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"A Continuous Process" and "Three Stages" : An Analysis of the Causes of Emotional Dysregulation in Depressed Adolescents

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Date: 2024-03-10T00:00:00+00:00

Abstract

The increasing early onset of depression has drawn considerable attention to emotional dysregulation in adolescents. Emotion regulation ability, as a key factor for emotional stability, enables adolescents to effectively manage their emotional states; meanwhile, the dynamic nature and multi-stage processing characteristics of emotion regulation constitute important components thereof, and research on these aspects facilitates a systematic elucidation of the features and causes of emotional dysregulation in depressed adolescents. The extended process model divides emotion regulation into three stages—identification, selection, and execution—emphasizing the inter-influential relationships between stages and reconstructing the dynamic process of emotion regulation. Based on this model, a review of the characteristics of depressed adolescents across these three stages of emotion regulation reveals deficits at each stage. Given the integrity and continuity of the three stages, to clarify which stage' s impairment or interruption in emotional dysregulation among depressed adolescents affects subsequent stages, the extent of such influence, and whether guided interventions can alter this impact, future research could: 1) combine EEG technology with drift-diffusion models to reconstruct the dynamic change process of emotion regulation; 2) more comprehensively investigate characteristics of adolescents with varying levels of depressive symptom severity; and 3) focus on the duality of abnormal emotional reactivity to more systematically reveal the causes of emotional dysregulation in depressed adolescents, thereby exploring intervention pathways and measures for emotional dysregulation in this population.

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Full Text

"A Continuous Process" and "Three Stages" : An Analysis of the Causes of Emotional Dysregulation in Depressed Adolescents

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Abstract

The increasing prevalence of depression among younger populations has drawn considerable attention to emotional dysregulation in adolescents. Emotional regulation ability serves as a critical factor for emotional stability, enabling effective management of one' s emotional state. The dynamic nature and multi-stage processing characteristics of emotion regulation constitute essential components of this construct, and investigating these features facilitates a systematic elucidation of the characteristics and underlying causes of emotional dysregulation in depressed adolescents. The Extended Process Model (EPM) divides emotion regulation into three stages—identification, selection, and implementation —emphasizing the interdependent relationships between stages and thereby capturing the dynamic nature of emotion regulation. Based on this model, we examined the characteristics of depressed adolescents across these three stages of emotion regulation and found deficiencies in each stage. Given the holistic and continuous nature of these three stages, future research should systematically investigate which specific impairments or disruptions in emotional dysregulation affect subsequent stages, the extent of these effects, and whether directive interventions can alter these impacts. To achieve this goal more comprehensively, we propose: (1) integrating EEG technology with drift diffusion models to reconstruct the dynamic process of emotion regulation; (2) conducting more comprehensive investigations of adolescents with varying levels of depressive symptoms; and (3) focusing on the dual aspects of abnormal emotional reactivity to more systematically reveal the causes of emotional dysregulation in depressed adolescents, thereby exploring intervention pathways and measures.

Keywords: depression, emotion regulation, adolescents, the extended process model

Received: 2022-05-18
This research was supported by the Henan Provincial Philosophy and Social Science Planning Project (2021BJY003), Henan Provincial Key R&D and Promotion Special Project (Science and Technology Tackling) (222102320007), Henan Provincial Songshan Laboratory Pre-research Project (YYJC012022010), and NingboTech University Talent Introduction Fund Project (20231101Z0074).
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Depression encompasses both depressive tendency and major depressive disorder (He Zhenhong & Zhang Dandan, 2018). Major depressive disorder (MDD), as the typical representative of depressive disorders, is also known as Major Depressive Disorder (American Psychiatric Association, 2013). Like other mental disorders, depression follows a developmental trajectory: from complete health to major depression, individuals typically pass through a stage of depressive tendency, also termed subthreshold depression (SubD), where depressive symptoms are present but do not meet clinical diagnostic criteria (Judd, 1994). Notably, without timely and appropriate intervention, this population is at high risk of developing major depression. In recent years, increasing life pressures and accumulated negative emotions without adequate resolution have led to a growing number of individuals with depressive tendencies, with a trend toward younger age groups. Research indicates a gradual increase in the prevalence of depressive tendencies among adolescents (Wang Mengyang, 2021). According to the *China National Mental Health Development Report (2019-2020)*, the detection rate of depression among adolescents in 2020 was 24.6%, with mild depression at 17.2% and severe depression at 7.4%. The recently released *2022 National Depression Blue Book* further revealed that individuals under 18 years old account for 30% of all depression patients. These statistics underscore the severity and urgency of adolescent depression. Moreover, adolescence represents not only a high-risk period for depression (Hou Jinqin & Chen Zhiyan, 2016) but also the optimal window for intervention (Ahmed et al., 2015), making it crucial to seize this critical period for timely and appropriate adjustments.

Adolescence (ages 11-18, Sawyer et al., 2012) is marked by a series of physiological, cognitive, emotional, and social changes that render this transitional period critical for the development of emotion regulation. First, from a developmental perspective, adolescents experience dramatic physiological and physical changes, growing desires for independence, and face academic and occupational pressures alongside fluctuating social relationships—challenges that often elicit intense emotional responses and significant stress (Casey et al., 2010). Second, cognitively, the executive functions and behavioral decision-making capacities required for emotion regulation develop rapidly during adolescence (Dumontheil, 2014). However, prefrontal regions lag behind the development of limbic structures such as the amygdala, ventral striatum, and orbitofrontal cortex (Somerville & Casey, 2010), resulting in relatively weaker emotion regulation abilities. Taken together, heightened emotional reactivity combined with immature regulatory capacities likely renders adolescents more vulnerable to emotional dysregulation (Ahmed et al., 2015). Additionally, research on developmental trajectories of depressive emotions among Chinese adolescents indicates a linear increase in depressive emotions for both males and females between ages 10 and 19 (Hou Jinqin & Chen Zhiyan, 2016), establishing adolescence as a high-risk period for emotional problems, particularly depression.

The core symptoms of depression manifest primarily in two dimensions: depressed mood and anhedonia (Zhao Cancong et al., 2017; Aldao et al., 2010), indicating that depressed individuals exhibit deficits and poor outcomes in reg-

ulating both negative and positive emotions. Emotion regulation refers to the process by which individuals attempt to influence which emotions they have, when they have them, and how they experience and express these emotions (Gross, 2015). The early classic Emotion Regulation Process Model posited that emotion regulation can occur at any stage of emotion generation and proposed five categories of strategies operating at different phases of emotion emergence (Gross, 1998). However, this model essentially describes only emotion generation rather than the complete emotion regulation process. In reality, emotion regulation is a dynamic process that endows personal experiences with intrinsic meaning and expresses emotions through the collaborative interplay of physiological, cognitive, and behavioral components (Waters & Thompson, 2014). Nevertheless, current research on emotion regulation in depressed adolescents has predominantly focused on isolated stage-specific characteristics, such as which regulation strategies are selected and their usage frequency (Zhang Shaohua et al., 2020). This fragmented approach, which examines the complete emotion regulation process in isolation, not only neglects the process-oriented and dynamic nature of emotion regulation but also fails to systematically capture the full characteristics of how depressed adolescents regulate emotions. Therefore, to more deeply investigate the features and causes of emotional dysregulation in depressed adolescents, it is necessary to integrate the latest theoretical models of emotion regulation to examine differences between depressed and healthy adolescents throughout the entire emotion regulation process.

2 The Extended Process Model of Emotion Regulation

The Extended Process Model of Emotion Regulation (EPM) builds upon the classic emotion regulation process model by incorporating the influences of temporal dynamics and contextual factors on the emotion regulation process (Gross, 2015). It defines emotion regulation as a dynamic, multi-stage process in which regulation strategies are implemented and monitored over time to achieve individual regulatory goals (Huang Yufei et al., 2022; Gross, 2015; Lincoln et al., 2022; Sheppes et al., 2015). Within this framework, emotion generation and regulation are modeled as two distinct yet interacting processes. When external or internal environmental stimuli are perceived and evaluated as goal-congruent, emotion generation operates as a primary appraisal system, producing emotional responses. Over time, these emotional responses feed back into the internal and external environment, influencing subsequent emotional processes. When emotional responses are incongruent with individual goals, a secondary appraisal system—emotion regulation—is activated to interact with the emotion generation process (Gross, 2015). Consequently, the target of emotion generation is specific stimuli in the environment, whereas the target of emotion regulation is the emotion generation process itself.

The EPM not only explains how emotion regulation initiates, how specific strategies are selected and implemented, but also identifies when the emotion regulation process fails when individuals do not successfully adapt to emotions (McRae

& Gross, 2020; Sheppes et al., 2015). Specifically, the model conceptualizes emotion regulation as a series of appraisal stages: the identification stage, selection stage, and implementation stage, with each stage comprising three sub-steps: perception, evaluation, and action (Lincoln et al., 2022). The entire emotion regulation process begins with the identification stage, which determines the direction of subsequent regulation and essentially constitutes the process of establishing emotion regulation goals. Individuals must engage skills such as emotional awareness and clarity (perception sub-step) to decide whether to regulate an emotion based on discrepancies between current and target emotional states, prior experiences, and potential benefits of regulation. Additionally, this step requires self-efficacy (evaluation sub-step), and only after obtaining positive evaluation results will the goal to regulate emotions be activated (action sub-step). The activation of emotion regulation goals triggers the selection stage, where individuals perceive and evaluate available strategies based on accessible resources, the quality and intensity of emotions, and the costs and benefits of specific strategies, ultimately selecting an appropriate strategy from multiple options. Thus, the selection stage determines how individuals effectively modify emotions in the identified direction (Sheppes et al., 2015). Accordingly, the desired emotional state (emotion regulation goal) and the method for changing emotions (emotion regulation strategy) create the conditions for generating regulation outcomes in the implementation stage (Li Hong et al., 2019). Activation of the selected overall strategy induces the implementation stage, which involves translating the chosen strategy into appropriate sub-strategies for emotion regulation based on specific contexts after strategy selection (McRae et al., 2012).

In actual situations, these three stages interact and influence one another: behaviors generated from a specific appraisal stage become the context for the next appraisal stage, inducing new appraisal stages. This reflects the crucial dynamic characteristic of the entire appraisal system. When emotion regulation is successful, this process cycles repeatedly, and only when the discrepancy between the individual' s target state and the altered context falls below a certain threshold—i.e., when the regulation goal is achieved (e.g., the individual no longer feels disgust)—does the appraisal system cycle cease, demonstrating that this is a continuous, iterative process (Williams et al., 2018). Conversely, Sheppes et al. (2015) also describe potential stages where emotion regulation deficits may emerge: emotion regulation may be impaired at the identification stage (e.g., when emotional states are misunderstood or distorted, or when prior experiences result in low self-efficacy for emotion regulation), potentially leading to failure in initiating regulation; deficits at the selection stage (e.g., inadequate representation of available strategies, overvaluation of maladaptive strategies) may result in selecting ineffective strategies; and failures at the implementation stage (e.g., misevaluation of specific regulation strategies) may produce poor or ineffective final regulation outcomes.

In fact, the EPM reflects the important role of cognitive flexibility in emotion regulation (Genet & Siemer, 2011; Ochsner & Gross, 2007). Cognitive flexi-

bility, as part of a broader set of executive functions, refers to an individual' s capacity to modify thoughts and behaviors according to goals and changing situational demands (Meiran, 2010). Research has found that cognitive flexibility can predict the effectiveness of cognitive reappraisal when individuals are instructed to regulate emotions under both negative and positive emotion inductions (Malooly et al., 2013). Specifically, when instructed to down-regulate negative emotions, attention shifts more effectively from processing the affective aspects of negative material to non-affective aspects, and when instructed to up-regulate positive emotions, attention shifts more effectively from processing the non-affective aspects of positive material to affective aspects. This entire process is also associated with self-efficacy in cognitive reappraisal (Grol & de Raedt, 2020; Malooly et al., 2013).

The EPM captures the multi-stage processing and dynamic nature of emotion regulation, holding significant importance for investigating individual characteristics of emotion regulation. However, upon reviewing previous research, only a few studies have integrated the EPM. For example, some researchers simulated the dynamic emotion regulation process at the monitoring stage of the EPM and found that when negative emotions are high, individuals monitor their regulation effectiveness and choose to switch emotion regulation strategies, which partially supports the conceptualization of the EPM (Murphy & Young, 2020). Another study on somatic symptom disorders examined the dynamic regulation process in patients based on the EPM and noted that the model provides detailed distinctions of emotion regulation changes in patients, offering insights for improving therapeutic interventions for this population (Schnabel et al., 2022). Hughes et al. (2020) conducted a review of the relationship between personality traits and the three stages of emotion regulation based on the EPM, calling for future research to continue using theoretical frameworks (e.g., EPM) for literature integration. Crum et al. (2020), building upon research on stress mindset and stress reappraisal, combined the EPM to propose a comprehensive theoretical model of stress optimization: treating stress optimization as an intervention to guide individuals in flexibly identifying, selecting, and implementing regulation strategies consistent with optimizing stress responses to achieve valued goals.

In summary, this paper systematically reviews the characteristics of depressed adolescents across the three stages of emotion regulation based on the EPM and proposes future research directions for exploring relationships between stages. This approach not only provides a novel perspective for investigating the mechanisms through which depression impacts adolescent emotion regulation but also offers new insights and theoretical foundations for interventions targeting emotional dysregulation in depressed adolescents.

3 Emotion Regulation in Depressed Adolescents

Based on the definition of emotion regulation and the EPM, emotion regulation is essentially a dynamic, multi-stage processing mechanism in which the various

appraisal stages, though distinct, mutually influence one another (Gross, 2015). Therefore, this paper systematically reviews relevant research on emotion regulation in depressed adolescents according to the three stages delineated by the EPM, aiming to better investigate the characteristics of emotion regulation in this population by reconstructing the regulation process.

3.1 Establishment of Emotion Regulation Goals

The identification stage refers to the process where, after an environmental element activates an individual' s emotion generation appraisal system, the individual perceives and evaluates the emotion (as negative or positive) and decides whether regulation is needed and in which direction (up-regulation or down-regulation), thereby establishing specific action goals (Huang Yufei et al., 2022). However, at this stage, depressed adolescents exhibit negative cognitive processing biases toward information, specifically including attention bias, interpretation bias, and memory bias (Beck, 2008).

Attention bias refers to the phenomenon where individuals, when confronted with multiple stimuli, attend only to certain specific stimuli (Han Bingxue et al., 2020). Depression Cognitive Theory posits that compared to healthy populations, depressed individuals demonstrate more pronounced negative biases in cognitive patterns during information acquisition and processing of emotional stimuli (Ao et al., 2020; Beck & Weishaar, 1989). This theory is supported by numerous studies. For instance, research on adolescents as a vulnerable population indicates a significant positive correlation between attention bias and adolescent depression (Platt et al., 2017), and when stimulus duration is longer, depressed adolescents' selective bias toward negative stimuli becomes more pronounced (Hankin et al., 2010). These findings align with the Negative Potentiation Hypothesis, which suggests that depressed individuals show stronger emotional responses to negative emotional stimuli (Rottenberg et al., 2005). However, Emotion Context Insensitivity theory argues that depressed patients display emotional detachment from both positive and negative stimuli, manifested as reduced positive and negative emotional responses across physiological, behavioral, and self-report measures (Bylsma, 2020; Bylsma et al., 2008). From an evolutionary perspective, this may be because depression is a functional state characterized by disengagement that motivationally withdraws individuals from their environment (Nesse, 2000; Stretton et al., 2021). This theory' s hypothesis regarding positive stimuli aligns with the Positive Attenuation Hypothesis (Rottenberg et al., 2005). Research on depressed adolescents also supports these theories, showing that they typically experience a "positive blockade" —that is, their capacity for cognitive processing of positive emotions decreases, and the salience of positive stimuli declines (Zhang Ping et al., 2017). Overall, although different hypotheses and theories hold varying views on attention biases in depressed adolescents when facing stimuli of different valences, significant differences in attention bias between depressed and healthy adolescents when processing stimuli are well-established.

Depressed adolescents not only differ from their healthy peers in attention to stimuli but also exhibit negative interpretation bias toward stimuli. Beck (2008) noted in the negative schema model that interpretation is a critical step in the cognitive processing chain where external stimuli are understood and assigned "meaning." Depression Cognitive Theory also indicates that depression is associated with negative interpretation bias (Mathews & MacLeod, 2005). Existing research has found that compared to healthy controls, depressed patients are more likely to interpret neutral information negatively (Milders et al., 2010) and make more negative and fewer positive interpretations when facing ambiguous information (Everaert et al., 2017), a pattern confirmed in studies of adolescents with clinical depression (Orchard et al., 2016). Additionally, research has shown that adolescents with higher depression levels score lower on positive interpretation and higher on negative interpretation compared to those with lower depression levels (Klein et al., 2018). Furthermore, due to being in adolescence, depressed adolescents are more sensitive to peer acceptance and rejection and more likely to interpret ambiguous social stimuli as more negative or threatening (Platt et al., 2013). In summary, compared to healthy adolescents, depressed adolescents show a tendency toward more negative interpretation of stimuli, which may lead to less frequent use of positive reappraisal strategies and more repetitive negative thinking in subsequent emotion regulation (Everaert et al., 2020).

Furthermore, individuals' cognitive processing of stimuli is often linked to the activation of information in memory. Depressed patients typically prioritize remembering threatening or aversive negative stimuli, a tendency known as negative memory bias, which manifests primarily during memory encoding and retrieval stages. Specifically, during encoding, negative information receives deeper processing than neutral and positive information; during retrieval, the recognition criterion for negative information is lowered, allowing individuals to recognize more negative information (Zhu Yongze et al., 2014). Studies on adolescent populations have shown that compared to healthy controls, depressed adolescents are more likely to remember negative words, and this memory pattern deepens with age (Holt et al., 2016). Moreover, higher depression levels are associated with greater recall of negative self-referential words (Smith et al., 2018). This persistent negative memory pattern in depressed adolescents may hinder their later selection of effective adaptive emotion regulation strategies, preventing recovery from negative emotions and leading to persistent or worsening depressive symptoms (Delaney et al., 2020). This phenomenon is also observed in adolescents whose depressive symptoms have remitted (Yamamoto & Shimada, 2012).

The EPM indicates that at the identification stage, the perception sub-step' s task is to detect emotions, the evaluation sub-step's task is to determine whether the emotional valence is sufficiently negative or positive to activate emotion regulation, and the action sub-step subsequently activates emotion regulation goals (Gross, 2015). However, compared to healthy adolescents, depressed adolescents exhibit more negative attention, interpretation, and memory biases toward stim-

uli. Such perception and evaluation deficits may impair the establishment of emotion regulation goals, ultimately leading to emotion regulation failure.

3.2 Selection of Emotion Regulation Strategies

After establishing emotion regulation goals, individuals enter the selection stage. At this stage, individuals assess the feasibility of perceived emotion regulation strategies based on their own circumstances and current environment, ultimately selecting a specific strategy. The EPM suggests that if individuals perceive too few strategies, make erroneous evaluations of various factors, or become overly reliant on a particular strategy at this stage, it may lead to failure in subsequent regulation stages (Huang Yufei et al., 2022).

Numerous emotion regulation strategies exist, and current research on strategies used by depressed individuals has primarily focused on cognitive reappraisal and expressive suppression. The former is a typical cognitive change strategy that focuses on altering the meaning of a potential situation or changing one' s relationship to it (Kross & Ayduk, 2011), thereby enhancing or diminishing negative or positive emotions (Ochsner & Gross, 2008) and consequently increasing life satisfaction and subjective well-being (Liu Wen et al., 2020). Therefore, it is termed an adaptive emotion regulation strategy. Expressive suppression, conversely, is a response-focused strategy that regulates emotions by inhibiting behaviors associated with emotional responses (Goldin et al., 2008). Although this strategy can reduce behavioral expression of negative emotions, it intensifies physiological responses and sympathetic nervous system activity, leading to stronger negative emotional experiences and lower subjective well-being (Gross, 2010). Long-term use also increases the discrepancy between internal experiences and external expressions, thereby impairing social functioning (Huang Xushu & Luo Yuejia, 2010). Consequently, it is considered a maladaptive emotion regulation strategy (Sun Yan et al., 2020; Goldin et al., 2008). Research findings on strategy usage tendencies in depressed adolescents have been relatively consistent: more severe depressive symptoms in adolescents correlate with less use of adaptive strategies like cognitive reappraisal and more use of maladaptive strategies like expressive suppression, with subthreshold depressed adolescents' strategy usage falling between non-depressed and depressed adolescents (Zhang Shaohua et al., 2020; Schäfer et al., 2017).

At the strategy selection stage, the perception sub-step displays possible emotion regulation strategies, the evaluation sub-step assesses these strategies using contextual factors, and the final action sub-step activates the goal to use a specific strategy (Gross, 2015). As described above, depressed adolescents over-rely on maladaptive strategies such as expressive suppression at the perception sub-step, which reduces the pool of effective regulation strategies available for selection and consequently creates difficulties in emotion regulation. On the other hand, at the implementation stage of the EPM, the perception sub-step must perceive relevant features of the external world and various ways to implement specific strategies; the evaluation sub-step assesses these different sub-strategies

and selects the most promising one for implementation; and the action sub-step completes the output of final regulation effects. Without the action sub-step at the implementation stage, other emotion regulation stages would become nonfunctional. However, because depressed adolescents show a preference for maladaptive strategies at the selection stage, this also affects strategy implementation in the subsequent stage, rendering the emotion regulation process ineffective.

3.3 Implementation Effects of Emotion Regulation Strategies

After selecting a regulation strategy, individuals enter the final stage of the EPM —the implementation stage. Based on previous emotion regulation goals and selected strategies, individuals at this stage need to develop specific cognitive and behavioral plans before implementation (Sheppes et al., 2015).

The implementation effect of emotion regulation strategies essentially represents the effectiveness of emotion regulation, which is the focus of concern and the goal of clinical interventions. Existing research has found that when individuals regulate emotions spontaneously, healthy controls remain immersed in positive stimuli for longer durations, whereas depressed individuals more easily become immersed in negative stimuli and disengage from positive stimuli more quickly (Levens & Gotlib, 2010). Individuals recovered from depressive symptoms also tend to use expressive suppression more frequently during spontaneous emotion regulation, with significantly poorer regulation effects compared to normal controls (Ehring et al., 2010). Additionally, researchers have found that after encountering negative events, depressed adolescents show stronger anterior insula activation compared to healthy control adolescents (Jankowski et al., 2018), indicating that depressed adolescents experience more intense negative emotions and poorer emotion regulation outcomes (Mo Licheng et al., 2021; He et al., 2020). These findings demonstrate that interactive effects exist among the appraisal stages of the EPM, where cognitive processing biases and inappropriate strategy selection in the first two stages significantly impact the emotion regulation effectiveness of depressed adolescents. However, individuals' cognitive processing habits are difficult to change, suggesting that targeting strategy selection may be an effective approach for improving emotional dysregulation in depressed adolescents.

Research has found that compared to other strategies such as expressive suppression and rumination, cognitive reappraisal demonstrates good evolutionary and environmental adaptability, represents the most effective method for improving emotional states, and is particularly suitable for treating emotion regulation deficits in depressed patients (Cheng Li et al., 2009; Huang Xushu & Luo Yuejia, 2010; Mo Licheng et al., 2021; He et al., 2020; Ochsner et al., 2015). Therefore, researchers have questioned whether guiding depressed individuals to use effective emotion regulation strategies can enhance their regulation effectiveness and reduce differences from healthy individuals. However, current research on this topic has yielded inconsistent conclusions. Behavioral studies by

Ehring et al. (2010) found that recovered depressed patients could use cognitive reappraisal to reduce negative emotions under guidance, with effectiveness not significantly different from controls. In EEG research, the Late Positive Potential (LPP) is sensitive to emotional stimuli and regulation instructions, making it a commonly used component for studying controlled processing of emotional stimuli and allowing examination of cognitive reappraisal implementation effects (Hajcak et al., 2010). Studies have shown that although mild-to-moderate depressed patients can use cognitive reappraisal under guidance to reduce negative emotional experiences, with significantly decreased LPP amplitudes, these amplitudes remain larger than those of normal subjects, indicating that while cognitive reappraisal is somewhat effective for mild-to-moderate depressed patients, their emotion regulation capacity remains lower than healthy individuals (Zhang Kuo et al., 2016). On the other hand, regarding regulation strategies for positive emotions, Krompinger et al. (2008) found that cognitive reappraisal use could not enhance individuals' responses to positive emotional stimuli to elicit larger LPP amplitudes, whereas Langeslag and van Strien (2010) found that cognitive reappraisal could increase LPP amplitudes elicited by positive emotional stimuli. Additionally, research by Wang Xiaoxia et al. (2015) demonstrated that although depressed adults could use cognitive reappraisal to enhance and diminish positive emotions on behavioral measures, abnormal activation was observed in emotion regulation-related brain regions (orbitofrontal cortex, temporal lobe) during positive emotion regulation. Studies on enhancing positive emotions in adolescents further found that adolescents could not use cognitive reappraisal to strengthen LPP amplitudes elicited by positive emotional stimuli (Deng Xinmei, 2014; Sai Liyang, 2016). However, research exploring the effects, characteristics, and underlying neural mechanisms of cognitive reappraisal for enhancing positive emotions in depressed adolescents is still lacking, representing a key focus for our future research.

4 Future Research Directions

This paper systematically reviewed differences in emotion regulation between depressed and healthy adolescents from the perspective of the EPM, revealing deficits in depressed adolescents across all three stages of emotion regulation. Given the interactive effects among appraisal systems—where maladaptive characteristics exhibited by depressed adolescents at earlier stages affect their performance at subsequent stages—this paper proposes several future research directions to clarify which stage disruptions impact subsequent stages and whether directive interventions can alter these effects.

4.1 Holistic and Continuous Nature of Emotion Regulation

The EPM proposes that each of the three emotion regulation stages involves different decision points, meaning that each stage contains potential critical points for regulation failure, and failure at any stage impacts subsequent stages and the entire regulation process (Gross, 2015). Therefore, deficits in early

emotional cognitive processing and strategy selection in depressed adolescents likely contribute to poor regulation outcomes at the strategy implementation stage. However, research exploring the dynamic impact of depression on the entire continuous process of emotion regulation is still lacking.

From a reinforcement learning perspective, emotion regulation can be viewed as a series of behavioral decision-making processes aimed at achieving desired emotional states: individuals' decisions are often accompanied by outcome feedback, which in turn influences subsequent decision-making behaviors (Yu Tengxu, 2019; Etkin et al., 2015). The Drift Diffusion Model (DDM) further posits that human behavioral decisions involve an information accumulation process; when accumulated information exceeds a certain threshold, a decision is made. During this information accumulation process, "noise" exists that affects decision speed and outcomes, transforming what would be stable and rapid choices with certain value tendencies into circuitous and repetitive processes (Ratcliff et al., 2016). Given that emotion regulation is theoretically (Westen & Blagov, 2007) and empirically (Heilman & Miclea, 2015) related to decision-making, this model' s application to emotion regulation actually reflects the dynamic and holistic nature of the regulation process and the continuity between stages. The "noise" in the process may represent attention, interpretation, and memory biases toward emotional stimuli, or biases in strategy selection. Therefore, research incorporating the DDM can help reconstruct individuals' emotion regulation processes. A recent study combined this model with emotion regulation, decomposing behavior after guided cognitive reappraisal into underlying dynamic processes representing different cognitive-emotional components: initial affective bias when viewing aversive stimuli and subsequent decision-making processes when evaluating emotional responses (Warren et al., 2020). This study demonstrated that guided cognitive reappraisal can effectively regulate emotions by altering DDM parameters (Seo & Oemisch, 2020). Future research could extend this approach to studies of emotional dysregulation in depressed adolescents, exploring characteristics at each stage of their emotion regulation to propose more targeted intervention methods.

4.2 Comprehensiveness of Symptom Levels

Reviewing previous research on emotion regulation in depressed adolescents reveals inconsistent findings, resulting in a lack of uniformity and comparability across studies. Although Timbremont et al. (2008) argue that no significant differences exist in memory bias among currently depressed, never-depressed, and remitted depressed adolescents, other research suggests that varying depression levels may contribute to differences in attention (Liu Hejun & Yang Haibo, 2019), interpretation (Klein et al., 2018), and memory biases (Smith et al., 2018), as well as differences in the frequency (Zhang Shaohua et al., 2020) and effectiveness (Shapero et al., 2018) of emotion regulation strategy use. Therefore, disagreement remains regarding whether guided cognitive reappraisal is effective for improving emotion regulation capacity in depressed adolescents,

perhaps precisely because the severity of depressive symptoms targeted in various studies differs. Based on the EPM' s proposition that the three stages of emotion regulation have causal and mutually influential relationships, research on emotion regulation effectiveness in depressed adolescents must consider the depression severity of study participants. Moreover, given that a substantial proportion of adolescents currently exhibit depressive symptoms without meeting diagnostic criteria for major depression, and that this population carries high risk for developing major depression, increased attention and in-depth research on this group are warranted. Only through such efforts can timely interventions be effectively implemented to prevent symptom exacerbation.

4.3 Dual Nature of Abnormal Emotional Reactivity

Integrating the aforementioned theories and research findings, inconsistent perspectives exist regarding how depressed adolescents establish regulation goals for stimuli of different valences at the identification stage. Specifically, Emotion Context Insensitivity theory' s views on regulating negative stimuli contradict the Negative Potentiation Hypothesis, while its views on regulating positive stimuli align with the Positive Attenuation Hypothesis (Bylsma, 2020; Bylsma et al., 2008; Rottenberg et al., 2005). At the strategy selection stage, Zhang Shaohua et al. (2020) also found that emotion regulation strategy use may be influenced by the valence of the emotion being regulated. Specifically, when regulating negative emotions, adolescents' depressive symptoms show significant positive correlations with expressive venting strategy use, whereas this relationship does not exist when regulating positive emotions. The above two stages both show differences depending on the valence of emotions being regulated, yet current research on depressed adolescents at the strategy implementation stage has primarily focused on down-regulating negative emotions, with few studies examining positive emotion regulation (Wang Xiaoxia et al., 2015; van Kleef et al., 2022). Consequently, a comprehensive understanding of whether and how positive emotion regulation effectiveness in depressed adolescents is influenced by the first two stages remains elusive. In fact, from the dual emotion perspective of depression, emotional dysregulation in depressed adolescents manifests primarily in two aspects: persistent low mood and loss of pleasure, with the latter corresponding specifically to poor effectiveness in up-regulating positive emotions (Hayes et al., 2015). Given that positive emotions also hold significant importance for mental health and social functioning, future research on emotional dysregulation in depressed adolescents should strengthen its focus on positive emotion regulation to better reconstruct the characteristics of emotion regulation in this population and identify optimal intervention methods.

4.4 Feasibility of Intervention Measures

Although differences in depression severity among participants across studies prevent effective comparison of results, overall findings indicate that when depressed individuals receive guidance to understand effective emotion regulation

strategies and their usage, they can employ cognitive reappraisal to regulate negative emotions to some extent (Zhang Kuo et al., 2016; Hajcak et al., 2010; Shapero et al., 2018). Currently, to address the deficit of depressed individuals' tendency to select maladaptive strategies, clinical psychologists have proposed numerous cognitive therapeutic approaches. Among these, Cognitive Behavioral Therapy (CBT) is the most commonly used method in existing psychotherapies for depression, demonstrating good efficacy for mild depression. CBT focuses on identifying and modifying negative thoughts, transforming dysfunctional cognitions into more adaptive ones through cognitive restructuring and behavioral experiments (Spinhoven et al., 2018). In terms of core principles, cognitive reappraisal strategy training shares striking similarities with CBT. Based on the process-oriented and dynamic characteristics of emotion regulation, providing guided cognitive reappraisal training to depressed patients—i.e., guiding them to select adaptive strategies at the strategy selection stage to regulate their emotions—would help them more effectively identify negative thoughts and beliefs, improve their responses and evaluations to negative events, and thereby enhance emotion regulation effectiveness and environmental adaptation capacity. Moreover, existing research has shown that guided cognitive reappraisal interventions can also reduce negative emotional experiences in children and adolescents (Liu Wen et al., 2020). Therefore, future research can investigate the impact of guided cognitive reappraisal interventions on adolescent emotion regulation, providing continuously optimized new insights for future intervention measures.

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