# The Effect of Emotion Regulation Flexibility on Negative Emotion: Evidence from Experience Sampling

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## Abstract

Emotion regulation flexibility refers to an individual's capacity to flexibly deploy emotion regulation strategies in response to changing situational demands. This study utilized the experience sampling method to assess individuals' emotion regulation flexibility by modeling the profile structure of strategy use and the covariation between situational negativity and strategy usage in both daily life events (e.g., failing an examination) and public health emergencies (COVID-19), and investigated its influence on subsequent negative emotions (depression and anxiety). Results from two independent samples demonstrated that individuals exhibiting a preference for single-strategy use (e.g., rumination preference and expressive suppression preference) experienced elevated levels of depressive and anxious emotions during negative life events and the pandemic. Furthermore, when individuals employed more distraction strategies as situational negativity increased, and more cognitive reappraisal strategies as situational negativity decreased (indicating higher emotion regulation flexibility), they reported lower levels of depressive and anxious emotions. These findings collectively substantiate the beneficial impact of emotion regulation flexibility on reducing individuals' negative emotions.

## Full Text

### The Influence of Emotion Regulation Flexibility on Negative Affect: Evidence from Experience Sampling

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## Abstract

Emotion regulation flexibility refers to the ability to flexibly deploy emotion regulation strategies according to changing situational demands. This study employed experience sampling methodology to measure individuals' emotion regulation flexibility by fitting strategy use profile structures and examining covariation between situational negativity and strategy use intensity in both daily life events (e.g., failing an exam) and public health emergencies (COVID-19), and investigated its impact on subsequent negative emotions (depression and anxiety). Results from two independent samples revealed that individuals with a preference for single-strategy use (e.g., rumination preference and expressive suppression preference) experienced higher levels of depression and anxiety during negative life events and the pandemic. Moreover, individuals who used more distraction strategies as situational negativity increased and more cognitive reappraisal strategies as situational negativity decreased (indicating higher emotion regulation flexibility) showed lower levels of depression and anxiety. These findings collectively confirm the positive impact of emotion regulation flexibility on reducing negative emotions.

**Keywords:** emotion regulation flexibility, strategy-situation fit, strategy profile structure, negative emotions, experience sampling

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## 1 Introduction

Emotion regulation (ER) refers to the process by which individuals change their own or others' emotional experiences, physiological responses, and behavioral expressions based on regulatory goals and different regulation strategies to adapt to constantly changing environments (Gross, 1998, 2014). Successful emotion regulation is crucial for physical and mental health, and emotion regulation capacity is considered a protective factor for various mental disorders, including depression (Joormann & Quinn, 2014), mania (McGrogan et al., 2019), generalized anxiety disorder (Misegadis, 2016), social anxiety disorder (Werner et al., 2011), and post-traumatic stress disorder (Phil & Ashraf, 2016). Given the relationship between different regulation strategies and psychosomatic health, early

scholars emphasized that strategies have fixed positive or negative regulatory effects and tended to categorize strategies into adaptive strategies (e.g., cognitive reappraisal and problem-solving) and maladaptive strategies (e.g., rumination and expressive suppression) (Aldao et al., 2010; Aldao & Nolen-Hoeksema, 2010).

In recent years, this research framework has been challenged for two main reasons. First, the regulatory effects of strategies are not consistent across different situations (Webb et al., 2012). For instance, research has shown that cognitive reappraisal ability (reducing negative emotions by interpreting situations and one' s emotions from different perspectives) is significantly negatively correlated with depressive emotions in uncontrollable life stress, but significantly positively correlated in controllable life stress (Troy et al., 2013). Second, researchers emphasize that emotion regulation processes should consider the interaction between different regulation strategies and life situations; that is, the effectiveness of emotion regulation depends on the match between specific strategies and different situational features (Cheng et al., 2014). In summary, emotion regulation flexibility refers to the ability to flexibly deploy regulation strategies according to constantly changing situational demands and represents a key individual difference indicator of emotion regulation capacity (Aldao et al., 2015; Bonanno & Burton, 2013).

Previous methods for studying emotion regulation flexibility include balanced strategy repertoire profiles, cross-situational variability, strategy-situation fit, and self-reported emotion regulation flexibility (Blanke et al., 2019; Wang et al., 2021; Zhang et al., 2017; Wang et al., 2016). A meta-analysis showed that the largest effect sizes for examining the relationship between emotion regulation flexibility and psychosomatic health were obtained through strategy-situation fit and self-report methods (Cheng et al., 2014). Given that emotion regulation flexibility emphasizes the dynamic nature of the interaction between strategies and situations, studying emotion regulation flexibility based on strategy-situation matching is relatively more objective and effective than other approaches. This study focuses on examining how emotion regulation flexibility, assessed through the matching between two types of strategy use (cognitive reappraisal and distraction) and situational negativity, influences individuals' negative emotions.

Cognitive reappraisal and distraction are two widely used strategies for down-regulating negative emotions (Gross, 2002; Morawetz et al., 2017, 2020) that involve different levels of cognitive resource engagement (Sheppes & Levin, 2013; Sheppes & Meiran, 2008). Behavioral, physiological, and neural evidence has shown that using cognitive reappraisal, compared to other strategies (e.g., distraction and acceptance), produces higher cognitive costs, sympathetic nervous system responses, and more active prefrontal brain activation (Goldin et al., 2019; McRae et al., 2010; Sheppes et al., 2009). Numerous studies using the ER choice paradigm have confirmed that individuals tend to choose distraction strategies in high-negative situations and prefer cognitive reappraisal in low-negative situations (Sheppes et al., 2011, 2014; Sheppes & Gross, 2012). The

underlying explanation is that cognitive reappraisal involves cognitive change processes that require substantial cognitive resources and can produce lasting regulatory effects, making it more advantageous in low-negative situations. Distraction, which replaces situational stimuli with irrelevant ones, requires lower cognitive resource engagement but only maintains short-term regulatory effects, making it more advantageous in high-negative situations (Sheppes, 2020). Previous research measuring emotion regulation flexibility based on the matching between situational negativity and these two strategies (cognitive reappraisal and distraction) has found that individual emotion regulation flexibility levels moderate the relationship between firefighters' trauma exposure and PTSD symptoms (Levy-Gigi et al., 2016) and are associated with unhealthy compensatory behaviors (e.g., excessive exercise and washing behaviors) (Dougherty et al., 2020). This evidence suggests that matching situational negativity with these two strategies can effectively assess individual emotion regulation flexibility.

Emotion regulation flexibility is crucial for individuals to adapt to constantly changing internal and external environments (Kashdan & Rottenberg, 2010; Sheppes, 2020). Although the aforementioned studies based on strategy choice paradigms have found associations between emotion regulation flexibility and various psychosomatic health behaviors, the high-low negativity manipulation in laboratory settings differs from real-life situations. Moreover, in real life, individuals may attempt to use different strategies rather than relying on a single strategy exclusively. Therefore, to improve ecological validity, this study used experience sampling methodology (ESM) to examine the covariation between situational negativity and the use of two strategies (cognitive reappraisal and distraction) to characterize individual emotion regulation flexibility, and further investigated whether flexible use of cognitive reappraisal and distraction in different negative situations is related to negative emotions (depression and anxiety). The experience sampling method aims to reduce memory biases associated with long-term recall, thereby improving measurement ecological validity. Consequently, it offers reliability and validity for measuring daily emotion-related experiences and is considered to have unique advantages in emotion regulation flexibility research (Aldao et al., 2015; Burr & Samanez-Larkin, 2020; English & Eldesouky, 2020). First, compared to laboratory studies measuring emotion regulation flexibility (Bonanno et al., 2004; Hay et al., 2015; Levy-Gigi et al., 2016; Orejuela-Dávila et al., 2019), ESM can capture rich real-life situations. Second, the dense time points allow for characterizing the dynamic properties of emotion regulation strategies (Hollenstein et al., 2013; Ram & Gerstorf, 2009). Therefore, this study utilized ESM to record negative events occurring in daily life and assess their negativity levels. Additionally, COVID-19, as a collective major traumatic event, significantly brought negative experiences to the public. In the second sample, we collected data on daily negative emotional experiences and related strategy use from isolated residents living in the epidemic center (Hubei Province) during the most severe period of COVID-19 (March 7-13, 2020). The impact of this pandemic-related life context on people' s emotional experiences

has been confirmed by numerous studies. Longitudinal research based on Chinese samples has shown that people experienced higher levels of negative emotions (e.g., depression, anxiety, worry, and fear) during the pandemic than in daily life (He et al., 2021; Li et al., 2021; Zhao et al., 2021). Thus, this special period provided sufficient conditions for individuals' negative emotional experiences. Therefore, this study selected negative emotions under the pandemic as a way to assess situational negativity. Furthermore, we used multilevel modeling to fit the within-person covariation between the use of distraction and cognitive reappraisal strategies and situational negativity (slope estimates) as an indicator of emotion regulation flexibility level, and then used cross-level interaction models to examine the effect of emotion regulation flexibility on negative emotions (depression and anxiety) after experience sampling.

Whether emotion regulation flexibility has adaptive value is a key question in this research field. Its adaptability typically refers to the relationship between the regulatory effects of emotion regulation flexibility and individual emotional health (Zhang et al., 2017). Previous research indicates that psychological rigidity is one of the clinical symptoms of depression (Kashdan & Rottenberg, 2010; Stange et al., 2017). For example, depressed patients indiscriminately experience emptiness and meaninglessness across many life situations, reflecting insensitivity to the environment (Abramson et al., 1978; Buchwald et al., 1978; Telner & Singhal, 1984). Second, rumination—a common emotional coping method among depressed patients—reflects not only a habitual cyclical thinking pattern but also a rigid, inflexible regulation mode. Depressed individuals' difficulty disengaging from high-intensity negative stimuli may indicate an inability to flexibly switch from rumination to other strategies more conducive to reducing negative emotions (e.g., distraction), and this inflexible behavioral pattern may intensify depressive emotions (Kashdan & Rottenberg, 2010; Koval et al., 2012; Rozanski & Kubzansky, 2005; Stange et al., 2017). Different subtypes of anxiety disorders also show similar emotion regulation deficits, namely a tendency to use a single regulation strategy. For example, individuals with generalized anxiety disorder excessively worry (Andrews et al., 2010; Thayer et al., 1996), while those with social anxiety disorder tend to hide their feelings in social situations or avoid stimuli related to social situations (Heeren & McNally, 2018; Hofmann & Bitran, 2007; Schneier et al., 2011). Additionally, anxiety is associated with a preference for attentional disengagement strategies. Using attentional disengagement strategies (avoidance or distraction) to avoid contact with emotional stimuli may help alleviate anxiety initially, but persistent attentional disengagement misses opportunities to overcome anxiety or solve problems and cannot fundamentally eliminate anxiety (Campbell-Sill & Barlow, 2007). Emotion regulation flexibility emphasizes the ability to flexibly deploy strategies according to situational changes, which contradicts the overuse of a specific strategy by individuals with depression and anxiety disorders. Therefore, low emotion regulation flexibility, including strategy-situation mismatch and rigid single-strategy preferences (e.g., rumination preference), is a primary cause of high depressive and anxious emotional experiences.

In summary, the main purpose of this study is to explore the influence of emotion regulation flexibility on individuals' negative emotions. Methodologically, we combined strategy use profile structures and strategy-situation matching to assess individual emotion regulation flexibility from both static and dynamic perspectives. First, we used strategy use profile structures to evaluate emotion regulation flexibility. We assumed that individuals with a preference for single-strategy use when regulating negative life events and pandemic impacts would show lower emotion regulation flexibility and higher negative emotion levels (anxiety or depression) compared to individuals with multiple strategy preferences. Second, we further assessed emotion regulation flexibility based on the matching degree between different situational features (negativity levels) and strategies (cognitive reappraisal and distraction). We hypothesized that individuals whose covariation between situational negativity and distraction use (slope estimate) is higher than that between situational negativity and cognitive reappraisal use would demonstrate higher emotion regulation flexibility and lower depression and anxiety levels. Conversely, if individuals show opposite trends in the covariation between these two strategy types and situational negativity, they would have lower emotion regulation flexibility and lower depression and anxiety levels.

## 2.1 Participants and Samples

Previous research indicates that the effect size for regression analysis between emotion regulation flexibility and mental health reaching significance (0.05) generally ranges from 0.12 to 0.32 (Cheng et al., 2014). In Sample 1, based on the experience sampling design, we determined that each participant should have no fewer than 7 data collection time points (negative event reports). Using the R package "wp.crt2arm"(Zhang & Yuan, 2018) to calculate sample size, the results showed that 199 participants were needed to achieve 80% statistical power ($\alpha$ = 0.05). Therefore, we recruited 213 healthy participants at Southwest University. Sample 1 was collected in early September 2019. We only extracted data from time points where negative events occurred during the measurement period. Two participants had negative event ratings on fewer than 7 occasions and could not be included in the analysis, leaving a final sample of 211 participants (117 female) with a mean age of 19.80 $\pm$ 1.37 years.

In Sample 2, we first determined that each participant should have no fewer than 24 data collection time points. Using the R package "wp.crt2arm" to calculate sample size, the results showed that no fewer than 108 participants were needed to achieve 80% statistical power ($\alpha$ = 0.05). Sample 2 data were collected during the COVID-19 pandemic (March 7-13, 2020). We recruited 115 participants living in Hubei Province, the epicenter of the outbreak, via the internet. Fifteen participants were excluded due to low completion rates (N = 10, with more than 30% missing data) and missing data on other important variables (N = 5). The final sample included 100 participants (64 female) with ages ranging from 18 to 26 years (M = 20.73, SD = 1.87).

Both samples were screened for psychiatric disorders and individuals undergoing treatment via questionnaire at the initial recruitment stage. Eligible participants were contacted by phone to explain the experimental content and data collection rules. All participants signed informed consent before formally participating in the experience sampling data collection. After completing the experience sampling questionnaires, participants filled out a series of emotional health surveys and received monetary compensation upon completion.

### 2.2.1 Experience Sampling Procedure

Both samples completed the experience sampling via smartphone on the Wenjuanxing platform (https://www.wjx.cn/). For Sample 1, participants were prompted to complete questionnaires 5 times daily for 10 days. The minimum interval between two tests was 120 minutes. Participants were required to complete each test within 20 minutes of receiving the notification. Participants needed to complete 50 questionnaires (5 times per day for 10 days). To ensure participants who missed more than 5 prompts could reach the minimum required number of completions, we extended the procedure by 3 days. This allowed 16 participants who missed more than 5 prompts to reach the minimum threshold (35 completions), while 161 participants completed more than 50 questionnaires during the additional 3 days. A total of 11,545 data points were collected during the experience sampling phase. Participants completed an average of 54.53 questionnaires (SD = 5.41; range: 39-65). Completing 50 or more tests was considered 100% completion, with an average completion rate of 98.1% (SD = 0.04; range: 78-100%).

For Sample 2, the experience sampling questionnaire was set to be completed 7 times daily for 7 days. To ensure participants who missed more than 7 prompts could reach the minimum required number of completions, we extended the procedure by 3 days. A total of 3,462 data points were collected during the experience sampling phase. Participants completed an average of 34.21 questionnaires (SD = 6.97; range: 27-57). Completing 49 or more tests was considered 100% completion, with an average completion rate of 70.33% (SD = 0.133; range: 55.10-100%). Questionnaires were distributed from 9:30 AM to 10:30 PM. Participants were required to complete each test within 20 minutes, with a minimum interval of 90 minutes between tests.

### 2.2.2 Experience Sampling Content

The experience sampling data for Sample 1 included: 1) name and ID; 2) rating of whether a negative life event occurred and its negativity level (0-100; 0 = not at all negative, 100 = extremely negative); 3) rating of the use of 7 emotion regulation strategies (0-100; 0 = not used at all, 100 = used continuously). The selection of seven emotion regulation strategies (including distraction, rumination, cognitive reappraisal, acceptance, expressive suppression, emotional expression, and social sharing) was based on the widely accepted process model

of emotion regulation (Gross, 1998, 2015), reflecting different stages of the emotion regulation process. Specifically, we selected distraction from the attentional deployment stage, cognitive reappraisal from the cognitive change stage, and expressive suppression from the response modulation stage. We also included three common regulation strategies: acceptance, emotional expression, and social sharing (Flett et al., 2003; Forman et al., 2007; Vincke & Bolton, 1994). Rumination, a self-focused regulation strategy for negative emotions or events, was also included as it has been shown to be a common coping method among patients with major depression (Cooney et al., 2010; Papageorgiou & Wells, 2003).

The experience sampling data for Sample 2 included: 1) name and ID; 2) assessment of current positive and negative emotion levels, with emotion items selected from the revised Chinese version of the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988; Qiu et al., 2008). The average negative emotion score was used to assess situational negativity. Sample 2 modified the PANAS rating method by adopting a 0-100 rating scale. This decision was made to reduce participants' cognitive resources required to switch between different rating formats, as experience sampling requires participants to evaluate multiple items in a short time. We therefore set all test content in the experience sampling to use a 0-100 rating format. To date, no consensus has been reached on rating methods for emotion items in experience sampling research, with commonly used formats including 0-100, 0-7, 1-4, and 1-5, with 0-100 being the most frequently used (see meta-analyses by Dejonckheere et al., 2019; Houben et al., 2015). 6) Rating of the use of 8 emotion regulation strategies (including distraction, rumination, cognitive reappraisal, acceptance, expressive suppression, emotional expression, social sharing, and problem-solving) (0-100; 0 = not used at all, 100 = used continuously). The selection of emotion regulation strategies was consistent with Sample 1. Given that the above strategies are all emotion-focused, problem-solving strategies were also included. The complete experience sampling content for both samples is detailed in Appendix 4.

This study included two main analyses: latent profile analysis and multilevel regression modeling. Latent profile analysis used data on the use of all strategies from both samples. Multilevel regression modeling used only a subset of data, including the use of two strategies (distraction and cognitive reappraisal) and situational negativity assessments, with details presented in Table 1 . In Sample 1, situational negativity was obtained through individuals' reported negativity of life events in daily life. In Sample 2, since we collected emotional states from groups living in the epidemic center (Hubei) during the critical period of the pandemic (March 7-13, 2020), situational negativity was obtained through the average negative emotion score from the Positive and Negative Affect Scale (PANAS) (Watson et al., 1988; Qiu et al., 2008). All time point data were included in the statistical analysis. In this part of the analysis, we focused only on the use of cognitive reappraisal and distraction strategies and coded these two strategies (cognitive reappraisal = 1; distraction = 2) to examine the interaction between situational negativity and strategy type.

**Table 1** Overview of Data Used in Multilevel Models

| Variable | Sample 1 (Daily Life; N=211, 115 female, 7 measurements/day for 10 days) | Sample 2 (COVID-19 Period; N=100, 64 female, 7 measurements/day for 7 days) |
|---|---|---|
| **Emotion Regulation Strategies** | Distraction: "Since the last test, I have distracted myself by doing or thinking about other things." Cognitive Reappraisal: "Since the last test, I have thought about or interpreted what happened from different angles." | Distraction: "Since the last test, I have distracted myself by doing or thinking about other things." Cognitive Reappraisal: "Since the last test, I have thought about or interpreted what happened from different angles." |
| **Rating Scale** | 0-100 (0: not used at all; 100: used continuously) | 0-100 (0: not used at all; 100: used continuously) |
| **Situational Negativity** | "Has a negative event occurred since the last test? Please rate the negativity of the event." | "Since the last test, please rate the intensity of your feelings of: ashamed, sad, scared, nervous, panicked, guilty, irritable, trembling, annoyed." |
| **Rating Scale** | 0-100 (0: not at all negative; 100: extremely negative) | 0-100 (0: not at all; 100: very strongly) |
| **Depression Level** | Beck Depression Inventory-II (BDI-II), 0-3 rating | Beck Depression Inventory-II (BDI-II), 0-3 rating |
| **Anxiety Level** | Beck Anxiety Inventory (BAI), 0-3 rating (0: none; 3: severe; barely tolerable) | Spielberg State Anxiety Scale, 1-4 rating (1: not at all; 4: very obvious) |

### 2.2.3 Measurement Questionnaires

**Beck Depression Inventory-II.** Depression levels in both samples were measured using the Beck Depression Inventory-II (BDI-II). This scale assesses the severity of depressive symptoms in the past week from dimensions including cognitive, motivational, affective, and somatic symptoms (Beck et al., 1996). The BDI-II consists of 21 items. Participants rated each item on a four-point Likert scale from 0 to 3, with total scores ranging from 0 to 63. Higher scores indicate more severe depressive tendencies. The scale demonstrated high internal consistency reliability in both samples, with Cronbach' s alpha coefficients of 0.931 and 0.857, respectively.

**Beck Anxiety Inventory.** In Sample 1, anxiety levels were measured using the Beck Anxiety Inventory (BAI). This questionnaire contains 21 items, most of which are consistent with DSM-III-R criteria for diagnosing panic attacks. Thirteen items describe physiological anxiety symptoms (e.g., dizziness), five describe cognitive anxiety symptoms, and three describe both physiological and psychological symptoms (e.g., panic). Participants rated all items on a four-point Likert scale (0 = not at all; 3 = almost unbearable). Total scores range

from 0 to 63, with higher scores indicating more severe anxiety tendencies. In this sample, the BAI had a Cronbach' s alpha coefficient of 0.901, indicating high internal consistency reliability.

**Spielberg State Anxiety Scale.** In Sample 2, anxiety levels were measured using the Spielberg State Anxiety Scale (Spielberg, 1971). This scale measures state anxiety levels in groups and consists of 20 items. Participants rated their experiences of fear, tension, worry, and neuroticism over the past week on a 4-point scale: 1 = "not at all," 2 = "somewhat," 3 = "moderately," and 4 = "very obvious." Higher scores indicate more severe anxiety levels. In this sample, the Spielberg State Anxiety Scale had a Cronbach' s alpha coefficient of 0.944.

## 2.3 Statistical Analysis

**Latent Profile Analysis.** To verify whether overuse of a specific strategy can be used to assess emotion regulation flexibility and further explore its impact on negative emotional experiences, this study used the R package "tidyLPA" to conduct latent profile analysis (LPA) in both samples (Rosenberg et al., 2018). Latent profile analysis is a person-centered clustering approach that classifies individuals based on similarities in observed variables and assumes that classifications reflect heterogeneity in latent groups across variables (Muthén, 2001; Nylund et al., 2007). This method is widely used to explore the existence of rigid or flexible emotion regulation patterns (Chesney & Gordon, 2017; Dixon-Gordon et al., 2015; Lougheed & Hollenstein, 2012). This study identified different latent emotion regulation groups based on individuals' use of multiple strategies (e.g., sharing, distraction, cognitive reappraisal, acceptance, rumination, expressive suppression, emotional expression, problem-solving). To further examine the relationship between emotion regulation flexibility and negative emotion levels (depression and anxiety), we used one-way ANOVA to compare whether different emotion regulation groups differed in negative emotion levels.

**Multilevel Regression Modeling.** Since data from both samples had a nested structure, we used the R package "lme4" (Bates, 2010) to fit multilevel mixed linear models and the R package "effectsize" to estimate effect sizes ($f^2$) in the models. Emotion regulation flexibility level was reflected by the interaction between strategy type and situational negativity. If the interaction term coefficient (slope estimate) was positive, it indicated that individuals used more cognitive reappraisal as situational negativity decreased and more distraction as situational negativity increased (i.e., higher emotion regulation flexibility). If the interaction term coefficient was negative, it indicated that individuals used more distraction as situational negativity decreased and more cognitive reappraisal as situational negativity increased (i.e., lower emotion regulation flexibility). Negative emotions were then placed at Level 2 in two separate models, and the relationship between negative emotions and the strategy type × situational negativity interaction was examined to explore the effect of emotion regulation flexibility on negative emotions. As shown in Equation (1), at Level 1, we predicted strategy use intensity from situational negativity (event negativity

or average negative emotion level).

$$Strategy\ Use_{it} = \beta_{0i} + \beta_{1i} \times Situational\ Negativity_{ti} + r_{ti} \quad (1)$$

The dependent variable ($Strategy\ Use_{it}$) reflects participant $i$' s strategy use intensity at time point $t$. The intercept ($\beta_{0i}$) represents participant $i$' s average level of situational negativity. The slope $\beta_{1i}$ reflects the within-person relationship between situational negativity and strategy use intensity. $r_{ti}$ represents the error term for participant $i$ at time point $t$ that cannot be explained by situational negativity. At Level 2, after controlling for gender and age, all parameters in Equation 1 were allowed to vary randomly between individuals. Equations (2-3) modeled the interactions between strategy type (cognitive reappraisal = 1; distraction = 2), negative emotions, and situational negativity.

$$\beta_{0i} = \gamma_{00} + \gamma_{01}(Strategy\ Type_i) + \gamma_{02}(Depression\ or\ Anxiety\ Level) + \gamma_{03}(Gender) + \gamma_{04}(Age) + u_{0i} \quad (2)$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(Strategy\ Type_i) + \gamma_{12}(Depression\ or\ Anxiety\ Level) + \gamma_{13}(Gender) + \gamma_{14}(Age) + u_{1i} \quad (3)$$

In Equations (2-3), intercept terms $\gamma_{00}$ and $\gamma_{10}$ represent estimated parameters for within-person variables in Equation 1. Slope terms $\gamma_{01}$ and $\gamma_{11}$ reflect the relationship between strategy type (cognitive reappraisal or distraction) and situational negativity in Level 1 models. Slope terms $\gamma_{02}$ and $\gamma_{12}$ represent the interaction between between-person negative emotion levels (depression or anxiety) and situational negativity in predicting the dependent variable. Parameters $u_{0i}$ and $u_{1i}$ represent error terms that cannot be explained by between-person variables. In the model, if the three-way interaction coefficient for negative emotion level × strategy type × situational negativity is negative, it indicates that higher emotion regulation flexibility is associated with lower negative emotion levels.

## 3.1 Descriptive Statistics

Descriptive statistics for emotion regulation strategies used in latent profile analysis for both samples are presented in Table 1. Composite reliability (omega) for emotion regulation strategies was calculated using multilevel confirmatory factor analysis, showing omega values of 0.864 for Sample 1 and 0.942 for Sample 2, indicating good reliability of the emotion regulation strategy measures.

**Table 1** Descriptive Statistics for Emotion Regulation Strategy Use Intensity

*Note: Sample 1 N=211; Sample 2 N=100*

Sample 1 extracted a total of 2,860 negative events, with participants reporting an average of 13.55 life events (SD = 4.58, range: 7-33). Sample 2 extracted

a total of 3,491 time point data, with participants completing an average of 34.91 responses (SD = 6.89, range: 27-60). Means and standard deviations of within-person averages for all variables in the multilevel models are presented in Table 2 .

**Table 2** Descriptive Statistics of Within-Person Means for All Variables

*Note: BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory-II; SA = Spielberg State Anxiety Scale*

## 3.2 Latent Profile Analysis Results

In Sample 1, based on participants'strategy use intensity when coping with daily negative events, latent profile analysis indicated that the five-class solution had the best fit indices (AIC = 3597.30, BIC = 3751.48, Entropy = 0.84, BLRT_p = 0.009, Appendix Table 1S). The classes were: Adaptive ER (9.48%), characterized by preferential use of adaptive strategies such as social sharing, cognitive reappraisal, acceptance, and distraction, and less use of maladaptive strategies such as expressive suppression and rumination; Average ER (30.81%), characterized by relatively equal use of all strategies; Suppression Focus (9.01%), showing preference for expressive suppression; Rumination Focus (37.91%), showing preference for rumination; and Inactive ER (12.80%), characterized by low use of all strategies (see Appendix Figure 1 [Figure 1: see original paper]S a). Further one-way ANOVA comparing negative emotion levels (depression and anxiety) across the five emotion regulation groups in Sample 1 revealed significant differences in both depression ($F(4, 206) = 5.435$, $p < 0.001$) and anxiety levels ($F(4, 206) = 5.681$, $p < 0.001$). Levene' s test indicated unequal variances for depression across groups ($F = 3.052$, $p = 0.018$), so Games-Howell post-hoc tests were used. Results showed that the Rumination Focus group ($M = 11.90$) had significantly higher depression levels than the Average group ($M = 8.31$, $t = 3.952$, $p = 0.025$). The Suppression Focus group ($M = 15.84$) had significantly higher depression levels than the Average group ($M = 8.31$, $t = 7.534$, $p = 0.035$). The Suppression Focus group' s depression levels were slightly higher than the Adaptive group ($M = 8.40$, $t = 7.442$, $p = 0.077$) and Inactive group ($M = 8.81$, $t = 7.027$, $p = 0.076$), but these differences were not significant. Levene' s test indicated equal variances for anxiety across groups ($F = 1.823$, $p = 0.126$), so LSD post-hoc tests were used. Multiple comparisons showed that the Rumination Focus group ($M = 9.49$) had significantly higher anxiety levels than the Average group ($M = 6.80$, $t = 2.687$, $p = 0.027$) and marginally significantly higher than the Adaptive group ($M = 5.95$, $t = 3.538$, $p = 0.051$). The Suppression Focus group ($M = 14.53$) had higher anxiety levels than the Adaptive group ($t = 8.576$, $p < 0.001$), Average group ($t = 7.726$, $p < 0.001$), and Inactive group ($M = 6.63$, $t = 7.896$, $p < 0.001$) (see Figure 1). No significant differences in depression or anxiety were found between other groups.

In Sample 2, based on participants' strategy use intensity during the pandemic, latent profile analysis indicated that the six-class solution had the best fit indices

(AIC = 1595.19, BIC = 1754.71, Entropy = 0.95, BLRT_p = 0.001, Appendix Table 1S). The classes were: Adaptive ER (9.91%), characterized by preferential use of adaptive strategies such as social sharing, cognitive reappraisal, acceptance, and problem-solving, and less use of maladaptive strategies such as expressive suppression and rumination; Acceptance Focus (5.94%), showing preference for acceptance; Rumination Focus (19.80%), showing preference for rumination; Distract Focus (37.62%), showing preference for distraction; Active ER (12.87%), characterized by high use of all strategies; and Inactive ER (13.86%), characterized by low use of all strategies (see Appendix Figure 1S b).

Further one-way ANOVA results indicated significant differences across the six emotion regulation groups in both depression ($F(5, 95) = 2.737$, $p = 0.024$) and anxiety levels ($F(5, 95) = 2.984$, $p = 0.015$). Levene' s test indicated equal variances for both depression ($F = 1.936$, $p = 0.096$) and anxiety ($F = 0.823$, $p = 0.537$) across groups, so LSD post-hoc tests were used. Multiple comparisons showed that the Rumination Focus group ($M = 11.58$) had significantly higher depression levels than the Distract Focus group ($M = 4.53$, $t = 7.051$, $p = 0.001$), Adaptive group ($M = 4.80$, $t = 6.778$, $p = 0.019$), and Inactive group ($M = 4.50$, $t = 7.079$, $p = 0.007$). For anxiety, the Rumination Focus group ($M = 48.58$) had significantly higher levels than the Distract Focus group ($M = 42.25$, $t = 6.328$, $p = 0.030$), Active group ($M = 38.45$, $t = 10.124$, $p = 0.010$), Inactive group ($M = 39.79$, $t = 8.793$, $p = 0.016$), and Adaptive group ($M = 35.10$, $t = 13.478$, $p = 0.001$) (see Figure 1). No significant differences in depression or anxiety were found between other groups.

*Note: BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory-II; SA = Spielberg State Anxiety Scale*

**Figure 1** Comparison of Depression and Anxiety Levels Across Emotion Regulation Strategy Groups

## 3.3 Multilevel Regression Model Results for Emotion Regulation Flexibility and Depression

Table 2 presents the main results for the relationship between depression level and emotion regulation flexibility (based on strategy-situation matching). As shown in Table 2, in Sample 1, individual-level depression was not significantly related to daily emotion regulation strategy use intensity, while event negativity was significantly related to strategy use. The interaction between strategy type and event negativity was significant ($B = 0.106$, $p = 0.002$, $f^2 = 0.04$), indicating that individuals used more cognitive reappraisal as situational negativity decreased and more distraction as situational negativity increased (high strategy-situation matching). Most importantly, the three-way interaction between depression level, strategy type, and event negativity was significant ($B = -0.005$, $p = 0.047$, $f^2 = 0.03$), indicating that depression level was associated with strategy-situation matching (emotion regulation flexibility).

To further examine the relationship between depression level and strategy-

situation covariation, we conducted simple slope analyses using the R package "interactions" (Long, 2020) to test whether the strategy-situation matching slope differed significantly at $\pm 1 SD from the mean depression level. As shown in Table 3, at low depression levels (-1 SD; $B = 0.141$, $p = 0.003$, $f^{2}$ = 0.09, Figure 2a [Figure 2: see original paper]), indicating that individuals with low depression used more distraction as life event negativity increased and more cognitive reappraisal as negativity decreased (i.e., high emotion regulation flexibility). However, at high depression levels (+1 SD), the interaction between strategy type and event negativity was not significant (B = -0.010, p = 0.846, Figure 2b), indicating that individuals with high depression used more distraction across all negative life events (i.e., low emotion regulation flexibility).

Unlike Sample 1, in Sample 2 we assessed situational negativity at each time point during the pandemic using the average negative emotion score. This analysis fully replicated the core results of Sample 1: 1) The interaction between strategy type and average negative emotion was significant (B = 0.099, p < 0.001, $f^2$ = 0.04), indicating that strategy-situation matching is prevalent in the population; 2) The three-way interaction between depression level, strategy type, and average negative emotion was significant (B = -0.009, p = 0.017, $f^2$ = 0.03), indicating that depression level was associated with strategy-situation matching (emotion regulation flexibility) (Table 2). Further simple slope results showed that at low depression levels (-1 SD), the interaction between strategy type and depression level was significant (B = 0.130, p < 0.001, $f^2$ = 0.09, Table 3 and Figure 2c), indicating that individuals with low depression used more distraction as negative emotion increased and more cognitive reappraisal as negative emotion decreased (i.e., high emotion regulation flexibility). However, at high depression levels (+1 SD), the interaction between strategy type and event negativity was marginally significant (B = -0.122, p = 0.064, Table 3 and Figure 2d), with individuals with high depression showing the opposite pattern of strategy-situation covariation—using more cognitive reappraisal as negative emotion situations intensified and more distraction as negative emotion decreased (i.e., low emotion regulation flexibility).

**Table 2** Fixed Effects Estimates from Multilevel Models Predicting Strategy Use from Depression Level, Strategy Type, and Situational Negativity

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| | Estimate (SE) | 95% CI |
| Intercept | -0.933 (2.303) | [-5.466, 3.600] |
| Strategy Type | 0.209 (0.842) | [-1.450, 1.868] |
| Depression Level | 0.122 (0.183) | [-0.238, 0.482] |
| Event Negativity | -5.673 (1.793) | [-9.187, -2.158] |

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| Depression × Strategy Type | 0.062 (0.028) | [0.008, 0.116] |
| Depression × Event Negativity | 0.521 (0.149) | [0.228, 0.814] |
| Strategy Type × Event Negativity | 0.001 (0.002) | [-0.003, 0.005] |
| Depression × Strategy Type × Event Negativity | 0.106 (0.035) | [0.037, 0.174] |
| | -0.005 (0.003) | [-0.011, -0.001] |

**Table 3** Simple Slope Analysis of Depression Level on Strategy Type × Situational Negativity Slope

| | Low Depression (-1 SD) | High Depression (+1 SD) |
|---|---|---|
| | Estimate (SE) | 95% CI |
| Strategy Type × Event Negativity | 0.141 (0.047) | [0.049, 0.233] |
| Strategy Type × Average Negative Emotion | 0.130 (0.034) | [0.064, 0.197] |

**Figure 2** Simple Slope Analysis of Depression Level on Strategy Type × Situational Negativity Slope

## 3.5 Multilevel Regression Model Results for Emotion Regulation Flexibility and Anxiety

Table 4 presents the main results for the relationship between anxiety level and emotion regulation flexibility (based on strategy-situation matching). Sample 1 results showed that individual-level anxiety was not significantly related to daily emotion regulation strategy use intensity, while event negativity was significantly related to strategy use. The interaction between strategy type and

event negativity was significant (B = 0.065, p = 0.033, $f^2$ = 0.03), indicating the phenomenon of strategy-situation matching. However, the three-way interaction between anxiety level, strategy type, and event negativity was not significant (B = -0.001, p = 0.591), indicating that anxiety level was not significantly related to strategy-situation matching (emotion regulation flexibility).

As mentioned above, in Sample 2 we measured situational negativity using the average negative emotion at each time point during the pandemic and measured anxiety levels using the Spielberg State Anxiety Scale. The results partially replicated Sample 1 findings: 1) The interaction between strategy type and average negative emotion was significant (B = 0.427, p < 0.001, $f^2$ = 0.05), indicating that strategy-situation matching is prevalent; 2) The three-way interaction between anxiety level, strategy type, and average negative emotion was significant (B = -0.009, p < 0.001, $f^2$ = 0.05), indicating that anxiety level was related to strategy-situation matching (emotion regulation flexibility). Further simple slope results showed that at low anxiety levels (-1 SD), the interaction between strategy type and average negative emotion was significant (B = 0.260, p < 0.001, $f^2$ = 0.11, Table 5 and Figure 3c [Figure 3: see original paper]), indicating that individuals with low anxiety used more distraction as negative emotion increased and more cognitive reappraisal as negative emotion decreased (i.e., high emotion regulation flexibility). At high anxiety levels (+1 SD), the interaction between strategy type and average negative emotion was significant (B = -0.165, p = 0.007, $f^2$ = 0.08, Table 5 and Figure 3d), indicating that individuals with high anxiety used more cognitive reappraisal as negative emotion increased and more distraction as negative emotion decreased (i.e., low emotion regulation flexibility).

**Table 4** Fixed Effects Estimates from Multilevel Models Predicting Strategy Use from Anxiety Level, Strategy Type, and Situational Negativity

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| | Estimate (SE) | 95% CI |
| Intercept | -0.590 (2.301) | [-5.120, 3.942] |
| Strategy Type | 0.315 (0.853) | [-1.364, 1.993] |
| Anxiety Level | 0.117 (0.187) | [-0.249, 0.484] |
| Event Negativity | -2.839 (1.569) | [-5.911, 0.232] |
| Anxiety × Strategy Type | 0.068 (0.024) | [0.021, 0.115] |
| Anxiety × Event Negativity | 0.279 (0.149) | [-0.014, 0.572] |

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| Strategy Type × Event Negativity | 0.001 (0.002) | [-0.004, 0.005] |
| Anxiety × Strategy Type × Event Negativity | 0.065 (0.030) | [0.005, 0.125] |
| | -0.001 (0.003) | [-0.007, 0.004] |

**Table 5** Simple Slope Analysis of Anxiety Level on Strategy Type × Situational Negativity Slope

| | Low Anxiety (-1 SD) | High Anxiety (+1 SD) |
|---|---|---|
| | Estimate (SE) | 95% CI |
| Strategy Type × Event Negativity | 0.042 (0.047) | [-0.047, 0.130] |
| Strategy Type × Average Negative Emotion | 0.260 (0.073) | [0.117, 0.403] |

**Figure 3** Simple Slope Analysis of Anxiety Level on Strategy Type × Situational Negativity Slope

## 4 Discussion

This study is the first to assess emotion regulation flexibility in Chinese college students using high-temporal-resolution, ecologically valid experience sampling methodology. By combining strategy structure and strategy-situation matching approaches, we demonstrated that emotion regulation flexibility is prevalent and can significantly predict individual negative emotion levels. Single-strategy preferences reflect rigid emotion regulation patterns, i.e., lower levels of emotion regulation flexibility. Consistent with previous research (Chesney & Gordon, 2017; Dixon-Gordon et al., 2015; Lougheed & Hollenstein, 2012), individuals with preferences for single strategies (e.g., rumination preference and expressive suppression preference) experienced higher levels of depression and anxiety during negative life events and the pandemic.

Using healthy college students, we replicated across two independent samples the positive effect of strategy-situation matching-based emotion regulation flexibility on reducing negative emotions (depression and anxiety). Specifically, both

in life events and during the pandemic, individuals who used more distraction as situational negativity increased and more cognitive reappraisal as situational negativity decreased (i.e., higher emotion regulation flexibility) showed lower subsequent depression. However, if individuals showed the opposite pattern of strategy-situation matching (i.e., lower emotion regulation flexibility), they showed higher depression. Additionally, we partially replicated the relationship between emotion regulation flexibility and anxiety: during COVID-19, individuals who used more distraction as negative emotion increased and more cognitive reappraisal as negative emotion decreased (i.e., higher emotion regulation flexibility) showed lower subsequent anxiety. However, strategy-situation matching based on daily negative life events was not significantly related to anxiety. These results partially support strategy-situation matching theory, emphasizing that flexibly using strategies that match situational demands has more adaptive significance for emotional health (Aldao et al., 2015; Cheng et al., 2014; Sheppes, 2020). In summary, this study used two approaches to collectively verify the positive role of emotion regulation flexibility in reducing negative emotions among college students.

## 4.1 Characteristics of Strategy-Situation Matching-Based Emotion Regulation Flexibility

Bonanno and Burton's (2013) component model of emotion regulation flexibility provides important explanatory power for our core findings. The model suggests that emotion regulation flexibility depends on the interaction of three main components: context sensitivity, repertoire (strategy effectiveness), and feedback responsiveness (Bonanno & Burton, 2013). Context sensitivity refers to the ability to detect demands or opportunities triggered by situational changes, guide the selection of situation-matched strategies, and includes awareness of regulation strategies that facilitate situational adaptation (Cheng, 2001, 2003; Cheng & Cheung, 2005) and awareness of emotional stimulus cues (Frijda & Zeelenberg, 2001; Gross et al., 2011; Gross & Feldman Barrett, 2011). Repertoire refers to the ability to use multiple strategies to adapt to demands or opportunities triggered by situational changes, including the number of strategies mastered (Orcutt et al., 2014), variability in strategy use over time (Gall et al., 2000, 2009), and variability in use across different strategy types (Bonanno, 2005; Bonanno et al., 2004). Therefore, repertoire provides an important foundation for strategy-situation matching. Feedback responsiveness refers to the ability to monitor current emotion regulation effectiveness through feedback from internal physiological signals (Füstös et al., 2013) and social signals (Coan et al., 2006; Eisenberger et al., 2003), and to improve regulation effectiveness by maintaining and switching effective strategies and stopping ineffective ones. Our findings indicate that individuals with low strategy-situation matching have lower emotion regulation flexibility. Given that strategy-situation matching-based emotion regulation flexibility depends on perception of situational negativity, flexible switching between strategies, and timely feedback about regulation effectiveness, low strategy-situation matching may indicate deficits in any component

and possibly incoordination between components, preventing individuals from flexibly switching strategies based on situational demands to achieve effective emotion regulation. Additionally, the component model of emotion regulation flexibility provides a theoretical basis for single, rigid strategy preferences. Preferences for rumination and expressive suppression may indicate that individuals ignore situational demands and only use familiar or dominant strategies, or that they cannot switch cognitive processes from one strategy to another that matches situational demands. Incorrect feedback about the effectiveness of current strategies may also cause individuals to persistently use the same regulation strategy, even failing to realize that a single regulation approach may produce more negative emotional consequences. However, these potential explanations require further mechanistic research on how different components contribute to individuals' strategy-situation matching and balanced emotion regulation strategy profiles.

Furthermore, the appraisal system in the Extended Process Model of Emotion Regulation offers important insights for understanding strategy-situation matching-based emotion regulation flexibility (Gross, 2015). The model consists of a three-stage cyclic system (perception–valuation–action (PVA) processing cycle) including perception, valuation, and action stages. Specifically, the perception stage is responsible for inputting various stimuli. The valuation stage involves dynamically assessing the value of situational stimuli based on current goals, context, and prior experiences with similar stimuli. The action stage includes generating responses adapted to the valuation. In this theoretical framework, the first PVA generates emotion, and the second PVA' s process of perceiving and evaluating the first PVA and generating behavior toward it constitutes emotion regulation. The three-level appraisal system (core, contextual, and conceptual) in the PVA cycle partially determines regulatory behavior output. In constantly changing life situations, individuals need to continuously update their appraisal systems to guide adaptive strategy behavior. Specifically, the use of cognitive reappraisal and distraction in high- versus low-negative situations involves evaluating one' s own cognitive capacity, physiological responses, and contextual information related to emotional stimuli (Beedie & Lane, 2012; Raio et al., 2013; Urry & Gross, 2010). Therefore, the study highlights the critical role of the appraisal system for situational features in emotion regulation flexibility.

## 4.2 Expansion of Strategy-Situation Matching Theory

This study enriches strategy-situation matching theory. Early research on strategy-situation matching focused primarily on the matching between emotion-focused strategies and problem-focused strategies with situational controllability (Cheng, 2001, 2003; Cheng et al., 2006). Specifically, cognitive reappraisal (an emotion-focused strategy) has higher adaptability in uncontrollable situations because emotion is the only thing that can be changed when the situation is uncontrollable and other actions cannot be taken. However,

when encountering relatively controllable situations, solving problems in the situation (problem-focused strategy) is more advantageous. Therefore, using cognitive reappraisal or problem-solving strategies according to situational controllability reflects higher emotion regulation flexibility (Cheng, 2001; Cheng et al., 2012). Subsequent research verified the positive relationship between emotion regulation flexibility and mental health by examining the matching between cognitive reappraisal ability/use and situational controllability (Haines et al., 2016; Troy et al., 2013). The present study, based on the process model of emotion regulation, demonstrates that matching between strategies from different regulation stages (distraction and cognitive reappraisal) and situational negativity can also characterize individual emotion regulation flexibility. Numerous behavioral studies have shown that situational negativity manipulated through picture stimuli influences individuals' choices between attentional disengagement (distraction) and cognitive reappraisal strategies (Levy-Gigi et al., 2016; Sheppes et al., 2011, 2014; Sheppes & Levin, 2013). In this study, we used negative events and negative emotions during the pandemic to characterize situational negativity, showing that situational negativity includes not only the valence of emotional information but also individuals' subjective responses to emotional information (Sheppes, 2020). Recent research has examined the influence of situational social properties (e.g., closeness to others) on strategy selection (English et al., 2017). Additionally, regulation goals and personality traits are important factors affecting individual emotion regulation processes (Eldesouky & English, 2019a, 2019b; Millgram et al., 2019). Therefore, future research should expand strategy-situation matching theory by examining the matching between strategies and different situational traits and other factors (e.g., regulation goals and personality traits) to explore the important role of emotion regulation flexibility behavior in physical and mental health.

## 4.3 Relationship Between Emotion Regulation Flexibility and Depression/Anxiety

Regarding the relationship between emotion regulation flexibility and depression/anxiety, our findings indicate that emotion regulation flexibility is adaptive. Lack of emotion regulation flexibility (e.g., single-strategy preferences and strategy-situation mismatch) leads college students to experience higher levels of depression and anxiety, potentially for several reasons: 1) Attentional biases lead to situational feature appraisal deviations: for example, depressed patients show attentional processing biases toward negative stimuli and difficulty disengaging (Beck & Bredemeier, 2016; Disner et al., 2011), while anxiety disorder patients show hypervigilance toward threat stimuli (Campbell-Sills et al., 2014). Appraisal errors and limitations regarding situational features greatly influence strategy selection guided by situational demands, forming single-strategy tendencies (e.g., depressed individuals tend to use rumination, while anxious individuals tend to use worry). 2) Habitual single-strategy use: Single-strategy tendencies and dominant processing make it difficult for individuals to retrieve dif-

ferent strategies for emotion regulation based on different situational demands. 3) Deficits in cognitive control resources may be an important factor contributing to negative emotion regulation flexibility deficits in anxiety and depression patients. Thus, emotion regulation inflexibility is likely one cause of emotion regulation deficits in depression and anxiety. These findings have clinical significance for the treatment and intervention of emotional disorders. Previous clinical interventions have focused on improving individuals' abilities to use cognitive reappraisal and distraction strategies. Our findings suggest that interventions should not only focus on improving strategy use ability but also train individuals to use situation-matched strategies in different contexts (Mennin, 2004, 2006; Wenzel, 2017). Specifically, intervention goals based on strategy-situation negativity matching aim to improve individuals' sensitivity to situational negativity while helping them understand differences in the effectiveness of cognitive reappraisal and distraction across different situational types, thereby learning to flexibly deploy regulation strategies according to situational demands. Additionally, expanding individuals' emotion regulation strategy repertoire provides a foundation for flexible strategy switching across situations, avoiding single, rigid strategy preferences.

## 4.4 Limitations and Future Directions

Despite its theoretical and practical significance, this study has several limitations. First, our conclusions are based on healthy college student samples, limiting the generalizability of the findings. Given that emotion regulation rigidity may be a primary manifestation of emotion regulation deficits in clinical mental disorders, future research should replicate these findings in clinical samples (e.g., depression, anxiety disorders) to clarify the important role of emotion regulation flexibility in emotional processing in mental disorders and as a potentially effective transdiagnostic method. Additionally, future research should examine differences in emotion regulation flexibility across other age groups (e.g., children, adolescents, and elderly) to explain developmental patterns of emotion regulation flexibility.

Second, this study only examined cognitive reappraisal and distraction strategies based on their costs and benefits in situations with different negativity levels; however, real-life situations are rich and complex with diverse feature attributes. Therefore, examining the matching between these two strategies and other situational features (e.g., situational controllability, social properties) will help provide a more comprehensive understanding of situations suitable for specific strategies and the role of strategy-situation matching theory in regulatory effectiveness in real life (Eldesouky & English, 2019a, 2019b).

Third, this study did not explore the psychological mechanisms of emotion regulation flexibility. Early component theories of emotion regulation flexibility emphasized interactions between different components but lacked an integrated research perspective (Bonanno & Burton, 2013). Recent research emphasizes emotion regulation decision-making behaviors, such as determining whether

emotion regulation is needed, selecting optimal strategies from available options, stopping ineffective strategies, and switching to effective strategies, which can provide in-depth exploration of the cognitive processes underlying emotion regulation flexibility (Sheppes, 2020). Moreover, some researchers propose examining the psychological mechanisms of emotion regulation flexibility at different stages from a cognitive control perspective. Specifically, when individuals realize regulation is unnecessary, they need to use inhibitory control. During the selection stage, individuals need to effectively switch between different strategies, involving switching and updating abilities in cognitive control. When aware that a regulation strategy is effective, individuals need to inhibit other strategies to maintain effective strategy use (Pruessner et al., 2020). Thus, cognitive control is crucial for understanding the dynamic cognitive processes of emotion regulation flexibility (Dreisbach & Fröber, 2019; Goschke & Bolte, 2014). To further improve the reliability and validity of data collected with this method, future research should include attention check questions and randomize the order of questionnaire items to ensure participants complete each test carefully, thereby improving data quality.

## 5 Conclusion

This study is the first to demonstrate that emotion regulation flexibility can significantly predict depression and anxiety in college students based on strategy use profiles and strategy-situation matching in daily life. Specifically: (1) College students with single-strategy preferences (e.g., rumination preference and expressive suppression preference, indicating low emotion regulation flexibility) experienced higher levels of depression and anxiety during negative life events and the pandemic compared to other strategy profile structures (e.g., average group, inactive group). (2) Based on the covariation between strategy use (cognitive reappraisal and distraction) and situational negativity (negative life events and COVID-19), emotion regulation flexibility levels in college students' daily lives can be effectively measured, and the prevalence of emotion regulation flexibility was demonstrated. (3) College students with high emotion regulation flexibility (using more distraction as situational negativity increased and more cognitive reappraisal as situational negativity decreased) experienced lower levels of depression and anxiety, indicating that emotion regulation flexibility has positive effects on college students' emotional health. These findings support strategy repertoire breadth and strategy-situation matching as important theoretical foundations in emotion regulation flexibility research and provide effective methods for measuring individual emotion regulation flexibility. Additionally, they deepen our understanding of emotion regulation deficits in clinical mental disorder patients and populations experiencing major collective traumatic events (e.g., pandemics, earthquakes).

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**Supplementary Materials**

## 1 Strategy Cross-Situational Variability Analysis Results

Strategy variability includes two indicators: between-strategy variability and within-strategy variability (Aldao et al., 2015). Between-strategy variability at the individual level can be calculated by averaging the standard deviations (SDs) of all strategy use intensities at each time point. Within-strategy variability at the individual level can be calculated by averaging the SDs of each strategy' s use across all time points. High between-strategy variability reflects the degree of strategy change across time and situations. High within-strategy variability reflects the degree of change in the same strategy' s use across different situations. Previous research based on four experience sampling samples verified the negative relationship between strategy variability (both between- and within-strategy) and individual negative emotion experiences, indicating that strategy variability can measure emotion regulation flexibility to some extent (Blanke et al., 2019). Using the same method, hierarchical regression results for Sample 1 showed that after controlling for age, gender, and average strategy use, Model 2 including between- and within-strategy variability explained 2.7% of the variance in the dependent variable (adjusted $R^2 = 0.027$, $F(2, 207) = 3.178$, $p = 0.009$). Only between-strategy variability significantly predicted depression ($\beta$ = -0.227, $p = 0.015$) and anxiety ($\beta$ = -0.346, $p < 0.001$). Hierarchical regression results for Sample 2 showed that after controlling for age, gender, and average strategy use, only between-strategy variability significantly predicted state anxiety ($\beta$ = -0.281, $p = 0.039$) but not depression ($\beta$ = -0.036, $p = 0.708$).

## 2 Latent Profile Analysis Model

All strategy use intensities from both samples were used for a series of exploratory latent profile analyses. Commonly used fit indices include AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion), LMRT (Lo-Mendell-Rubin likelihood ratio test), BLRT (Bootstrap likelihood ratio test), and Entropy. Generally, a model with higher entropy, lower AIC and BIC, and significant BLRT indicates good model fit (Celeux & Soromenho, 1996; Nylund et al., 2007; Schwarz, 2007). All class fit values are presented in Table 4.

**Table 1S** Model Fit Comparison

| Model | AIC | BIC | Entropy | prob_{min} | prob_{max} | BLRT_p |
|---|---|---|---|---|---|---|
| 1-Class | 4200.12 | 4250.34 | 1.00 | 1.00 | 1.00 | - |
| 2-Class | 3850.45 | 3930.78 | 0.91 | 0.85 | 0.95 | <0.001 |
| 3-Class | 3700.23 | 3810.67 | 0.88 | 0.78 | 0.92 | <0.001 |
| 4-Class | 3650.18 | 3790.73 | 0.86 | 0.72 | 0.90 | <0.001 |
| 5-Class | 3597.30 | 3751.48 | 0.84 | 0.68 | 0.88 | 0.009 |
| 6-Class | 3595.45 | 3770.67 | 0.85 | 0.65 | 0.87 | 0.056 |

**Figure 1S** Optimal Latent Profile Structures for Both Samples. *Note: x-axis shows different strategy types, y-axis shows standardized strategy use intensity.*

## 3.1 Multilevel Regression Model Preliminary Analysis

We used null models to estimate the means, standard deviations, and intraclass correlation coefficients (ICC) for the independent variable (situational negativity) and dependent variable (strategy use intensity) in the Level 1 models for both samples. In Sample 1, the mean strategy use intensity was 42.895 (SE = 1.209), with within-person and between-person SDs of 23.769 and 16.895, respectively. The ICC for strategy use intensity was 0.336, indicating that 33.6% of the total variance in strategy use intensity was between-person and 66.4% was within-person. The mean situational negativity (event negativity) was 40.99 (SE = 1.171), with within-person and between-person SDs of 22.459 and 16.409, respectively. The ICC for situational negativity was 0.348, indicating that 34.8% of the total variance was between-person and 65.2% was within-person.

In Sample 2, the mean strategy use intensity was 40.585 (SE = 2.377), with within-person and between-person SDs of 16.205 and 23.687, respectively. The ICC for strategy use intensity was 0.681, indicating that 68.1% of the total variance was between-person and 31.9% was within-person. The mean situational negativity (average negative emotion) was 11.861 (SE = 1.419), with within-person and between-person SDs of 6.018 and 14.171, respectively. The ICC for situational negativity was 0.847, indicating that 84.7% of the total variance was

between-person and 15.3% was within-person. All ICC values were greater than 0.059, indicating that multilevel modeling was appropriate.

## 3.2 Supplementary Multilevel Model Formulas

$$Strategy\ Use_{it} = \beta_{0i} + \beta_{1i} \times Situational\ Negativity_{ti} + r_{ti} \quad (1)$$

$$\beta_{0i} = \gamma_{00} + \gamma_{01}(Strategy\ Type_i) + \gamma_{02}(Depression\ or\ Anxiety\ Level) + \gamma_{03}(Gender) + \gamma_{04}(Age) + \gamma_{05}(Education\ L$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(Strategy\ Type_i) + \gamma_{12}(Depression\ or\ Anxiety\ Level) + \gamma_{13}(Gender) + \gamma_{14}(Age) + \gamma_{15}(Education\ L$$

## 3.3 Multilevel Model Results

**Table 2S** Fixed Effects Estimates from Multilevel Models Predicting Strategy Use from Depression Level, Strategy Type, and Situational Negativity (with Education Level Controlled)

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| | Estimate (SE) | 95% CI |
| Intercept | -0.654 (2.307) | [-5.197, 3.889] |
| Education Level | 1.333 (1.278) | [-1.183, 3.849] |
| Event Negativity | -2.447 (2.096) | [-6.573, 1.681] |
| Depression Level × Strategy Type | 0.121 (0.183) | [-0.238, 0.479] |
| Depression Level × Event Negativity | -5.673 (1.793) | [-9.187, -2.158] |
| Strategy Type × Event Negativity | 0.062 (0.028) | [0.008, 0.116] |

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| Depression × Strategy Type × Event Negativity | 0.521 (0.149) | [0.228, 0.814] |

**Table 3S** Fixed Effects Estimates from Multilevel Models Predicting Strategy Use from Anxiety Level, Strategy Type, and Situational Negativity (with Education Level Controlled)

| Predictor | Sample 1 (Event Negativity) | Sample 2 (Average Negative Emotion) |
|---|---|---|
| | Estimate (SE) | 95% CI |
| Intercept | -0.347 (2.308) | [-4.892, 4.197] |
| Education Level | 1.279 (1.283) | [-1.249, 3.805] |
| Event Negativity | -2.125 (2.119) | [-6.296, 2.049] |
| Anxiety Level × Strategy Type | 0.101 (0.187) | [-0.266, 0.468] |
| Anxiety Level × Event Negativity | -2.839 (1.569) | [-5.915, 0.236] |
| Strategy Type × Event Negativity | 0.068 (0.024) | [0.021, 0.115] |
| Anxiety × Strategy Type × Event Negativity | 0.279 (0.149) | [-0.014, 0.572] |

## 4.1 Sample 1 Experience Sampling Content

1. Please fill in your name and ID number.

2. Since the last test, please rate the degree to which you felt each of the following emotions (0-100; 0 = not at all negative, 100 = extremely negative): happy, nervous, ashamed, active, sad, inspired, lonely, focused, relaxed, alert, hostile, tired, determined, disappointed, angry, irritable, anxious, scared.
3. Since the last test, has anything negative happened?
    - Please briefly describe in one sentence.
    - Please rate the negativity of this event (0-100; 0 = not at all negative, 100 = extremely negative).
4. Please rate the degree to which you used 7 emotion regulation strategies (0-100; 0 = not used at all, 100 = used continuously):
    - Since the last test, I have distracted myself by doing or thinking about other things (distraction).
    - Since the last test, I have continuously or involuntarily thought about what happened or immersed myself in my emotions (rumination).
    - Since the last test, I have thought about or interpreted what happened from different angles (cognitive reappraisal).
    - Since the last test, I have accepted what happened or my feelings (acceptance).
    - Since the last test, I have suppressed my emotional expression (expressive suppression).
    - Since the last test, I have expressed my emotions through facial expressions, such as crying (emotional expression).
    - Since the last test, I have shared my emotions with others (social sharing).

## 4.2 Sample 2 Experience Sampling Content

1. Please fill in your name and ID number.
2. Since the last test, please rate the degree to which you felt each of the following emotions (0-100; 0 = not at all negative, 100 = extremely negative): proud, sad, active, nervous, ashamed, energetic, grateful, enthusiastic, scared, irritable, elated, annoyed, trembling, panicked, happy, excited, guilty.
3. Since the last test, how much time did you spend viewing pandemic-related information? (0-100; 0 = no searching at all, 100 = constantly searching).
    - Please rate the positivity/negativity of the pandemic-related information you saw (0-100; 0 = not at all negative, 100 = extremely negative).
4. Since the last test, have you interacted with others online through phone, QQ, WeChat, Weibo, etc.? (0-100; 0 = no interaction at all, 100 = constantly interacting).
    - What proportion of the interaction was about pandemic-related content? (0-100; 0 = no pandemic discussion at all, 100 = constantly discussing pandemic).
5. Since the last test, have you had face-to-face interactions with others?

(0-100; 0 = no interaction at all, 100 = constantly interacting).
    - What proportion of the interaction was about pandemic-related content? (0-100; 0 = no pandemic discussion at all, 100 = constantly discussing pandemic).
6. Since the last test, have you left your home, and how far did you go? Rating reference: didn' t leave, stayed at home (x = 0); left home, moved within the community or near home (0 < x < 50); left the community or went far from home (50 < x < 100).
7. Since the last test, have you attended online classes?
    - How engaged were you during online classes? (0-100; 0 = not engaged at all, 100 = very engaged).
8. Please rate the degree to which you used 8 emotion regulation strategies (0-100; 0 = not used at all, 100 = used continuously):
    - Since the last test, I have distracted myself by doing or thinking about other things (distraction).
    - Since the last test, I have continuously or involuntarily thought about what happened or immersed myself in my emotions (rumination).
    - Since the last test, I have thought about or interpreted what happened from different angles (cognitive reappraisal).
    - Since the last test, I have accepted what happened or my feelings (acceptance).
    - Since the last test, I have suppressed my emotional expression (expressive suppression).
    - Since the last test, I have expressed my emotions through facial expressions, such as crying (emotional expression).
    - Since the last test, I have shared my emotions with others (social sharing).
    - Since the last test, I have worked hard to solve the current problem or develop problem-solving plans (problem-solving).

*Note: Figure translations are in progress. See original paper for figures.*