect of regulation condition on subjective effort [$F(3, 67) = 8.05$, $p < 0.001$, $\eta^2 = 0.27$]. Pairwise comparisons indicated that all three active strategies were rated as more effortful than PV (all *p*s ≤ 0.015). Importantly, RI did not differ significantly from either CR [$t(67) = -0.62$, $p = 0.541$, $d = -0.06$] or distraction [$t(67) = 1.61$, $p = 0.134$, $d = 0.13$], indicating that RI did not require greater subjective effort than the two established strategies. Distraction was rated as more effortful than CR [$t(67) = -2.90$, $p = 0.015$, $d = -0.19$] (**Figure 5C, right**).

Discussion

Study 2b extends Study 2a by showing that RI's advantage is not limited to comparisons with other ways of changing one's relation to the same scene. Across interpersonal and event-based contexts, RI produced larger reductions in negative emotion than CR, distraction, and PV, indicating a reliable advantage in immediate regulatory effectiveness.

Crucially, this stronger relief did not require greater regulatory investment. Participants spent comparable time applying RI, CR, and distraction, and RI required no greater subjective effort than either CR or distraction. Thus, RI's advantage cannot be explained by participants simply trying harder or spending longer on the task. This pattern is consistent with greater regulatory efficiency: RI produced stronger relief without requiring greater time or greater subjective effort than the two established strategies. One possible explanation, tested more directly in Studies 3 and 4, is that reversed imagery may combine scene generation with the elicitation of counter-valent affect, allowing RI to produce stronger relief without additional perceived effort.

Study 3 — Mechanistic Examination: Cognitive and Affective Pathways

Building on the efficacy and efficiency results from Study 2, Study 3 turned to the question of *mechanism*—through what cognitive-affective pathway does RI achieve its effects?

To address this question, we focused on the comparison between RI and CR. This pairing was chosen for three reasons: First, CR is one of the most extensively studied and theoretically central strategies in the ER literature (McRae & Gross, 2020a), providing a well-characterized benchmark against which to locate a novel strategy such as RI. Second, both CR and RI operate on mental representations of negative events, but they do so in different ways: CR modifies the meaning of the original scene (Gross, 1998; McRae & Gross, 2020), whereas RI generates a reversed second scene that can supply counter-valent affect. This makes the RI–CR comparison especially diagnostic for testing whether RI is simply a form of CR or instead relies on a distinct scene-generation mechanism. Third, attentional redirection strategies such as distraction and perspective-based distancing primarily shift the focus or vantage point from which the scene is processed, rather than transforming the scene's core representational content, and thus are less directly informative for testing whether RI works by generating a second scene rather than modifying the original one.

Across two experiments, we progressively tested these contrasting mechanisms. Study 3a mapped the subjective feature profiles of RI and CR, and Study 3b tracked the real-time emergence of counter-emotions during regulation. The hypothesized CR and RI pathways are illustrated in **Figure 6**.

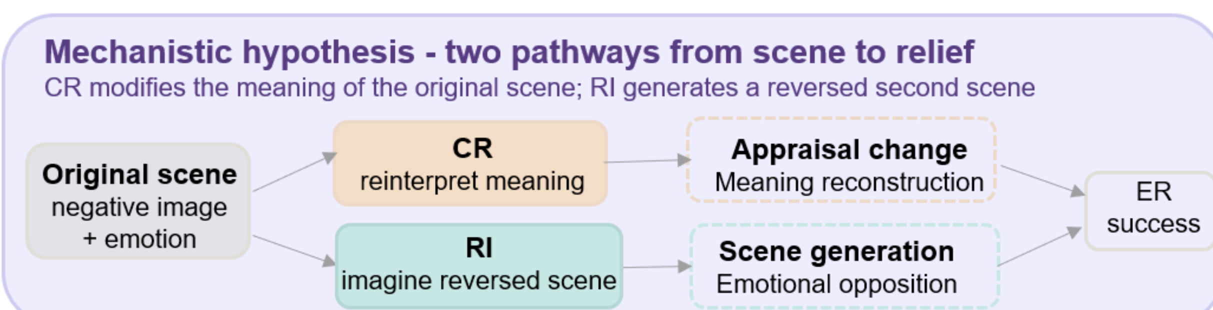

Figure 6. **Mechanistic hypothesis.** CR was hypothesized to regulate emotion by modifying the meaning of the original scene through appraisal change and meaning reconstruction. RI was hypothesized to regulate emotion by generating a reversed second scene alongside the original, thereby engaging scene generation and emotional opposition. Both pathways were expected to contribute to ER success.

Study 3a — Feature-Based Comparison: Scene Generation versus Meaning Reappraisal

Study 3a provided an initial test of the hypothesized mechanistic distinction between RI and CR. As outlined in the Study 3 introduction, both strategies engage mental representation but at different layers: RI is hypothesized to generate a reversed second scene, evoking counter-affective responses through the contrast between this generated scene and the original, whereas CR modifies the meaning of the original scene through reinterpretation without generating a second scene-level representation. Although the RI model describes scene deconstruction, scene reversal, and emotional counteraction as three components for analytic clarity, these components need not unfold as strictly separable temporal stages. In practice, the construction of the reversed scene and the emergence of opposing affect may be tightly coupled.

To examine this distinction at the feature level, participants implemented PV, RI, and CR in mini-blocks and then rated their subjective experience along four dimensions. Two dimensions indexed RI-related processes: *scene generation* (the extent to which an alternative scenario was vividly built) and *emotional opposition* (the extent to which opposing emotions were experienced). Two dimensions indexed reappraisal-related processes: *appraisal change* (the degree of change in evaluating the event)(Gross, 1998b) and *meaning reconstruction* (the extent to which the event's significance was reframed)(Lazarus, 1982). We predicted that RI would elicit higher ratings on scene generation and emotional opposition, whereas reappraisal would be more strongly associated with appraisal change and meaning reconstruction. Beyond mean-level comparisons, we conducted exploratory mediation analyses to examine whether these feature dimensions statistically accounted for the regulatory effects of RI and CR. This feature-based comparison allowed us to test whether the two strategies engage distinct cognitive-affective operations, as proposed.

Methods

Participants

Fifty-one participants (21 men, 30 women; $M = 21.61$, $SD = 1.93$) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a one-way repeated-measures ANOVA with three levels. With $\alpha = 0.05$, $power = 0.80$, a medium effect size ($Cohen's\ f = 0.25$), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 28 participants would be required. Our sample of 51 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

Ninety images (45 interpersonal, 45 event-based) were selected from our validated stimulus set. Images were randomly distributed across the three regulation conditions (PV, RI, CR) such that each condition contained an equal number of interpersonal and event-based images. To confirm that stimulus assignment was balanced across regulation conditions, we used the pre-rating data obtained in the pilot study. For each pilot participant, ratings were averaged across the images assigned to each Study 3a condition set, and one-way repeated-measures ANOVAs were conducted to compare negative intensity, arousal, and vividness across the three condition sets. Results showed no significant differences in negative intensity [$F(2, 58) = 1.95$, $p = 0.151$, $\eta^2 = .063$; PV $= 2.69 \pm 1.22$; RI $= 2.61 \pm 1.11$; CR $= 2.68 \pm 1.19$], arousal [$F(2, 58) = 0.18$, $p = 0.837$, $\eta^2 = .006$; PV $= 6.99 \pm 0.81$; RI $= 7.02 \pm 0.86$; CR $= 7.00 \pm 0.94$], and vividness [$F(2, 58) = 0.89$, $p = 0.416$, $\eta^2 = 0.030$; PV $= 6.85 \pm 1.35$; RI $= 6.82 \pm 1.28$; CR $= 6.80 \pm 1.31$].

Procedure

The training procedure was similar to that used in the pilot study: participants received standardized instructions for each regulation condition (PV, RI, CR) and completed a brief supervised practice phase to familiarize themselves with the timing, strategy implementation, and rating procedure.

The experiment adopted a mini-block design consisting of 18 blocks in total, with 6 blocks per strategy condition (PV, RI, and CR). Each mini-block contained five trials, and block order was pseudorandomized across participants. Each mini-block was followed by a short 15-second rest period before the next block began. Detailed instructions for each strategy are provided in **SI-Text 2**.

Unlike our previous paradigm, in which each image was viewed once under a single regulation instruction, the present study separated emotion induction and regulation within each trial. Each mini-block began with a 2-second block instruction screen indicating the strategy to be used (e.g., “Please use RI in the next few trials”). As shown in **Figure 7**, within each block, trials followed a fixed sequence: (1) a fixation cross was presented for a jittered duration (300–500 ms), (2) pre-induction: a negative image was shown for 8 seconds to allow full emotional engagement, during which participants rated their initial negative emotional intensity, (3) a strategy instruction prompt appeared for 2 seconds, (4) post-regulation: the same image reappeared for an additional 8 seconds during which participants implemented the assigned strategy, followed by a second emotional intensity rating, and (5) a 2-second inter-trial interval before the next trial began.

After all five trials within a mini-block were completed, participants were presented with a feature rating screen for a maximum of 45 seconds. On this screen, they evaluated the extent to which they had experienced the four predefined cognitive features during that block, using four separate 9-point Likert scales (1 = not at all, 9 = very strongly). The four dimensions were: (1) scene generation (“I vividly constructed an alternative scene that differed from the original one”), (2) emotional opposition (“I experienced feelings opposite to the original emotion”); (3) appraisal change ("I changed the way I evaluated the event"), and (4) meaning reconstruction ("I found new meaning or perspective in the event"). The block-level ratings aimed to capture the subjective signature of the cognitive process engaged during each strategy.

Statistics

A two-way repeated measures ANOVA was conducted to examine the effects of *regulation condition* (PV, CR, RI) and *context* (interpersonal, event-based) on trial-level ER success (operationalized as the reduction in negative affect, pre-induction minus post-regulation, such that higher scores reflected greater decreases in negative emotion) and block-level feature ratings (scene generation, emotional opposition, appraisal change, and meaning reconstruction). All other statistical procedures and requirements were identical to those used in Study 2a.

Mediation analysis: To examine whether the subjective feature dimensions statistically accounted for the regulatory effects of RI and CR, we conducted a series of single-mediator models using the causal mediation framework (Imai et al., 2010). Because the mediators were not experimentally manipulated, these analyses were interpreted as exploratory evidence for statistical indirect pathways rather than as definitive proof of causal mechanisms.

For each comparison (RI vs. PV; CR vs. PV), the independent variable X was regulation condition (1 = RI or CR, 0 = PV). The dependent variable Y was trial-level ER success, operationalized as the reduction in negative affect from pre-induction to post-regulation. The mediators M were the block-level feature ratings: scene generation, emotional opposition, appraisal change, and meaning reconstruction.

For each mediator and each contrast, we fitted a separate linear mediation model estimating: (a) the effect of regulation condition on the mediator (a path), (b) the association between the mediator and ER success while controlling for regulation condition (b path), (c) the average causal mediation effect (ACME; indirect effect), (d) the average direct effect (ADE), and (e) the total effect. Indirect effects were evaluated using nonparametric bootstrap confidence intervals with 5,000 resamples. Separate models were run for RI vs. PV and CR vs. PV, yielding eight single-mediator models in total. Because the mediators were not experimentally manipulated and were tested in separate single-mediator models, the reported proportions mediated should be interpreted as exploratory estimates of the relative strength of each indirect pathway, rather than as additive or unique causal contributions.

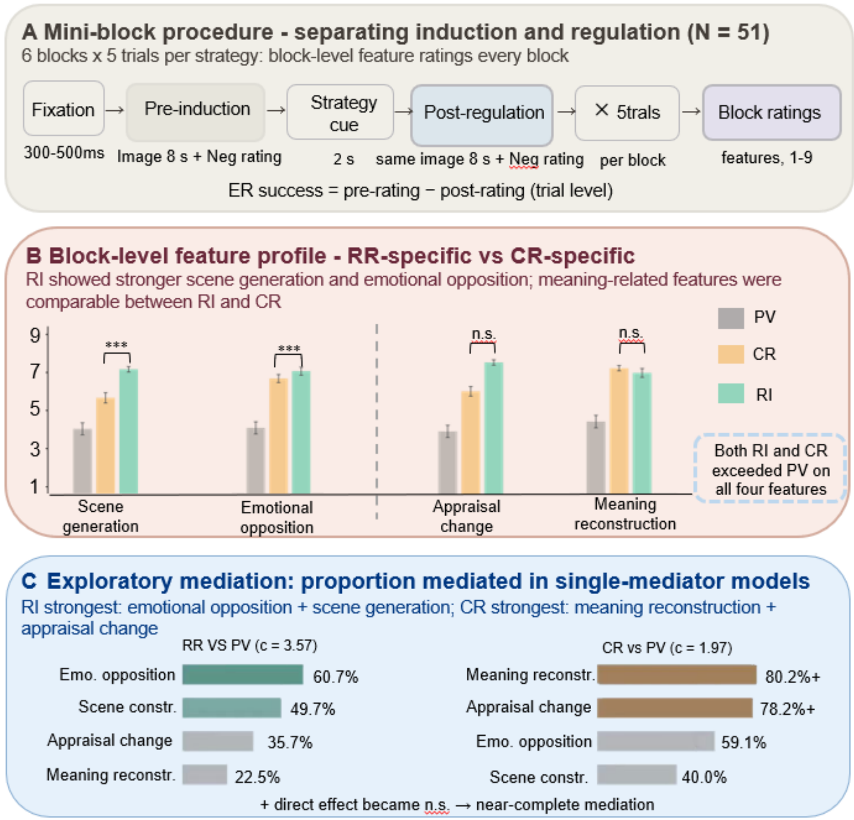

Figure 7. Study 3a design and results: feature-based comparison of RI and CR. (A) Study 3a mini-block procedure. Each mini-block began with a strategy instruction and contained five trials. In each trial, participants first viewed a negative image to allow emotion induction and provided an initial negative-emotion rating. After a strategy cue, the same image was re-presented while participants implemented PV, CR, or RI, followed by a second negative-emotion rating. ER success was computed as the pre-regulation negative-emotion rating minus the post-regulation rating. After each mini-block, participants completed block-level ratings of four subjective features: scene generation, emotional opposition, appraisal change, and meaning reconstruction. **(B)** Block-level feature profiles. RI elicited higher ratings than CR on scene generation and emotional opposition, whereas RI and CR did not differ significantly on appraisal change or meaning reconstruction. Both active strategies exceeded PV on all four feature dimensions. **(C)** Exploratory mediation results from separate single-mediator models. For RI versus PV, the largest proportions mediated were observed for emotional opposition and scene generation. For CR versus PV, the largest proportions mediated were observed for meaning reconstruction and appraisal change. Because mediators were not experimentally manipulated and were tested in separate single-mediator models, these percentages should be interpreted as exploratory estimates of the relative strength of each indirect pathway, not as additive or unique causal contributions. Error bars indicate standard errors of the mean. ***$p < .001$; n.s. = not significant.

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1**.

A preliminary *regulation condition* × *context* repeated-measures ANOVA revealed neither a main effect of context nor a context × regulation interaction (all ps > 0.05). Therefore, data were collapsed across context, and a one-way repeated-measures ANOVA was conducted with *regulation condition* as the sole factor.

Trial-level ER success

A repeated-measures ANOVA revealed a significant main effect of *regulation condition* [$F(2, 100) = 78.86$, $p < 0.001$, $\eta^2 = 0.61$]. Participants reported the highest levels of ER success in the RI condition, followed by CR, and the lowest levels in the PV condition. Pairwise comparisons (FDR-corrected) confirmed that RI was significantly more effective than CR [$t(50) = 6.48$, $p < 0.001$, $d = 0.78$], and that both strategies were significantly more effective than PV [RI vs. PV: $t(50) = 11.24$, $p < 0.001$, $d = 1.76$; CR vs. PV: $t(50) = 6.90$, $p < 0.001$, $d = 0.97$]. These findings showed that RI produced greater immediate ER success than CR within the present feature-comparison design.

Block-level ratings

For Scene Generation, there was a significant main effect of *regulation condition* [$F(2, 100) = 52.38$, $p < 0.001$, $\eta^2 = 0.51$]. Pairwise comparisons (FDR-corrected) showed that RI was significantly higher than CR [$t(50) = 5.39$, $p < 0.001$, $d = 0.67$], and both exceeded PV [RI vs. PV: $t(50) = 8.84$, $p < 0.001$, $d = 1.43$; CR vs. PV: $t(50) = 5.82$, $p < 0.001$, $d = 0.76$].

For Emotional Opposition, the main effect of *regulation condition* was significant [$F(2, 100) = 61.76$, $p < 0.001$, $\eta^2 = 0.55$]. RI was rated higher than CR [$t(50) = 5.62$, $p < 0.001$, $d = 0.65$], and both exceeded PV [RI vs. PV: $t(50) = 9.58$, $p < 0.001$, $d = 1.55$; CR vs. PV: $t(50) = 6.48$, $p < 0.001$, $d = 0.90$].

For Appraisal Change, the main effect of *regulation condition* was significant [$F(2, 100) = 51.20$, $p < 0.001$, $\eta^2 = 0.51$]. RI and CR did not significantly differ ($p = 0.488$). However, both strategies produced higher ratings than PV [RI vs. PV: $t(50) = 8.96$, $p < 0.001$, $d = 1.30$; CR vs. PV: $t(50) = 7.29$, $p < 0.001$, $d = 1.14$].

For Meaning Reconstruction, the main effect of *regulation condition* was significant [$F(2, 100) = 49.89$, $p < 0.001$, $\eta^2 = 0.50$]. CR was slightly higher than RI, though this difference was not significant ($p = 0.256$). Both strategies, however, were rated substantially higher than PV [RI vs. PV: $t(50) = 7.60$, $p < 0.001$, $d = 1.15$; CR vs. PV: $t(50) = 7.91$, $p < 0.001$, $d = 1.27$]. Together, these ratings revealed a strategy-specific feature profile (**Figure 7B**). RI showed greater engagement of scene generation and emotional opposition than CR, whereas appraisal change and meaning reconstruction were similarly elevated in both active strategies relative to PV.

Mediation analysis

RI vs. PV

Across all models, RI produced a robust total increase in trial-level ER success relative to PV (total effect: $c = 3.57$, $SE = 0.29$, $p < 0.001$, 95% CI [2.99, 4.12]). Each of the four mediators showed a significant indirect effect (all ACMEs $p < 0.001$), indicating that RI engaged all four feature dimensions. The direct effect of RI remained significant after controlling for each mediator (ADEs range 1.40 to 2.77, all *p*s < 0.001), indicating partial mediation: RI's advantage over PV is partly, but not entirely, explained by these feature processes.

- For Scene generation, RI increased scene-construction ratings (a path: $a = 3.13$, $SE = 0.34$, $t = 9.09$, $p < 0.001$, 95% CI [2.45, 3.81]), and higher scene generation predicted greater trial-level ER success (b path: $b = 0.57$, $SE = 0.06$, $t = 8.91$, $p < 0.001$, 95% CI [0.44, 0.69]). The indirect effect was significant (ACME: $a \times b = 1.78$, $SE = 0.28$, $p < 0.001$, 95% CI [1.26, 2.35]), explaining 49.7% of the total effect. After controlling for this mediator, the direct effect of RI remained significant (ADE: $c' = 1.80$, $SE = 0.36$, $p < 0.001$, 95% CI [1.10, 2.51]), indicating partial mediation.

- For Emotional Opposition, RI increased emotional-opposition ratings (a path: $a = 3.60$, $SE = 0.35$, $t = 10.34$, $p < 0.001$, 95% CI [2.91, 4.29]); in turn, stronger emotional opposition predicted greater trial-level ER success (b path: $b = 0.60$, $SE = 0.06$, $t = 10.17$, $p < 0.001$, 95% CI [0.48, 0.72]). This indirect pathway showed the largest mediation (ACME: $a \times b = 2.17$, $SE = 0.33$, $p < 0.001$, 95% CI [1.58, 2.86]), explaining 60.7% of the total effect. After controlling for this mediator, the direct effect of RI remained significant (ADE: $c' = 1.40$, $SE = 0.39$, $p < 0.001$, 95% CI [0.65, 2.17]), indicating partial mediation.

- For Appraisal Change, RI increased appraisal-change ratings (a path: $a = 2.96$, $SE = 0.38$, $t = 7.78$, $p < 0.001$, 95% CI [2.20, 3.71]), and higher appraisal change predicted greater trial-level ER success (b path: $b = 0.43$, $SE = 0.06$, $t = 6.72$, $p < 0.001$, 95% CI [0.30, 0.56]). The indirect effect was significant (ACME: $a \times b = 1.27$, $SE = 0.38$, $p < 0.001$, 95% CI [0.63, 2.09]), explaining 35.7% of the total effect. After controlling for this mediator, the direct effect of RI remained significant (ADE: $c' = 2.30$, $SE = 0.49$, $p < 0.001$, 95% CI [1.27, 3.21]), indicating partial mediation.

- For Meaning Reconstruction, RI increased meaning-reconstruction ratings (a path: $a = 2.54$, $SE = 0.40$, $t = 6.39$, $p < 0.001$, 95% CI [1.75, 3.33]), and higher meaning-reconstruction predicted greater trial-level ER success (b path: $b = 0.32$, $SE = 0.07$, $t = 4.73$, $p < 0.001$, 95% CI [0.18, 0.45]). The indirect effect was significant (ACME: $a \times b = 0.80$, $SE = 0.31$, $p < 0.001$, 95% CI [0.31, 1.50]), explaining 22.5% of the total effect. After controlling for this mediator, the direct effect of RI remained significant (ADE: $c' = 2.77$, $SE = 0.46$, $p < 0.001$, 95% CI [1.78, 3.59]), indicating partial mediation.

CR vs. PV

Across all models, CR produced a reliable total increase in trial-level ER success relative to PV (total effect: $c = 1.97$, $SE = 0.31$, $p < 0.001$, 95% CI [1.33, 2.56]). All four mediators showed significant indirect effects (all ACMEs $p < 0.001$), indicating that CR also engaged each of the four feature dimensions.

- For Scene generation, CR increased scene-construction ratings (*a* path: $a = 1.63$, $SE = 0.41$, $t = 3.94$, $p < 0.001$, 95% CI [0.81, 2.45]), and higher scene generation predicted greater trial-level ER success (*b* path: $b = 0.48$, $SE = 0.06$, $t = 8.60$, $p < 0.001$, 95% CI [0.37, 0.60]). The indirect effect was significant (ACME: $a \times b = 0.79$, $SE = 0.25$, $p < 0.001$, 95% CI [0.33, 1.31]), explaining 40.0% of the total effect. After controlling for this mediator, the direct effect of CR remained significant (ADE: $c' = 1.18$, $SE = 0.28$, $p < 0.001$, 95% CI [0.62, 1.74]), indicating partial mediation.

- For Emotional Opposition, CR increased emotional-opposition ratings (*a* path: $a = 2.09$, $SE = 0.40$, $t = 5.17$, $p < 0.001$, 95% CI [1.29, 2.89]); in turn, stronger emotional opposition predicted greater trial-level ER success (*b* path: $b = 0.56$, $SE = 0.05$, $t = 10.79$, $p < 0.001$, 95% CI [0.45, 0.66]). The indirect effect was significant (ACME: $a \times b = 1.17$, $SE = 0.27$, $p < 0.001$, 95% CI [0.67, 1.74]), explaining 59.1% of the total effect. After controlling for this mediator, the direct effect of CR remained significant (ADE: $c' = 0.81$, $SE = 0.27$, $p = 0.006$, 95% CI [0.26, 1.33]), indicating partial mediation.

- For Appraisal Change, CR increased appraisal-change ratings (*a* path: $a = 2.57$, $SE = 0.38$, $t = 6.78$, $p < 0.001$, 95% CI [1.82, 3.32]), and greater appraisal change predicted greater trial-level ER success (*b* path: $b = 0.60$, $SE = 0.05$, $t = 11.02$, $p < 0.001$, 95% CI [0.49, 0.71]). The indirect effect was large and significant (ACME: $a \times b = 1.54$, $SE = 0.28$, $p < 0.001$, 95% CI [1.03, 2.11]), explaining about 78.2% of the total effect. After controlling for this mediator, the direct effect of CR was no longer significant (ADE: $c' = 0.43$, $SE = 0.28$, $p = 0.132$, 95% CI [−0.12, 1.01]), suggesting substantial—possibly predominant—mediation via appraisal change.

- For Meaning Reconstruction, CR increased meaning-reconstruction ratings (*a* path: $a = 2.79$, $SE = 0.35$, $t = 7.92$, $p < 0.001$, 95% CI [2.09, 3.49]), and higher meaning reconstruction predicted greater trial-level ER success (*b* path: $b = 0.57$, $SE = 0.07$, $t = 8.57$, $p < 0.001$, 95% CI [0.44, 0.70]). The indirect effect was significant (ACME: $a \times b = 1.58$, $SE = 0.27$, $p < 0.001$, 95% CI [1.09, 2.15]), explaining 80.2% of the total effect. After accounting for this mediator, the direct effect of CR was non-significant (ADE: $c' = 0.39$, $SE = 0.34$, $p = 0.249$, 95% CI [−0.28, 1.06]), suggesting substantial—possibly predominant—mediation via meaning reconstruction.

Summary: Taken together, the single-mediator models suggest that RI's effect was most strongly associated with imagery-based scene generation and emotional opposition, whereas CR's effect was most strongly associated with appraisal change and meaning reconstruction. The relative pattern of these exploratory indirect pathways is summarized in **Figure 7D.**

Discussion

Study 3a provided initial evidence for the hypothesized mechanistic distinction between RI and CR. As predicted, RI elicited higher ratings on scene generation and emotional opposition, supporting the idea that RI involves constructing a vivid reversed scenario and experiencing affect that contrasts with the original emotion. However, RI and CR did not differ on appraisal change or meaning reconstruction, suggesting that RI may also engage meaning-related processes rather than replacing them entirely.

The mediation analyses further clarified these patterns. In single-mediator models, emotional opposition and scene generation accounted for the largest proportions of RI's total effect, whereas appraisal change and meaning reconstruction accounted for smaller proportions and left significant direct effects. For CR, appraisal change and meaning reconstruction emerged as the strongest pathways, and the direct effect became non-significant after controlling for either mediator, suggesting that CR's effect was largely transmitted through semantic reinterpretation in these models.

This pattern suggests that RI does not operate *instead of* semantic reinterpretation but rather *in addition* to it. RI may incorporate meaning-change processes similar to CR while adding a distinct layer: imagery-based scene reversal that generates counter-emotions. Thus, RI's regulatory advantage may stem from stronger engagement of scene generation and emotional opposition on top of meaning-change processes shared with CR. Study 3b tested this possibility more directly by tracking whether counter-emotions emerge during RI implementation.

Study 3b — Real-Time Tracking: Emergence of Counter-Emotions

Study 3a suggested that RI may augment reappraisal-like meaning-change processes with stronger scene generation and emotional opposition. In exploratory single-mediator models, these RI-related features—particularly emotional opposition—showed the strongest indirect pathways for RI, whereas CR was more strongly associated with appraisal change and meaning reconstruction. However, Study 3a relied on retrospective feature ratings collected after strategy implementation, which may reflect post-hoc inference rather than online affective processes.

Study 3b addressed this limitation by capturing changes in positive and negative affect during strategy execution. If RI operates through online emotional counteraction, it should elicit stronger positive-affect gain during regulation than CR, and this emergent positive affect should statistically account for RI's effect on negative-emotion reduction.

Methods

Participants

Sixty-two participants (31 men, 31 women; $M = 21.50$, $SD = 1.72$) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a one-way repeated-measures ANOVA with three levels. With $\alpha = 0.05$, $power = 0.80$, a medium effect size ($Cohen's\ f = 0.25$), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 28 participants would be required. Our sample of 62 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

Study 3b employed the same stimulus set, condition structure (PV, RI, CR), and image assignment scheme as Study 3a. The stimulus comparability check reported in Study 3a therefore applies to the present study.

Procedure

The training procedure and experimental design were identical to Study 3a. Participants received standardized instructions for each regulation condition (PV, RI, CR) and completed a brief supervised practice phase. The experiment adopted a mini-block design consisting of 18 blocks in total (6 blocks per strategy condition), with each mini-block containing five trials. Block order was pseudorandomized across participants, and each mini-block was followed by a 15-second rest period. Detailed instructions for each strategy are provided in **SI-Text 2**.

The trial structure was similar to Study 3a, with two key modifications to enable real-time tracking of counter-affective processes. As in Study 3a, each mini-block began with a 2-second block instruction screen indicating the strategy to be used. As shown in **Figure 8A**, within each block, trials followed a fixed sequence: (1) a fixation cross was presented for a jittered duration (300–500 ms), (2) pre-induction**:** a negative image was shown for 16 seconds (extended from 8 seconds in Study 3a) to allow full emotional engagement, during which participants rated both their negative and positive emotional intensity (9-point scale; 1 = minimum, 9 = maximum), (3) a strategy instruction prompt appeared for 2 seconds, (4) post-regulation: the same image reappeared for an additional 16 seconds during which participants implemented the assigned strategy and again rated both negative and positive emotional intensity, and (5) a 2-second inter-trial interval before the next trial began.

Unlike Study 3a, Study 3b did not include block-level feature ratings. Instead, the critical dependent measures were the real-time changes in positive and negative affect captured within each trial, allowing us to directly assess whether counter-affective experiences emerged during regulation.

Statistics

Two dependent variables were computed for each trial. First, trial-level ER success was operationalized as the reduction in negative affect from pre-regulation to post-regulation (Neg_pre − Neg_post), such that higher scores reflected greater decreases in negative emotion. Second, as an exploratory composite index of online emotional counteraction, we computed an Emotional

Counteraction Index (ECI). The ECI combined two theoretically relevant components: negative-affect reduction, calculated as (Neg_pre − Neg_post), and positive-affect gain, calculated as (Pos_post − Pos_pre). Both components were summed and then divided by the scale maximum (9). Higher ECI values therefore indicated stronger online emotional counteraction, reflecting both the reduction of negative affect and the emergence of positive affect during regulation.

A two-way repeated-measures ANOVA was conducted to examine the effects of regulation condition (PV, CR, RI) and context (interpersonal, event-based) on each dependent variable. All other statistical procedures and requirements were identical to those used in Study 2a.

Mediation analysis: To examine whether positive-affect gain statistically accounted for the regulatory effects of RI and CR, we employed the same single-mediator framework described in Study 3a (Imai et al., 2010; 5,000 bootstrap resamples). The mediator was trial-level positive-affect gain, calculated as Pos_post − Pos_pre, which indexed the emergence of positive affect during regulation. Separate models were run for RI vs. PV and CR vs. PV, yielding two mediation models in total. As in Study 3a, because the mediator was not experimentally manipulated, these analyses were interpreted as exploratory evidence for statistical indirect pathways rather than as definitive causal proof.

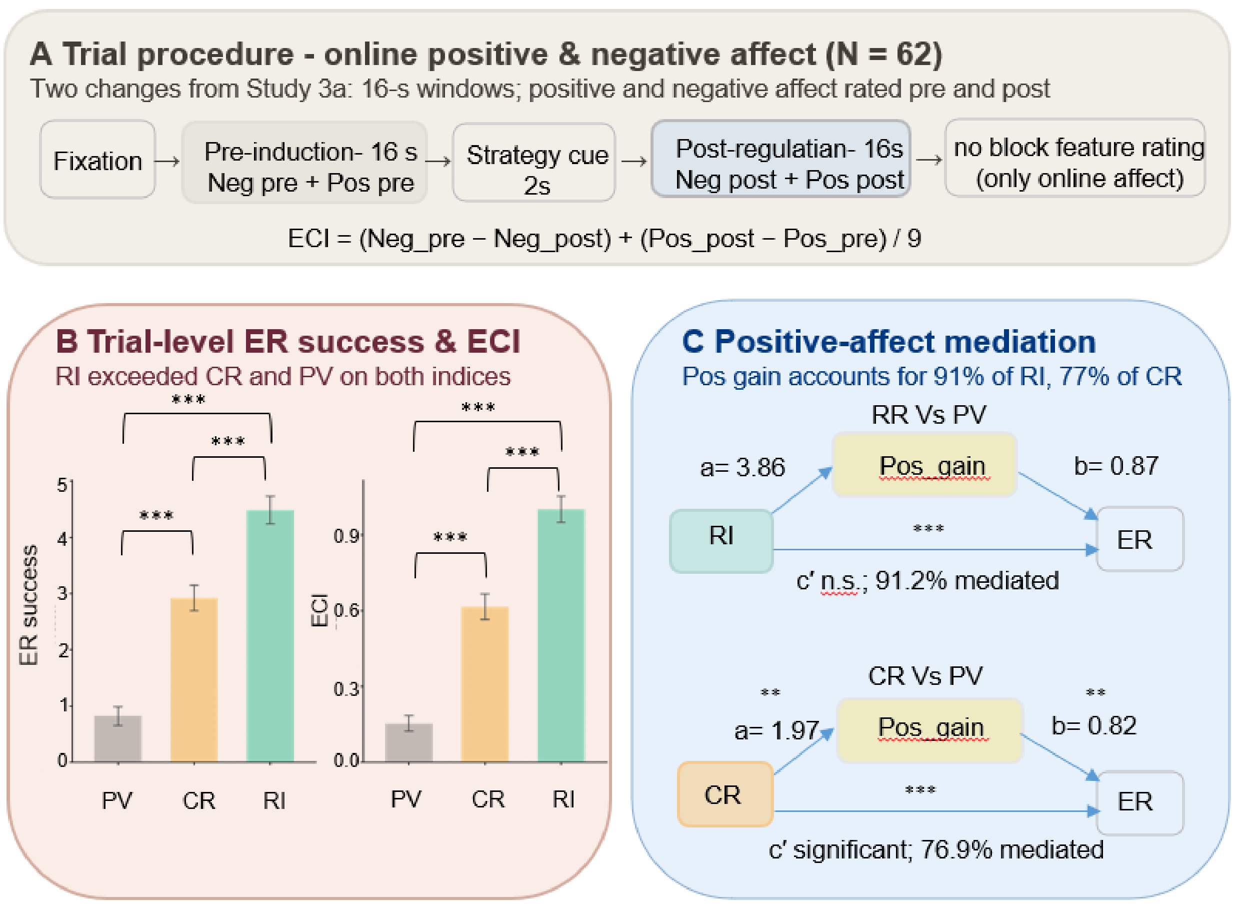

Figure 8. Study 3b design and results: online emergence of counter-emotions during RI. **(A)** Trial procedure. Study 3b used the same mini-block structure as Study 3a but replaced retrospective block-level feature ratings with trial-level online affect ratings. On each trial, participants first viewed a negative image for 16 s and rated both negative and positive affect. After a strategy cue, the same image was re-presented for 16 s while participants implemented PV, CR, or RI, followed by post-regulation ratings of negative and positive affect. ER success was computed as negative affect before regulation minus negative affect after regulation. The Emotional Counteraction Index (ECI) combined negative-affect reduction and positive-affect gain: ECI = (Neg_pre − Neg_post) + (Pos_post − Pos_pre) / 9. **(B)** Trial-level ER success and ECI. RI produced greater negative-affect reduction and a higher ECI than both CR and PV. **(C)** Exploratory single-mediator models testing positive-affect gain as an online counter-emotion pathway. Positive-affect gain accounted for 91.2% of the RI effect, with the direct effect becoming non-significant after including the mediator. For CR, positive-affect gain accounted for 76.9% of the effect, while the direct effect remained significant. Mediation percentages are from separate single-mediator models and should be interpreted as exploratory estimates rather than definitive causal decomposition. Error bars indicate standard errors of the mean. $^{**}p < .01$; $^{***}p < .001$; n.s. = not significant.

Results

To maintain a concise and reader-friendly main text, descriptive statistics (*M* ± *SD*) for each condition are summarized in **SI-Text 1**. The Study 3b procedure and main online-affect results are summarized in **Figure 8**.

A preliminary *regulation condition* × *context* repeated-measures ANOVA revealed neither a main effect of *context* nor a *context* × *regulation condition* interaction (all *p*s > 0.05). Therefore, data were collapsed across context, and a one-way repeated-measures ANOVA with *regulation condition* as the as the sole factor.

Trial-level ER success

There was a robust main effect of *regulation condition* [$F(2, 122) = 118.67$, $p < 0.001$, $\eta^2 = 0.66$]. Participants reported the highest levels of ER success in the RI condition, followed by CR, and the lowest levels in the PV condition. Pairwise comparisons (FDR-corrected) confirmed that RI was significantly more effective than CR [$t(61) = 10.13$, $p < 0.001$, $d = 1.00$], and that both strategies were significantly more effective than PV [RI vs. PV: $t(61) = 13.64$, $p < 0.001$, $d = 2.09$; CR vs. PV: $t(61) = 7.33$, $p < 0.001$, $d = 1.08$]. These findings showed that RI produced the strongest immediate negative-affect reduction among the three conditions (**Figure 8B, left**)

Emotional Counteraction Index

There was a significant main effect of *regulation condition* [$F(2, 122) = 111.30$, $p < 0.001$, $\eta^2 = 0.65$]. Follow-up pairwise comparisons (FDR-corrected) confirmed that RI produced a higher ECI than CR [$t(61) = 9.21$, $p < 0.001$, $d = 0.90$]. Both strategies produced a higher ECI than PV [RI vs. PV: $t(61) = 13.14$, $p < 0.001$, $d = 2.04$; CR vs. PV: $t(61) = 7.57$, $p < 0.001$, $d = 1.14$] (**Figure 8B, right**).

Mediation analysis

The positive-affect gain mediation models are summarized in **Figure 8C**.

RI vs. PV. RI produced a robust total increase in trial-level ER success relative to PV (total effect: $c = 3.66$, $SE = 0.21$, $p < 0.001$, 95% CI [3.22, 4.08]). For positive emotion gain, RI substantially increased the magnitude of positive affect change during regulation (*a* path: $a = 3.86$, $SE = 0.19$, $t = 19.88$, $p < 0.001$, 95% CI [3.47, 4.24]), and greater positive emotion gain strongly predicted greater trial-level ER success (*b* path: $b = 0.87$, $SE = 0.05$, $t = 19.73$, $p < 0.001$, 95% CI [0.77, 0.95]). The indirect effect was significant (ACME: $a \times b = 3.34$, $SE = 0.22$, $p < 0.001$, 95% CI [2.91, 3.77]), explaining 91.2% of the total effect within this single-mediator model. After controlling for this mediator, the direct effect of RI was no longer significant (ADE: $c' = 0.32$, $SE = 0.22$, $p = 0.121$, 95% CI [−0.08, 0.78]), consistent with near-complete statistical mediation in this single-mediator model.

CR vs. PV. CR produced a reliable total increase in trial-level ER success relative to PV (total effect: $c = 2.10$, $SE = 0.20$, $p < 0.001$, 95% CI [1.71, 2.48]). For positive emotion gain, CR increased the magnitude of positive affect change during regulation (*a* path: $a = 1.97$, $SE = 0.19$, $t = 10.09$, $p < 0.001$, 95% CI [1.60, 2.35]), and greater positive emotion gain strongly predicted greater trial-level ER success (*b* path: $b = 0.82$, $SE = 0.04$, $t = 20.39$, $p < 0.001$, 95% CI [0.74, 0.90]). The indirect effect was significant (ACME: $a \times b = 1.62$, $SE = 0.17$, $p < 0.001$, 95% CI [1.29, 1.95]), explaining 76.9% of the total effect. After controlling for this mediator, the direct effect of CR remained significant (ADE: $c' = 0.48$, $SE = 0.16$, $p = 0.002$, 95% CI [0.17, 0.81]), indicating partial mediation.

Discussion

Study 3b examined whether positive affect emerges during RI implementation rather than being inferred retrospectively after the task. The results supported this online counter-emotion account. RI produced greater negative-affect reduction than CR and generated stronger positive-affect gain during the regulation window. Thus, participants did not merely report afterward that RI had helped them feel better; positive affect increased while they were using the strategy.

A central contribution of this study is that it links RI’s regulatory effect to online affective change. RI produced a larger Emotional Counteraction Index than CR, indicating stronger combined negative-affect reduction and positive-affect gain. This pattern is consistent with the proposal that RI engages an affective pathway characterized by the generation of opposing emotional states during imagined reversal.

The mediation results further supported this interpretation. In the RI model, positive-affect gain accounted for 91.2% of the total effect, and the direct effect became non-significant after including this mediator. This pattern is consistent with near-complete statistical mediation in the single-mediator model, suggesting that RI’s immediate benefit was closely linked to the positive affect generated during regulation. For CR, positive-affect gain also accounted for a substantial portion of the effect, but a significant direct effect remained, suggesting that CR additionally relies on other pathways, likely the meaning-change processes identified in Study 3a.

Finally, the absence of context effects suggests that the online counter-emotion pattern was not limited to either interpersonal or event-based stimuli in the present design. However, this should be interpreted cautiously: the absence of a significant interaction does not prove equivalence across contexts. Study 5 directly examined contextual boundary conditions by testing whether immediate relief and later rebound diverge across interpersonal and event-based situations.

Study 4 — Cognitive System Differentiation: Visual Simulation versus Semantic Processing

Building on Study 3's evidence that RI and CR rely on different cognitive–affective pathways (counter-emotion generation vs. meaning reinterpretation), Study 4 asked whether these pathways are anchored in distinct processing systems. Specifically, we examined the idea that RI depends primarily on a visual–imagery/simulation system, whereas reappraisal relies more on semantic–conceptual processing.

To test this, we used two complementary approaches. **Study 4a** employed a task-switching paradigm to assess how readily each strategy can be engaged after tasks that tax visual versus verbal processing. **Study 4b** examined whether stable individual differences in visual versus verbal cognitive style differentially predict the effectiveness of RI and CR, testing whether the processing-system distinction observed at the task level also manifests at the level of individual traits. Together, these studies aimed to provide converging behavioral evidence that RI and reappraisal draw more strongly on different processing routes—visual imagery/simulation for RI and semantic–conceptual processing for CR. This processing-system hypothesis is illustrated in **Figure 9**.

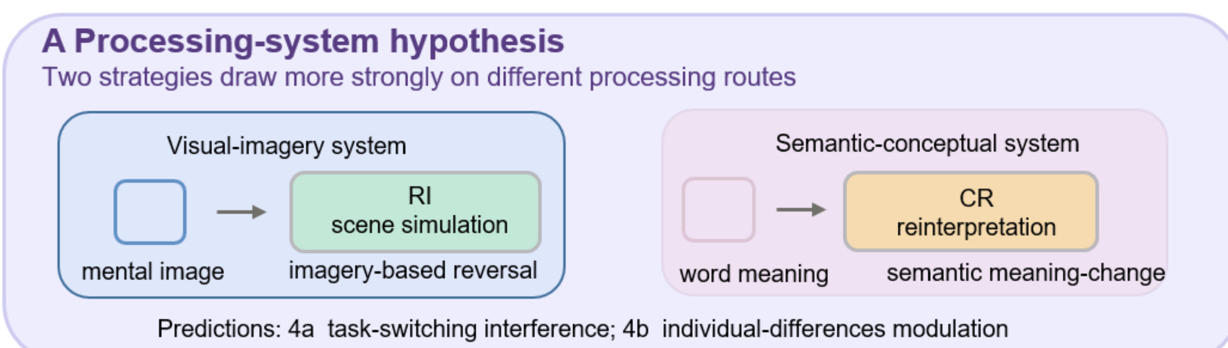

Figure 9. Processing-system hypothesis for Study 4. RI was hypothesized to rely more strongly on visual imagery/simulation, whereas CR was hypothesized to rely more strongly on semantic–conceptual processing. Study 4a tested this prediction using task-switching interference, and Study 4b tested it using individual differences in visual versus verbal cognitive style.

Study 4a — Task-Switching Costs: Processing-System Evidence

Study 4a was designed to test whether RI and CR show selective switching costs that are consistent with reliance on different processing systems. Based on the idea that RI primarily draws on visual simulation whereas CR relies more heavily on semantic–conceptual processing, we used a task-switching paradigm in which participants alternated between cognitive tasks and emotion regulation. The preceding tasks were either visually demanding (3D mental rotation judgment) or semantically demanding (noun categorization by semantic class).

If each strategy depends more strongly on a particular processing route, then a preceding task that taxes the same route should produce greater interference than a task that taxes a different route. This prediction follows from the broader task-switching logic that switching between task sets can incur performance costs, especially when cognitive control must reconfigure processing resources (Monsell, 2003). We therefore predicted that RI would show larger switching costs following visual tasks than semantic tasks, whereas CR would show the opposite pattern, with greater costs following semantic tasks than visual tasks (Predicted pattern is shown schematically in **Figure 10A**).

Methods

Participants

Fifty-five participants (29 men, 26 women; $M = 21.67$, $SD = 1.86$) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a 2 × 2 repeated-measures ANOVA. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.25), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 24 participants would be required to detect the smallest anticipated effect. Our sample of 55 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

All 100 images (50 interpersonal, 50 event-based) were selected from our validated stimulus set. Each image was presented twice across the experiment, yielding 200 trials in total. Trials were distributed across four condition combinations (RI-visual, RI-semantic, CR-visual, CR-semantic), with each condition containing 50 trials and an equal number of interpersonal and event-based image presentations. To confirm that stimulus assignment was balanced across conditions, we used the pre-rating data obtained in the pilot study. For each pilot participant, ratings were averaged across the images assigned to each Study 4a condition set, and one-way repeated-measures ANOVAs were conducted to compare negative intensity, arousal, and vividness across the four condition sets. Results showed no significant differences in negative intensity [$F(3, 87) = 0.46$, $p = 0.714$, $\eta^2 = 0.02$; RI-vis = 2.74 ± 1.52; RI-sem = 2.64 ± 1.29; CR-vis = 2.68 ± 1.10; CR-sem = 2.71 ± 1.17], arousal [$F(3, 87) = 0.93$, $p = 0.430$, $\eta^2 = 0.03$; RI-vis = 7.08 ± 1.07; RI-sem = 7.06 ± 0.84; CR-vis = 6.91 ± 0.97; CR-sem = 7.00 ± 0.87], or vividness [$F(3, 87) = 1.67$, $p = 0.180$, $\eta^2 = 0.05$; RI-vis = 6.91 ± 0.91; RI-sem = 6.96 ± 0.86; CR-vis = 6.80 ± 0.92; CR-sem = 6.79 ± 0.74].

Procedure

The training procedure was similar to Study 3a, with additional components to accommodate the task-switching paradigm. Participants received standardized instructions for each regulation condition (RI, CR) and completed a brief supervised practice phase. Additionally, participants were trained on two preceding tasks: a visual task (3D mental rotation judgment)(Shepard & Metzler, 1971) and a semantic task (noun categorization by semantic class)(Rosch, 1975). They also practiced transitioning from each preceding task into the ER phase. Training lasted approximately 10 minutes. Detailed instructions for each strategy are provided in SI-Text 2.

The experiment adopted a 2 (*regulation condition*: RI vs. CR) × 2 (*preceding task type*: visual vs. semantic) within-subjects design. The main task consisted of 20 mini-blocks (5 per condition combination). Each mini-block contained five trials, and block order was pseudorandomized across participants. Each mini-block was followed by a 45-second period for block-level ratings and a 20-second rest period.

As shown in **Figure 10B**, within each block, trials followed a fixed sequence: (1) a fixation cross was presented for a jittered duration (300–500 ms), (2) pre-regulation phase: a negative image was shown for 8 seconds to allow full emotional engagement, during which participants rated their negative emotional intensity, (3) a strategy instruction prompt (RI or CR) appeared for 2 seconds, (4) preceding task phase: participants completed an 8-second task—either visual (3D mental rotation) or semantic (noun categorization)—followed by a 1-second switch cue (“Switch to ER task”), (5) post-regulation phase: the same image reappeared for 8 seconds during which participants implemented the assigned strategy and provided a post-regulation emotion rating, and (6) a 2-second inter-trial interval before the next trial began.

After each mini-block, participants completed two block-level ratings: preceding-task difficulty and task-to-regulation switch difficulty.

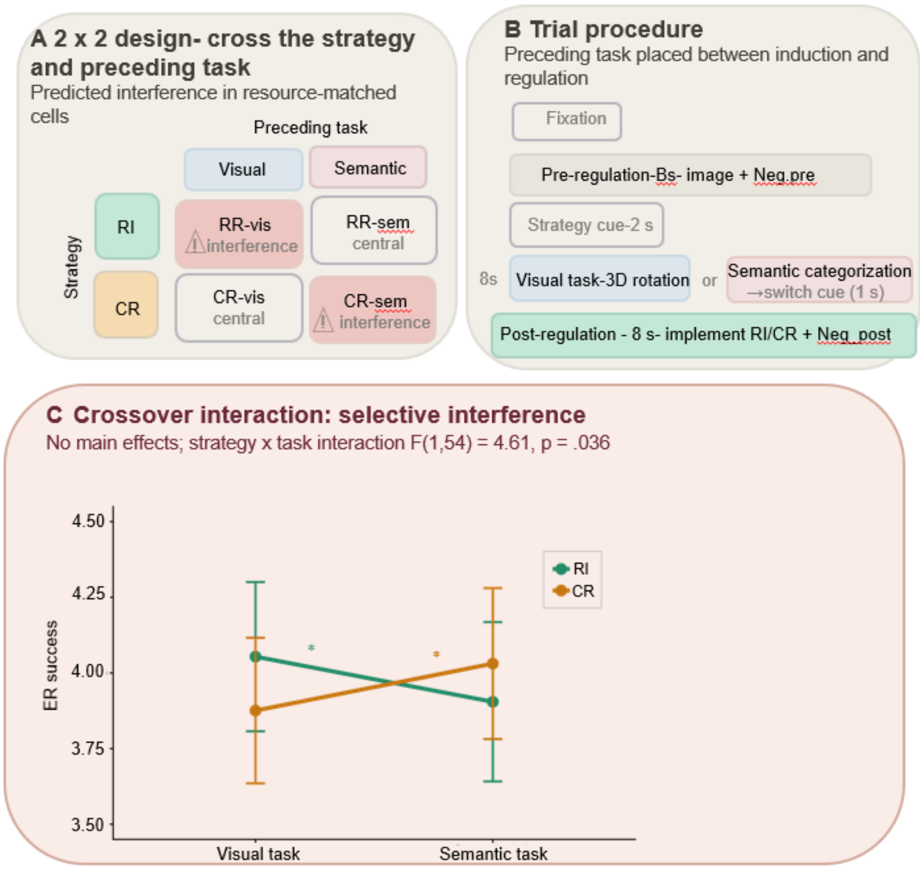

Figure 10. Study 4a design and results: task-switching evidence for processing-system differentiation. **(A)** Study 4a used a 2 × 2 within-subject design crossing regulation strategy (RI vs. CR) with preceding task type (visual vs. semantic). The predicted interference occurred in resource-matched cells: RI was expected to be more disrupted after a visual task, whereas CR was expected to be more disrupted after a semantic task. **(B)** Trial procedure. Each trial began with fixation, followed by an 8-s pre-regulation presentation of a negative image and an initial negative-emotion rating. After a 2-s strategy cue, participants completed an 8-s preceding task, either 3D mental rotation or semantic noun categorization, followed by a 1-s switch cue. The same image was then re-presented for 8 s while participants implemented RI or CR and provided a post-regulation negative-emotion rating. ER success was computed as the reduction in negative affect from pre- to post-regulation. **(C)** ER success as a function of regulation strategy and preceding task type. There were no significant main effects of regulation strategy or task type, but the strategy × task interaction was significant. RI was less effective after visual than semantic tasks, whereas CR was less effective after semantic than visual tasks. Error bars indicate standard errors of the mean. *$p < .05$.

Statistical Analysis

A three-way repeated measures ANOVA was conducted to examine the effects of *regulation condition* (CR, RI), *preceding task type* (visual, semantic) and *context* (interpersonal, event-based) on trial-level ER success and block-level ratings. All other statistical procedures and requirements were identical to those used in Study 2a.

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1**.

A preliminary repeated-measures ANOVA with *regulation condition* × *task type* × *context* revealed neither a main effect of *context* nor any interactions involving *context* (all *p*s > 0.05). Therefore, data were collapsed across context, and the main analyses used a two-way repeated-measures ANOVA with *regulation condition* and *task type* as within-subject factors.

Trial-level ER success

There was no significant main effect of *regulation condition* [$F(1, 54) = 0.07$, $p = 0.80$, $\eta^2 < 0.01$], and no significant main effect of *task type* [$F(1, 54) = 0.01$, $p = 0.97$, $\eta^2 < 0.01$]. However, the *regulation condition* × *task type* interaction was significant [$F(1, 54) = 4.61$, $p = 0.036$, $\eta^2 = 0.08$]. Follow-up paired-samples *t*-tests (FDR-corrected) indicated that, for the RI strategy, regulation effectiveness was significantly lower following the visual task compared to the semantic task [$t(54) = -2.75$, $p = 0.016$, $d = -0.37$]. Conversely, for the CR strategy, effectiveness was significantly lower following the semantic task compared to the visual task [$t(54) = -2.45$, $p = 0.018$, $d = -0.33$]. This crossover interaction suggests that the effectiveness of a given cognitive regulation strategy is systematically modulated by the nature of the preceding task. This crossover interaction is shown in **Figure 10C**.

Block-level ratings

Preceding task difficulty. A 2 (regulation condition: RI vs. CR) × 2 (task type: visual vs. semantic) repeated-measures ANOVA on perceived preceding task difficulty revealed no significant main effect of *regulation condition* ($p = 0.17$), no significant main effect of *task type* ($p = 0.22$), and no significant interaction ($p = 0.54$). Difficulty ratings were comparable across conditions, suggesting that the cognitive demands of the preceding tasks were equivalent across regulatory conditions.

Task-to-regulation switch difficulty. A parallel ANOVA on perceived difficulty of switching from the preceding task to emotion regulation revealed no significant main effect of *regulation condition* ($p = 0.34$), no significant main effect of *task type* ($p = 0.24$), and no significant interaction ($p = 0.42$). Switch difficulty ratings were highly similar across conditions (RI–visual: $M = 3.69$, $SD = 1.60$; RI–semantic: $M = 3.74$, $SD = 1.59$; CR–visual: $M = 3.76$, $SD = 1.46$; CR–semantic: $M = 3.88$, $SD = 1.57$), suggesting comparable switching demands regardless of preceding task or regulation strategy.

Discussion

Study 4a examined whether RI and CR rely on dissociable cognitive systems by testing how each strategy responds to switching from visual-simulation versus semantic-conceptual tasks. The theoretical prediction was that RI would show greater disruption following visual tasks (due to shared visual-simulation resources), whereas CR would show greater disruption following semantic tasks (due to shared semantic-conceptual resources). The results provided support for this processing-system dissociation hypothesis.

The critical finding was a significant crossover interaction between regulation strategy and preceding task type. RI was less effective after a visual task than after a semantic task, whereas CR showed the opposite pattern. Importantly, this pattern occurred without a general main effect of task difficulty or strategy effectiveness. Thus, the result does not simply mean that one task was harder or one strategy was weaker. Instead, each strategy was selectively disrupted by the type of processing resource it relies on most. RI appears to depend more on visual imagery resources, whereas CR depends more on semantic-conceptual resources.

Notably, this crossover pattern emerged despite the absence of main effects. Neither strategy showed an overall advantage, and neither preceding task type produced uniformly greater disruption. This suggests that the two strategies are comparably effective under normal conditions, and that the selective interference effects are specifically attributable to resource competition between the preceding task and the regulatory mechanism—rather than general cognitive load.

The block-level ratings provided important control information. Participants reported comparable difficulty for the visual and semantic preceding tasks, and comparable ease of switching into regulation across all conditions. This makes it less likely that the crossover interaction was driven by gross differences in perceived task demands or switching difficulty, and is more consistent with a processing-resource competition account.

Taken together, Study 4a provides converging behavioral evidence for the processing-system dissociation hypothesis. The crossover interaction provides behavioral evidence consistent with the idea that RI and CR draw on partly distinct cognitive pathways—visual simulation for RI, semantic processing for CR—echoing the mechanistic distinctions identified in Studies 3a–3b. Study 4b complements this investigation by examining whether the same processing-system distinction emerges at the level of individual differences, testing whether participants' dispositional preferences for visual versus verbal processing differentially predict their success with RI versus CR.

Study 4b — Cognitive Style Modulation: Individual Differences in Processing Preference

Study 4b adopted a complementary individual-differences approach by asking whether participants' dispositional preferences for visual versus verbal processing differentially predicted the effectiveness of RI and CR. If RI relies primarily on visual-imagery processes, individuals with stronger visual cognitive orientation should achieve greater regulatory success with RI. If CR relies more strongly on semantic–conceptual processing, individuals with stronger verbal orientation might show greater success with CR. Thus, we predicted that visual preference would positively predict RI effectiveness, whereas verbal preference would positively predict CR effectiveness. This individual-differences approach provided a complementary test of whether the processing-system distinction observed at the task level in Study 4a also appears in stable cognitive-style differences.

Methods

Participants

Fifty-three participants (24 men, 29 women; *M* = 21.77, *SD* = 2.01) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a repeated-measures within-between interaction design (to evaluate the interaction between continuous covariates and within-subject conditions). With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.25), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 34 participants would be required to detect the smallest anticipated effect. Our sample of 53 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

All 100 images (50 interpersonal, 50 event-based) were selected from our validated stimulus set. Because each image was presented once in the RI condition and once in the CR condition, baseline affective properties were inherently matched across strategy conditions. Image order and condition order were randomized across participants to minimize order effects.

Procedure

The training procedure was similar to Study 3a. The current study employed a 2 (regulation strategy: RI vs. CR) within-subjects design, with participants' cognitive style (visual preference, verbal preference) measured as continuous individual-difference variables. Prior to the main task, participants completed a visualizer–verbalizer questionnaire (VVQ; Antonietti & Giorgetti, 1998). The questionnaire included separate visual-preference and verbal-preference subscales, rated on

5-point scales. Composite scores were calculated for each subscale and treated as continuous predictors. The cognitive-style assessment and RI/CR within-subject procedure are summarized in **Figure 11A**.

The main experiment consisted of 40 mini-blocks, with 20 RI blocks and 20 CR blocks. Each mini-block contained five trials. Block order was counterbalanced using a Latin square design to control for sequence effects.

As shown in Figure X, each trial followed a fixed sequence: (1) a fixation cross was presented for a jittered duration (300–500 ms), (2) pre-regulation phase: a negative image was shown for 5 seconds to allow initial emotional engagement, during which participants rated their negative emotional intensity (1–9 scale), (3) a strategy prompt (RI or CR) appeared for 2 seconds, (4) regulation phase: the same image reappeared for 8 seconds while participants implemented the assigned strategy and provided a post-regulation emotion rating, and (5) a 2-second inter-trial interval before the next trial began.

Upon completing all mini-blocks, participants entered a final assessment phase (~10 minutes), where they reflected on their strategy preferences, perceived difficulty, and the relative effectiveness of visual vs. semantic supports. They also completed a brief emotional recovery task. The entire experiment, including the pretest and main task, lasted approximately 75 minutes.

Statistics

A repeated-measures ANCOVA was conducted with *strategy* (RI, CR) as the within-subjects factor and *cognitive style* (visual preference, verbal preference) as continuous participant-level covariates. This approach tested whether individual differences in cognitive processing orientation differentially modulate the effectiveness of RI versus CR. For significant *cognitive style* × *strategy* interactions, simple slope analyses were conducted to examine the relationship between cognitive style and regulatory effectiveness within each strategy. All other statistical procedures were identical to those used in Study 4a.

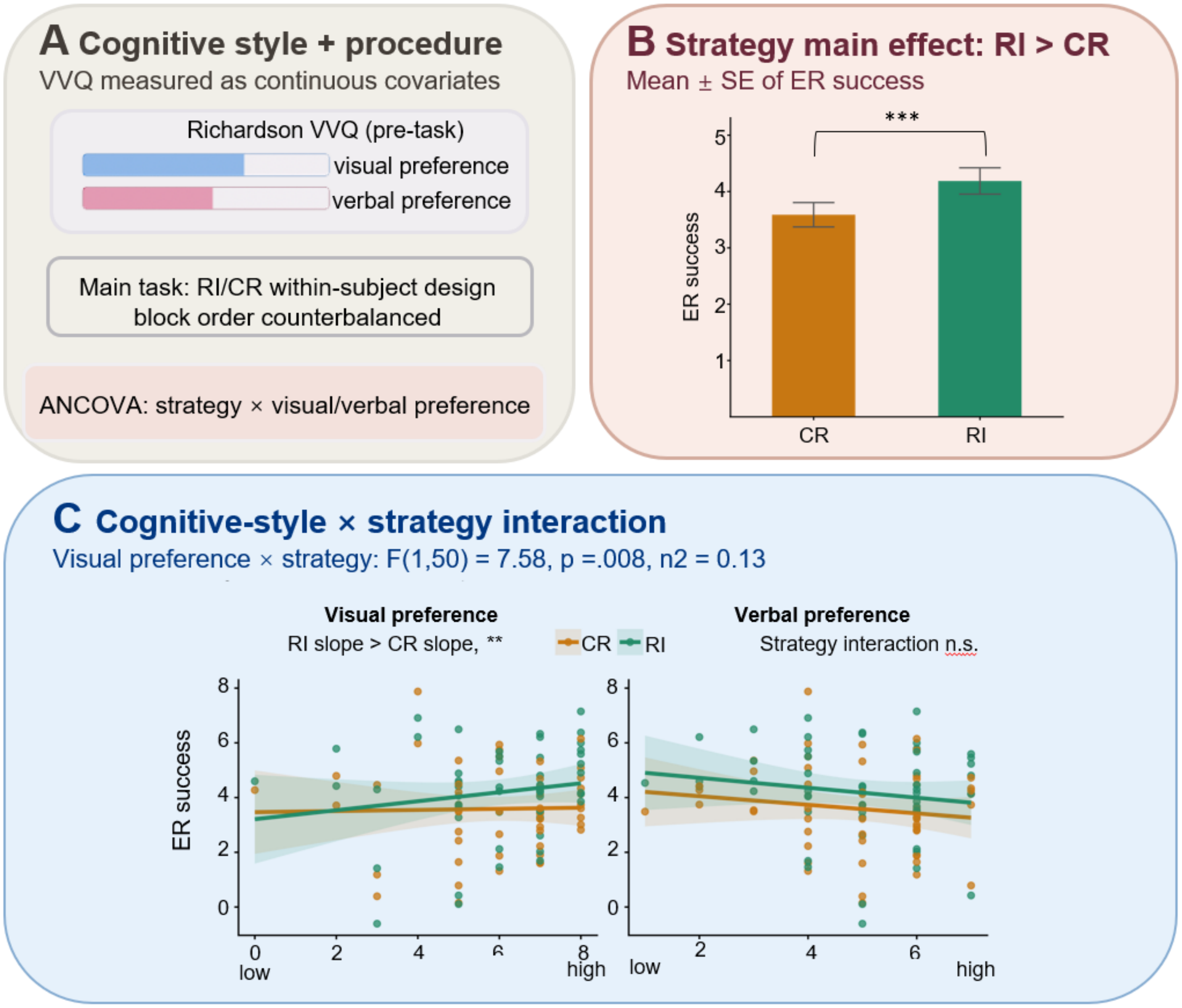

Figure 11. Study 4b design and results: cognitive-style modulation of RI and CR. (A) Participants completed a visualizer–verbalizer cognitive-style questionnaire before the main task. Visual-preference and verbal-preference scores were entered as continuous participant-level covariates in a repeated-measures ANCOVA. Participants then completed a two-strategy within-subject regulation task comparing RI and CR. **(B)** Strategy main effect. RI produced greater ER success than CR, indicating stronger negative-affect reduction across contexts. **(C)** Cognitive-style modulation. Visual preference significantly interacted with strategy: stronger visual preference predicted greater RI success relative to CR. In contrast, the verbal preference × strategy interaction was not significant, indicating no reliable CR-specific advantage associated with verbal preference. Shaded bands indicate confidence intervals around fitted regression lines. Error bars indicate standard errors of the mean. $p < .01$, $p < .001$; n.s. = not significant.

Results

To maintain a concise and reader-friendly main text, descriptive statistics (*M* ± *SD*) for each condition are summarized in **SI-Text 1**.

A preliminary repeated-measures ANCOVA with *strategy* × *cognitive style scores* × *context* revealed neither a main effect of *context* nor any interactions involving *context* (all *p*s > 0.05). Therefore, data were collapsed across context, and the main analysis used a repeated-measures ANCOVA with strategy (RI vs. CR) as the within-subject factor and visual preference and verbal preference as continuous covariates.

Trial-level ER success

The main strategy effect and cognitive-style modulation results are shown in **Figure 11B–C**.

There was a significant main effect of *strategy* [$F(1, 50) = 33.60$, $p < 0.001$, $\eta^2 = 0.40$], with RI producing greater emotion reduction than CR ($M = 4.19$, $SD = 1.70$ vs. $M = 3.59$, $SD = 1.58$; $d = 0.81$; **Figure 11B**). Neither visual preference nor verbal preference showed significant main effects (all *p*s > 0.05).

Critically, the visual preference × *strategy* interaction was significant [$F(1, 50) = 7.58$, $p = 0.008$, $\eta^2 = 0.13$], indicating that visual cognitive style differentially modulated the effectiveness of RI versus CR (**Figure 11C**). The verbal preference × *strategy* interaction was not significant ($p = 0.227$).

Simple slope analyses were conducted to decompose the significant interaction. For RI, visual preference significantly predicted emotion reduction ($b = 0.24$, $SE = 0.10$, $t = 2.43$, $p = 0.017$), indicating that participants with stronger visual cognitive orientation achieved greater regulatory success with RI. Conversely, verbal preference negatively predicted RI effectiveness ($b = -0.28$, $SE = 0.12$, $t = -2.30$, $p = 0.024$), indicating that participants with stronger verbal cognitive orientation achieved weaker regulatory success with RI. The overall regression model for RI was significant [$F(2, 50) = 4.22$, $p = 0.017$, $R^2 = 0.08$].

For CR, neither visual preference ($b = 0.07$, $SE = 0.09$, $t = 0.76$, $p = 0.452$) nor verbal preference ($b = -0.19$, $SE = 0.11$, $t = -1.64$, $p = 0.105$) significantly predicted emotion reduction. The overall regression model for CR was not significant [$F(2, 50) = 1.37$, $p = 0.260$, $R^2 = 0.03$].

Discussion

Study 4b examined whether individual differences in visual–verbal cognitive style modulate the effectiveness of RI and CR. The results provided partial converging support for the processing-system hypothesis. In addition to the overall advantage of RI over CR, visual preference selectively predicted RI success: participants with stronger visual cognitive orientation showed greater emotion reduction when using RI. This finding is consistent with the idea that RI benefits from the ability or tendency to construct vivid scene-level simulations.

By contrast, verbal preference did not positively predict CR success, and neither visual nor verbal preference significantly predicted CR effectiveness. Thus, Study 4b provided clearer support for the visual-imagery basis of RI than for a verbal-style basis of CR. One possibility is that CR is a broad and flexible family of cognitive-change operations, implemented through multiple tactics such as reinterpretation and distancing, and therefore may not be tightly captured by a general visual–verbal preference measure (McRae & Gross, 2020b; Webb et al., 2012b). However, this null effect should be interpreted cautiously and tested with more direct measures of semantic processing ability or verbal reappraisal fluency.

Together with Study 4a, these findings provide converging but asymmetric evidence for processing-system differentiation. Study 4a showed that RI and CR were selectively disrupted by resource-matched preceding tasks, whereas Study 4b showed that RI—but not CR—was modulated by individual differences in visual preference. This convergence strengthens the claim that RI is anchored in visual-imagery/simulation processes, while leaving open the possibility that CR's semantic–conceptual basis may require more targeted measures than the broad verbal-preference index used here.

Study 5 — Contextual Specificity: Shared Mechanism, Context-Specific Experience, and the Role of Tangibility

Studies 3 and 4 established that RI operates through imagery-based scene generation and counter-emotion generation, distinguishing it mechanistically from reappraisal's semantic reinterpretation. Study 5 turned to a different question: does the motivational architecture and durability of RI differ across scenarios that afford—or fail to afford—a target for symbolic retaliation, and how does the tangibility of the underlying loss shape its sustained effects?

Our theoretical framework proposes a dual-architecture view: RI may involve a context-general control-restoration mechanism that operates across both interpersonal and event-based contexts, while additionally recruiting a context-specific affective experience in interpersonal contexts—symbolic retaliation. In interpersonal scenarios, the presence of a salient harm-doer provides a target for role-reversed imagination, allowing the regulator to imagine reversing the social relation and experiencing revenge-related imagery or retaliatory satisfaction (Horowitz, 2007). Such revenge-related responses may be affectively rewarding after rejection (Chester & DeWall, 2017). In event-based scenarios, outcome reversal can still restore a sense of control within the imagined scene, consistent with broader theories of perceived control, but there is no interpersonal target for retaliation and the imagined restoration remains vulnerable to the fact that the actual loss has not been undone (Rothbaum et al., 1982). **Figure 12** summarizes this dual-architecture framework, distinguishing the shared control-restoration channel from the interpersonal-specific symbolic-retaliation pathway and the independent role of loss tangibility.

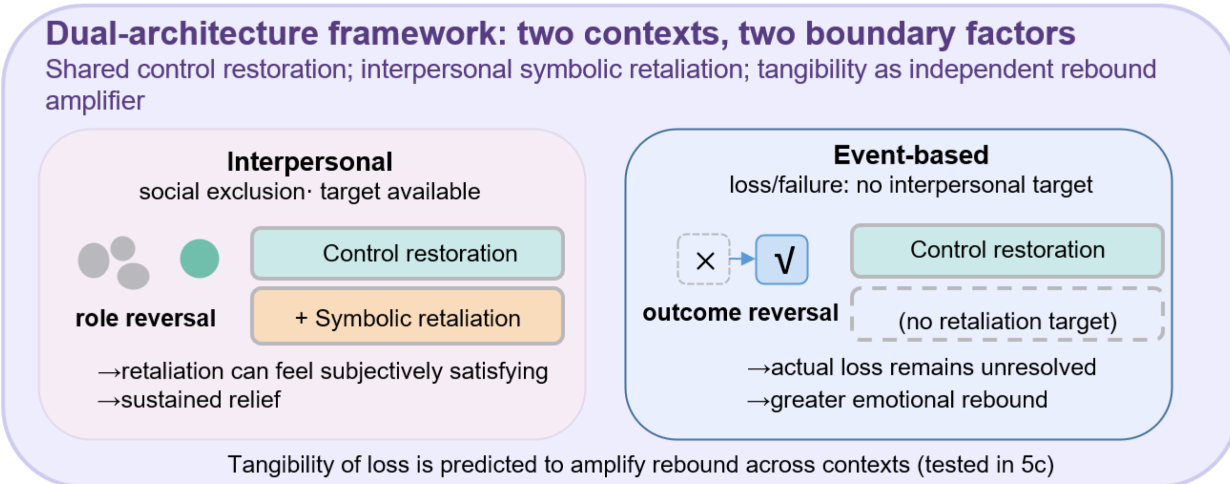

Figure 12. Dual-architecture framework for Study 5. RI was hypothesized to involve a shared control-restoration channel across interpersonal and event-based contexts, while additionally recruiting a context-specific symbolic-retaliation experience when an interpersonal target is available. In interpersonal contexts, role reversal allows the regulator to imagine occupying a more agentic position relative to the original harm-doer, which may provide a subjectively satisfying reversal and support more sustained relief. In event-based contexts, outcome reversal can still restore control within the imagined scene, but there is no interpersonal target for symbolic retaliation and the actual loss remains unresolved, making emotional rebound more likely once regulation stops. Tangibility of loss was treated as an independent factor that may amplify rebound across contexts and was tested directly in Study 5c.

We therefore advance four hypotheses: (i) immediate regulatory efficacy should be comparable across contexts, reflecting the shared control-restoration channel; (ii) interpersonal contexts should elicit a context-specific retaliatory experience that accompanies—and may enhance—successful regulation, whereas perceived control should predict regulation success across both contexts as a context-general mechanism; (iii) owing to the retaliatory "closure" afforded in interpersonal contexts, role-based RI should yield sustained relief with minimal emotional rebound, whereas outcome-based RI in event-based contexts should yield weaker sustained effects with stronger rebound; and (iv) tangibility of loss should operate as an independent amplifier of rebound that compounds across both contexts, thereby providing a causal test of whether the concreteness and irreversibility of what is lost—rather than merely the presence or absence of an interpersonal target—contributes to the fragility of imaginative restoration.

Across three experiments, Study 5 tested these predictions by first dissociating context-specific retaliatory experiences from the context-general control mechanism (5a), then examining the behavioral consequences in rebound patterns (5b), and finally providing a causal test of the tangibility hypothesis through loss magnitude manipulation (5c). Together, these experiments map the boundaries of RI along two orthogonal dimensions: the availability of a symbolic retaliation target, and the tangibility of what has been lost.

Study 5a — Dissociating Context-Specific Retaliation from Context-General Control

Study 5a provided a direct test of the proposed dual-architecture account: RI may engage a context-general control-restoration mechanism across scenarios, while additionally recruiting a context-specific retaliatory experience when an interpersonal target is present.

Participants applied both RI and CR to interpersonal social-exclusion and event-based material-loss scenarios. After regulation, they rated perceived control and revenge-related feelings, including satisfaction associated with imagined retribution. We focused on two experiential predictions. First, interpersonal contexts should elicit stronger revenge-related feelings than event-based contexts, particularly under RI, reflecting the symbolic retaliation afforded by role-based reversal. This context effect should be attenuated under CR, which relies more on semantic reinterpretation than on imagery-based role reversal. Second, perceived control should be comparable across contexts, consistent with its proposed role as a context-general regulatory experience rather than a motive uniquely tied to either role reversal or outcome reversal.

We also examined trial-level ER success to verify that RI produced immediate regulatory benefits across contexts. Including CR as a specificity contrast allowed us to test whether the context-specific retaliatory profile was selectively amplified by imagery-based role reversal rather than by effective regulation in general. Together, these tests establish the experiential architecture that motivates the rebound predictions examined in Studies 5b and 5c.

Methods

Participants

Sixty-eight participants (34 men, 34 women; M = 21.51, SD = 1.64) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) to detect a medium-sized interaction effect in a 2 × 2 repeated-measures ANOVA. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's* f = 0.25), and an assumed correlation among repeated measures of 0.50, the analysis indicated that a minimum of 24 participants would be required. Our sample of 68 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

Fifty images (25 interpersonal, 25 event-based) were selected from our validated stimulus set. Each image was presented twice, once in the RI condition and once in the CR condition, with assignment order randomized across participants. Because identical images were used across both strategy conditions, baseline affective properties were inherently matched, ensuring that observed differences between RI and CR were not attributable to stimulus content.

Procedure

Participants first received standardized training on the two ER strategies used in this experiment: RI and CR. During a brief practice session, they were shown sample negative images and practiced each strategy until they demonstrated sufficient understanding. They were also introduced to the two post-block rating items—sense of control and desire for revenge—and were provided with examples to ensure comprehension.

As shown in **Figure 13A**, the main task used a within-subjects mini-block design consisting of 20 blocks, with ten RI blocks and ten CR blocks. Each block presented five negative images that were matched across conditions for valence, arousal, and vividness. Block order was pseudorandomized for each participant. Each trial began with a brief fixation period (300–500 ms), followed by an 8-second presentation of a negative image during which participants rated their initial emotional intensity. A strategy cue then appeared for 2 seconds, after which the same image was shown again for 8 seconds while participants applied the instructed strategy and provided a regulated emotional intensity rating. A 2-second inter-trial interval separated consecutive trials. After completing all five trials in a block, participants rated their sense of control and desire for revenge on separate 1–9 Likert scales. Each block was followed by a 15-second rest period.

Statistical Analysis

First, to examine whether the two strategies differed in immediate regulatory efficacy across contexts, a 2 (*strategy*: RI, CR) × 2 (*context*: interpersonal, event-based) repeated-measures ANOVA was conducted on trial-level ER success.

Second, to test whether interpersonal contexts elicited stronger revenge-related experiences than event-based contexts, parallel 2 (*strategy*: RI, CR) × 2 (*context*: interpersonal, event-based) repeated-measures ANOVAs were conducted on the motivational variables: revenge-related feelings and perceived control. A significant strategy × context interaction would indicate that context effects on motivational experiences differed between RI and CR. Simple-effects analyses with FDR correction were used to decompose significant interactions.

All other statistical procedures and requirements were identical to those used in Study 2a.

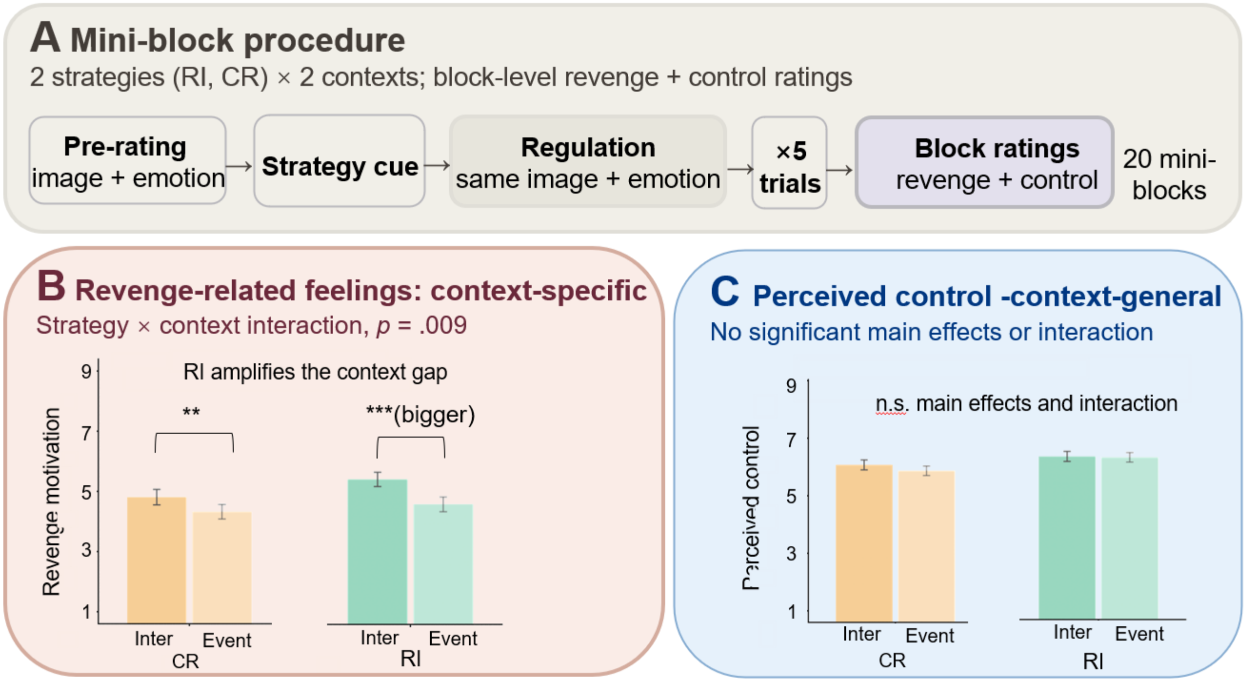

Figure 13. Study 5a design and motivational experience profiles. (A) Mini-block procedure. Participants completed RI and CR blocks in interpersonal and event-based contexts. Each mini-block contained five trials, followed by block-level ratings of revenge-related feelings and perceived control. **(B)** Revenge-related feelings showed a strategy × context interaction. Interpersonal contexts elicited stronger revenge-related feelings than event-based contexts, and this context difference was larger under RI than under CR, indicating that imagery-based role reversal amplified revenge-related experience when an interpersonal target was available. **(C)** Perceived control showed no significant main effects of strategy or context and no strategy × context interaction, consistent with a context-general control-restoration profile. Error bars indicate standard errors of the mean. ***p* < .01, ***p* < .001; n.s. = not significant.

Results

To maintain a concise and reader-friendly main text, descriptive statistics (*M* ± *SD*) for each condition are summarized in **SI-Text 1**.

Trial-level ER success

There was a significant main effect of strategy [$F(1, 67) = 56.05$, $p < 0.001$, $\eta^2 = 0.46$], indicating greater emotion reduction under RI than under CR. The main effect of context was not significant ($p = 0.822$), suggesting comparable immediate regulation across interpersonal and event-based contexts. The strategy × context interaction was significant [$F(1, 67) = 7.86$, $p = 0.007$, $\eta^2 = 0.11$]. Simple-effects analyses showed that RI produced greater ER success than CR in both interpersonal contexts [$t(67) = 6.08$, $p < 0.001$, $dz = 0.74$] and event-based contexts [$t(67) = 7.82$, $p < 0.001$, $dz = 0.95$]. Within the RI condition, ER success did not differ significantly between interpersonal and event-based contexts ($p = 0.125$). Within the CR condition, ER success was higher in interpersonal than event-based contexts [$t(67) = 2.81$, $p = 0.007$ $dz = 0.34$]. Thus, RI showed robust regulatory efficacy in both contexts, whereas the context difference was more evident under CR.

Context Differences in Motivational Experiences

Revenge related feeling. There was a significant main effect of strategy [$F(1, 67) = 10.39$, $p = 0.002$, $\eta p^2 = 0.134$], a significant main effect of context [$F(1, 67) = 17.56$, $p < 0.001$, $\eta p^2 = 0.208$], and a significant strategy × context interaction [$F(1, 67) = 7.14$, $p = 0.009$, $\eta p^2 = 0.096$]. Follow-up comparisons for the main effects showed that RI elicited stronger revenge-related feelings than CR overall [$t(67) = 3.22$, $p = 0.002$, $d = 0.30$], and that interpersonal contexts elicited stronger revenge-related feelings than event-based contexts overall [$t(67) = 4.19$, p < .001, d = 0.45]. Simple-effects analyses further showed that RI elicited stronger revenge-related feelings than CR in both interpersonal contexts [$t(67) = 3.53$, $p < .001$, $d = 0.42$] and event-based contexts [$t(67) = 2.16$, $p = 0.035$, $d = 0.18$]. In addition, interpersonal contexts elicited stronger revenge-related feelings than event-based contexts within both RI [$t(67) = 4.56$, $p < .001$, $d = 0.57$] and CR [$t(67) = 3.11$, $p = 0.003$, $d = 0.33$]. The interaction indicates that although interpersonal contexts elicited stronger revenge-related feelings across strategies, this context difference was larger under RI than under CR, suggesting that imagery-based role reversal selectively amplified revenge-related experience when an interpersonal target was available (**Figure 13B**).

Perceived control. There were no significant main effects of *strategy* ($p = 0.083$) and *context* ($p = 0.214$), and interaction ($p = 0.278$). Perceived-control ratings were comparable across contexts and strategies, consistent with the hypothesis that control restoration operates as a context-general process (**Figure 13C**).

Discussion

Study 5a examined whether RI elicits distinct motivational experiences across interpersonal and event-based contexts. The results supported a dissociation between context-specific retaliatory experience and context-general perceived control. Interpersonal contexts elicited stronger revenge-related feelings than event-based contexts, and this context difference was more pronounced under RI than under CR. This suggests that role-based reversal selectively amplifies symbolic-retaliation experience when an interpersonal target is available.

In contrast, perceived control showed no context-specific pattern: control ratings were comparable across interpersonal and event-based contexts and across strategies. This supports the view that control restoration is a context-general experiential component of regulation, whereas revenge-related feelings are more context-specific. Together with the trial-level ER-success results, these findings suggest that RI can be immediately effective across contexts while recruiting different experiential layers depending on whether the original scenario contains an identifiable interpersonal target.

Taken together, these findings suggest that RI engages a dual-process structure: a context-general mechanism (control restoration) that supports regulatory efficacy across scenarios, and a context-specific affective experience (symbolic retaliation) that characterizes—and may enhance—RI's effects in interpersonal settings. This dissociation has important implications for understanding when and why RI may produce sustained versus transient regulatory effects. Because revenge-related responses can be affectively rewarding after rejection (Chester & DeWall, 2017), an imagined reversal in interpersonal RI may provide a subjectively satisfying form of symbolic retaliation without requiring real-world action. In contrast, because control over tangible losses cannot be genuinely restored through imagination, event-based RI may be more vulnerable to rebound as reality reasserts itself. Studies 5b and 5c directly test these predictions by examining patterns of emotional rebound across contexts and by experimentally manipulating loss tangibility.

Study 5b — Emotional Rebound: Interpersonal versus Event-based contexts

Study 5b examined whether the motivational dissociation identified in Study 5a produces distinct behavioral signatures in the form of emotional rebound, defined here as the re-emergence of negative affect after an initial decrease during regulation (Huang et al., 2026). We reasoned that interpersonal RI may produce more durable relief because role reversal provides an interpersonal target for symbolic retaliation: the participant can imagine reversing the social relation and experiencing a subjectively satisfying counter-position. This idea is consistent with evidence that revenge-related responses can be affectively rewarding after rejection (Chester & DeWall, 2017), although the present study concerns imagined rather than enacted retaliation. In event-based contexts, by contrast, outcome reversal may reduce distress temporarily by restoring perceived control within imagination, but control over tangible losses cannot be genuinely restored through imagination (Lillie & Strelan, 2016). Thus, when attention returns to the original event, negative affect may be more likely to return.

To test this possibility, participants applied RI to both interpersonal and event-based scenarios, and we tracked negative affect across three phases: before regulation, during regulation, and after regulation. We predicted a V-shaped pattern in both contexts—an initial decrease during RI followed by partial rebound—but expected rebound to be stronger in event-based contexts than in interpersonal contexts.

Methods

Participants

Fifty-seven participants (29 men, 28 women; M = 20.18, SD = 2.14) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a 2 × 3 repeated-measures ANOVA. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.25), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 34 participants would be required to detect the smallest anticipated effect. Our sample of 57 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

All 100 images (50 interpersonal, 50 event-based) were drawn from the pilot-validated stimulus set. To confirm that the two context sets were comparable in baseline affective properties, we used the pre-rating data obtained in the pilot study. The pilot ratings indicated no reliable context differences in negative intensity, arousal, or vividness (all *p*s ≥ .099). Thus, baseline affective properties were comparable across interpersonal and event-based images.

Procedure

The training procedure was similar to previous studies. The experiment followed a 2 (context: interpersonal, event-based) × 3 (time: before, during, and after ER) within-subject design. The task was divided into 20 mini-blocks (10 interpersonal, 10 event-based), with block order randomized across participants. Each block contained 5 trials. Each trial used the same image across the three phases, allowing us to track the trajectory of negative affect for a single scenario before, during, and after RI.

As shown in **Figure 14A**, each trial consisted of three phases. All three phases began with a 2-second fixation cross. In the first phase (before ER), participants naturally viewed the image for 8 seconds and then rated their negative emotional intensity (1–9 scale) within 4.5 seconds. In the second phase (during ER), participants viewed the same image for 8 seconds while applying RI and then provided a regulated emotion rating. In the third phase (after ER), participants naturally viewed the image again for 8 seconds without using any regulation strategy and then provided a final emotion rating. Participants used response buttons to move a cursor along the rating scale within the 4.5-second response window.

Statistical Analysis

A 2 (*context*: interpersonal vs. event-based) × 3 (*time*: before, during, after ER) repeated-measures ANOVA was conducted to examine the temporal dynamics of emotional experience and the rebound effect across contexts. All other statistical procedures and requirements were identical to those used in Study 2a.

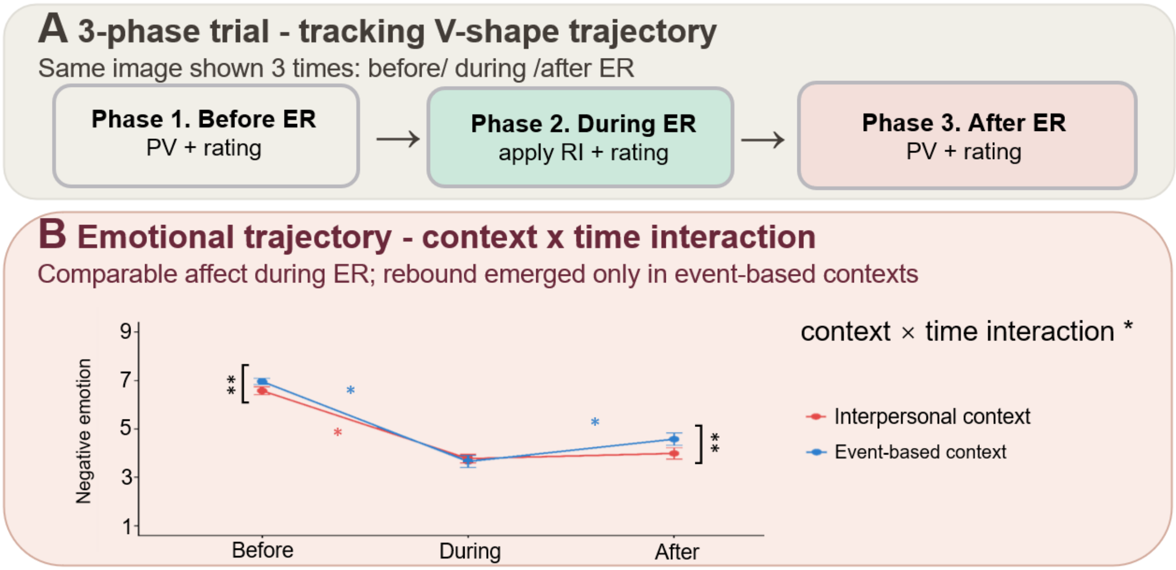

Figure 14. Study 5b design and results: emotional rebound across interpersonal and event-based contexts. (A) Three-phase trial procedure. The same image was presented three times within each trial. In Phase 1, participants passively viewed the image and rated their negative affect before regulation. In Phase 2, they viewed the same image while applying RI and rated negative affect during regulation. In Phase 3, they viewed the same image again without regulation and rated negative affect after regulation. **(B)** Emotional trajectory across the three phases. Negative affect decreased from before to during RI in both contexts. During RI, negative affect did not differ significantly between interpersonal and event-based contexts, indicating that RI brought affect to a comparable level during active regulation. After regulation ended, negative affect rebounded significantly only in event-based contexts, whereas interpersonal contexts showed no significant rebound. Black asterisks indicate context differences at a given time point; colored asterisks indicate within-context changes over time. Error bars indicate standard errors of the mean. **p* < .05, ***p* < .01.

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1**.

The *context* × *time* interaction was significant [$F(2,112) = 4.26$, $p = 0.017$, $\eta^2 = 0.08$; **Figure 14B**]. This interaction indicated that the temporal trajectory of negative affect differed between interpersonal and event-based contexts. Rebound was operationalized as the increase in negative affect from during ER to after ER. We present the effects of *context* and *time* separately below.

Effects of Context

The main effect of *context* was significant [$F(1, 56) = 7.02$, $p = 0.010$, $\eta^2 = 0.11$], with participants reporting lower negative feelings in the interpersonal than in the event-based contexts overall.

Simple effects analysis examining *context* differences at each *time* point indicated that, while participants reported comparable negative feelings in interpersonal and event-based blocks during

ER ($p = 0.590$), they reported lower negative feelings in the interpersonal than in the event-based blocks both before- [$F(1, 56) = 11.31$, $p = 0.001$, $\eta^2 = 0.17$] and after ER [$F(1, 56) = 9.88$, $p = 0.003$, $\eta^2 = 0.15$]. Thus, despite higher negative affect for event-based images before regulation, RI brought negative affect to a comparable level across contexts during active regulation. The context difference re-emerged after regulation ended (**Figure 14B**).

Effects of Time

The main effect of *time* was significant [$F(2, 112) = 111.98$, $p < 0.001$, $\eta^2 = 0.67$]. Consistent with our prediction, participants experienced a V-shaped pattern of negative feelings over time (before, during, and after ER). Pairwise comparison (FDR corrected) indicated that, they showed a significant decrease in negative feelings from before to during ER [$t(56) = -15.16$, $p < 0.001$, $d = -1.69$], and a significant rebound from during to after ER [$t(56) = 2.56$, $p = 0.013$, $d = 0.32$].

Critically, the V-shaped trajectory differed between contexts. Simple effects analysis within each *context* revealed significant effects of *time* in both interpersonal [$F(2, 55) = 91.44$, $p < 0.001$, $\eta^2 = .77$] and event-based contexts [$F(2, 55) = 97.52$, $p < 0.001$, $\eta^2 = 0.78$]. Both contexts showed significant decreases in negative affect from before to during ER (both ps < 0.001), indicating that RI reduced negative affect during active regulation in both types of scenarios. However, only event-based contexts showed a significant rebound from during to after ER ($p = 0.006$), whereas the corresponding rebound was not significant in interpersonal contexts ($p = 0.765$; **Figure 14B**).

Discussion

Study 5b examined whether the motivational dissociation identified in Study 5a produces distinct behavioral signatures in the form of emotional rebound. The results supported the contextual-specificity hypothesis: although RI reduced negative affect during regulation in both contexts, rebound after regulation was more evident in event-based contexts than in interpersonal contexts.

The primary finding was a significant context × time interaction. Negative affect decreased during RI in both contexts, indicating that RI produced immediate relief across interpersonal and event-based scenarios. However, only event-based contexts showed a significant increase in negative affect after regulation ended. In interpersonal contexts, negative affect remained relatively stable after regulation, suggesting more sustained relief.

This asymmetry suggests that immediate relief and sustained relief may depend on partly different conditions. RI can reduce distress in the moment across contexts, but its durability may depend on whether the imagined reversal provides a subjectively satisfying resolution. In interpersonal contexts, role reversal may provide such resolution through symbolic retaliation. In event-based contexts, outcome reversal may reduce distress temporarily, but the original loss remains unchanged, making negative affect more likely to return once attention shifts back to reality.

An informative secondary finding was that negative affect during RI did not differ between contexts, even though event-based images elicited higher negative affect before and after regulation. This suggests that RI can bring emotional responses to a comparable level during active regulation, but that the sustainability of this relief differs once regulation stops.

These findings extend Study 5a by showing that context-specific motivational experiences are accompanied by distinct temporal trajectories of affect. The dissociation between immediate relief and sustained relief has practical implications: RI may be especially useful for interpersonal harm, where symbolic reversal can remain subjectively satisfying, but it may require supplementary strategies in event-based contexts, where the concrete consequences of the event remain unresolved. Study 5c provides a more direct test of this interpretation by experimentally manipulating the tangibility of loss.

Study 5c — Manipulating Loss Magnitude: A Causal Test of the Tangibility Hypothesis

Study 5b showed that rebound was stronger in event-based than interpersonal contexts. However, this finding leaves open whether stronger rebound reflects the absence of an interpersonal target for symbolic retaliation, the presence of more concrete and irreversible losses, or both. Study 5c addressed this issue by experimentally manipulating the magnitude of a concrete monetary loss. If monetary loss itself undermines the durability of RI, then trials involving monetary deductions should show stronger rebound after regulation, even if RI remains effective during regulation. This design allowed us to test whether tangible loss magnitude functions as an independent boundary condition of RI.

Specifically, we introduced monetary deductions (¥0, ¥1, or ¥5) on a trial-by-trial basis within both interpersonal and event-based scenarios. The key prediction concerned the temporal trajectory of rebound. A significant loss magnitude × time interaction, together with a replicated context × time interaction and a non-significant context × loss magnitude × time interaction, would support the idea that monetary loss amplifies rebound across contexts rather than specifically explaining the event-based deficit. This design therefore provided a causal test of the tangibility account while distinguishing it from the target-availability account established in Studies 5a–b.

Methods

Participants

Fifty-eight participants (31 men, 27 women; $M = 20.60$, $SD = 1.79$) took part in the study. All provided informed consent and received compensation for their participation. A priori power analysis was conducted using G*Power (version 3.1.9.7) for a 2 × 2 × 3 repeated-measures

ANOVA. With $\alpha = 0.05$, *power* = 0.80, a medium effect size (*Cohen's f* = 0.25), and an assumed correlation of 0.50 among repeated measures, the analysis indicated that a minimum of 34 participants would be required to detect the smallest anticipated effect. Our sample of 58 participants exceeded this threshold, ensuring adequate statistical power.

Stimulus Selection

Picture stimuli were identical to those used in Study 5b.

Procedure

The experimental paradigm and task procedure were identical to Study 5b, with the following exception: to test whether tangible loss magnitude modulates the rebound effect, some of trials were randomly embedded with a sign indicating that participants' final reward would be reduced by ¥1 or ¥5. Within each context block (interpersonal or event-based), there were 1/3 trials with no loss, 1/3 trials with a "–¥1" sign, and 1/3 trials with a "–¥5" sign. The loss signs appeared at the beginning of each trial and remained visible throughout the three phases (before, during, after ER), ensuring that participants were aware of the monetary consequence while regulating their emotions (**Figure 15A**).

Statistics

A 3 (*time*: before, during, after ER) × 2 (*context*: interpersonal vs. event-based) × 3 (*loss magnitude*: ¥0, ¥1, ¥5) repeated-measures ANOVA was conducted to examine how monetary loss magnitude modulated the emotional rebound effect across contexts. Post-hoc pairwise comparisons were corrected using the FDR method. All other statistical procedures and requirements were identical to those used in Study 2a.

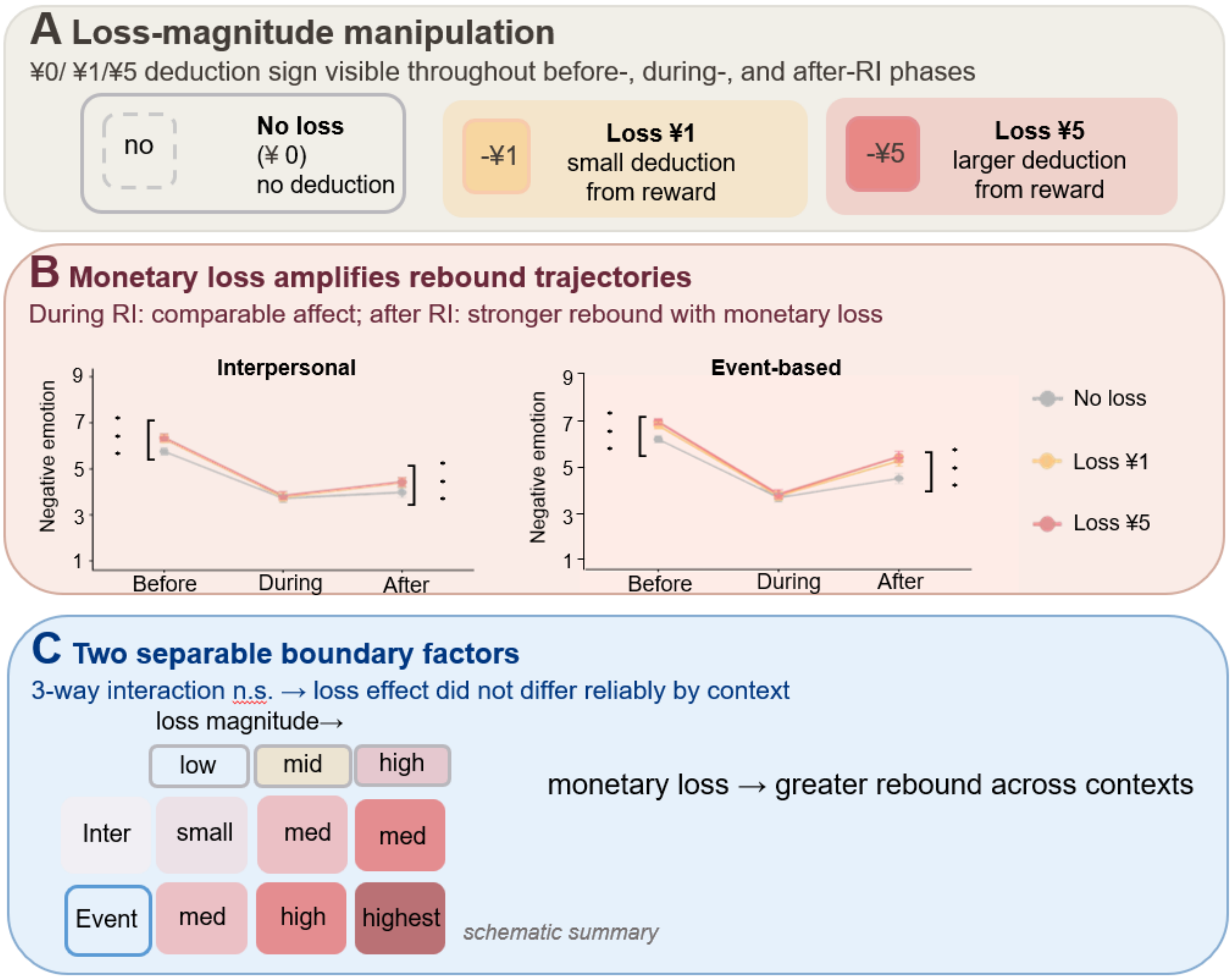

Figure 15. Study 5c loss-magnitude manipulation and rebound results. (A) Trials included no loss (¥0), small loss (−¥1), or larger loss (−¥5), with the loss sign visible throughout all three phases. **(B)** Negative-affect trajectories showed that RI brought affect to a broadly comparable level during regulation, but rebound after regulation was larger when monetary loss was present. **(C)** Conceptual summary: event-based contexts showed stronger rebound overall, and monetary loss amplified rebound across contexts. The non-significant three-way interaction suggests that the monetary-loss effect did not differ reliably by context. Error bars indicate standard errors of the mean.

Results

To maintain a concise and reader-friendly main text, descriptive statistics ($M \pm SD$) for each condition are summarized in **SI-Text 1 Table S13a**.

The *context* × *time* interaction was significant [$F(2,114) = 9.62$, $p < 0.001$, $\eta^2 = 0.14$; **Figure 15B**], replicating the context-specific rebound pattern observed in Study 5b. The *loss magnitude* × *time* interaction was also significant [$F(4, 228) = 5.08$, $p = 0.001$, $\eta^2 = 0.08$; **Figure 15B**], indicating that monetary loss magnitude modulated the temporal trajectory of negative affect. The *context* × *loss magnitude* × *time* interaction was not significant ($p = 0.365$; **Figure 15C**), suggesting that the effect of monetary loss on the emotional trajectory did not differ reliably between interpersonal and event-based contexts. We present the effects of context, time, and loss magnitude separately below.

Effects of Context

The main effect of *image type* was significant [$F(1, 57) = 13.13$, $p = 0.001$, $\eta^2 = 0.187$], with participants reporting lower negative feelings in the interpersonal than in the event-based contexts overall.

A simple effects analysis examining *context* differences at each *time* point indicated that, while participants reported comparable negative feelings in the interpersonal than those in the event-based [$F(1, 57) = 0.01$, $p = 0.921$, $\eta^2 < 0.001$] blocks during ER, they reported lower negative feelings in the interpersonal than in the event-based blocks both before- [$F(1, 57) = 26.82$, $p < 0.001$, $\eta^2 = 0.32$] and after ER [$F(1, 57) = 18.67$, $p < 0.001$, $\eta^2 = 0.25$]. This pattern replicates Study 5b.

Effects of Time

The main effect of *time* was significant [$F(2, 114) = 131.48$, $p < 0.001$, $\eta^2 = 0.70$]. Replicating Study 5b, participants experienced a V-shaped pattern of negative feelings over time (before, during, and after ER). Pairwise comparison (FDR corrected) indicated that, they showed a significant decrease in negative feelings from before to during ER [$t(57) = -17.11$, $p < 0.001$, $d = -1.59$], and a significant rebound from during to after ER [$t(57) = 5.94$, $p < 0.001$, $d = 0.55$].

Simple effects analysis within each *context* revealed significant effects of *time* in both interpersonal [$F(2, 56) = 87.98$, $p < 0.001$, $\eta^2 = 0.76$] and event-based contexts [$F(2, 56) = 116.33$, $p < 0.001$, $\eta^2 = 0.81$]. Consistent with Study 5b: while both contexts showed significant decreases from before to during ER (both *p*s < .001), the event-based context showed a more significant rebound from during to after ER ($\Delta = 1.31$, $p < 0.001$ for event-based vs. $\Delta = 0.49$, $p = 0.002$ for interpersonal), confirming the more pronounced V-shaped trajectory in event-based contexts.

Effects of loss magnitude

The main effect of *loss magnitude* was significant [$F(2, 114) = 32.71$, $p < 0.001$, $\eta^2 = 0.37$]. Pairwise comparisons (FDR-corrected) revealed a monotonic increase in negative feelings with loss amount: no loss < loss ¥1 [$t(57) = -5.05$, $p < 0.001$, $d = -0.25$], and loss ¥1 < loss ¥5 [$t(57) = -4.46$, $p < 0.001$, $d = -0.06$].

Critically, simple effects analysis examining *loss magnitude* differences at each *time* point revealed a striking pattern. During ER, negative affect did not differ significantly across loss conditions [$F(2, 56) = 2.96$, $p = 0.060$, $\eta^2 = 0.10$], suggesting that RI brought affect to a broadly comparable level despite different monetary consequences. However, significant differences emerged both before ER [$F(2, 56) = 12.10$, $p < .001$, $\eta^2 = 0.302$] and after ER [$F(2, 56) = 26.73$, $p < 0.001$, $\eta^2 = 0.49$], with negative feelings increasing monotonically with loss amount at both time points.

Simple effects analysis within each loss condition confirmed the predicted dose-response pattern for rebound [no loss: $F(2, 56) = 94.41$, $p < 0.001$, $\eta^2 = 0.77$; loss ¥1: $F(2, 56) = 105.25$, $p < 0.001$, $\eta^2 = 0.79$; loss ¥5: $F(2, 56) = 113.52$, $p < 0.001$, $\eta^2 = 0.80$]. All conditions showed significant decreases from before to during ER (all *p*s < .001) and significant increases from during to after ER (all *p*s ≤ 0.003). Critically, the magnitude of rebound increased with loss amount ($\Delta = 0.54$ for no loss, $\Delta = 1.07$ for loss ¥1, $\Delta = 1.10$ for loss ¥5). This pattern demonstrates that tangible loss magnitude directly amplifies emotional rebound, providing causal support for the tangibility hypothesis.

Discussion

Study 5c tested whether experimentally imposed monetary loss limits the durability of RI. The results supported this hypothesis. During regulation, participants reduced negative affect to broadly comparable levels across the ¥0, ¥1, and ¥5 conditions, indicating that RI's immediate effect remained robust even when monetary loss was present. Thus, larger monetary consequences did not prevent participants from benefiting from RI in the moment.

However, the pattern changed after regulation ended. Negative affect rebounded more strongly when monetary loss was present. Rebound was smallest in the no-loss condition and larger in both monetary-loss conditions, suggesting that concrete monetary consequences made the imagined restoration less durable once participants stopped regulating. In simpler terms, RI could temporarily reduce distress even when money was at stake, but the presence of an actual loss made it harder for imagination alone to sustain that relief after regulation ceased. Although the rebound values were numerically similar for the ¥1 and ¥5 conditions, both loss conditions showed greater rebound than the no-loss condition, supporting the idea that tangible monetary consequences amplify rebound.

The non-significant context × loss magnitude × time interaction was theoretically informative. It suggests that the effect of monetary loss on rebound did not depend strongly on whether the scenario was interpersonal or event-based. Thus, tangible loss is not merely a feature of event-based scenarios; rather, concrete monetary consequences can amplify rebound across contexts whenever the loss is personally consequential. At the same time, event-based contexts continued to show stronger rebound overall, indicating that target availability and monetary loss magnitude are separable boundary conditions. Together, these findings are consistent with a two-factor account in which symbolic-retaliation target availability and monetary loss magnitude contribute separably to the durability of RI (**Figure 15C**).

Together, Studies 5b and 5c provide converging evidence for the contextual specificity of RI's regulatory effects. The immediate efficacy of RI appears to be relatively context-general: both role-based and outcome-based reversals can reduce distress in the moment. However, the sustainability of these effects depends jointly on two boundary conditions: whether a symbolic retaliation target is available, and whether the distressing episode carries concrete, personally consequential loss. Interpersonal RI may be more durable when role reversal provides a subjectively satisfying symbolic reversal, whereas RI becomes more vulnerable to rebound when the situation contains tangible losses that remain unresolved after regulation. These findings have important practical implications for the strategic deployment of RI, suggesting that supplementary strategies may be needed whenever the distressing episode lacks a retaliatory target or carries substantial tangible consequences.

General discussion

Across one pilot study and five main studies, the present work introduced and tested RI as a distinct emotion regulation strategy. The findings support three main conclusions. First, RI reliably reduces negative affect and can outperform both perspective-based and established regulation strategies while requiring no greater time or subjective effort than established active strategies. Second, RI operates through an imagery-based counter-emotion pathway: individuals generate a reversed scene, and the positive or retaliatory affect elicited by that scene accounts for a substantial portion of the regulatory effect. Third, RI has principled boundary conditions. It is most durable when the original episode contains an interpersonal target that can be symbolically reversed, and it becomes less durable when the distress involves concrete, personally consequential loss. Together, these findings suggest that RI is not merely a variant of reappraisal, distancing, or counterfactual thinking, but a distinct form of regulation based on generating a reversed second scene.

1. RI as a scene-generating regulation strategy

At the broadest level, RI extends the taxonomy of ER by introducing a mode of regulation that generates a second scene-level representation to stand alongside the original, rather than operating only on the original. Across the established families, the distressing episode remains the only scene-level representation on which regulation operates: reappraisal modifies what the scene *means* (Gross, 1998; Ochsner & Gross, 2005), distancing modifies the self's *relation* to the scene (Kross & Ayduk, 2017; Powers & LaBar, 2019), and distraction modifies *engagement* with it (Webb et al., 2012). RI is distinctive in a different respect: rather than operating on the original scene, it constructs a second, reversed scene-level representation and supplies the counter-valent affect that drives regulation.

Three lines of evidence converge on this definitional claim. The pilot study first demonstrated that, even without instruction, participants gravitated toward RI-consistent coping when asked how they typically deal with the kinds of adversity depicted in the stimuli: 74% endorsed role reversal for interpersonal scenes and 75% endorsed outcome reversal for event-based scenes, both well above chance. This spontaneous preference suggests that RI captures an intuitive regulatory tendency rather than an artificial laboratory imposition, and that the two forms—role reversal for interpersonal harm and outcome reversal for material loss—emerge organically as a function of which element of the scene is most readily reversed into a counter-scene.

Study 1 then established that instructed RI reliably reduces negative affect relative to passive viewing in a social-exclusion context (d = 1.39), providing the baseline evidence that the strategy works. Crucially, Study 2a isolated the active ingredient: by holding the scenario constant and varying only perspective along a "you–me–other" axis, we showed that RI's advantage cannot be reduced to generic perspective change. Direct immersion into the victim's perspective ("me") tended to heighten negative affect; distancing into a bystander's perspective ("other") did not show the same reliable and durable advantage as RI; only role-reversed imagination into the excluder's perspective ("you") produced strong and persistent relief. The critical dimension, then, is not whether perspective changes but whether the regulator actively generates a counter-scene whose role configuration inverts that of the original. Distancing *relocates* the self with respect to an unchanged scene; RI *instantiates* a second scene whose role configuration is the reverse of the first. This distinction—between modulating one's position relative to a single scene and generating a second scene—could be what produces durable affective change.

This claim survives a stronger test. Study 2b compared RI against CR and distraction—the two most extensively studied strategies in the ER literature—across both interpersonal and event-based contexts. RI produced larger reductions in negative affect than either benchmark, while requiring no greater implementation time or subjective effort than CR or distraction. Because effort and duration were matched, RI's advantage cannot be attributed to simply trying harder or investing more resources; rather, it reflects a qualitatively different regulatory operation—one that trades operations on the original scene for generation of a reversed second scene that does the affective work in parallel.

2. The counter-emotion mechanism and its processing-system anchor

If RI is a distinct regulatory category, what cognitive-affective operations does it recruit, and in what cognitive architecture are those operations anchored? Studies 3 and 4 addressed these two questions in tandem.

At the process level, RI appears to work by generating positive or retaliatory emotions during the act of imagery itself. Participants did not merely feel better after the task and then infer that RI had helped them. Rather, positive counter-emotions emerged while they were constructing the reversed scene, and these online emotional changes were closely linked to RI's regulatory effect. Study 3a's retrospective feature ratings showed that RI was rated substantially higher than CR on scene generation (the explicit construction of a reversed counter-scene) and emotional opposition (the affective clash between original and reversed scenes; both *d*s > 0.65), while the two strategies did not differ on appraisal change or meaning reconstruction. This pattern is consistent with the idea that the original and reversed scenes remain co-activated enough for the reversed scene to oppose the affective pull of the original. Exploratory single-mediator analyses further suggested that, for RI, emotional opposition and scene generation showed the strongest indirect pathways, whereas for CR, meaning reconstruction and appraisal change showed the strongest indirect pathways. Because these mediators were not experimentally manipulated and were tested in separate single-mediator models, these estimates should be interpreted as exploratory evidence for relative indirect pathways rather than as definitive causal decomposition.

These findings support a dual-channel account of RI. The first channel is representational: RI builds a second, reversed scene that competes with the original distressing scene. The second channel is affective: this reversed scene elicits counter-valent emotions, such as relief, control, satisfaction, or revenge-related pleasure, which offset the original negative affect, consistent with evidence that positive emotions can undo the lingering effects of negative emotional states (Fredrickson et al., 2000). These two channels are closely linked. The counter-emotion is not simply a later consequence of imagery; it is part of what makes the reversed scene regulatory (Study 3b confirms that counter-affect emerges during—not after—regulation). This distinguishes RI from CR, which primarily works by changing the meaning of the original scene.

At the architecture level, RI and CR are anchored in dissociable processing systems. Study 4a used a task-switching paradigm to test for selective interference from preceding cognitive tasks. The critical finding was a crossover interaction in the absence of main effects: RI was selectively impaired when preceded by a visual 3D-rotation task, whereas CR was selectively impaired when preceded by a semantic categorization task. Because participants rated the two preceding tasks as equally difficult and the switches as equally effortful, the interference can hardly be attributed to general cognitive load; it more likely reflects competition within partly overlapping processing resources. RI draws on the visual-imagery system to construct the reversed scene; CR draws on the semantic-conceptual system to reorganize the meaning of the original scene.

Study 4b converged on the same dissociation from an independent angle. Trait visual preference (measured by the Visualizer-Verbalizer Questionnaire) positively predicted individual success with RI ($b = 0.24$, $p = 0.017$), while trait verbal preference negatively predicted it ($b = -0.28$, $p = 0.024$); neither trait dimension predicted CR's effectiveness. The parallel between state-level interference (Study 4a) and trait-level modulation (Study 4b) is theoretically important: the processing-system distinction is not merely a task artifact but a stable feature of how these strategies engage the cognitive system.

Together, Studies 3 and 4 specify RI at two levels. Functionally, it is a dual-channel strategy that combines scene-level generation with online counter-emotion production. Architecturally, it is anchored in visual-imagery processing rather than semantic reinterpretation. These two properties are plausibly linked: counter-emotions emerge from imagined reversed scenes precisely because imagery, unlike semantic representation, is known to elicit genuine affective response (Holmes et al., 2006, 2009; Holmes & Mathews, 2010); . In other words, the imagery anchor is not an incidental implementational detail—it is what makes scene-level generation affectively potent in the first place. A semantically described reversal (e.g., a verbal statement such as "I could have been the one doing the rejecting") would presumably not generate the same counter-affective pull; it is the vividness of the constructed scene that supplies the affective content on which the counter-emotion mechanism depends. A consequence of this design is that RI's efficacy does not require the reversed scene to be plausible or causally coherent; it requires only that the scene be vivid enough to evoke counter-valent affect of sufficient intensity. This contrasts sharply with reappraisal, whose efficacy is constrained by how plausible the reinterpretation feels to the regulator (Gross & John, 2003): an implausible reinterpretation fails because it does not get believed, whereas an implausible reversal can still succeed because it does not need to be believed—it needs to be felt.

3. Two orthogonal factors bound RI's durability: target-availability and tangibility

Having established what RI is and how it works, Study 5 turned to when it succeeds and when it fails. The answer, we argue, is structured by two dissociable factors that jointly specify RI's boundaries.

The first factor concerns the motivational architecture of RI. Study 5a provided direct evidence that RI recruits *two* affective channels, not one: a context-general control-restoration channel that is engaged across both interpersonal and event-based contexts, and a context-specific symbolic-retaliation channel that is engaged only when an interpersonal target is available in the generated reversed scene. The strategy × context interaction on revenge ratings was significant; the same comparison for control ratings was not. Regression analyses confirmed the functional architecture: perceived control predicted emotion reduction across both contexts (RI: $\beta = 0.69$; CR: $\beta = 0.48$) and was not moderated by context in either strategy. Revenge motivation, in contrast, predicted emotion reduction in a context-dependent manner only under RI: the context × revenge interaction was significant for RI ($\beta = 0.26$, $p = 0.040$) but not for CR ($p = 0.652$). Role-based RI in interpersonal contexts therefore generates a reversed scene that supports two affective channels simultaneously—restored agency and symbolic retribution—whereas outcome-based RI in event-based contexts generates a reversed scene that supports only the first, because there is no interpersonal target on which retribution could operate in the counter-scene.

This dual motivational architecture has direct behavioral consequences. Study 5b tracked emotional trajectories across three phases—before, during, and after regulation—and found the predicted V-shape, with a critical asymmetry between contexts. During regulation, both contexts produced comparable relief; after regulation, interpersonal contexts maintained the regulated state with no significant rebound, whereas event-based contexts showed significant rebound back toward baseline. The interpretation follows directly from the motivational analysis: because symbolic retaliation can be subjectively completed within the generated reversed scene—"the revenge is complete once imagined" (Chester & DeWall, 2017)—interpersonal RI produces durable relief; because imagined control over a tangible event cannot genuinely restore what has been lost, event-based RI is vulnerable once attention returns to the original scene and the counter-scene no longer holds its affective dominance.

The second factor—tangibility of loss—is what Study 5c isolated experimentally. By introducing monetary deductions (¥0, ¥1, ¥5) on a trial-by-trial basis within both contexts, we asked whether larger tangible losses amplify rebound, and whether they do so differentially across contexts. Three results constitute the causal test. First, loss magnitude did not affect immediate efficacy: during-regulation ratings were equivalent across loss levels, indicating that **the construction of the reversed scene and its in-the-moment affective payoff are robust to the stakes involved**. Second, loss magnitude monotonically amplified post-regulation rebound (Δ = 0.54 for ¥0, 1.07 for ¥1, 1.10 for ¥5), providing causal evidence that tangibility undermines sustained relief. Third, and most theoretically informative, the three-way context × loss × time interaction was not significant: tangibility amplified rebound to a comparable degree in both contexts, and the baseline interpersonal-versus-event asymmetry established in Study 5b was preserved even when loss magnitude was held constant. This pattern indicates that tangibility and target-availability operate as independent, additive drivers of rebound, not as features of the same underlying dimension.

Both components of this two-factor structure connect to existing theoretical and empirical lineages, and our findings extend rather than displace those lineages. The amplification of rebound by tangible loss is consistent with the broader observation that high-intensity, low-controllability events systematically attenuate regulatory efficacy across diverse strategies (Sheppes & Levin, 2013; Van Bockstaele et al., 2024); what our results add is causal specification that the attenuation operates through delayed rebound rather than through reduced immediate engagement, since during-regulation ratings remained equivalent across loss levels. The V-shaped trajectory we observed—relief during regulation, partial reassertion of distress after—also aligns with neural evidence that the prefrontal-driven inhibition recruited during active regulation dissipates once regulation ceases, allowing affective signals to re-emerge (Diers et al., 2023; Walter et al., 2009). Read together, these two literatures supply a mechanistic account of why tangibility selectively damages durability rather than immediate efficacy: while regulation is active, the imagined reversed scene can hold its affective dominance even against tangible loss; once regulation ceases and the original scene's affective signal is no longer being actively suppressed, the irreversibility of tangible loss is what makes that signal hardest to keep displaced.

We therefore advance a two-factor account of RI's durability. Target-availability is a property of the scenario: interpersonal harm affords a reversed scene whose imagined retribution can be subjectively completed, whereas event-based harm does not. Tangibility is a property of the loss: the more concrete and irreversible what has been taken away in the original scene, the more sharply the regulator's attention snaps back to that original scene once regulation ceases, regardless of whether the context is interpersonal or event-based. These factors map onto two distinct theoretical lineages—the symbolic-retaliation tradition in the interpersonal-rejection literature (Richman & Leary, 2009) and the primary-versus-secondary-control distinction (Rothbaum et al., 1982)—and our findings suggest that these lineages describe truly separable factors rather than alternative framings of the same phenomenon. An interpersonal insult that also reduces material resources would engage both factors; a symbolic event loss without material consequence would engage neither. This refinement may be particularly important for predicting when RI will produce lasting benefit and when it requires supplementation by other strategies.

4. Positioning RI within the ER literature

The framework developed across Studies 1–5 makes a claim that is more structural than it might first appear. We have not merely added a strategy to a list; we have argued that the existing list is built on an assumption—that regulation operates on a single representation—and that this assumption excludes a regulatory mode the human mind routinely deploys. The empirical results, taken together, are most parsimoniously read as evidence for this stronger claim. The behavioral dissociation between RI and distancing in Study 2a (matched perspective change, divergent durability) cannot be accommodated by treating both as variants of perspective-taking, because perspective-taking does not predict why an inverted role configuration would generate counter-valent affect that a relocated vantage does not. The processing-system dissociation in Study 4 cannot be accommodated by treating RI as a variant of CR, because CR would not predict selective interference from visual rather than semantic preceding tasks, nor would it predict the trait-level pattern in which visualizers benefit from RI but not from CR. The two-factor durability structure in Study 5 cannot be accommodated by treating RI as a variant of counterfactual thinking, because counterfactual frameworks have no theoretical machinery to generate the orthogonal interaction of target-availability and tangibility that Study 5c isolated experimentally. In each case, the data force a category boundary that the alternative absorptions do not predict. We turn now to specifying where this boundary sits within the existing literature, beginning with the process model and moving outward to neighboring constructs.

Within Gross's process model (Gross, 1998; Gross & Thompson, 2007), most established strategies map onto specific stages: distraction to attentional deployment, CR to cognitive change, and suppression to response modulation. Each of these operations works on the single representation the regulator has before them. In this sense, RI is not another operation on the original scene; it is a scene-generating operation that adds a new reversed representation to the regulatory workspace. As illustrated in **Figure 16**, RI can be understood as a scene-generating extension of the process model. It may operate at a situation-representational level, by adding a reversed counter-scene that competes with the original in the mental workspace, and at an evaluative level, by allowing the reversed scene to supply counter-valent affect that weakens the dominance of the original negative emotion. Both routes share the same core operation: RI adds a new scene-level representation, whereas established strategies adjust the regulator's attention to, meaning of, stance toward, or response to the original scene. RI therefore marks an addition to the process-model inventory rather than a variant of an existing stage.

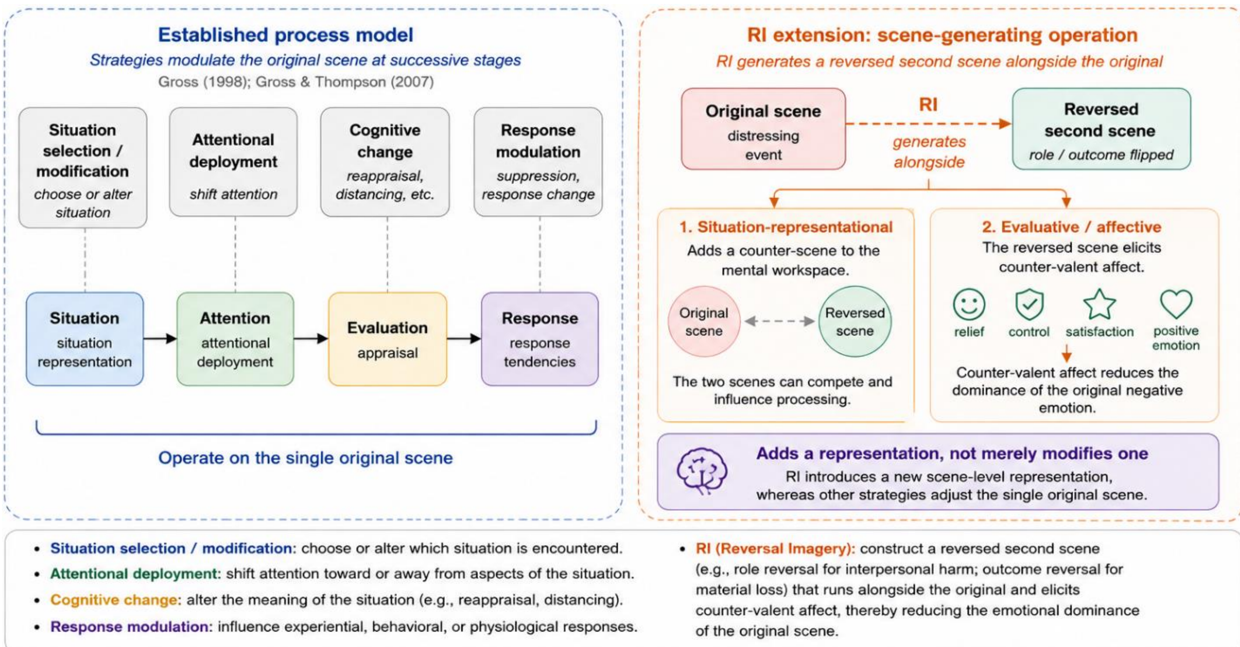

Figure 16. RI as a scene-generating extension of the process model. Established ER strategies can be mapped onto different stages of the emotion-generative process. Situation selection and situation modification alter which situation is encountered; attentional deployment changes engagement with the original scene; cognitive change modifies the meaning of that scene; and response modulation alters the emotional response after it has been generated. RI extends this taxonomy by introducing a representational operation not explicitly captured by the standard model: the generation of a reversed second scene alongside the original. This added representation can influence emotion in two complementary ways: it can compete with the original situation representation in the mental workspace, and it can supply counter-valent affect during evaluation, thereby reducing the emotional dominance of the original negative scene.

RI also differs from neighboring constructs that involve imagination. *Counterfactual thinking* generates alternatives to reality, but its primary function is usually explanatory or preparatory: people ask what could have happened and what they might do differently next time (Roese, 1997). *Mental simulation* often serves a future-oriented function, helping individuals prepare for possible events (Taylor & Schneider, 1989). *Distancing* changes the standpoint from which a person views the original scene, but the scene itself remains unchanged. *Psychodynamic defenses* such as projection (Freud, 1961) or catharsis (Bushman et al., 1999) operate via displacement or discharge of affect, not through the generation of a structured counter-scene whose reversed configuration supplies online counter-emotion. What is distinctive about RI, across all these comparisons, is the combination of three features: it generates a second scene, the second scene is structurally reversed relative to the original, and its immediate function is affective repair rather than causal reasoning or future planning.

5. Broader implications and open questions

The present framework also opens several practical directions. RI may be useful when individuals struggle to reinterpret a negative event but can still generate a vivid alternative scene (Troy et al., 2013). In such cases, imagining a reversed version of the episode may offer a relatively direct route to relief by restoring agency, control, dignity, or emotional balance. This may be relevant to common experiences such as social rejection, embarrassment, interpersonal conflict, minor failure, loss, or other everyday setbacks. RI may also be adapted into guided imagery exercises in counseling, educational settings, and digital mental-health tools, where brief prompts could help individuals construct restorative counter-scenes in a structured way. Importantly, RI need not replace established strategies. Instead, it may complement reappraisal, distancing, acceptance, and problem-focused coping by offering a scene-generating route to regulation when meaning change or attentional disengagement is difficult. Future research should examine how RI can be tailored to different individuals, contexts, and delivery formats, including guided imagery, visual prompts, and personalized training.

Several limitations bound the strength of these conclusions and define the next phases of this research program. First, role-based RI involves briefly imagining oneself in an agentic or harm-doer role within a reversed interpersonal scene (Abeditehrani et al., 2021). This should be understood as a virtual and symbolic regulatory process, not as an endorsement of real-world retaliation, aggression, or “fighting violence with violence.” Although imagined role reversal produced emotional relief in the present studies, it remains unknown whether repeated use could influence aggressive cognition, interpersonal attitudes, or real-world behavior. Future work should examine this possibility directly, including whether RI can be guided in ways that preserve its regulatory benefits while minimizing any risk of reinforcing retaliatory tendencies. Second, the present studies used validated image stimuli rather than personally experienced life events. It remains to be tested whether RI generalizes to autobiographical adversity, especially when distress unfolds over days or weeks rather than within a single laboratory session. Third, we tested tangible loss using a monetary-loss manipulation. Other forms of tangible loss, such as physical injury, missed opportunities, or long-term status loss, may produce similar or different rebound patterns. Fourth, the present evidence for the “second scene” account is behavioral and experiential.

Neuroimaging studies are needed to test whether RI indeed recruits visual-imagery and affective circuits while the neural representation of the original scene remains active. Such evidence would provide a stronger biological test of the claim that RI regulates emotion by adding a reversed representation rather than simply overwriting the original one.

Conclusion

RI is a regulatory capacity that many people intuitively use but that emotion regulation theory has not yet clearly articulated. The present work shows that RI is not simply escapist fantasy or a variant of reappraisal. It is a structured regulatory operation in which individuals generate a reversed second scene, experience counter-valent emotion from that scene, and thereby reduce the emotional dominance of the original distressing event. Its benefits are strongest when the reversed scene can provide symbolic resolution, and its durability is limited when the original event involves tangible, irreversible loss. By showing that people can regulate emotion not only by changing the meaning of reality or shifting attention away from it, but also by imagining a reversed alternative to it, RI identifies an overlooked route through which humans cope with unwanted experience.

Appendix

Text 1 Descriptive data of all studies.

Table S1 Descriptive data of the preliminary questionnaire (M ± SD).

Items	Interpersonal context	Event-related context
Trial-level scene classification		
Correctly classified	72.66 ± 23.88 %	86.88 ± 14.34 %
Misclassified	16.01 ± 13.92 %	2.20 ± 3.93 %
Mixed	11.33 ± 15.46 %	10.92 ± 13.65 %
Block-level coping preference		
RI-consistent	74.00 ± 35.07 % (role reversal)	75.3 ± 32.88 % (outcome reversal)
RI-inconsistent	25.33 ± 27.63 % (outcome reversal)	12.00 ± 22.35 % (role reversal)
Other methods	15.67 ± 28.73 %	13.33 ± 25.37 %

Table S2 Descriptive data of the pilot study (M ± SD).

Items	Interpersonal context	Event-related context
Trial level		

Items	Interpersonal context	Event-related context
Negative intensity	2.70 ± 0.96	2.66 ± 1.53
Arousal	6.87 ± 0.93	7.14 ± 1.00
Vividness	6.79 ± 0.85	6.89 ± 0.88
Emotional change after RI	5.58 ± 0.68	5.64 ± 1.18
Block-level cognitive processes		
Scene deconstruction	6.80 ± 0.99	7.07 ± 0.99
Scene reversal	6.97 ± 1.20	7.37 ± 1.02
Emotional counterreaction	6.23 ± 1.86	7.52 ± 0.95
Block-level counter emotions		
Control	6.14 ± 1.60	6.44 ± 1.73
Revenge	5.75 ± 1.91	/
Superiority	6.04 ± 2.20	/
Satisfaction	6.28 ± 1.92	/
Safety	/	7.58 ± 1.18
Relaxation	/	7.57 ± 1.19
Release	/	7.44 ± 1.24

Table S3 Descriptive data of Study 1 (M ± SD).

Item	PV	RI
Regulation duration (s)	2.94 ± 1.16	2.71 ± 1.11
Mean negative emotion	6.41 ± 1.41	3.49 ± 1.53
Subjective effort/engagement	5.32 ± 2.07	6.17 ± 1.63

Table S4 Descriptive data of Study 2a (M ± SD).

Item	PV	DI	Distancing	RI
Mean emotion (during ER)	4.77 ± 1.35	5.41 ± 1.11	4.50 ± 1.31	3.29 ± 1.67
Mean emotion (post-task)	5.74 ± 1.66	5.72 ± 1.59	5.48 ± 1.43	5.25 ± 1.53

Table S5 Descriptive data of Study 2b (M ± SD).

Item	PV	Distraction	CR	RI
Regulation duration (s)	2.75 ± 1.02	2.74 ± 1.04	2.89 ± 1.05	2.79 ± 1.07
Mean negative emotion	6.43 ± 1.39	4.55 ± 1.29	3.84 ± 1.50	3.52 ± 1.52
Subjective effort	5.34 ± 2.07	6.25 ± 1.34	5.95 ± 1.68	6.05 ± 1.60

Table S6 Descriptive data of Study 3a (M ± SD).

Item	PV	CR	RI
Trial-level ER success	1.60 ± 1.62	3.49 ± 1.46	5.07 ± 1.31
Scene generation	4.07 ± 2.24	5.71 ± 1.92	7.16 ± 1.03
Emotional opposition	3.95 ± 2.28	6.05 ± 1.79	7.55 ± 1.00
Appraisal change	4.07 ± 2.25	6.65 ± 1.50	7.02 ± 1.52
Meaning reconstruction	4.39 ± 2.30	7.18 ± 0.99	6.92 ± 1.67

Table S7 Descriptive data of Study 3b (M ± SD).

Item	Interpersonal context			Event-related context		
	PV	CR	RI	PV	CR	RI
Counterbalance Index (ECI)	0.16 ± 0.24	0.64 ± 0.42	1.01 ± 0.42	0.15 ± 0.26	0.60 ± 0.39	0.99 ± 0.42
Negative emotion decay (norm.)	0.09 ± 0.14	0.33 ± 0.21	0.50 ± 0.22	0.09 ± 0.15	0.32 ± 0.20	0.49 ± 0.22
Positive emotion gain (norm.)	0.06 ± 0.11	0.30 ± 0.23	0.51 ± 0.22	0.06 ± 0.12	0.28 ± 0.21	0.50 ± 0.22
Negative emotion change	0.82 ± 1.28	3.00 ± 1.86	4.54 ± 1.99	0.82 ± 1.38	2.84 ± 1.78	4.43 ± 1.99
Positive emotion change	-0.58 ± 0.98	-2.73 ± 2.08	-4.56 ± 1.96	-0.54 ± 1.05	-2.52 ± 1.89	-4.50 ± 1.96
Revenge	3.30 ± 2.23	4.12 ± 2.09	5.67 ± 2.26	2.98 ± 2.14	4.07 ± 1.76	4.99 ± 2.25
Control	3.47 ± 2.00	5.05 ± 1.86	6.41 ± 1.62	3.13 ± 2.09	5.30 ± 1.57	6.40 ± 1.52
Superiority	2.98 ± 2.02	4.36 ± 1.97	5.98 ± 1.79	2.85 ± 2.05	4.47 ± 1.65	5.84 ± 1.81

Table S9 Descriptive data of Study 4a (M ± SD).

Item	Visual pre-task		Semantic pre-task	
	CR	RI	CR	RI
Trial-level ER success	3.88 ± 1.78	4.05 ± 1.83	4.03 ± 1.85	3.90 ± 1.95
Negative emotion change	2.60 ± 1.50	4.20 ± 1.61	2.57 ± 1.59	4.20 ± 1.72
Pre-task emotion rating	3.78 ± 1.74	3.59 ± 1.74	3.69 ± 1.88	3.51 ± 1.84
Task-to-regulation switch difficulty	3.76 ± 1.45	3.69 ± 1.60	3.88 ± 1.57	3.74 ± 1.70
Preceding task difficulty	6.34 ± 1.32	6.48 ± 1.32	6.21 ± 1.42	6.45 ± 1.41

Table S10 Descriptive data of Study 4b (M ± SD).

Item	CR	RI
VVQ-Visual preference	5.96 ± 1.81	5.96 ± 1.81
VVQ-Verbal preference	4.94 ± 1.46	4.94 ± 1.46
Trial-level ER success	3.59 ± 1.57	4.19 ± 1.70

Table S11 Descriptive data of Study 5a (M ± SD).

Item	Interpersonal		Event-based	
	CR	RI	CR	RI
Trial-level ER success	3.46 ± 1.44	4.58 ± 1.57	3.25 ± 1.39	4.76 ± 1.34
Revenge response	4.81 ± 2.12	5.42 ± 1.95	4.32 ± 1.98	4.59 ± 2.01
Control response	6.07 ± 1.42	6.27 ± 1.44	5.87 ± 1.35	6.24 ± 1.37

Table S12 Descriptive data of Study 5b (M ± SD).

Phase	Interpersonal context	Event-related context
Before ER	6.58 ± 1.22	6.96 ± 0.97
During ER	3.77 ± 1.35	3.65 ± 1.85
After ER	3.99 ± 1.76	4.58 ± 1.93

Table S13 Descriptive data of Study 5c (M ± SD).

Phase	Interpersonal context			Event-related context		
	No loss	Loss ¥1	Loss ¥5	No loss	Loss ¥1	Loss ¥5
Before ER	5.76 ± 1.20	6.29 ± 1.26	6.36 ± 1.27	6.19 ± 1.13	6.78 ± 1.07	6.95 ± 1.01
During ER	3.72 ± 1.35	3.77 ± 1.25	3.84 ± 1.32	3.68 ± 1.34	3.76 ± 1.37	3.83 ± 1.46
After ER	3.97 ± 1.50	4.40 ± 1.46	4.44 ± 1.44	4.51 ± 1.64	5.26 ± 1.71	5.45 ± 1.72
Post-task	5.70 ± 1.42	6.05 ± 1.49	6.04 ± 1.51	5.89 ± 1.32	6.16 ± 1.30	6.36 ± 1.37

Text 2 Strategy instructions

PV: The picture will be presented shortly. Please look at the pictures naturally, simply experiencing whatever feelings arise in the moment, and do not use any particular strategy.

Direct immersion (interpersonal context only): The picture will be presented shortly. Please think about how you would feel in the situation of the excluded person in the picture.

Distancing (interpersonal context only; adapted from He et al., 2018)): The picture will be presented shortly. Please think about how you would feel in this situation if you are a third person (e.g., passerby) who was not involved in the scene.

RI:

Interpersonal context: The picture will be presented shortly. Please imagine a completely opposite scene in which the roles are reversed — you are no longer the person being excluded, but the one doing the excluding. Vividly imagine yourself refusing to include someone or leaving someone out of an activity. Pay close attention to how this role reversal makes you feel.

Event-based context: The picture will be presented shortly. Please imagine a completely opposite scene in which the outcome of the event is reversed — for example, your belongings were never lost (or the failure never occurred). As vividly as possible, imagine that the item is still in your hands or safely stored, or that the event did not end in failure but in success. Focus on how you feel in this imagined situation.

CR (adapted from Ochsner et al., 2002):

Interpersonal context: The picture will be presented shortly. Please keep your understanding of the exclusion event itself unchanged, but try to reinterpretation the negative situation you are experiencing in a less negative way. For example, you might think about how this experience could help you recognize who your real friends are, or how it might make you more resilient. The key is to change how you interpret and evaluate the event, rather than to change the event itself.

Event-based context: The picture will be presented shortly. Please keep your understanding of the lost or failure event itself unchanged, but try to reinterpretation the negative situation you are experiencing in a less negative way. For example, you might think about the actual value of the item, the lessons you have learned from this experience, or how this loss compares with other, more important things in your life. The key is to change how you interpret and evaluate the event, rather than to change the event itself.

Distraction (adapted from Kreddig et al., 2022): The picture will be presented shortly. Your task is to distract your attention away from any thoughts, feelings, or sensations about the voice/picture. You should do this by thinking about the different rooms in your home. Imagine your home, room by room, as much as you can. Picture the colors of the walls, furniture, photos on the wall, making each room as vivid as possible. Imagine yourself being there, occupy your thoughts, and imagine as many images, scenes, sounds, and activities as you can. As vividly and in as much detail as possible. Even if your thoughts drift elsewhere, bring them immediately back to thoughts about your home. Forming a mental image of your home is your primary task. It is important that you continue imagining your home in vivid detail.

Text 3 Conceptual Distinctions Between RI and Related Constructs

RI versus established emotion-regulation strategies

RI overlaps with several established ER strategies, but it differs from them in the mental object on which regulation acts. CR changes the meaning of an emotional event, distraction redirects attention away from emotional information, expressive suppression inhibits the outward expression of emotion, and acceptance involves allowing emotional experience to occur without attempting to eliminate it (Gross, 1998; Gross & Thompson, 2007; Webb et al., 2012). These strategies differ substantially in their mechanisms and consequences, but they share a common feature: the original distressing scene remains the central representation on which regulation operates.

RI differs because it introduces a reversed second scene alongside the original. Rather than only changing meaning, attention, distance, acceptance, or expression, the regulator imagines a counter-scene in which a key element of the distressing episode is reversed, such as the role, outcome, or power relation. This second scene supplies counter-valent affect—relief, control, satisfaction, or symbolic retaliation—that reduces the emotional dominance of the original scene. Thus, RI is not defined merely by the use of imagination, but by a specific representational operation: generating a reversed scene-level representation for immediate affective repair.

RI also differs from established strategies in its form of contextual specificity. Regulation strategies are known to vary in their effectiveness depending on goals and situational demands (Ochsner & Gross, 2005; Sheppes et al., 2011; Tamir et al., 2008). RI's contextual specificity is built into the structure of the imagined counter-scene. In interpersonal contexts, the most reversible element is often the role relation between victim and agent; RI therefore tends to take the form of role reversal. In event-based contexts, the most reversible element is often the outcome itself; RI therefore tends to take the form of outcome reversal. Thus, RI is context-sensitive not simply because people choose different strategies in different situations, but because the form of reversal depends on what element of the original scene can be meaningfully reversed.

Finally, RI appears to rely more strongly on visual-imagery and scene-simulation processes than many established strategies. Reappraisal often depends on semantic-conceptual reinterpretation (Ochsner & Gross, 2005), whereas RI requires the construction of an imagined scene that can evoke affect in its own right. Mental imagery is known to elicit emotional responses and can influence mood more strongly than verbal processing in some contexts (Holmes et al., 2006; Holmes & Mathews, 2010). This distinction helps explain why RI can produce counter-emotional effects even when the imagined reversal is not literally plausible: the reversed scene does not need to be believed as true in the same way a reappraisal does; it needs to be vivid enough to generate counter-valent affect.

RI vs. Other Emotion Regulation Strategies

RI also differs from neighboring constructs that involve imagination, affective discharge, or defensive transformation. Counterfactual thinking involves imagining alternatives to reality—what might have happened instead—but it is typically studied as a reflective process supporting causal reasoning, learning, regret, and preparation for future behavior (Roese, 1997; Epstude & Roese, 2008; Van Hoeck et al., 2015). RI can contain counterfactual elements, but its immediate function is different: it uses the imagined reversal to repair affect in the present.

Mental simulation similarly involves imagining possible events, but it is often prospective and action-oriented, helping individuals prepare for future possibilities (Taylor & Schneider, 1989;

Addis et al., 2007; D'Argembeau & Van der Linden, 2004). RI is primarily retrospective and reparative: it returns to a specific distressing episode and constructs a reversed version of that episode to reduce its emotional impact.

Projection and catharsis differ from RI in another way. Projection involves attributing one's own unacceptable feelings or traits to others, often as a defensive process (Freud, 1961). Catharsis emphasizes the discharge or expression of affect; however, experimental work suggests that cathartic expression does not necessarily produce lasting relief and may even increase aggressive tendencies in some contexts (Bushman et al., 1999). RI does neither. It does not externalize responsibility or simply release emotion; instead, it constructs an alternative emotional scene that counterbalances the original one.

Psychological compensation also differs from RI. In Adlerian theory, compensation refers to attempts to offset perceived inferiority, deficiency, or loss through achievement, mastery, or success in another domain (Adler, 1927). RI stays within the same narrative domain: it imagines a reversed version of the original distressing scene itself. The goal is not to succeed elsewhere, but to symbolically reverse the scene that caused distress.

Together, these comparisons suggest that RI occupies a distinct conceptual niche. It is a deliberate, imagery-based, scene-generating form of regulation in which a reversed second scene is constructed for immediate affective repair.

Table S14. Conceptual comparison of RI and related constructs

Construct	Primary function	Temporal focus	Mental object	Core mechanism	Relation to original scene
Reversal imagery (RI)	Immediate affective repair through reversal	Past/current distressing episode	Reversed second scene generated alongside the original	Imagery-based role or outcome reversal; counter-valent affect	Adds a reversed scene that competes with the original
Cognitive reappraisal (Gross, 1998; Ochsner & Gross, 2005)	Change emotional meaning	Current or past event	Original scene	Semantic-conceptual reinterpretation	Modifies the meaning of the original scene
Distraction (Gross, 1998; Sheppes et al., 2011; Webb et al., 2012)	Reduce emotional engagement	Current emotion episode	Alternative attentional target	Attentional redirection	Reduces processing of the original scene

Construct	Primary function	Temporal focus	Mental object	Core mechanism	Relation to original scene
Distancing (Kross & Ayduk, 2017; Powers & LaBar, 2019)	Reduce emotional involvement	Current or remembered event	Original scene viewed from distance	Shift in self-perspective or psychological distance	Changes vantage point on the original scene
Expressive suppression (Gross, 1998; Webb et al., 2012)	Reduce outward emotional expression	Response phase	Emotional response	Inhibition of expression	Modulates response after emotion is generated
Acceptance (Webb et al., 2012)	Allow emotional experience without resistance	Current emotional experience	Original emotion or experience	Nonjudgmental allowing	Changes relation to emotion rather than reversing the scene
Counterfactual thinking (Roese, 1997; Epstude & Roese, 2008; Van Hoeck et al., 2015)	Causal reasoning, learning, regret, preparation	Past event	Alternative possible event	Comparison between actual and alternative outcomes	Generates alternatives mainly for reflection or learning
Mental simulation (Taylor & Schneider, 1989; Addis et al., 2007; D'Argembeau & Van der Linden, 2004)	Future preparation or motivation	Future event	Possible future scenario	Prospective imagination or rehearsal	Simulates possible events, often for planning
Projection (Freud, 1961)	Defend against internal conflict	Present, often implicit	Other person or external target	Attribution or displacement of internal affect	Externalizes affect or traits rather than constructing a reversed scene
Catharsis (Bushman et al., 1999)	Release emotional tension	Present	Expressed affect	Emotional discharge	Releases affect without restructuring the scene
Psychological compensation (Adler, 1927)	Restore self-worth or control through another route	Future or parallel domain	Alternative achievement or domain	Redirection of effort, value, or mastery	Restores self-worth outside the original scene

Text 4 Participant Demographics

Study	N (Total Participants)	Gender (M/F)	Mean Age (SD)
Pilot Study	30	15/15	21.10 (1.40)
Study 1	68	35/33	21.37 (1.44)
Study 2a	52	27/25	20.06 (1.84)

Study 2b	68	35/33	21.37 (1.44)
Study 3a	51	21/30	21.61 (1.93)
Study 3b	62	31/31	21.50 (1.72)
Study 3c	58	29/29	21.90 (2.40)
Study 4a	55	29/26	21.67 (1.86)
Study 4b	53	24/29	21.77 (2.01)
Study 5a	68	34/34	21.51 (1.64)
Study 5b	57	29/28	20.18 (2.14)
Study 5c	58	31/27	20.60 (1.79)

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