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Tracking perceived stress, anxiety, and depression in daily life: a double-downward spiral process

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Introduction: Previous studies using retrospective questionnaires have suggested a complex relationship between perceived stress and related negative emotions and emphasized their importance in mental health. However, how daily perceived stress, anxiety, and depression interact dynamically in a natural context remains largely unexplored.

Methods: This study conducted a longitudinal survey that applied experience sampling methodology to data from 141 Chinese college students (58% women, mean age = 20.1 ± 1.63 years).

Results: The hierarchical linear models confirmed that daily perceived stress and negative emotions (i.e., perceived depression and anxiety) could reciprocally reinforce one another with the characteristic dynamics of a cognitive–emotional downward spiral. Additionally, anxiety and depression could further circularly aggravate each other imminently. These two intertwined downward-spiral processes constitute a double-downward-spiral model.

Discussion: The findings contribute to a better understanding of the interactive mechanisms underlying perceived stress and its related negative emotions in everyday life and highlight the significance of early emotion regulation and stress relief in healthy people.

KEYWORDS

perceived stress, anxiety, depression, experience sampling methodology (ESM), downward spiral model

Introduction

Negative emotions are a general dimension of subjective distress and unpleasurable activation that subsumes various aversive mood states (Watson et al., 1988). From an evolutionary psychology perspective, negative emotions have adaptive functions, such as helping people identify threats and dangers (Nesse, 1990). In contrast, from the mental health standpoint, negative emotions are more likely to cause a range of dysfunctional reactions and detrimental outcomes, such as impairment of an individual's thought–activity sequence and chronic burnout of social responsibilities, and predict various forms of psychopathology, particularly mood disorders (Fredrickson and Branigan, 2005; Lapid Pickman et al., 2021; Liu M. et al., 2021). Many studies have proposed that anxiety and perceived depression are the most damaging negative states of mind. They are prevalent in people's daily lives and lead to serious mental health problems over time without valid interventions (Ren et al., 2016; Monzonis-Carda et al., 2021; Casey et al., 2022).

However, the question remains how seemingly unavoidable negative emotions in daily life gradually deteriorate, resulting in emotional problems or obstacles for healthy individuals. Previous studies, mostly based on cross-sectional and cross-lag longitudinal

methodologies, have indicated that perceived stress, anxiety, and perceived depression are potential antecedents of mood disorders (Asmundson et al., 2020; García-Mieres et al., 2020; Armon et al., 2021), and show close associations with each other (Levine et al., 2019; Huang et al., 2021). However, studies have focused only on the effect of major stress events and serious negative emotions, and these variables have rarely been proposed in short-term longitudinal cycles as a potential risk for mood disorders in daily life. In reality, it is the neglected daily trifles that shape our long-term psychological states. For example, daily chores better predict stress-related health issues than major life events (Miller et al., 2008). The accumulation of negative reactions to minor stresses will likely cause health problems and psychological disorders (Miller et al., 2008; Johnsson et al., 2015). Therefore, it is necessary to explore the dynamic internal interaction, mediation, and moderation mechanisms between daily perceived stress and related perceived negative emotions (i.e., anxiety and depression) in a natural context. This study examined a double-downward-spiral process model of daily perceived stress, anxiety, and perceived depression to determine how minor stresses and negative emotions in everyday life gradually become serious and why they lead to mental health problems.

Perceived stress is an individual's cognitive assessment of the threat posed by stressors and their ability to cope with these threats (Liu Z. et al., 2021). In the process of coping with stressful events, individuals are prone to produce a series of negative emotions such as anxiety, depression, anger, and pain (Pereira-Morales et al., 2019; Huang et al., 2021; Clayborne et al., 2022). For example, Israeli et al. (2018) triggered participants' perceived stress through an impromptu speech task and found that induced stress promoted a more severe state of anxiety in participants. In addition, a recent experience sampling study also supported that perceived stress at a certain moment in daily life could positively predict imminent anxiety (Du and Xu, 2019). Anxiety can also play a role in perceived stress. Anxiety is often closely related to negative cognitive styles such as rumination (Brosschot et al., 2006), which leads to higher levels of physical and psychological arousal in individuals, causing them to become hyper-focused on future stressors, further exacerbating their subjective experience of stress (Yang and Liu, 2016).

Perceived stress is suggested to predict depression positively. The diathesis-stress theory proposes that specific life stress is essential for triggering depression (Monroe and Simons, 1991). Consistent with this theory, studies have also shown that perceived stress has a stable positive relationship with perceived depression, even in different time windows (Xu et al., 2018; Levine et al., 2019). Individuals in stressful situations may have different evaluation and coping styles to outside stimuli; therefore, they may adopt negative cognitive styles that could worsen depression (Rodríguez-Naranjo and Caño, 2016). However, persistent perceived depression can

lead to increased stress. According to the cognitive resource theory (Kahneman, 1973), processing depressed emotions might deplete or divert the resources needed to perform control functions. This diversion of resources leaves individuals with insufficient cognitive resources to cope with environmental events, leading them to perceive more stress (Padmala et al., 2011; Bui et al., 2021). A recent study supported the finding that depressed mothers raising children perceived more parenting stress than healthy mothers (Ma et al., 2019).

Moreover, it is well known that depression and anxiety are highly interdependent, meaning that individuals with high levels of depression (anxiety) tend to have severe anxiety (depression) (Chavira et al., 2004; González-Mesa et al., 2020). Despite the high co-occurrence of depression and anxiety, these disorders differ in nature. According to the tripartite model of anxiety and depression, anxiety is simply a high level of negative emotion, whereas depression combines low levels of positive emotion with high levels of negative emotion. Anxiety is associated with high physical arousal, whereas depression is not (Anderson and Hope, 2008). Thus, in addition to exploring the bidirectional cognitive-emotional facilitation relationship between perceived stress and negative emotions (anxiety and depression), we also examined whether there was mutual reinforcement between anxiety and depression as two distinct emotional states to provide an explanation for their co-occurrence (Kuppens and Verduyn, 2017).

Emotions are not self-generated but are caused by changes in the internal or external (usually social) environment (Kuppens and Verduyn, 2017). Because of constant changes in individuals' internal and external environments, temporary emotions fluctuate dynamically. Perceived stress is another dynamic variable that can easily change with time, the environment, and other factors (Henderson et al., 2016; Ekuni et al., 2022). However, most previous horizontal and vertical studies have tended to treat stress and negative emotions as relatively "stable" states. Retrospective questionnaires have been widely used to measure stress, anxiety, and depression. However, this approach might have a "memory-experience bias" and fail to sensitively capture the dynamic changes of these variables in daily life because perceived stress and emotions can be situational (Ellison et al., 2020). Therefore, previous results have mostly been based on observations over relatively long periods in different groups. How do individuals' perceived stress, depression, and anxiety change dynamically and affect each other? This question has not yet been answered well. To answer it, we needed to use a dynamic assessment method to conduct intensive tracking measurements of perceived stress, perceived depression, and anxiety in daily life.

The experience sampling method (ESM) repeatedly collects and records individuals' instantaneous assessments of daily life in a short period and has been validated by numerous studies (Francis et al., 2021; Parsons and Young, 2022). It can be used effectively to study the trajectory of individual variables over time and context and their related influencing factors. For example, Du et al. (2019) administered five surveys to 100 university students every day for a single week to collect real-time data on their mindful state and positive emotions at each time point. They found that a mindful state and positive emotions could reciprocally enhance each other in a dynamic upward spiral. Compared with

TABLE 1 Descriptive statistics: means, standard deviations, and ICCs.

| Variables | N | Mean | SD | ICC(1) | ICC(2) |
|---|------|-------|-------|--------|--------|
| Daily perceived stress _(t + 2) | 4015 | 37.64 | 25.07 | 0.685 | 0.984 |
| Depression _(t + 2) | 4015 | 15.27 | 21.96 | 0.606 | 0.977 |
| Anxiety _(t + 2) | 4015 | 32.78 | 28.08 | 0.566 | 0.973 |

process as a “downward-spiral process of negative emotion.” The downward spiral of stress sensitization theory provides initial evidence to support this process. It has been proposed that daily stressors might not evoke a significant mood episode but instead progressively and covertly lower affective thresholds, leading people to become more sensitive to stress and prone to negative emotions and full-blown episodes of perceived stress and depressive symptoms (Post, 2007). In addition, a previous cross-lag study investigated the downward-spiral model between perceived stress and depressive symptoms. Levine et al. (2019) tested 658 first-year students using stress, depressive, and perfectionism questionnaires four times every 2–3 months. The results showed that freshmen experienced increased stress and depressive symptoms that contributed to each other longitudinally in a circular and additive manner; this was moderated by self-critical perfectionism (Levine et al., 2019). However, few studies have used a more sensitive and realistic method, such as ESM, to explore the interaction effect model of perceived stress, anxiety, and depression in healthy people’s daily lives. Therefore, we constructed and examined a double-downward-spiral model with two parts: (1) a cognitive–emotional downward-spiral process of perceived stress and negative emotions (anxiety and depression) and (2) an emotional–emotional downward-spiral process of anxiety and perceived depression.

This study aimed to provide evidence of the dynamic reciprocal or mediating link between perceived stress, anxiety, and depression in normal daily life. We conducted ESM study to provide new insights into the dynamically perceived stress, anxiety, and depression experienced by individuals over time in diverse everyday contexts. Our hypotheses were as follows:

H1: Perceived stress at time $t + 1$ mediates the positive prediction of negative emotions (i.e., anxiety and depression) at time t on negative emotions (i.e., anxiety and depression) at time $t + 2$, and, in turn, negative emotions (i.e., anxiety and depression) at time $t + 1$ mediate between perceived stress at time t and time $t + 2$. This is an examination of the cognitive–emotional downward-spiral model.

H2: Anxiety at time t predicts higher anxiety at time $t + 2$ through more perceived depression at time $t + 1$ and vice versa, and perceived depression at time t predicts perceived depression at time $t + 2$ through more anxiety at time $t + 1$. This is an examination of the emotion–emotion downward-spiral model.

Figures 1A, B illustrate the theoretical double-downward-spiral model.

TABLE 3 Step 2 in mediating analysis of Anxiety_t, DPS_{t+1}, and Anxiety_{t+2} and mediating analysis of Depression_t, DPS_{t+1}, and Depression_{t+2}.

| Step 2. Independent variable | DPS _{t+1} (Mediating variable) | | |
|------------------------------|---|-------|--------|
| | B | SE | p |
| Anxiety _t | 0.229 | 0.026 | <0.001 |
| Depression _t | 0.168 | 0.033 | <0.001 |

Materials and methods

Participants and procedures

We recruited all the study participants through social media (WeChat and QQ, two popular communication platforms in China) and posters at a Chinese university. The initial sample consisted of 172 participants, but we excluded 31 participants with completion rates below 75%. The final sample comprised 141 students (58% women and 42% men) with a mean age of 20.1 years ($SD = 1.63$) (except for five participants for whom demographic information was unavailable).

First, we invited all the participants to join a group on the social networking platform WeChat, informing them of the research details and securing written informed consent. Over the next 12 consecutive days (19–30 October 2020), they had to complete a brief questionnaire three times daily (at 9:30, 15:30, and 22:30), assessing their perceived stress, subjective depression, and anxiety levels. Thus, each participant completed 36 questionnaires. According to Bolger et al.’s (2012) power simulations curve, power is improved more by increasing sample size than time points, and a power of 80% can be achieved with under 120 samples while keeping the time points to nine. Our study’s sample size was 141, and the number of time points was 36. Therefore, our study’s power was suitable.

The participants accessed the questionnaire each time by responding to a web link we sent to their cell phones via WeChat. We asked all the participants to allow new message notifications from WeChat and to complete the questionnaire within one hour of receiving the link. We offered each participant RMB2–3 (about US\$ 0.30–0.45) per completed questionnaire. The university’s ethics committee approved this study, and all participants declared they had no history of mental disorders.

Measures

Daily perceived stress (DPS)

Following previous experience sampling studies (Xu et al., 2018), we used three items to measure perceived stress, all derived from the Perceived Stress Scale (Cohen et al., 1983): (1) feeling unable to control important things in one’s life; (2) feeling nervous and stressed; and (3) constantly thinking that things must be done by oneself. The rating score ranged from 0 (not at all) to 100 (extremely). The higher the mean score for these three items, the greater the perceived stress. The Cronbach’s alpha for the study sample was 0.83.

Perceived depression and anxiety

Many previous studies have used dynamic assessment methods to test emotions, primarily through single self-scripted items whose effectiveness has been verified (Xu et al., 2018; Pawluk et al., 2021). We used a single self-administered questionnaire to measure negative emotions (i.e., perceived anxiety and depression). Referring to a previous study (Xu et al., 2018), we used the specifically compiled item “Are you anxious at this moment” to measure perceived anxiety and the item “Are you depressed at the moment” to measure perceived

TABLE 4 Step 1 and Step 3 in mediating analysis of DPS_t , $Anxiety_{t+1}$, and DPS_{t+2} and mediating analysis of DPS_t , $Depression_{t+1}$, and DPS_{t+2} .

| Dependent variable | Step 1. Independent variable | | | Step 3. Independent variable and mediating variable | | | | | | | | | | | |
|--------------------|------------------------------|-----------|----------|---|-----------|----------|-----------------|-----------|----------|--|-----------|----------|--------------------|-----------|----------|
| | DPS_t | | | $DPS_t \rightarrow Anxiety_{t+1} \rightarrow DPS_{t+2}$ | | | | | | $DPS_t \rightarrow Depression_{t+1} \rightarrow DPS_{t+2}$ | | | | | |
| | | | | DPS_t | | | $Anxiety_{t+1}$ | | | DPS_t | | | $Depression_{t+1}$ | | |
| | <i>B</i> | <i>SE</i> | <i>p</i> | <i>B</i> | <i>SE</i> | <i>p</i> | <i>B</i> | <i>SE</i> | <i>p</i> | <i>B</i> | <i>SE</i> | <i>p</i> | <i>B</i> | <i>SE</i> | <i>p</i> |
| DPS_{t+2} | 0.255 | 0.030 | <0.001 | 0.203 | 0.024 | <0.001 | 0.174 | 0.022 | <0.001 | 0.240 | 0.028 | <0.001 | 0.135 | 0.027 | <0.001 |

depression. The rating score ranged from 0 (not at all) to 100 (extremely), with higher scores indicating more severe anxiety or depression. We also used the hierarchical linear model (HLM 7.0) to analyze the reliability estimates for anxiety and perceived depression. The reliability estimates for anxiety and perceived depression were 0.970 and 0.975, respectively.

Analysis using hierarchical linear models

Because we needed to examine both the relationships within individuals and between individuals, we used HLM7.0 to construct a 1-1-1 mediated hierarchical linear model since all variables in the model were measured at Level 1 (within individuals). Following Du and Xu (2019), we tested the mediation process via CWC(M) (centered within the context of the reintroduction of the subtracted means at Level 2) (Zhang et al., 2009) following these analysis steps:

Step 1. We established an equation between the independent variable (negative emotions at t) and the dependent variable (negative emotions at $t + 2$) in Level 1. We calculated the average stress measured by each participant over 12 days and added that to Level 2 to create Model 1:

MODEL 1

Level 1:

$$Neg_{(t+2)i} = \pi_{0i} + \pi_{1i} * (Neg_{ti}) + e_{ti}$$

Level 2:

$$\pi_{0i} = b_{00} + b_{01} * (M_{i_Neg}) + u_{0i}$$

$$\pi_{1i} = b_{10}$$

where t represents the moment, and i represents the individual. $Neg_{(t+2)i}$ represents the negative emotions of the i th participant at $t + 2$ and $Neg_{(t)i}$ represents the perceived stress of the i th participant at t . M_{i_Neg} is the average of all negative emotions measured by the i th participant, which represents the total negative emotions of the participant. The intercept π_{0i} represents the mean value of negative emotions measured by the i th participant. e_{ti} denotes the residual. b_{10} represents the predictive degree of negative emotions at t to negative emotions at $t + 2$ and b_{01} represents the predictive effect of overall negative emotions on negative emotions at $t + 2$.

Step 2. We established the relationship between the independent variable (negative emotions at t) and mediating variable (daily perceived stress at $t + 1$) at Level 1. Then, the negative emotions of each individual are averaged and put into Level 2 in the equation, as follows:

MODEL 2

Level 1:

$$DPS_{(t+1)i} = \pi_{0i} + \pi_{1i} * (Neg_{ti}) + e_{ti}$$

Level 2:

$$\pi_{0i} = b_{00} + b_{01} * (M_{i_Neg}) + u_{0i}$$

$$\pi_{1i} = b_{10}$$

Similar to the first equation, $DPS_{(t+1)i}$ represents the i th participants' daily perceived stress at $t + 1$. In this model, b_{10} represents the prediction degree of negative emotions at one moment to daily perceived stress at the next moment, and b_{01} represents the predictive effect of overall negative emotions on daily perceived stress at $t + 1$.

Step 3. We tested the relationship between the independent variable (negative emotions at t), mediating variable (daily perceived stress at $t + 1$), and dependent variable (negative emotions at $t + 2$) at Level 1. The means of the independent variable (negative emotions at t) and mediating variable (daily perceived stress at $t + 1$) for each participant were calculated and placed in Level 2, as seen in Model 3.

MODEL 3

Level 1:

$$Neg_{(t+2)i} = \pi_{0i} + \pi_{1i} * (DPS_{(t+1)i}) + \pi_{2i} * (Neg_{ti}) + e_{ti}$$

Level 2:

$$\pi_{0i} = b_{00} + b_{01} * (M_{i_DPS}) + b_{02} * (M_{i_Neg}) + u_{0i}$$

$$\pi_{1i} = b_{10}$$

$$\pi_{2i} = b_{20}$$

Many of the symbols in this equation are similar to those above. M_{i_DPS} , which has not appeared before, represents all participants' overall daily perceived stress. In this equation, b_{10} and b_{20} represent the predictive effect of negative emotions at t and daily perceived stress at $t + 1$ on negative emotions at $t + 2$, respectively, and b_{01} and b_{02} represent the extent to which overall negative emotions and daily perceived stress could predict negative emotions at $t + 2$.

Using the same procedure described above, we analyzed the mediation model among daily perceived stress at t (the independent variable), negative emotions at $t + 1$ (the mediating variables), and daily perceived stress at $t + 2$ (the dependent variable). As above, we analyzed the mediation effect among anxiety at t (the independent variable), perceived depression at $t + 1$ (the mediating variable), and anxiety at $t + 2$ (the dependent variable). Then, we examined the mediating role of anxiety at $t + 1$ in the dynamic association between perceived depression at t and perceived depression at $t + 2$.

Results

We excluded 31 participants with completion rates below 75%, leaving us with 4,015 valid responses from 141 participants (>75% completion) for analysis. The excluded participants' stress and anxiety assessments did not differ significantly from those of the included participants ($t_{stress} = -0.640, p = 0.523; t_{anxiety} = -0.292, p = 0.771$); however, their perceived depression levels were significantly higher than those of the included participants ($t_{depression} = 2.411, p = 0.017$).

Each included participant responded 28.48 times on average. We deleted missing data at Level 1 when making an MDM file in HLM 7.0. We used the Level 1 data to examine the temporal association among the variables. **Table 1** shows the primary variables, including means, standard deviations, and intraclass correlation coefficients (ICCs). ICC (1) is the ratio of between-group variance to the total variance, and ICC (2) is the group mean reliability (Castro, 2002). The null models showed that the ICC (1) values of daily perceived stress, depression, and anxiety were 0.685, 0.606, and 0.566, respectively, indicating that 68.5, 60.6, and 56.6% of the variances were due to inter-individual factors, and 31.5, 39.4, and 43.4% were due to intra-individual factors. The ICC (2) values were all greater than 0.70, indicating that the multilayer linear model was appropriate for this study (LeBreton and Senter, 2008).

Cognitive–emotional downward-spiral model

This study explored the interconnections between perceived stress, anxiety, and depression in healthy individuals' everyday lives. Therefore, we first examined the relationships within and between individuals with perceived stress and negative emotions (perceived anxiety and depression).

In the mediating model of negative emotions at t , daily perceived stress at $t + 1$, and negative emotions at $t + 2$ (results shown in **Tables 2, 3**), we found that a higher level of participants' negative emotions at t predicted more negative emotions at $t + 2$ ($b_{10}(Anxiety(t) \rightarrow Anxiety(t + 2)) = 0.146, SE = 0.037, p < 0.001$; $b_{10}(Depression(t) \rightarrow Depression(t + 2)) = 0.121, SE = 0.034, p < 0.001$). Similarly, Level 1 results showed that negative emotions at t were significantly positively correlated with daily perceived stress at $t + 1$ ($b_{10}(Anxiety(t) \rightarrow DPS(t + 1)) = 0.229, SE = 0.026, p < 0.001$; $b_{10}(Depression(t) \rightarrow DPS(t + 1)) = 0.168, SE = 0.033, p < 0.001$). Moreover, this mediating model revealed that daily perceived stress at $t + 1$ played a remarkable mediating role in the association between negative emotions at t and $t + 2$ ($b_{10}(DPS(t + 1) \rightarrow Anxiety(t$

$+ 2)) = 0.260, SE = 0.036, p < 0.001$; $b_{10}(DPS(t + 1) \rightarrow Depression(t + 2)) = 0.072, SE = 0.028, p < 0.05$).

We also examined the mediating model of daily perceived stress at t , negative emotions at $t + 1$, and perceived stress at $t + 2$ (results shown in **Tables 4, 5**). The model indicated that participants' daily perceived stress at t could predict higher perceived stress at $t + 2$ ($b_{10}(DPS(t) \rightarrow DPS(t + 2)) = 0.255, SE = 0.030, p < 0.001$). Our results furtherly demonstrated that daily perceived stress at t was positively associated with negative emotions at $t + 1$ ($b_{10}(DPS(t) \rightarrow Anxiety(t + 1)) = 0.298, SE = 0.043, p < 0.001$; $b_{10}(DPS(t) \rightarrow Depression(t + 1)) = 0.108, SE = 0.028, p < 0.001$). We also found negative emotions at $t + 1$ were remarkably positively related to daily perceived stress at $t + 2$ after controlling for daily perceived stress at t ($b_{10}(Anxiety(t + 1) \rightarrow DPS(t + 2)) = 0.255, SE = 0.030, p < 0.001$; $b_{10}(Depression(t + 1) \rightarrow DPS(t + 2)) = 0.255, SE = 0.030, p < 0.001$). Notably, the dynamic relationship between daily perceived stress at t and $t + 2$ was also significantly mediated by perceived depression and anxiety at $t + 1$.

Emotional–emotional downward-spiral model

We also explored the dynamic relationship and influence of the trajectory between perceived anxiety and depression. The results showed that perceived depression at $t + 1$ was an effective mediator for the dynamic relationship between anxiety at t and anxiety at $t + 2$ ($b_{10}(Anxiety(t) \rightarrow Depression(t + 1)) = 0.102, SE = 0.021$; $b_{10}(Depression(t + 1) \rightarrow Anxiety(t + 2)) = 0.118, SE = 0.031; ps < 0.001$). However, the results also showed that anxiety at $t + 1$ played a remarkable mediating role in the dynamic relationship between perceived depression at t and perceived depression at $t + 2$ ($b_{10}(Depression(t) \rightarrow Anxiety(t + 1)) = 0.155, SE = 0.037; b_{10}(Anxiety(t + 1) \rightarrow Depression(t + 2)) = 0.080, SE = 0.012; ps < 0.001$). **Tables 6, 7** present the results.

Discussion

This research aimed to determine how natural stresses and negative emotions (i.e., anxiety and perceived depression) dynamically interact in everyday life and why they can gradually become severe and lead to mental health problems. Therefore, we examined a double-downward-spiral process model of daily perceived stress, anxiety, and depression using an ESM approach. Consistent with our initial hypothesis, the results showed that perceived anxiety or depression at t predicted a higher level of perceived stress at $t + 1$, whereas perceived stress at $t + 1$ predicted more severe perceived anxiety or depression at $t + 2$. These results suggest that each time participants perceived more anxiety and depression, they perceived higher stress at the next moment and then experienced still more perceived anxiety and depression. In other words, the hysteretic positive prediction of the same negative emotion was dynamically mediated by perceived stress. Additionally, perceived stress at t predicted a higher level of perceived stress at $t + 2$ via an increase in perceived anxiety or depression at $t + 1$. These findings suggest that daily perceived stress and negative emotions (i.e., anxiety and perceived depression) could mutually and reciprocally reinforce one another with the characteristic dynamics of a cognitive–emotional downward spiral

TABLE 5 Step 2 in mediating analysis of DPS_t , $Anxiety_{t+1}$, and DPS_{t+2} and mediating analysis of DPS_t , $Depression_{t+1}$, and DPS_{t+2} .

| Step 2. Independent variable | Mediating variable | | | | | |
|------------------------------------|--------------------|-----------|----------|--------------------|-----------|----------|
| | $Anxiety_{t+1}$ | | | $Depression_{t+1}$ | | |
| | <i>B</i> | <i>SE</i> | <i>p</i> | <i>B</i> | <i>SE</i> | <i>p</i> |
| DPS_t | 0.298 | 0.043 | <0.001 | 0.108 | 0.028 | <0.001 |

TABLE 6 Step 1 and Step 3 in mediating analysis of Depression_t, Anxiety_{t + 1}, and Depression_{t + 2} are outside the parentheses; mediating analysis of Anxiety_t, Depression_{t + 1}, and Anxiety_{t + 2} are inside the parentheses.

| Dependent Variable | Step 1. Independent variable | | | Step 3. Independent variable and mediating variable | | | | | |
|---|---|--------------|----------------|---|--------------|---------------|---|--------------|----------------|
| | Depression _t (Anxiety _t) | | | Depression _t (Anxiety _t) | | | Anxiety _{t + 1} (Depression _{t + 1}) | | |
| | B | SE | p | B | SE | p | B | SE | p |
| Depression _{t + 2} (Anxiety _{t + 2}) | 0.121(0.146) | 0.034(0.037) | <0.001(<0.001) | 0.109(0.134) | 0.015(0.034) | <0.01(<0.001) | 0.080(0.118) | 0.012(0.031) | <0.001(<0.001) |

(Hypothesis 1) in healthy individuals’ daily lives. People perceive stress and negative emotions every day; these emotions reinforce each other and become increasingly negative if they do not regulate or handle them properly.

The results also supported the emotional–emotional downward-spiral model of Hypothesis 2 between perceived anxiety and depression. That is, perceived anxiety at this moment would lead to more severe depression in the next moment, and then more severe depression would cause more anxiety in a lagging moment; subsequently, the expanded anxiety would further promote later perceived depression. These two intertwined downward-spiral processes constitute a double-downward-spiral model. Our results corroborated and extended the findings of many previous studies on the association between perceived stress, anxiety, and depression.

In the cognitive–emotional downward-spiral process, perceived stress and negative emotions appeared to be reciprocally strengthened. This finding aligned with the cognitive model of depression. Beck (2008) comprehensively reviewed the psychological and biological correlates of depression and deemed that stress can trigger depression and is probably mediated by cognitive distortions. From the perspective of cognitive resource allocation, daily perceived stress might encourage individuals to be highly alert and induce negative emotions (Bulley et al., 2017). Negative emotions might also largely occupy attentional resources and prevent individuals from focusing on information more conducive to solving problems, resulting in more passive and fixed thinking (Meinhardt and Pekrun, 2003). Negative emotions associated with threats might induce rumination (Curci et al., 2013), which can impair the analytical thinking and executive control needed to cope with stressful life events and lead to inefficient processing and increased self-criticism as individuals further perceive the stress of unresolved life events (Bernstein et al., 2017; Zuroff et al., 2021). This cognitive–emotional downward-spiral process is essential in understanding cognitive–emotional

interactions in theory (Simpson et al., 2001). Symptomatology does not occur in isolation; examining how stress and negative emotions influence each other helps us understand the effect of these variables on mental health and how poor mental health outcomes could be sustained over time. In practice, these results imply that an effective way to prevent mental problems would be to interrupt the downward spiral of perceived stress and negative emotions (anxiety and depression) in daily life.

Our results also demonstrated an emotional–emotional downward spiral of perceived anxiety and depression in everyday contexts. More anxiety might expose individuals to more depression later; in turn, individuals who experience more depression might be more anxious at the next moment. Empirical research supports our results. For instance, studies have found that anxious individuals tend to experience persistent negative rumination (Modini et al., 2018), which leads to fatigue (Querstreet and Cropley, 2012). Fatigued individuals exhibit more depressive symptoms than those who are not fatigued (Corfield et al., 2016). Studies have also suggested that individuals with depression have lower self-efficacy and are more likely to perceive anxiety when facing external events (Dai and Feng, 2008; Sharma and Kumra, 2022). This finding provides further insight into understanding and extending the self-predictive emotion system enabling individuals to respond directly to their emotions rather than uncontrolled ongoing events (Kuppens and Verduyn, 2015).

Prior studies on the relationship between stress, anxiety, and depression have mostly focused on participants who met those clinical diagnostic criteria (Price et al., 2019; Tolin et al., 2021; Truchot et al., 2021). However, daily prevention is more practical and effective than treatment alone. Addressing the dynamic processes of emotions and their regulation in healthy people has great value (Kuppens and Verduyn, 2015). The current study found that the interconnection of perceived stress, anxiety, and depression among typical college students followed a dynamic downward spiral that increased their perceived stress, anxiety, and depression over time. College students daily stressors include academic performance, interpersonal relationships, life adjustment, and employment (Li and Mei, 2002). Without effective regulation of the stress triggered by these daily pressures, long-term maintenance and accumulation of perceived stress and induced negative emotions can synergistically lead to serious mood disorders (Kong et al., 2021). Therefore, action is necessary to interrupt the downward spiral and mitigate the deterioration of negative cognitions and emotions to prevent mood disorders. In clinical practice, interventions for established mood disorders require more therapeutic resources and time than interventions for negative cognition and emotions in daily life. Therefore, daily interventions

TABLE 7 Step 2 in mediating analysis of Depression_t, Anxiety_{t + 1}, and Depression_{t + 2} are outside the parentheses; mediating analysis of Anxiety_t, Depression_{t + 1} and Anxiety_{t + 2} are inside the parentheses.

| Step 2. Independent variable | Mediating variable | | |
|---|---|---------------|-----------------|
| | Anxiety _{t + 1} (Depression _{t + 1}) | | |
| | B | SE | p |
| Depression _t (Anxiety _t) | 0.155 (0.102) | 0.037 (0.021) | <0.001 (<0.001) |

are of practical importance for maintaining emotional health as a low-cost, high-yield way to prevent psychological problems (Beames et al., 2021).

Although this study produced some innovative results, it had some limitations. First, emotions include three dimensions: physiological arousal, subjective experience, and behavioral responses (Kuppens and Verduyn, 2017). However, we only examined the subjective experience of emotions and not physiological arousal or behavior. Future studies should use all three dimensions to comprehensively and dynamically assess daily stress and negative emotions. Second, our results were based on a sample of college students in China; thus, they should be applied cautiously to other populations. Third, we did not consider specific natural factors that might confuse the double-downward-spiral processes. Future studies should consider more contextual mediating or moderating factors, such as positive emotions, which might have a potential buffering effect on this downward-spiral process. Also, the dropout participants showed higher perceived depression than the participants who completed more than 75% of the tests, implying that the depressive mood affected their daily life behavior and highlighting the need for more research considering the dynamic negative emotions of daily life.

In conclusion, this study provides further insight into the dynamic interaction between perceived stress, anxiety, and depression in an everyday context through an ESM investigation. We found that daily perceived stress and negative emotions (i.e., perceived anxiety and depression) could reinforce one another over time in a cognitive–emotional downward spiral; also, perceived anxiety and depression could also affect each other over time by activating an emotional–emotional downward spiral. These results imply a double-downward-spiral process model to better understand the reciprocal relationship of daily perceived stress, anxiety, and perceived depression in a natural context. Our findings highlight the value of timely regulation and intervention of subtle stress and negative emotions in daily life and extend the results of previous work on the associations between stress and negative emotions.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of Southwest Jiaotong

University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

GF involved in the conceptualization of the study, writing, revising, and editing the manuscript, and the supervision of the project. XX involved in collecting the data, writing the manuscript, and data analyses. JL involved in collecting the data and reviewing the manuscript. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

- Anderson, E., and Hope, D. (2008). A review of the tripartite model for understanding the link between anxiety and depression in youth. *Clin. Psychol. Rev.* 28, 275–287. doi: 10.1016/j.cpr.2007.05.004
- Armon, D. B., Fine, N. B., Seligman, Z., Ginzburg, K., and Ben-Zion, Z. (2021). COVID-19 epidemic-induced changes in mood and anxiety mediate the relationship between resilience and symptoms of depression and generalized anxiety in sexual assault survivors. *J. Affect. Disord. Rep.* 6:100252. doi: 10.1016/j.jadr.2021.10.0252
- Asmundson, G. J. G., Paluszek, M. M., Landry, C. A., Rachor, G. S., McKay, D., and Taylor, S. (2020). Do pre-existing anxiety-related and mood disorders differentially

- impact COVID-19 stress responses and coping? *J. Anxiety Disord.* 74:102271. doi: 10.1016/j.janxdis.2020.102271
- Beames, J. R., Kikas, K., and Werner-Seidler, A. (2021). Prevention and early intervention of depression in young people: an integrated narrative review of affective awareness and ecological momentary assessment. *BMC Psychol.* 9:113. doi: 10.1186/s40359-021-00614-6
- Beck, A. T. (2008). The evolution of the cognitive model of depression and its neurobiological correlates. *Am. J. Psychiatry* 165, 969–977. doi: 10.1176/appi.ajp.2008.08050721
- Bernstein, E. E., Heeren, A., and McNally, R. J. (2017). Unpacking rumination and executive control: a network perspective. *Clin. Psychol. Sci.* 5, 816–826. doi: 10.1177/2167702617702717
- Bolger, N., Stadler, G., and Laurenceau, J.-P. (2012). “Power analysis for intensive longitudinal studies” in *Handbook of Research Methods for Studying Daily Life*, eds M. R. Mehl and T. S. Conner (New York, NY: Guilford Press), 285–301.
- Brosschot, J. F., Gerin, W., and Thayer, J. F. (2006). The perseverative cognition hypothesis: a review of worry, prolonged stress-related physiological activation, and health. *J. Psychosom. Res.* 60, 113–124. doi: 10.1016/j.jpsychores.2005.06.074
- Bui, T. H. T., Nguyen, T. N. T., Pham, H. D., Tran, C. T., and Ha, T. H. (2021). The mediating role of self-compassion between proactive coping and perceived stress among students. *Sci. Prog.* 104:003685042110118. doi: 10.1177/00368504211011872
- Bulley, A., Henry, J. D., and Suddendorf, T. (2017). Thinking about threats: memory and prospection in human threat management. *Conscious. Cogn.* 49, 53–69. doi: 10.1016/j.concog.2017.01.005
- Casey, S. M., Varela, A., Marriott, J. P., Coleman, C. M., and Harlow, B. L. (2022). The influence of diagnosed mental health conditions and symptoms of depression and/or anxiety on suicide ideation, plan, and attempt among college students: findings from the healthy minds study, 2018–2019. *J. Affect. Disord.* 298, 464–471. s
- Castro, S. L. (2002). Data analytic methods for the analysis of multilevel questions: a comparison of intraclass correlation coefficients, $r_{wg(j)}$, hierarchical linear modeling, within- and between-analysis, and random group resampling. *Leadersh. Quart.* 25, 69–93. doi: 10.1016/S1048-9843(01)00105-9
- Chavira, D. A., Stein, M. B., Bailey, K., and Stein, M. T. (2004). Comorbidity of generalized social anxiety disorder and depression in a pediatric primary care sample. *J. Affect. Disord.* 80, 163–171. doi: 10.1016/S0165-0327(03)00103-4
- Clayborne, Z. M., Colman, I., Kingsbury, M., Torvik, F. A., Gustavson, K., and Nilsen, W. (2022). Prenatal work stress is associated with prenatal and postnatal depression and anxiety: findings from the Norwegian mother, father and child cohort study (MoBa). *J. Affect. Disord.* 298, 548–554. doi: 10.1016/j.jad.2021.11.024
- Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *J. Health Soc. Behav.* 24, 385–396. doi: 10.2307/2136404
- Corfield, E. C., Martin, N. G., and Nyholt, D. R. (2016). Co-occurrence and symptomatology of fatigue and depression. *Compr. Psychiatry* 71, 1–10. doi: 10.1016/j.comppsy.2016.08.004
- Curci, A., Lanciano, T., Soletti, E., and Rimé, B. (2013). Negative emotional experiences arouse rumination and affect working memory capacity. *Emotion* 13, 867–880. doi: 10.1037/a0032492
- Dai, Q., and Feng, Z. Z. (2008). Research of relationship between depression and self-esteem, self-efficacy. *Chin. J. Clin. Psychol.* 16, 283–285.
- Du, J., An, Y., Ding, X., Zhang, Q., and Xu, W. (2019). State mindfulness and positive emotions in daily life: an upward spiral process. *Pers. Individual Differ.* 141, 57–61. doi: 10.1016/j.paid.2018.11.037
- Du, J., and Xu, W. (2019). Impact of daily stress on negative emotions: the mediating role of mind wandering. *Chin. J. Clin. Psychol.* 27, 772–776.
- Ekuni, R., Souza, B. M. N., Cogo-Moreira, H., Lourenço, F. C., and Pompeia, S. (2022). Bidirectional longitudinal dynamics of self-reported total sleep time and perceived stress: establishing potential causal relationships. *Sleep Health* 8, 406–409. doi: 10.1016/j.sleh.2022.01.004
- Ellison, W. D., Trahan, A. C., Pinzon, J. C., Gillespie, M. E., Simmons, L. M., and King, K. Y. (2020). For whom, and for what, is experience sampling more accurate than retrospective report? *Pers. Individ. Differ.* 163:110071. doi: 10.1016/j.paid.2020.110071
- Francis, Z., Depow, G., and Inzlicht, M. (2021). Do early birds share their worms? how prosocial behaviour and empathy vary across the day. *J. Res. Pers.* 90:104055. doi: 10.1016/j.jrp.2020.104055
- Fredrickson, B. L., and Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cogn. Emot.* 19, 313–332. doi: 10.1080/02699930441000238
- García-Mieres, H., Montesano, A., Villaplana, A., Trujillo, A., Salla, M., Paz, C., et al. (2020). Common and differential dimensions of personal identity between psychosis and depression: the relevance of gender and depressive mood. *J. Psychiatric Res.* 127, 48–56. doi: 10.1016/j.jpsychores.2020.05.015
- González-Mesa, E., Kabukcuoglu, K., Blasco, M., Körükcü, O., Ibrahim, N., González-Cazorla, A., et al. (2020). Comorbid anxiety and depression (CAD) at early stages of the pregnancy: a multicultural cross-sectional study. *J. Affect. Disord.* 270, 85–89. doi: 10.1016/j.jad.2020.03.086
- Henderson, H., Child, S., Moore, S., Moore, J. B., and Kaczynski, A. T. (2016). The influence of neighborhood aesthetics, safety, and social cohesion on perceived stress in disadvantaged communities. *Am. J. Commun. Psychol.* 58, 80–88. doi: 10.1002/ajcp.12081
- Huang, C., Xie, J., Owusua, T., Chen, Z., Wang, J., Qin, C., et al. (2021). Is psychological flexibility a mediator between perceived stress and general anxiety or depression among suspected patients of the 2019 coronavirus disease (COVID-19)? *Pers. Individ. Differ.* 183:111132. doi: 10.1016/j.paid.2021.111132
- Israeli, H., Itamar, S., and Shahar, G. (2018). The heroic self under stress: prospective effects on anxious mood in Israeli adults exposed to missile attacks. *J. Res. Pers.* 75, 17–25. doi: 10.1016/j.jrp.2018.05.003
- Johnsson, E., Zolkowska, K., and McNeil, T. F. (2015). Prediction of adaptation difficulties by country of origin, cumulate psychosocial stressors and attitude toward integrating: a swedish study of first-generation immigrants from Somalia, Vietnam, and China. *Int. J. Soc. Psychiatry* 61, 174–182. doi: 10.1177/0020764014537639
- Kahneman, D. (1973). *Attention and Effort*. Hoboken, NJ: Prentice-Hall.
- Kong, J., Liu, Y., Goldberg, J., and Almeida, D. M. (2021). Adverse childhood experiences amplify the longitudinal associations of adult daily stress and health. *Child Abuse Neglect* 122:105337. doi: 10.1016/j.chiabu.2021.105337
- Kuppens, P., and Verduyn, P. (2015). Looking at emotion regulation through the window of emotion dynamics. *Psychol. Inq.* 26, 72–79. doi: 10.1080/1047840X.2015.960505
- Kuppens, P., and Verduyn, P. (2017). Emotion dynamics. *Curr. Opin. Psychol.* 17, 22–26. doi: 10.1016/j.copsyc.2017.06.004
- Lapid Pickman, L., Gelkopf, M., and Greene, T. (2021). Do positive and negative emotional reactions during war predict subsequent symptomatology? a prospective experience sampling study. *J. Anxiety Disord.* 84:102492. doi: 10.1016/j.janxdis.2021.102492
- LeBreton, J. M., and Senter, J. L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organ. Res. Methods* 11, 815–852. doi: 10.1177/1094428106296642
- Levine, S. L., Milyavskaya, M., and Zuroff, D. C. (2019). Perfectionism in the transition to university: comparing diathesis–stress and downward spiral models of depressive symptoms. *Clin. Psychol. Sci.* 8, 52–64. doi: 10.1177/2167702619865966
- Li, H., and Mei, J. R. (2002). Types and characteristics of college stress. *Psychol. Sci.* 25, 398–401.
- Liu, M., Wang, N., Wang, P., Wu, H., Ding, X., and Zhao, F. (2021). Negative emotions and job burnout in news media workers: a moderated mediation model of rumination and empathy. *J. Affect. Disord.* 279, 75–82. doi: 10.1016/j.jad.2020.09.123
- Liu, Z., Liu, R., Zhang, Y., Zhang, R., Liang, L., Wang, Y., et al. (2021). Association between perceived stress and depression among medical students during the outbreak of COVID-19: the mediating role of insomnia. *J. Affect. Disord.* 292, 89–94. doi: 10.1016/j.jad.2021.05.028
- Ma, X. Y., Chen, F. M., Xian, X., Wang, Y., and Li, Y. F. (2019). The effect of maternal depression on preschoolers’ problem behaviors: mediating effects of maternal and paternal parenting stress. *Psychol. Dev. Educ.* 35, 103–111.
- Meinhardt, J., and Pekrun, R. (2003). Attentional resource allocation to emotional events: an ERP study. *Cogn. Emot.* 17, 477–500. doi: 10.1080/02699930244000039
- Miller, K. E., Omidian, P., Rasmussen, A., Yaqubi, A., and Daudzai, H. (2008). Daily stressors, war experiences, and mental health in Afghanistan. *Transcultural Psychiatry* 45, 611–638. doi: 10.1177/1363461508100785
- Modini, M., Rapee, R. M., and Abbott, M. J. (2018). Processes and pathways mediating the experience of social anxiety and negative rumination. *Behav. Res. Therapy* 103, 24–32. doi: 10.1016/j.brat.2018.01.009
- Monroe, S. M., and Simons, A. D. (1991). Diathesis–stress theories in the context of life stress research: implications for the depressive disorders. *Psychol. Bull.* 110, 406–425. doi: 10.1037/0033-2909.110.3.406
- Monzonis-Carda, I., Adelantado-Renau, M., Beltran-Valls, M. R., and Moliner-Urdiales, D. (2021). An examination of the association between risk of depression and academic performance according to weight status in adolescents: DADOS study. *J. Affect. Disord.* 290, 157–163. doi: 10.1016/j.jad.2021.04.086
- Nesse, R. M. (1990). Evolutionary explanations of emotions. *Hum. Nat.* 1, 261–289. doi: 10.1007/BF02733986
- Padmala, S., Bauer, A., and Pessoa, L. (2011). Negative emotion impairs conflict-driven executive control. *Front. Psychol.* 2:192. doi: 10.3389/fpsyg.2011.0192
- Parsons, C. E., and Young, K. S. (2022). Beneficial effects of sleep extension on daily emotion in short-sleeping young adults: an experience sampling study. *Sleep Health* 8, 505–513. doi: 10.1016/j.sleh.2022.05.008
- Pawluk, E. J., Koerner, N., Kuo, J. R., and Antony, M. M. (2021). An experience sampling investigation of emotion and worry in people with generalized anxiety disorder. *J. Anxiety Disord.* 84:102478. doi: 10.1016/j.janxdis.2021.102478
- Pereira-Morales, A. J., Adan, A., and Forero, D. A. (2019). Perceived stress as a mediator of the relationship between neuroticism and depression and anxiety symptoms. *Curr. Psychol.* 38, 66–74. doi: 10.1007/s12144-017-9587-7

- Post, R. M. (2007). Kindling and sensitization as models for affective episode recurrence, cyclicity, and tolerance phenomena. *Neurosci. Biobehav. Rev.* 31, 858–873.
- Price, M., Legrand, A. C., Brier, Z. M. F., and Hébert-Dufresne, L. (2019). The symptoms at the center: examining the comorbidity of posttraumatic stress disorder, generalized anxiety disorder, and depression with network analysis. *J. Psychiatric Res.* 109, 52–58. doi: 10.1016/j.jpsychires.2018.11.016
- Querstret, D., and Cropley, M. (2012). Exploring the relationship between work-related rumination, sleep quality, and work-related fatigue. *J. Occup. Health Psychol.* 17, 341–353. doi: 10.1037/a0028552
- Ren, F., Kang, X., and Quan, C. (2016). Examining accumulated emotional traits in suicide blogs with an emotion topic model. *IEEE J. Biomed. Health Informatics* 20, 1384–1396. doi: 10.1109/JBHI.2015.2459683
- Rodríguez-Naranjo, C., and Caño, A. (2016). Daily stress and coping styles in adolescent hopelessness depression: moderating effects of gender. *Pers. Individ. Differ.* 97, 109–114. doi: 10.1016/j.paid.2016.03.027
- Sharma, P. K., and Kumra, R. (2022). Relationship between mindfulness, depression, anxiety and stress: mediating role of self-efficacy. *Pers. Individ. Differ.* 186:111363.
- Simpson, J. R., Drevets, W. C., Snyder, A. Z., Gusnard, D. A., and Raichle, M. E. (2001). Emotion-induced changes in human medial prefrontal cortex: II. during anticipatory anxiety. *Proc. Natl. Acad. Sci.* 98, 688–693. doi: 10.1073/pnas.98.2.688
- Tolin, D. F., Lee, E., Levy, H. C., Das, A., Mammo, L., Katz, B. W., et al. (2021). Psychophysiological assessment of stress reactivity and recovery in anxiety disorders. *J. Anxiety Disord.* 82:102426. doi: 10.1016/j.janxdis.2021.102426
- Truchot, D., Andela, M., and Takhiart, H. (2021). Stressors met by quarantined French students during the COVID-19 pandemic. their links with depression and sleep disorders. *J. Affect. Disord.* 294, 54–59. doi: 10.1016/j.jad.2021.06.059
- Watson, D., Clark, L. A., and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *J. Pers. Soc. Psychol.* 54, 1063–1070. doi: 10.1037/0022-3514.54.6.1063
- Xu, W., Wang, Y. Z., and Fu, Z. F. (2018). The moderating role of dispositional mindfulness and locus of control in the impact of perceived stress on negative emotions in daily life. *J. Psychol. Sci.* 41, 749–754.
- Yang, Y., and Liu, Y. (2016). The cognitive neural mechanism of depressive rumination. *Adv. Psychol. Sci.* 24:1042. doi: 10.3724/SP.J.1042.2016.01042
- Zhang, Z., Zyphur, M. J., and Preacher, K. J. (2009). Testing multilevel mediation using hierarchical linear models: Problems and solutions. *Organ. Res. Methods* 12, 695–719. doi: 10.1177/1094428108327450
- Zuroff, D. C., Clegg, K.-A., Levine, S. L., Haward, B., and Thode, S. (2021). Contributions of trait, domain, and signature components of self-criticism to stress generation. *Pers. Individ. Differ.* 173:110603. doi: 10.1016/j.paid.2020.110603