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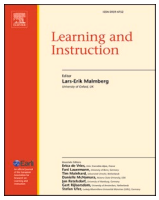

Emotion regulation and learning from academic failures

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ABSTRACT

Background: Research indicates negative emotions can impede learning, but studies on emotion regulation and learning from failure are limited.
Aims: This study hypothesized emotional integration (i.e., taking interest in negative emotions), anchored in self-determination theory, predicts the tendency to learn from academic failure, as opposed to emotion dysregulation and suppression that involve less than optimal responses to failure.
Sample: Two studies were conducted among college students, measured before and after an exam failure. Study 1 involved 907 students, with 385 reporting failure in the second measurement (mean age = 26.89; SD = 4.02). Study 2 included 484 students, with 147 reporting a specific failure in calculus (mean age = 22.19; SD = 2.56).
Method: In the first measurement, participants reported their emotion regulation styles and academic efficacy. In the second measurement, they reported adaptive and maladaptive responses to failure and their tendency to learn from it. Study 2 additionally assessed engagement before and after failure.
Results: Study 1 showed that adaptive responses mediated the positive link between emotional integration and learning from failure, whereas suppressive regulation and dysregulation hindered learning through maladaptive responses. Study 2 found that learning from failure mediated the link between emotional integration and engagement, while rumination linked dysregulation to disengagement; suppressive regulation again predicted maladaptive responses. Analyses controlled for initial engagement and academic efficacy.
Conclusions: Emotional integration, the tendency to be receptive to negative emotions, may foster learning and engagement after failure by treating emotions as informative and engaging non-judgmentally with the experience of failure.

1. Introduction

Failures are an inevitable part of the learning process and can facilitate learning (Kapur, 2008; Keith & Frese, 2005). Despite the common assertion that encountering impasses can promote learning through the subsequent explanation of these failures (e.g., VanLehn et al., 2003), there are significant individual differences in the capacity to learn from failure (Tulis et al., 2015). Learning from failure can be defined as students' active efforts to analyze the causes of failure and to apply cognitive and behavioral strategies to improve future performance. Research consistently indicates that one of the main obstacles to adaptive learning from failure is negative emotion elicited by the experience of failure (Boekaerts, 2006; Dresel et al., 2013). In a recent series of studies, Eskreis-Winkler and Fishbach (2019, 2020) demonstrated that failure can be ego-threatening, causing people to disengage and avoid learning because they cannot gather information from a situation they have not fully attended to. In the educational context, to alleviate unpleasant emotions caused by failure (e.g., fear, anxiety, frustration), students may divert their attention from the problem or engage in task-irrelevant coping activities, such as blaming others or denying the failure (Zhao, 2011).

To explain why some learners show adaptive affective and motivational reactions and learn from failure while others do not, researchers have examined achievement goals (Boekaerts, 2006; Dweck & Leggett, 1988), attitudes to errors (Tulis & Ainley, 2011), self-concept (Tulis et al., 2018), and aspects of self-regulated learning (Boekaerts & Cascallar, 2006; Pintrich & Schunk, 2002). Surprisingly, although negative emotions are likely to accompany failure, there is relatively little empirical research on styles of emotion regulation and how these relate to adaptive and maladaptive responses to failure (Tulis et al., 2015).

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Considering the harmful impact negative emotions can have on the inclination to learn from failure, Sharabi and Roth (2024) examined styles of emotion regulation through the lens of self-determination theory (SDT; Ryan & Deci, 2017). They argued the style may be an antecedent of learning from failure. They found the tendency to take an interest in negative emotions (emotional integration) was related to adaptive coping practices and to learning from failure but suppressive regulation and dysregulation were not. Moreover, learning from failure mediated the association between emotional integration and future engagement.

Our investigation elaborated on the previous research in three ways. First, while previous studies focused on outcomes of adaptive emotion regulation, we explored both adaptive and maladaptive emotion regulation and their simultaneous associations with learning from failure, engagement, and disengagement. Second, whereas other researchers measured general emotion regulation styles, we examined these styles specifically in relation to stress and anxiety experienced in the context of learning. Finally, previous research focused on adolescents, but we examined college students and their academic failures, thus enhancing generalizability.

1.1. Adaptive and maladaptive emotion regulation in SDT

Emotion regulation and coping are critical predictors of wellness (Cole et al., 2013; Gross, 2015). As negative emotions can hinder self-regulation, research and interventions on emotion regulation tend to focus on how individuals can actively diffuse or downregulate intense negative emotions and foster more positive feelings (Gross, 2015). However, from the perspective of SDT, emotions are not merely obstacles to effective self-regulation and psychological well-being. Instead, they play a crucial role as sources of information (Lazarus, 1991; LeDoux, 1995). Recognizing this information allows greater autonomous regulation and its associated positive outcomes (Schultz & Ryan, 2015). Emotions convey the relevance and meaning of events in relation to a person's needs, aims, or goals, thus enhancing the capacity for choice and authenticity. Over the past decade, research has emphasized the significance of SDT's conceptualization of adaptive emotion regulation in promoting psychological development and growth, making SDT especially relevant to education and learning (Roth & Benita, 2023; Roth et al., 2018).

Simply stated, SDT views emotions as informative for healthy functioning. Defensively avoiding emotions, particularly negative ones, prevents the use of this emotional information to make a volitional choice among possible actions (Roth & Benita, 2023). In this sense, experiences of failure are not an exception. Benefiting from them may hinge on the ability to attend to them and fully process them, including their emotional impact, distinguishing between what is achieved and what is desired.

SDT identifies three styles of emotion regulation (Roth et al., 2019; Ryan & Deci, 2017): (1) *emotional integration* is an integrative approach that is reflected in autonomous receptive attention to emotions; (2) *suppressive integration* is a controlled approach that involves minimization of emotional inputs mainly because they are perceived as threatening; (3) *dysregulation* is an amotivated approach that involves difficulties in regulating emotions (Roth et al., 2018). These styles differ in the quality and depth of emotional processing and in their respective consequences.

Emotional integration is defined as the most mature and adaptive form of emotion regulation. It involves the tendency to perceive negative emotions as legitimate experiences, explore them, and use the information for volitional choice of subsequent actions. A large body of research in the last four decades has demonstrated the importance of autonomous regulation for healthy development, full functioning, and effective self-regulation (Ryan & Deci, 2017). Suppressive regulation involves a controlled tendency to diminish negative emotions mainly because they are perceived as ego-threatening. This reluctant approach to negative emotions may stem from socialization that suggests certain negative emotions are illegitimate or even forbidden for various reasons (Roth & Benita, 2023). Finally, dysregulation involves an inability to regulate emotions or urges, implying an experience of being overwhelmed and paralyzed by negative emotions (Roth et al., 2014).

It is important to distinguish the concept of emotional integration from Gross's (2015) concept of reappraisal anchored in the process model of emotion regulation, a commonly studied approach in educational contexts (e.g., Beaumont, 2023; Davis & Levin, 2012). Gross (2015) differentiates between the emotion regulation practices that appear at different times along an unfolding emotional response. *Antecedent-focused* strategies appear early in this timeline before the emotional experience is fully present; *response-focused practices* come later when the emotional experience is underway. Two specific strategies have attracted considerable attention: *cognitive reappraisal* and *expressive suppression*. In expressive suppression, individuals attempt to reduce ongoing emotional expressions to prevent escalation. In contrast, in cognitive reappraisal, individuals attempt to think about the situation differently and to construe the emotion-eliciting situation in non-emotional terms such that the emotion does not become salient from the outset (Gross, 2002) or reframe potentially negative emotional situations in a more positive emotional light. Research highlights the affective, cognitive, social, and physiological benefits of reappraisal over suppression, largely due to its earlier timing in the emotional process (Gross, 2013; 2015).

From the SDT viewpoint, both, reappraisal and suppression can be adaptive or maladaptive; they can be adaptive when enacted autonomously as a result of integration and maladaptive when they are defensive and therefore controlled. Reappraisals, such as 'It's not that bad', 'He didn't mean it', or 'Every rose has its thorn', are defensively voiced by many victims. Alternatively, active reinterpretation can adaptively emerge from a prior process of emotional integration. By fully engaging with the emotional experience and exploring its meaning, individuals can voluntarily recognize when a different perspective on the situation is appropriate for everyday coping. For an elaborate distinction between emotional integration and other approaches to emotion regulation, see Roth et al. (2019) and Roth and Benita (2023).

1.2. Emotion regulation and learning from failure

Empirical research on emotion regulation and learning from failure is limited. Tulis and Dresel (2012) found rumination, which is associated with dysregulation, did not facilitate adaptive responses to errors. Sharabi and Roth (2024) were the first to systematically test the associations between emotional integration and learning from failure. They hypothesized that in failure situations triggering negative emotions, a tendency to explore these emotions and engage with the information they convey may facilitate learning. In contrast, avoiding emotional experiences may lead to disengagement from the situation, preventing meaningful learning from failure. In line with this claim, they found emotional integration was associated with learning from failure and with adaptive coping practices in response to failure, such as seeking social and instrumental support and viewing stressful experiences as opportunities for growth and development (Carver, 1997). Dysregulation and suppressive regulation were associated with maladaptive (defensive) coping practices (i.e., denial, blaming others, rumination). They also found adolescents' learning from failure on a math test mediated relations between emotional integration and engagement in math after failure when controlling for engagement and self-efficacy before the test. To the best of our knowledge, no other research has explored relations between emotional integration and learning from failure, or between learning from failure and other forms of emotion regulation that emphasize the importance of receptive attention to emotional experiences, such as mindfulness or acceptance (Brown & Ryan, 2003; Hayes et al., 1999).

1.3. The present studies

Two studies explored college students' responses to failure by approaching them twice, before and after an exam. We explored the emotional burden of failure, as it likely presents a challenge for emotion regulation. According to Pekrun's (2024) control-value theory, the intensity of negative emotions following failure depends on the importance attributed to the failure. Therefore, we focused on students' subjective experiences of failure in courses perceived as highly important - courses that are considered challenging, required for continuing studies, and have high failure rates. Specifically, Study 1 examined failure in an introductory statistics course for social sciences students and in a calculus course for engineering and natural sciences students, while Study 2 focused exclusively on failures in calculus among engineering and natural sciences students. We measured negative emotions both before and after the failure to confirm they were elicited.

Following Sharabi and Roth (2024), we hypothesized the tendency to integrate experiences of stress and anxiety is related to learning from failure. Thus, learning and benefiting from experiences of failure, which potentially elicit negative emotions, are dependent on the tendency to approach negative emotions in an explorative way (i.e., emotional integration). We further hypothesized the tendency to suppress and avoid stress and anxiety in the context of learning undermines the ability to learn from failure because it is difficult to learn from an experience that one has not fully attended to. Finally, we hypothesized that like suppressive regulation, dysregulation is negatively related to learning from failure because of the disorganized nature of the experience.

Sharabi and Roth (2024) examined how emotional integration may contribute to learning from failure and academic engagement following failure. Building on their work, we explored the correlates of emotional integration while simultaneously testing potential mediators in the relationship between maladaptive emotion regulation styles – specifically, suppressive regulation and emotional dysregulation – and learning from failure (Studies 1 and 2) and post-failure engagement (Study 2). Study 1 tested the hypothesis that adaptive coping practices mediate the relationship between emotional integration of stress and anxiety in college and learning from failure, whereas maladaptive coping practices mediate the link between maladaptive emotion regulation styles and learning from failure. Study 2 expanded on this by exploring engagement and disengagement following failure. Sharabi and Roth (2024) focused on learning from failure as the process through which emotional integration predicts engagement after failure but did not test the process through which maladaptive emotion regulation predicts engagement, as they did not find an association between dysregulation and suppressive regulation and engagement. Therefore, in Study 2, in addition to engagement, we measured disengagement following failure, attempting to identify processes mediating the association between maladaptive emotion regulation styles and disengagement.

In a commitment to open science, all research data and materials are available via [https://researchbox.org/4606].

2. Study 1

2.1. Introduction

In the first study, we approached freshman college students twice, once before and once after they experienced failure. Wave 1 took place during the third week of December (mid-semester), while Wave 2 was conducted during the first week of March, at the conclusion of the winter exam period. This second assessment was specifically timed to occur approximately two weeks after students received their grades, ensuring that the psychological impact of the perceived failure was still salient. In the Israeli context, the academic year consists of two terms, with an exam period at the end of each term. Learning from failure is particularly relevant in this context, as students have the option to retake each exam for improvement or even repeat the course the following year. We hypothesized the association between emotional integration and learning from failure would be mediated by adaptive coping practices of seeking social support and perceiving failures as potentially growth-promoting, whereas the association between maladaptive emotion regulation styles and learning from failure would be mediated by maladaptive coping practices of denial and rumination. In their recent study, Sharabi and Roth (2024) did not examine the processes mediating the relationship between maladaptive emotion regulation styles and learning from failure. Additionally, they assessed adolescents' general regulation styles for stress and anxiety. In contrast, we tested the regulation of college students specifically in relation to stress and anxiety elicited in the context of learning in college.

Coping and emotion regulation are closely interconnected, and recent conceptual papers attempted to identify their similarities and differences (Troy et al., 2023; Trudel-Fitzgerald et al., 2024). However, a thorough exploration of this topic is beyond the scope of this paper. For current purposes, it is important to distinguish between a trait-like tendency to either engage with one's negative emotional experiences (emotional integration) or defensively avoid them (suppressive regulation), and specific coping practices, such as support seeking or blaming others.

The coping literature commonly differentiates between task-oriented and defensive practices; the former are active and adaptive, while the latter are avoidance-oriented and non-adaptive (Carver et al., 1989). Adaptive strategies include direct problem-solving, seeking instrumental and emotional support (Newman, 2000; Raftery-Helmer & Grolnick, 2016), and interpreting stressful experiences as opportunities for development and growth (Carver, 1997). Individuals using these practices manage task demands with an outward approach. For instance, students who recognize a difficulty they cannot overcome alone may seek help (Raftery-Helmer & Grolnick, 2016). Defensive coping strategies often involve diverting attention from the task to protect oneself; they include denial, blaming others, and rumination (Tero & Connell, 1984).

We hypothesized the adaptive practices of seeking social support and viewing stressful experiences as opportunities for development and growth mediate the association between emotional integration and learning from academic failure. Thus, we hypothesized a tendency to be attentive to and explorative of one's negative emotions (i.e., emotional integration) will facilitate an open approach to failure despite the emotional discomfort. This exploration, in turn, will enable individuals to benefit from social support and learning, as negative emotions are perceived not as ego-threatening but as valuable information about the situation. Conversely, we hypothesized individuals relying on suppressive emotion regulation will struggle to learn effectively, as meaningful learning requires full attention to the experience. Furthermore, we hypothesized the predicted negative association between suppressive regulation and learning from academic failure is mediated by denial. Since suppressive regulation stems from perceiving emotions as ego-threatening, denial may serve as a mechanism to mitigate this perceived threat. Finally, we hypothesized the relationship between emotional dysregulation and learning from failure is mediated by rumination. When individuals feel overwhelmed by negative emotions, they may engage in repetitive, nonconstructive thinking, leading to ineffective attention and futile attempts to process the emotional experience.

We controlled for academic efficacy, as others have found this to be important to the prediction of learning from failure (Boekaerts, 2006; Dweck & Leggett, 1988; Elliot & Thrash, 2004). Fig. 1 summarizes Study 1's hypotheses.

2.2. Method

2.2.1. Participants and procedure

Eight weeks into the academic year (during the third week of

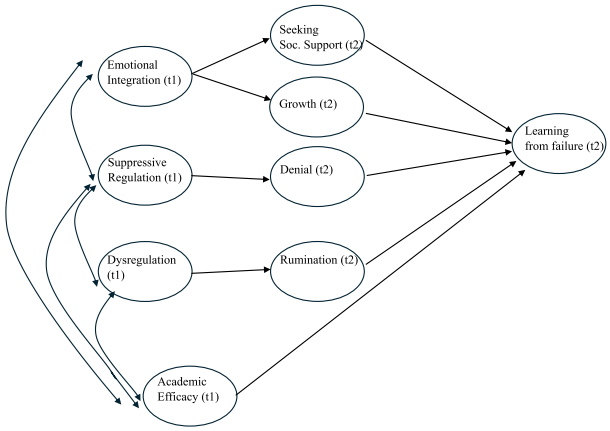

Fig. 1. Conceptual model examined in study 1.

December), we approached 907 college students at – blind - and asked them to complete self-report measures of emotion regulation styles and academic efficacy. We approached them again one week after the exam period of the first term (the first week of March) and received responses from 633 students (a 30% attrition rate). First, we asked if they perceived one of their grades as a failure. We focused on an introductory statistics course for social science students and a calculus course for engineering and natural science students. Three hundred and eighty-five students (mean = 26.89; SD = 4.02; 57.1% women) who perceived a grade in these courses as a failure were then asked to complete measures of adaptive and maladaptive responses to failure and learning from failure in relation to the specific experience. The students were from diverse faculties: 35.8% were engineering majors, 27.3% were social science majors, 13% were natural science majors, and the rest were from other faculties. The participants were Jewish Israelis. Slightly over half of the participants, 51.7%, reported a middle-class socio-economic background, 22.6% an upper middle-class background, 1.3% an upper-class background, 19.7% a lower middle-class background, and 4.7% a lower-class background. The research was approved by the IRB of -blind -.

2.2.2. Measures

All measures consisted of a Likert-type scale ranging from 1 (not true for me) to 7 (very true for me) unless otherwise stated.

2.2.2.1. Emotion regulation. The scales measuring emotional integration, dysregulation, and suppressive regulation were developed by Roth et al. (2009). We slightly modified the scales to assess regulation of anxiety and stress elicited specifically in a college setting. The modification involved the following: 'In situations that may trigger anxiety or stress in college, I … '. We focused on regulating stress and anxiety because these emotions are often triggered in the context of failure (Tulis et al., 2015). The scale for emotional integration consisted of six items measuring the extent to which respondents took an interest in their anxiety and stress, tried to understand the source, and believed the exploration of negative emotions was informative (e.g., 'I try to understand what this indicates about me and my situation'; 'I explore my emotions because it can help me understand important things about myself'). Cronbach's alpha was .91. Suppressive emotion regulation was measured with six items reflecting both the attempt to consistently avoid negative emotions and the attempt to hide them (e.g., 'I try to ignore feelings of stress or anxiety'). Cronbach's alpha was .88. The scale for dysregulation consisted of six items emphasizing the experience of being overwhelmed by negative emotions and difficulty with task-oriented functioning in situations eliciting negative emotions (e.g., 'I feel I have little control over my behavior'; 'I show my stress even in situations which are not appropriate for it'.). Cronbach's alpha was .90.

2.2.2.2. Coping with academic failure. The adaptive (coping) practices we measured were social support seeking and positive reinterpretation and growth in response to failure. We modified our scales to measure coping with the specific failure respondents had experienced. Before the items were presented, we used the stem: 'After I realized that I had failed the exam … '. Social support-seeking was assessed using three items from the How I Cope Under Pressure scale by Ayers et al. (1996), adapted by Raftery-Helmer and Grolnick (2016) (e.g., 'When I realized that I had failed the exam I talked about my feelings with someone who really understands'). Cronbach's alpha for this scale was .90. Positive reinterpretation and growth were measured using a subscale from the COPE inventory by Carver (1997). The subscale consists of three items assessing the extent to which a stressful experience is seen as an opportunity for development and growth (e.g., 'I tried to grow as a person as a result of the experience'). Cronbach's alpha for this subscale was .80.

Defensive coping practices included denial, and rumination. Denial was measured using three items from the Children's Academic Coping Inventory (CACI) by Tero and Connell (1984). The items assessed participants' attempts to deny the significance of failure (e.g., 'I pretended like it didn't really happen'). Cronbach's alpha for this scale was .86. Rumination was assessed using a subscale from Skinner et al. (2013), consisting of three items (e.g., 'I kept thinking about the failed test over and over'). Cronbach's alpha for this subscale was .88.

2.2.2.3. Learning from failure. Following Sharabi and Roth (2024), we used a 6-item scale to measure learning from failure. The scale included four items from Raftery-Helmer and Grolnick (2016) measuring active attempts to address the cause of perceived failure (e.g., 'After I realized that I had failed the exam, I tried to find out what I did wrong, so it won't happen again'). The scale also included two items from the Adaptive Reactions to Errors Scale (Dresel et al., 2013; Tulis et al., 2018) focusing on planning, initiation, and evaluation of cognitive processes and activities aimed at overcoming errors, specifically related to the experience of failure (e.g., 'After I realized that I had failed the exam, I began to explore topics where I wasn't as proficient'). Thus, the final scale consisted of six items measuring the tendency to learn from failure. Cronbach's alpha was .90.

2.2.2.4. Academic efficacy. We measured participants' academic self-efficacy to control for possible intervening variables using five items from the Patterns of Adaptive Learning Scale (PALS; Midgley et al., 2000) (e.g., 'Even if the work is hard, I can learn it'). Cronbach's alpha was .91.

2.2.2.5. Negative emotions following failure. Past research has shown both actual failures and the anticipation of failure can elicit negative emotions (e.g., Eskreis-Winkler & Fishbach, 2019, 2020; Hull et al., 2019). To verify students in our sample experienced negative emotions following failure, we asked them to rate the extent to which they felt stress, anxiety, frustration, and sadness immediately after realizing they had failed the exam. Responses were measured on a scale from 1 (not at all) to 7 (strongly agree), with a mean score of 4.607 ($SD = 1.647$) for these emotions. This was compared to their ratings of the same emotions at Time 1 when asked about college in general; this had a mean of 2.926 ($SD = .971$). A t-test revealed a significant difference, $T(384) = 21.28$, $p < .001$, Cohen's d was 1.549, indicating a substantial increase in negative emotions after failure. The pattern of results remained similar when each negative emotion was examined separately; the corresponding t tests for each emotion are reported in the Supplementary Materials.

Results.

Table 1 presents descriptive statistics and zero-order correlations among the research variables. As expected, emotional integration was the only emotion regulation style positively related to learning from failure. Suppressive regulation and dysregulation showed no association with learning from failure, despite our expectation of a negative

Table 1
Descriptive statistics and zero-order correlations among Study 1 variables.

		M	*SD*	Pearson *r*								
				1	2	3	4	5	6	7	8	9
1	Emotional integration (t1)	4.860	1.235	–								
2	Suppressive regulation (t1)	3.887	1.315	−.157**	–							
3	Dysregulation (t1)	3.550	1.431	−.010	−.070	–						
4	Academic efficacy (t1)	4.789	.925	.305**	.074	−.314**	–					
5	Learning from failure (t2)	4.691	1.479	.235**	.057	.002	.183**	–				
6	Seeking emotional Support (t2)	4.316	.1.733	.289**	−.268**	.084	.062	.254**	–			
7	Growth (t2)	4.067	1.487	.231**	.023	−.128*	.151**	.389**	.183**	–		
8	Denial (t2)	2.910	1.717	−.101*	.159**	.208**	−.123*	−.133	−.144**	.096	–	
9	Rumination (t2)	3.852	1.619	−.010	.027	.352**	−.170**	−.238**	.090	.012	.223*	–

*p < .05; **p < .01.

association. In line with our hypotheses, suppressive regulation was related to denial, and dysregulation was related to both denial and rumination. Finally, emotional integration was positively related to the adaptive coping practices of seeking social support and growth.

2.2.3. Main analyses

We tested the associations between emotion regulation styles, responses to failures and learning from failure using structural equation modeling (SEM) analyses with AMOS 29.0 software (IBM Corp, 2022) and maximum likelihood estimation to simultaneously test the hypothesis that the adaptive coping practices of seeking social support and perception of failure as growth-promoting would mediate the association between emotional integration and learning from failure. We further hypothesized an indirect negative association between suppressive regulation and learning from failure through denial and an indirect negative association between dysregulation and learning from failure through rumination. A bootstrapping mediation analysis with 5000 bootstrap samples was conducted with academic efficacy as the covariate (see Fig. 2). The SEM analysis was conducted with latent variables based on items as indicators.

Before testing the structural model, we first tested the fit of the measurement model using the following fit indices: ratio of chi-square to degrees of freedom (χ^2/df), Tucker–Lewis Index (TLI; Bollen, 1989), comparative fit index (CFI; Benita, 2020), and root mean square error of approximation (RMSEA; Browne & Cudeck, 1993). Indicators of acceptable fit comprise: a χ^2/df ratio of less than 2 (Carmines & McIver, 1981), CFI equal to or greater than .90, and RMSEA less than .08 (Browne & Cudeck, 1993; Hoyle, 1995). The measurement model had satisfactory fit, χ^2 (743) = 1410.02, χ^2/df = 1.89; TLI = .924; CFI = .931; RMSEA = .048.

Next, we tested the structural model (see Fig. 2). It demonstrated adequate fit indices, χ^2 (807) = 1552.630; χ^2/df = 1.92; TLI = .926; CFI = .93; RMSEA = .049. All coefficients were standardized. The total indirect effect of emotional integration on learning from failure through the two mediators (i.e., seeking social support and growth) was significant, with an effect of .157 (95% CI of .105, .221). Each of the two indirect effects was also significant, with an effect of .037 (95% CI of .011, .074) for seeking social support as a mediator and an effect of .137 (95% CI of .085, .207) for growth as a mediator. The negative indirect association of suppressive emotion regulation and learning from failure through denial was also significant, with an effect of −.032 (95% CI of −.063, −.012). The direct effect of suppressive regulation on learning from failure was significant and positive (β = .12; p = .008), contrasting with the negative indirect effect through denial. Given the non-significant bivariate correlation between these variables (r = .057), this pattern represents a suppression effect. We address this inconsistency and its theoretical implications in the Discussion. Finally, the negative indirect association of dysregulation and learning from failure through rumination was also significant, with an effect of −.117 (95% CI of −.076, −.171).

We tested an alternative model, similar to the one presented in Fig. 2, in which learning from failure served as a mediator of the associations between emotional integration, growth, and seeking emotional support (i.e., the dependent variable in the original model was specified as the mediator). The alternative model showed a reasonable fit, although poorer than the hypothesized model, χ^2(808) = 1637.681, χ^2/df = 2.027, TLI = .918, CFI = .923, RMSEA = .052. A chi-square difference test indicated a significant decrement in fit relative to the hypothesized model, $\Delta\chi^2(1) = 85.051$, p < .001.

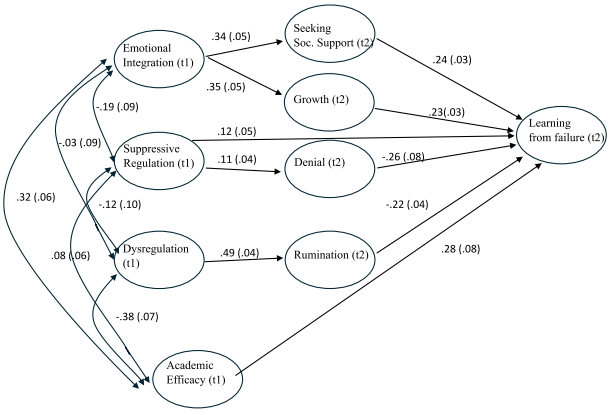

Fig. 2. Study 1: Coping Practices as Mediators of the Associations Between Emotion Regulation Styles and Learning from Failure
Note: **p < .01; *p < .05; Values represent unstandardized path coefficients; Values in parentheses indicate standard errors. For clarity, indicators and non-significant direct effects between emotion regulation styles and learning from failure are omitted; all are reported in the Supplementary Materials.

2.3. Summary of study 1

The link we found between emotional integration and learning from failure replicates Sharabi and Roth's (2024) findings and extends them to an older age group in a college setting. The results support the hypothesis that emotional integration is the only emotion regulation style positively associated with adaptive coping strategies and a greater tendency to learn from failure. Furthermore, adaptive coping mediates the relationship between integration and learning from failure. Importantly, Study 1 extended work by Sharabi and Roth (2024) by examining the indirect effects of maladaptive emotion regulation styles on learning from failure. The findings partially support the hypothesis that denial mediates the negative relationship between suppressive regulation and learning from failure, while rumination mediates the negative relationship between dysregulation and learning from failure. These results should be interpreted with caution, however, as we did not find a direct association between suppression or dysregulation and learning from failure, despite the significant indirect effect (see Table 1).

3. Study 2

3.1. Introduction

In Study 2, we extended our focus beyond learning from failure to examine its relationship with future engagement after failure. Sharabi and Roth (2024) explored the links between emotion regulation styles, learning from failure, and engagement. However, they only tested learning from failure as a mediator between emotional integration and post-failure engagement, as they found no direct associations between maladaptive emotion regulation styles and engagement. In Study 2, we measured disengagement, in addition to engagement, hoping to support the hypothesis that the association between maladaptive emotion regulation styles (suppression and dysregulation) and disengagement is mediated by maladaptive responses to failure.

Engagement refers to a student's active participation in the learning process (Reeve, 2012). This concept encompasses various dimensions, typically categorized as behavioral, cognitive, and emotional engagement (Skinner et al., 2009). We did not anticipate a connection between learning from failure and emotional engagement, defined as an experience of enthusiasm and interest. Therefore, we focused on behavioral engagement, which involves effort, concentration, and attention, and on cognitive engagement, characterized by using deep learning strategies rather than superficial ones.

Building on Sharabi and Roth (2024), we hypothesized that engaging with one's negative emotional experiences (emotional integration) will predict learning from failure, which, in turn, will predict greater engagement, characterized by increased effort and the use of more advanced learning strategies. Expanding on previous research, we also hypothesized attempts to avoid negative emotions (suppressive regulation) will predict denial, which, in turn, will predict disengagement. Finally, we hypothesized dysregulation will be linked to disengagement through rumination. To test these hypotheses, we approached college students twice: once before and once after a calculus exam. The conceptual model is presented in Fig. 3.

3.2. Method

3.2.1. Participants and procedures

Midway through the first semester (during the third week of December - six weeks after the semester began), we approached 482 Jewish Israeli students enrolled in a calculus course at three Israeli universities. The students responded to self-report measures of emotion regulation styles, academic engagement, and self-efficacy in calculus. We approached them again two weeks after the exam period of the first term, during the third week of March. Two hundred and ninety-one students participated in the second measurement, resulting in an attrition rate of 39%. Of these 291 participants, 143 reported experiencing failure in the exam (44.1% women; mean age = 22.23, SD = 2.55). All participants were freshmen in engineering (63.3%), computer science (28.6%), or physics (7.5%) departments; 34.2% of the participants had a middle-class socio-economic background, 49.4% an upper middle-class background, 8.5% an upper-class background, 6.6% a lower middle-class background, and 1.2% a lower-class background.

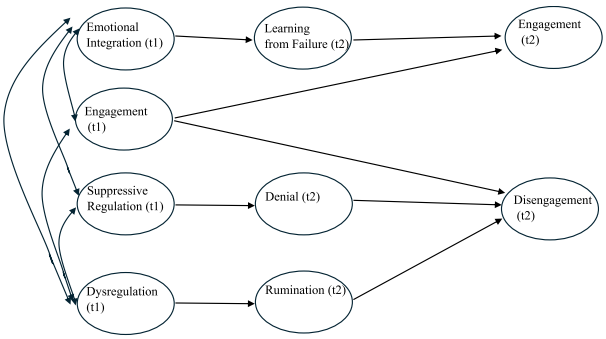

Fig. 3. Conceptual model examined in study 2.

Given the complexity of the SEM model, we used two approaches for power analysis, the power-all, which estimates the overall power of the SEM model, and the power-specific that estimates the power of the specific indirect effects. All power calculations were based on the given sample of n = 143 and alpha of .05. Power-all was estimated using MacCallum et al.'s (1996) approach. For the model presented in Fig. 3, the current sample yielded a power of .98. Power-specific was calculated for the indirect effect as this was the main goal of Study 2 and because indirect effects require a larger sample size. To calculate power for the mediation effects, we used Schoemann et al.'s (2017) Monte Carlo Power Analysis for indirect effect. Assuming a moderate effect size (.30 in a correlation metric), the current sample yielded a power of .90 for the mediation effect. Thus, Study 2 had adequate power. The research was approved by the IRB of – blind -.

3.2.2. Measures

Participants filled out questionnaires using a 7-point Likert-type scale, ranging from 1 (not true at all) to 7 (very true). Note that the reliability of emotion regulation style measures discussed in this section is based on data from all 291 participants, whereas the reliability of failure response measures is based on the 143 participants who perceived failure.

3.2.2.1. Emotion regulation, coping practices, learning from failures, and academic efficacy. These were the same measures as in Study 1. Cronbach's alphas were satisfactory. The reliabilities were .87, .86, and .87 for emotional integration, suppression, and dysregulation, respectively (measured at Time 1). For coping practices, they were .90, .79, and .84 for seeking social support, denial, and rumination, respectively (measured at Time 2). For learning from failure, Cronbach's alpha was .92 (measured at Time 2). For self-efficacy in calculus, it was .92 (measured at Time 1).

3.2.2.2. Classroom engagement. We assessed two dimensions of engagement, cognitive and behavioral, at the two measurement points, before and after the exam. For behavioral engagement, we used a 3-item scale from Skinner et al. (2009) (e.g., 'I try hard to do well in this class'). We measured cognitive engagement using Wolters' (2004) Metacognitive Strategies Questionnaire (e.g., 'If what I am working on in this class is difficult for me to understand, I figure out how to change the way I learn the material'). Cronbach's alphas were .80 and .84 for behavioral engagement before and after the exam, respectively, and .69 and .70 for cognitive engagement before and after the exam, respectively. The correlations between the two measures of engagement were .377 and .460 at Time 1 and Time 2, respectively. Over time, the engagement measures demonstrated even higher correlations, indicating consistency: .607 for behavioral engagement and .516 for cognitive engagement.

3.2.2.3. Classroom disengagement. This measure was developed for the present research and was distributed only at the second measurement point. It consisted of five items measuring lack of investment (e.g., 'I invested less time in my studies in comparison to my investment before the test'; 'It was difficult for me to concentrate and study'; 'I felt like it took the wind out of my sails'). The items followed the lead-in: 'After finding out I had performed poorly on the test, I felt … '. Cronbach's alpha for the scale was .90, and the correlations with the Time 2 measurements of engagement were −.34 (p = .000) for behavioral engagement and −.16 (p = .057) for cognitive engagement.

3.2.2.4. Negative emotions following failure. To confirm students experienced negative emotions following failure, we asked them to rate the

extent to which they felt stress, anxiety, frustration, and sadness immediately after realizing they had failed the exam. Responses were measured on a scale from 1 (not at all) to 7 (strongly agree), with a mean score of 4.383 ($SD = 1.375$) for these emotions. This was compared to their ratings of the same emotions at Time 1, when asked about college in general, which had a mean of 3.575 ($SD = 1.315$). A *t*-test revealed a significant difference, $T(146) = 5.384$, $p < .001$, Cohen's $d = 1.295$, indicating a substantial increase in negative emotions after failure. The pattern of results remained similar when examining each negative emotion separately.

3.3. Results

To rule out the possibility that the three emotion regulation styles are associated differently with academic ability and the perception of failure, participants were asked to report their exam grades. We examined correlations between emotion regulation strategies and both academic grades and perceptions of failure among the 291 participants who completed the second wave of data collection. All correlations were close to zero and nonsignificant. Specifically, correlations with grades were −.07 (p = .271) for suppression, −.01 (p = .924) for integration, and .02 (p = .803) for dysregulation. Correlations with perceptions of failure were .03 (p = .615), .05 (p = .448), and −.04 (p = .532), respectively.

Students were nested within three universities; however, the ICCs for the study variables were very small, indicating minimal between-university variability. For cognitive and behavioral engagement, the variance of the random intercept was estimated as zero, yielding an ICC of 0. For disengagement, the ICC was 0.0016, suggesting that virtually all variability occurred at the individual level. Given the negligible clustering effects and the small number of clusters, analyses were conducted using single-level models. Table 2 shows the associations among all research variables Inspection of Table 2 shows a replication of the associations observed in Study 1 between emotion regulation styles and responses to failure. Specifically, emotional integration was correlated with learning from failure, seeking instrumental and emotional support, and growth. In contrast, suppression was negatively related to seeking emotional support and positively related to denial. Dysregulation was positively related to rumination and negatively related to growth. Additionally, Table 2 reveals that, as expected, only emotional integration was related to behavioral and cognitive engagement, whereas dysregulation was related to disengagement. However, suppression was not correlated with either engagement or disengagement.

Next, we tested the hypothesized model, examining whether learning from failure mediated the relationship between emotional integration and both facets of engagement. We also asked whether suppressive regulation was linked to disengagement through the mediation of denial and whether rumination mediated the relationship between dysregulation and disengagement. As in Study 1, we conducted SEM analyses using latent variables in AMOS 29.0 (IBM Corp, 2022) with maximum likelihood estimation. The analysis was conducted twice, first with cognitive engagement as the outcome and then with behavioral engagement as the outcome. To account for prior engagement levels, we controlled for engagement at Time 1. Specifically, when cognitive engagement was the dependent variable, we controlled for cognitive engagement in calculus measured at Time 1. When behavioral engagement was the dependent variable, we controlled for behavioral engagement at Time 1. When disengagement was the dependent variable, we controlled for engagement, as disengagement was not measured at Time 1. As in Study 1, we computed latent variables by using the items as indicators.

First, we evaluated the measurement model; it demonstrated a satisfactory fit. When cognitive engagement was the outcome, the model fit indices were $\chi^2(959) = 1031.565$, $\chi^2/df = 1.076$, CFI = .992, TLI = .990, RMSEA = .013. When behavioral engagement was the outcome, the fit indices were $\chi^2(912) = 1341.953$, $\chi^2/df = 1.471$, CFI = .949, TLI

Table 2
Descriptive statistics and zero-order correlations among Study 2 variables.

		M	SD	Pearson *r*												
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Emotional integration (t1)	4.885	1.256	–													
2	Suppressive regulation (t1)	3.925	1.300	−.244**	–												
3	Dysregulation (t1)	3.230	1.325	.044	−.182**	–											
4	Math efficacy (t1)	5.602	1.189	.236**	.064	−.243**	–										
5	Learning from failure (t2)	4.125	1.451	.237**	.002	.050	.158	–									
6	Seeking emotional Support (t2)	4.397	.1727	.293**	−.330**	.016	−.026	.211*	–								
7	Growth (t2)	4.456	1.689	.259**	.123	−.171*	.257**	.306**	.314**	–							
8	Denial (t2)	2.520	1.476	−.081	.246**	−.111	.005	−.188*	−.172*	−.066	–						
9	Rumination (t2)	4.178	1.528	.092	.132	.275**	−.001	.176*	.011	−.014	.070	–					
10	Cog. Engage (t1)	5.025	1.180	.316**	.013	−.012	.343**	.413**	.038	.184*	−.164*	−.036	–				
11	Beha. Engage (t1)	5.404	1.258	.132*	.033	−.088	.261**	.170*	−.053	.068	−.157	.069	.377**	–			
12	Cog. Engage (t2)	5.177	1.034	.327**	−.040	.023	.352**	.501**	.092	.319**	−.085	.001	.516**	.357**	–		
13	Beha. Engage (t2)	5.279	1.156	.168**	−.007	−.066	.158**	.350**	.145	.223**	−.184*	.130	.281**	.607**	.460**	–	
14	Disengage (t2)	3.833	1.761	−.052	.091	.264**	−.083	−.080	−.080	−.243**	.132	.419**	−.209*	−.188*	−.160	−.340**	–

*p < .05; **p < .01.

= .943, RMSEA = .031.

Next, we conducted structural model analyses, as shown in Fig. 4. The fit indices indicated a satisfactory model fit for both cognitive and behavioral engagement. For cognitive engagement, the fit indices were $\chi^2(980) = 1596.252$, $\chi^2/df = 1.629$, CFI = .951, TLI = .948, RMSEA = .036. For behavioral engagement, the fit indices were $\chi^2(980) = 1497.347$, $\chi^2/df = 1.528$, CFI = .963, TLI = .961, RMSEA = .033.

The structural model results presented in Fig. 4 support the hypotheses on the correlates of emotional integration and dysregulation but provide only partial support for the correlates of suppressive regulation. The indirect effect of emotional integration on cognitive engagement through learning from failure was significant even when controlling for cognitive engagement at Time 1 (effect of .106; 95% CI of .077, .137), as was the indirect effect of emotional integration on behavioral engagement (effect of .024; 95% CI of .011, .041). The indirect effect of dysregulation on disengagement through rumination was significant, with an effect of .160 (95% CI of .112, .222). Finally, despite the positive relations between suppressive regulation and denial, the indirect effect of suppressive regulation on disengagement through denial was not significant, with an effect of .034 (95% CI of −.012, .084).

3.4. Summary of study 2

Study 2 examined how emotion regulation styles predict engagement and disengagement after academic failure. As hypothesized, emotional integration was positively associated with learning from failure, which in turn predicted both behavioral and cognitive engagement, even after controlling for prior engagement. Dysregulation predicted disengagement via rumination, confirming its maladaptive role. Although suppression was related to denial, its indirect effect on engagement via denial was not significant. Overall, the findings extend Study 1 by demonstrating that an adaptive process mediates the link between emotional integration and engagement, whereas a maladaptive process mediates the link between dysregulation and engagement, with suppression providing only partial support for the expected effects.

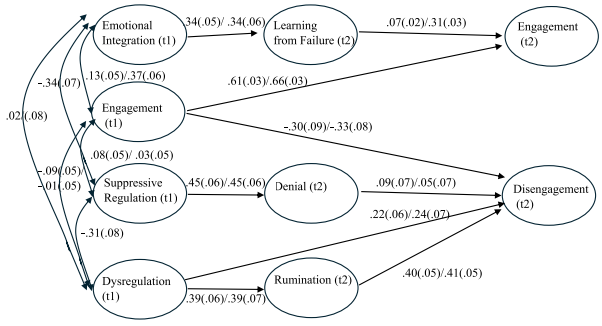

Fig. 4. Study 2: Responses to Failure as Mediatores of the Association Between Emotion Regulation Sthgyles and Engagement

Note: **p < .01; *p < .05.

Notes: (1) The value on the left represents the association when behavioral engagement is the dependent variable (DV), while the value on the right represents the association when cognitive engagement is the DV. (2) Values represent unstandardized path coefficients; values in parentheses indicate standard errors. (3) Engagement at Time 1 was controlled alongside the corresponding outcome measure (i.e., cognitive engagement at time 1 for cognitive engagement at time 2 and behavioral for behavioral). (4) The path coefficients for suppressive regulation, dysregulation, and their correlates are based on the model using cognitive engagement as the DV. The results for the behavioral engagement model are similar. (5) For clarity, indicators and non-significant direct effects between emotion regulation styles and learning from failure are omitted; all are reported in the Supplementary Materials.

4. General discussion

The results of Study 1 replicated and expanded on the findings of Sharabi and Roth (2024), suggesting adaptive coping practices in response to failure mediate the relationship between emotional integration and learning from failure. This suggests that a tendency to engage with one's negative emotions facilitates adaptive processing of failure experiences, despite their emotional burden. Study 1 further extended Sharabi and Roth's (2024) work by examining the indirect effects of maladaptive regulation styles on learning from failure. In contrast to emotional integration, suppressive emotion regulation was negatively associated with learning from failure through denial, while dysregulation showed a similar negative indirect effect through rumination. Notably, this study and the following one focused on a different age group (college students instead of adolescents) and used a measurement of emotion regulation styles specifically contextualized to the academic setting in college.

Study 2 replicated the associations among emotion regulation styles and responses to failure and extended the investigation by testing their associations with engagement and disengagement following failure on a calculus exam. We controlled for initial engagement as measured before the exam. In our sample, emotional integration was related to cognitive and behavioral engagement through the mediation of learning from failure, while dysregulation was related to disengagement through rumination. Suppressive regulation was related to denial, but neither suppression nor denial was related to either engagement or disengagement.

Learning from failure is not self-evident. While some researchers have highlighted failure as an opportunity for learning and for more sophisticated processing of learning material (Frese & Keith, 2015; Keith & Frese, 2005; Metcalfe, 2017), others say failure undermines learning because of the threat to self-worth in failure situations and the accompanying negative emotions (Eskreis-Winkler & Fishbach, 2019). Ego-threatening experiences may lead to attempts to hide or even deny the failure to defensively protect oneself from the costs of publicizing it (Eskreis-Winkler & Fishbach, 2020). We consistently found the suppressive regulation of emotions was related to denial. However, emotions may carry important information, and in this specific context, they may signal a gap between what one has achieved or mastered and what one aspires to achieve or master. Emotional integration may allow one to benefit from this information because it involves a more adaptive set of responses.

We found the tendency to explore negative emotions receptively and perceive them in a non-judgmental manner was consistently associated with seeking social support (rather than hiding or denying emotions) and viewing failure as an opportunity for growth. These findings suggest integrating emotional experiences with other aspects of the self – such as goals, values, and needs – may help individuals benefit from social support and adopt adaptive attitudes towards failure, free from the judgmental burden that often accompanies such experiences. Given these links between emotional integration and adaptive responses to failure, it is not surprising that emotional integration consistently predicted learning from failure and future engagement following failure, even after accounting for prior engagement before the exam (Time 1).

Dysregulation consistently correlated with rumination, and through rumination, it had a negative indirect effect on learning from failure. Study 2 supported the hypothesis that rumination mediates the link between dysregulation and disengagement, aligning with Tulis and Dresel's (2012) finding that rumination does not facilitate adaptive error reactions. While the negative associations we found for dysregulation were not surprising and replicate past findings, the results for suppressive emotion regulation warrant special attention.

The results for suppressive emotion regulation warrant special attention. Suppressive regulation of negative emotions may appeal to educators because it signifies control; unlike dysregulation, it allows students to manage their temper and avoid outbursts. However,

extensive research has shown its costs in relationships and cognitive processing (Gross, 2002; Roth et al., 2014). Our studies extend these findings to the context of learning, but with an important nuance. Specifically, we found an inconsistent mediation (suppression effect): while suppressive regulation was negatively related to learning from failure through the mediation of denial, its direct effect, once denial was controlled, was significant and positive. This finding may highlight a critical distinction between our conceptualization of suppression and the Process Model's definition of expressive suppression (Gross, 2002). While Gross focuses on the modulation of emotional expression (hiding outward signs), the suppressive style examined here involves a broader tendency to avoid the internal experience of negative emotion. Our results suggest that the 'cost' to learning stems primarily from this experiential avoidance, which is in this context consistently related to denial of the experience of failure. Once this defensive denial is statistically removed, the residual capacity to down-regulate intense emotion may allow learning from failure. Thus, while suppression as an attempt to avoid emotional experience hinders learning by blocking the informational value of failure, suppression-as-regulation (when decoupled from denial) may enable the persistence required to identify one's weaknesses. Given the weak suppression effect, this explanation remains speculative and should be interpreted with caution.

Sharabi and Roth (2024) similarly found suppressive regulation was negatively related to help-seeking and positively related to blaming others. We therefore suggest a trait-like tendency to avoid negative emotions may make it difficult to adaptively process experiences that elicit such emotions, as ego-threatening experiences are likely to hinder the use of negative emotions as information and impede a non-judgmental approach to failure. Thus, while suppression may enable engagement and persistence after failure, this engagement does not necessarily involve learning from the failure itself, such as identifying one's strengths and weaknesses, since avoiding negative emotions may prevent individuals from fully processing and reflecting on their failures.

5. Limitations and future research

Despite its strengths, such as measuring changes in engagement over time by controlling for initial outcome measures in Study 2, the present research has some limitations. First, we selected failures in important courses to ensure they were meaningful and likely to elicit negative emotions challenging regulation. However, we did not assess students' subjective appraisals of importance, which may affect both emotion regulation and constructive responses, potentially related to the observed associations. Second, only Study 2 controlled for initial engagement levels, allowing a stronger test of the predicted effects, whereas Study 1 did not account for initial levels of learning from failure, as failure experiences and responses were assessed only once. Consequently, Study 1 provides a weaker test of the predicted relationships. Third, because neither study controlled for initial levels of the mediator, the mediation analysis was less than optimal (Maxwell & Cole, 2007). Fourth, we measured the regulation of stress and anxiety, but future research should also consider other emotions that may arise in failure situations, such as frustration and disappointment. Fifth, incorporating objective indicators of academic performance, such as grades over time, would provide a more robust test of the associations between emotion regulation styles, learning from failure, and achievement. Finally, In the present study we treated emotion regulation styles as relatively stable person characteristics. However, recent research highlights substantial intraindividual variability (or flexibility) in emotion regulation, suggesting that individuals possess a repertoire of strategies and can flexibly deploy them depending on situational demands (Hu & Tamir, 2025). By not accounting for such variability, our study may overlook important aspects of emotion regulation adaptivity.

To address these limitations and strengthen causal interpretations, future research would benefit from adopting more rigorous methodological designs. One promising direction is the use of longitudinal designs in which mediators and outcomes are assessed across multiple time points, thereby clarifying the temporal ordering of effects. Another valuable approach would be experimental designs in which either emotional integration or the experience of academic failure is systematically manipulated. Such designs would allow researchers to move beyond correlational evidence, examine the causal trajectory of emotion regulation processes following failure, and lay the groundwork for developing effective interventions.

6. Summary

In sum, learning from failure is not always straightforward, partly because of the negative emotions elicited by failure. Our studies suggest that the way students regulate their negative emotions in learning contexts plays an important role in their ability to benefit from academic failure. Suppressive emotion regulation, which involves hiding or avoiding negative emotions, generally does not contribute to learning from failure, possibly because of the difficulty of processing and learning from an experience with which one does not fully engage. However, our findings reveal a suppression effect (inconsistent mediation): while suppressive regulation hinders learning when it is driven by experiential avoidance and denial, the underlying capacity to down-regulate intense affect may support learning once that defensive denial is controlled.

Dysregulation undermines academic engagement following failure because dysregulated responses are disorganized and ineffective. In contrast, emotional integration, the tendency to be receptive to and explore one's negative emotions, contributes to both learning from failure and engagement. This may stem from the tendency to view emotions as informational and to engage non-judgmentally in the painful experience of failure.

CRediT authorship contribution statement

Yonatan Sharabi: Writing – original draft, Project administration, Methodology, Formal analysis, Data curation. **Yaniv Kanat-Maymon:** Methodology, Formal analysis. **Guy Roth:** Writing – review & editing, Supervision, Resources, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Note

During the preparation of this work the authors used ChatGPT solely for language editing purposes (e.g., grammar and style). After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of competing interest

We have no conflict of interest to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.learninstruc.2026.102385.

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