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Clustering Adolescent Emotion Regulation Profiles via Gaussian Mixture Models

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A B S T R A C T

Objective: The objective of this study was to identify and characterize the latent profiles of cognitive and habitual emotion regulation strategies among a normative adolescent sample utilizing a person-centered analytical framework.

Methods and Materials: This cross-sectional study involved a sample of $N = 845$ Greek adolescents (aged 12to 18years) recruited via cluster sampling. Participants completed the validated Greek translations of the Cognitive Emotion Regulation Questionnaire (CERQ) and the Emotion Regulation Questionnaire (ERQ). Data were analyzed using Gaussian Mixture Modeling (GMM) to identify unobserved, multivariate configurations of emotion regulation strategies. Model fit indices, including the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and entropy, were utilized to determine the optimal number of latent profiles (denoted as k).

Findings: The GMM analysis revealed a $k = 3$profile solution as optimal. The largest group, labeled Adaptive Regulators (42%, $n = 355$), exhibited high use of constructive strategies (e.g., cognitive reappraisal) and low use of detrimental strategies. Maladaptive Regulators (27%, $n = 228$) were characterized by high levels of catastrophizing, rumination, and expressive suppression, alongside deficits in adaptive coping. The remaining Average Regulators (31%, $n = 262$) demonstrated mean-level scores across all assessed dimensions. Demographic analyses indicated a significant association between biological sex and profile membership ($\chi^2 = 24.56$, $p < .001$), with females significantly overrepresented in the Maladaptive Regulators profile. No significant differences were observed across early versus late age groups ($\chi^2 = 4.12$, $p = .127$).

Conclusion: Adolescents do not utilize emotion regulation strategies in isolation but rather deploy complex, distinct multivariate configurations. Identifying these latent profiles highlights the critical vulnerability of the maladaptive subgroup and underscores the necessity for targeted, personalized mental health interventions, such as tailored cognitive-behavioral or socio-emotional therapies, to mitigate psychopathology risk and promote normative developmental trajectories.

Keywords: *Adolescence, Emotion Regulation, Gaussian Mixture Models, Latent Profile Analysis, Mental Health, Person-Centered Approach.*

1. Introduction

Adolescence represents a critical developmental epoch characterized by profound biological, cognitive, and psychosocial transformations. Central to navigating this transitional period is the maturation of emotion regulation, defined as the intrinsic and extrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions to accomplish individual goals. The capacity to effectively regulate emotions is paramount for adolescent mental health, serving as a fundamental determinant of both psychological well-being and susceptibility to psychopathology (Li, 2025). During this developmental window, the neurobiological circuitry governing emotional reactivity undergoes rapid changes, often outpacing the development of the prefrontal cognitive control systems required for top-down emotional modulation. Consequently, adolescents are particularly vulnerable to emotion dysregulation, which transcends simple executive dysfunction and manifests as a distinct vulnerability factor across a spectrum of psychological domains (Seymour, 2025). The profound impact of emotion regulation strategies on overall adolescent mental health cannot be overstated, as these mechanisms dictate how young individuals process stress, build resilience, and interact with their evolving social environments (Nguyen et al., 2025). Furthermore, the intricate relationship between meta-emotions—how adolescents feel about their own feelings—and primary emotion regulation significantly influences resilience, particularly among vulnerable or neglected youth populations (Jesline et al., 2025).

The dichotomy between adaptive and maladaptive emotion regulation strategies is a focal point in developmental psychopathology. Adaptive strategies, such as cognitive reappraisal and problem-solving, are generally protective, whereas maladaptive strategies, including rumination, catastrophizing, and expressive suppression, are robustly linked to adverse psychological outcomes. For instance, the habitual reliance on maladaptive cognitive emotion regulation strategies has been shown to mediate the deleterious effects of childhood psychological maltreatment on the subsequent development of adolescent depressive symptoms (Wang et al., 2024). Similarly, longitudinal evidence highlights that early deficits in emotion regulation and executive functioning are predictive of escalating emotional and behavioral disorders as adolescents mature (T. Wright et al., 2024). The inability to tolerate ambiguity, a common cognitive stressor during adolescence, is also deeply intertwined with systemic emotional dysregulation, compounding the difficulty adolescents face when confronting uncertain future outcomes (D. Wright et al., 2024). Furthermore, longitudinal observations in clinical cohorts, such as youths diagnosed with obsessive-compulsive disorder, underscore that persistent emotion dysregulation is a central feature that exacerbates symptom severity over time (Thoustrup & et al., 2024).

Beyond internalizing symptoms, pervasive emotion dysregulation is a primary catalyst for severe and life-threatening externalizing behaviors, notably non-suicidal self-injury and suicidality. A systematic review of the literature confirms a strong, consistent relationship between deficient emotion regulation capabilities and the onset and maintenance of non-suicidal self-injury behaviors in adolescents (Tolan & Dersuneli, 2024). Multicenter studies further elucidate this dynamic, revealing that rumination, acting as a highly maladaptive cognitive regulation strategy, significantly amplifies the risk of non-suicidal self-injury among adolescents already suffering from clinical depression (He et al., 2025). The clinical picture becomes even more complex when considering suicidal ideation and tendencies. Research indicates that an intolerance of uncertainty drives suicidal ideation primarily through the pathway of maladaptive cognitive emotion regulation and the resulting unbearable psychological pain, termed psychache (Wu et al., 2025). A constellation of risk factors, encompassing systemic family dysfunction, cyberbullying, sleep disturbances, and fundamentally poor emotional regulation, synergistically elevate suicidal tendencies in this vulnerable demographic (Nikolić et al., 2025). Additionally, profiling adolescents who engage in self-harm reveals severe deficits in self-regulation, accompanied by heightened emotional symptomatology, substance use, and an increasing reliance on social networks as a compensatory, albeit destructive, coping mechanism (López-Martínez et al., 2025).

The contemporary landscape of adolescence is inextricably linked to the digital sphere, introducing novel contexts where emotion regulation is both tested and deployed. The ubiquitous use of smartphones and the internet has birthed modern psychological challenges, such as digital addiction and the fear of missing out. Maladaptive cognitive emotion regulation and experiential avoidance serve as crucial mechanisms linking personality traits, such as shyness, to the development of adolescent smartphone addiction, often exacerbated by a reliance on virtual rather than physical social support networks (Gao et al., 2025).

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Similarly, the fear of missing out—a pervasive anxiety in the digital age—fuels feelings of intense loneliness, a relationship that is significantly mediated by systemic emotion dysregulation and subsequent social media addiction (Türk & Koçyiğit, 2025). The realm of video gaming also intersects with these emotional processes. Deficits in cognitive emotion regulation are strongly associated with the escalation from recreational gaming to problematic video gaming during adolescence (Goagoses et al., 2025). However, the trajectory toward gaming addiction is not strictly isolated; perceived social support can modulate this relationship, highlighting the complex interplay between a youth's social environment, their emotional regulation capacity, and their digital behaviors (Naeem et al., 2025).

The development of adolescent emotion regulation is deeply embedded within their social ecology, particularly the family unit and peer networks. The socialization of negative emotions by parents acts as a critical moderating factor; parental responses to a child's distress can either buffer or exacerbate the link between adolescent impulsivity and subsequent emotion dysregulation (Friedman & Mezulis, 2025). Discrepancies in how mothers and adolescents perceive emotion socialization highlight complex family dynamics, particularly in youths presenting with elevated internalizing symptoms (Zhao et al., 2024). Multi-informant approaches reveal that incongruence in recognizing maternal emotion socialization efforts directly correlates with poorer emotion regulation outcomes in early adolescents, emphasizing the need for cohesive family communication (Zhao et al., 2025). Beyond the family, broader environmental stressors, such as childhood trauma, cast long shadows over adolescent mental health. The devastating impact of such trauma on well-being is heavily shaped and filtered through the adolescent's evolving emotion regulation abilities, alongside peer pressure and the availability of community social support (Omopo, 2025). Interestingly, the regulatory mechanisms developed in these social contexts also spill over into academic environments. For example, in educational settings, adaptive emotion regulation strategies serve a vital mediating role, transforming external emotional support from teachers and peers into active engagement in specific learning contexts, such as English as a Foreign Language classrooms (Zhang et al., 2024).

Given the profound implications of emotion regulation, extensive research has focused on interventions designed to bolster these skills. Mindfulness-based interventions have shown promise in educational settings, significantly improving emotion regulation strategies and reducing psychological symptoms in young adolescents from the general population (Piguet et al., 2025). A comprehensive review of mindful exercises corroborates these findings, suggesting that such physical-cognitive practices effectively enhance emotional regulation and overall mental health (Lin, 2025). Technological advancements are also being harnessed for therapeutic purposes. Virtual reality platforms are emerging as innovative tools to improve both emotion regulation and executive function in at-risk adolescent populations by providing safe, controlled environments for emotional exposure and practice (Northrup, 2025). Similarly, serious games—digital applications designed for educational rather than purely entertainment purposes—have been systematically validated as effective modalities for supporting and training emotional regulation strategies in youth intervention programs (Gómez-León, 2025). In more severe clinical contexts, specialized therapies are essential. For adolescents diagnosed with borderline personality disorder, targeted approaches like Emotion-Focused Therapy and meta-diagnostic protocols have proven highly efficacious in reconstructing foundational emotion regulation skills (Shadfar et al., 2025). Furthermore, cutting-edge chronotherapeutic interventions are being piloted to target the underlying brain circuitry governing emotion regulation, aiming to rapidly alleviate symptoms and reduce suicide risk in youths suffering from bipolar disorder (Kim et al., 2025).

Despite the wealth of literature linking emotion regulation to various developmental and clinical outcomes, a significant methodological limitation persists: the vast majority of existing research relies heavily on variable-centered approaches. Traditional regression and structural equation models evaluate how isolated emotion regulation strategies (e.g., variable X) predict specific outcomes (e.g., variable Y) across an entire sample. While informative, this approach assumes population homogeneity and obscures the reality that adolescents do not use these strategies in isolation. Instead, youths employ complex, idiosyncratic combinations of both adaptive and maladaptive strategies simultaneously. To capture this complexity, there is a pressing need for person-centered analytical techniques, which focus on identifying unobserved, latent subpopulations—or profiles—of individuals who share similar multivariate configurations of emotion regulation behaviors.

Gaussian Mixture Models represent a robust, probabilistic clustering approach uniquely suited for this

purpose. Unlike traditional clustering techniques like K-means, Gaussian Mixture Models account for the covariance structure of the data and provide rigorous statistical criteria for determining the optimal number of $k$latent profiles. By shifting the analytical lens from the variables to the individuals, we can identify holistic typologies of adolescent emotion regulation. Understanding these distinct profiles is clinically imperative, as adolescents in a predominantly "maladaptive" cluster may require vastly different psychoeducational or therapeutic interventions compared to those in an "average" or "inconsistently adaptive" cluster. Identifying these hidden stratifications within the adolescent population will allow for more precise, targeted, and personalized mental health interventions, ultimately mitigating the risk of severe psychopathology and promoting normative developmental trajectories. Therefore, the present study aims to identify and characterize the latent profiles of cognitive and habitual emotion regulation strategies among a normative adolescent sample utilizing Gaussian Mixture Modeling techniques.

2. Methods and Materials

2.1. Study Design and Participants

The current research employed a quantitative, cross-sectional design to investigate the latent profiles of emotion regulation among adolescents. The target population comprised middle and high school students attending public and private educational institutions across various urban and semi-urban regions in Greece, primarily focusing on the broader metropolitan areas of Athens and Thessaloniki to ensure a socioeconomically diverse demographic representation. A multi-stage cluster sampling technique was utilized to recruit participants, resulting in an exact final sample of 845adolescents. The age of the participants ranged from 12to 18years, capturing the critical developmental window of early to late adolescence where emotional regulation strategies undergo significant maturation and crystallization. Prior to the commencement of the study, strict ethical guidelines were adhered to, in accordance with the Declaration of Helsinki. Institutional ethical approval was obtained from the relevant regional educational authorities and the university's ethics review board. Due to the minor status of the participants, written informed consent was mandatory and collected from the parents or legal guardians of all participating students, alongside the active, written assent of the adolescents themselves. Participants were explicitly informed about the voluntary nature of the study, their right to withdraw at any moment without any penalty, and the strict confidentiality and anonymity protocols applied to their responses.

2.2. Measures

To comprehensively capture the multifaceted nature of adolescent emotion regulation, the study utilized a rigorously validated battery of self-report psychometric instruments that had been culturally adapted and translated into the Greek language. The primary instrument employed was the Greek version of the Cognitive Emotion Regulation Questionnaire, a multidimensional tool designed to identify the conscious, cognitive components of emotion regulation strategies utilized after experiencing negative life events. Participants responded to the items on a five-point Likert scale ranging from 1(indicating almost never) to 5(indicating almost always). This questionnaire assesses nine distinct cognitive strategies, including adaptive strategies such as positive reappraisal, putting into perspective, and planning, as well as maladaptive strategies like rumination, catastrophizing, and self-blame. The Greek adaptation of this tool has demonstrated excellent psychometric properties in previous literature, and in the present study, the internal consistency was robust, yielding a Cronbach's alpha coefficient of $\alpha = 0.86$for the overall scale, with subscale reliabilities ranging from $\alpha = 0.74$to $\alpha = 0.89$. In addition to this, the Emotion Regulation Questionnaire was administered to evaluate the habitual use of two specific emotion regulation strategies: cognitive reappraisal and expressive suppression. Respondents rated their agreement with various statements on a seven-point Likert scale. Both instruments were administered in a paper-and-pencil format during regular school hours under the supervision of trained research assistants who were available to clarify any misunderstandings regarding the phrasing of the items.

2.3. Data Analysis

The collected data were subjected to rigorous preliminary screening to address missing values, identify multivariate outliers, and ensure adherence to the assumptions of normality. Missing data, which accounted for less than 3%of the total dataset, were handled using the full information maximum likelihood estimation method to preserve statistical power and minimize bias. Following data standardization, where all emotion regulation subscale scores were converted to z-scores to ensure comparability

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across different metrics, Gaussian Mixture Modeling was employed as the primary analytical framework. Gaussian Mixture Modeling is an advanced probabilistic, model-based clustering technique that assumes the observed data points are generated from a mixture of a finite number of underlying Gaussian distributions with unknown parameters. The Expectation-Maximization algorithm was utilized to estimate the parameters of the mixture models iteratively, calculating the posterior probabilities of cluster membership for each adolescent. To determine the optimal number of latent emotion regulation profiles, models specifying between one and six clusters were systematically estimated and compared. The selection of the best-fitting model was guided by a combination of statistical information criteria and theoretical interpretability. Specifically, the Bayesian Information Criterion and the Akaike Information Criterion were utilized, where lower values indicate superior model fit and parsimony. Furthermore, the Bootstrapped Likelihood Ratio Test was applied to statistically compare the estimated model with $k$clusters against a model with $k-1$clusters, with a significance threshold set at $p < 0.05$. Finally, entropy values were evaluated to assess classification accuracy, with values closer to 1.0indicating clear delineation between the extracted profiles. All statistical computations and mixture modeling procedures were executed using the R statistical programming environment, specifically leveraging the functionalities of the 'mclust' and 'tidyLPA' packages.

3. Findings and Results

Prior to conducting the primary mixture modeling analyses, preliminary descriptive statistics were computed to examine the central tendencies and dispersion of the emotion regulation strategies within the sample of 845adolescents. The data were screened for normality, and skewness and kurtosis values fell within the acceptable thresholds of $-2.0$to 2.0, indicating that the distribution of the variables was suitable for the subsequent analyses. Overall, adolescents in the current sample reported utilizing adaptive cognitive emotion regulation strategies, such as positive reappraisal and planning, more frequently than maladaptive strategies, such as catastrophizing and self-blame. Table 1 presents the raw means, standard deviations, skewness, and kurtosis for the nine subscales of the Cognitive Emotion Regulation Questionnaire and the two subscales of the Emotion Regulation Questionnaire. Bivariate correlation analyses, while not tabulated here due to space constraints, revealed expected significant positive associations among the adaptive strategies (with Pearson's $r$ranging from 0.32to 0.58, $p < 0.001$) and among the maladaptive strategies (ranging from 0.28to 0.61, $p < 0.001$), supporting the construct validity of the measures within this Greek adolescent cohort.

Table 1

Descriptive statistics of emotion regulation strategies (N=845).

Variable	M	SD	Skewness	Kurtosis
Positive Reappraisal	3.54	0.82	−0.41	−0.12
Putting into Perspective	3.31	0.91	−0.25	−0.34
Planning	3.48	0.85	−0.38	−0.18
Acceptance	3.15	0.78	−0.11	−0.05
Rumination	2.95	0.94	0.15	−0.42
Catastrophizing	2.31	1.05	0.58	−0.11
Self-Blame	2.55	0.98	0.34	−0.28
Other-Blame	2.42	0.88	0.29	−0.15
ERQ-Reappraisal	4.85	1.12	−0.55	0.22
ERQ-Suppression	3.92	1.25	0.08	−0.51

To identify the latent emotion regulation profiles, Gaussian Mixture Models were estimated specifying between 1and 6latent classes. The standardized z-scores of all eleven emotion regulation variables were used as indicators in the models. Table 2 details the fit indices for each model. The Akaike Information Criterion and the Bayesian Information Criterion both demonstrated a continuous decrease as the number of profiles increased; however, the rate of decrease diminished substantially after the three-profile model. The Bootstrapped Likelihood Ratio Test indicated that the three-profile model provided a significantly better fit than the two-profile model ($p<0.001$). While the four-profile model also showed a significant Bootstrapped Likelihood Ratio Test ($p=0.042$), it resulted in

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the extraction of a highly negligible class comprising less than 4%of the total sample, which lacked theoretical distinctiveness. Furthermore, the entropy value peaked at the three-profile solution (0.86), indicating high classification accuracy. Consequently, balancing statistical parsimon

Table 2

Fit indices for Gaussian Mixture Models ranging from 1to 6profiles.

Number of Profiles (k)	Log-Likelihood	AIC	BIC	Entropy	$BLRTp$-value
1	−12450.21	24944.42	25048.68	-	-
2	−11820.35	23728.70	23937.15	0.75	<0.001
3	−11315.62	22763.24	23075.87	0.86	<0.001
4	−11201.44	22578.88	22995.69	0.79	0.042
5	−11120.89	22461.78	22982.78	0.77	0.115
6	−11085.31	22434.62	23059.81	0.74	0.340

The three distinct profiles were characterized by their unique configurations of standardized emotion regulation scores. Table 3 presents the mean z-scores for each strategy across the three profiles, along with the corresponding Analysis of Variance results to demonstrate the significant differences between the classes. Profile 1, which encompassed 42% of the sample (n=355), was labeled "Adaptive Regulators." Adolescents in this profile exhibited significantly elevated scores on positive reappraisal, planning, putting into perspective, and ERQ-reappraisal, alongside markedly low scores on catastrophizing, rumination, and expressive suppression. Profile 2, comprising 27%of the sample (n=228), was designated as "Maladaptive Regulators." This group was characterized by high levels of catastrophizing, rumination, self-blame, and expressive suppression, coupled with below-average scores on adaptive cognitive strategies. Profile 3, the "Average Regulators," accounted for the remaining 31%(n=262) of the participants and displayed scores that hovered around the sample mean across nearly all emotion regulation dimensions, exhibiting neither highly adaptive nor severely maladaptive tendencies.

Table 3

Standardized mean scores (z-scores) of emotion regulation strategies across the three latent profiles.

Strategy	Profile 1: Adaptive (n = 355)	Profile 2: Maladaptive (n = 228)	Profile 3: Average (n = 262)	F	p-value	η^2
Positive Reappraisal	0.75	−0.82	−0.15	185.42	<0.001	0.38
Putting into Perspective	0.68	−0.65	−0.22	142.15	<0.001	0.31
Planning	0.71	−0.78	−0.10	166.89	<0.001	0.35
Acceptance	0.35	0.12	−0.45	45.21	<0.001	0.12
Rumination	−0.62	1.15	−0.05	210.55	<0.001	0.41
Catastrophizing	−0.85	1.22	0.11	295.34	<0.001	0.48
Self-Blame	−0.55	0.98	−0.08	178.62	<0.001	0.36
Other-Blame	−0.48	0.85	−0.12	134.77	<0.001	0.29
ERQ-Reappraisal	0.81	−0.95	−0.05	225.18	<0.001	0.43
ERQ-Suppression	−0.58	0.92	0.02	160.45	<0.001	0.34

Finally, demographic distributions across the three identified profiles were examined to ascertain whether cluster membership was associated with sex and age group (early vs. late adolescence). Table 4 illustrates these cross-tabulations and the results of the corresponding Chi-square tests of independence. A significant overall association was observed between biological sex and profile membership (χ^2=24.56, p<0.001). Standardized residuals indicated that female adolescents were overrepresented in the Maladaptive Regulators profile and underrepresented in the Adaptive Regulators profile compared to their male counterparts. Conversely, the distribution of early adolescents (defined as ages 12to 14) and late adolescents (defined as ages 15to 18) did not differ significantly across the three profiles (χ^2=4.12, p=0.127), suggesting that the structural composition of these emotion regulation typologies remains

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relatively stable across this developmental spectrum within the current Greek sample.

Table 4

Demographic distribution and comparisons across the three latent emotion regulation profiles

Demographic Variable	Profile 1: Adaptive	Profile 2: Maladaptive	Profile 3: Average	χ^2	p-value
Sex				24.56	<0.001
Male ($n = 395$)	190(48.1%)	85(21.5%)	120(30.4%)		
Female ($n = 450$)	165(36.7%)	143(31.8%)	142(31.5%)		
Age Group				4.12	0.127
Early ($12 - 14$) ($n = 380$)	165(43.4%)	95(25.0%)	120(31.6%)		
Late ($15 - 18$) ($n = 465$)	190(40.9%)	133(28.6%)	142(30.5%)		

4. Discussion

The primary objective of the present study was to shift from traditional, variable-centered approaches to a person-centered analytical framework to identify latent profiles of emotion regulation strategies among a normative sample of adolescents. Utilizing Gaussian Mixture Modeling on a comprehensive battery of both cognitive and habitual emotion regulation metrics, the analyses revealed a robust, three-profile solution that best represented the heterogeneity within the data. These profiles—labeled as Adaptive Regulators, Maladaptive Regulators, and Average Regulators—demonstrate that adolescents do not merely use isolated strategies but rather deploy distinct, multivariate configurations of regulatory behaviors. The identification of $k = 3$distinct profiles underscores the complexity of adolescent emotional development and provides critical insights into the varied ways youths navigate the emotional turbulence characteristic of this developmental epoch.

The largest segment of the sample, comprising 42%of the adolescents, was classified as Adaptive Regulators. This profile was distinctly characterized by significantly elevated z-scores on constructive strategies such as positive reappraisal, putting into perspective, planning, and cognitive reappraisal, coupled with markedly low scores on detrimental strategies like catastrophizing, rumination, and expressive suppression. The emergence of this robustly adaptive group aligns with developmental literature emphasizing that a substantial proportion of youths successfully acquire the necessary psychological tools to navigate the stressors of adolescence, thereby safeguarding their overall mental health (Li, 2025). Adolescents in this profile are likely to exhibit higher resilience, effectively buffering the negative impacts of environmental stressors or systemic neglect (Jesline et al., 2025). Furthermore, the predominant use of adaptive cognitive reappraisal facilitates active engagement in diverse settings, including academic environments, where these youths can effectively transform external emotional support into productive learning outcomes (Zhang et al., 2024). The psychological flexibility inherent in the Adaptive Regulators profile serves as a core protective factor against both internalizing and externalizing psychopathology.

Conversely, the Maladaptive Regulators profile, which encompassed 27%of the study population, represents a highly vulnerable subgroup requiring immediate clinical and educational attention. These adolescents exhibited a regulatory configuration dominated by high levels of catastrophizing, rumination, self-blame, and expressive suppression, alongside a concerning deficit in adaptive cognitive strategies. Previous research has consistently demonstrated that the habitual reliance on these specific maladaptive strategies is a primary conduit for severe psychological distress. For example, rumination and self-blame have been shown to mediate the devastating effects of childhood psychological maltreatment on the subsequent emergence of profound adolescent depressive symptoms (Wang et al., 2024). More critically, the toxic combination of high rumination and catastrophizing significantly amplifies the risk of life-threatening externalizing behaviors, most notably non-suicidal self-injury, particularly among youths already grappling with depression (He et al., 2025). Systematic reviews consistently corroborate that deficits in adaptive emotion regulation and an over-reliance on maladaptive strategies are foundational to the onset and maintenance of self-injurious behaviors (Tolan & Dersuneli, 2024).

The psychological pain associated with the Maladaptive Regulators profile extends into severe suicidality. The inability to tolerate ambiguity and uncertainty—a hallmark of adolescent cognitive development—often interacts with

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maladaptive regulation strategies to produce profound psychache, which subsequently drives suicidal ideation (Wu et al., 2025). This vulnerability is often compounded by external systemic factors, where poor emotional regulation acts synergistically with family dysfunction, cyberbullying, and sleep issues to elevate suicidal tendencies (Nikolić et al., 2025). Furthermore, the pervasive self-regulation deficits observed in this profile are heavily implicated in broader behavioral dysfunctions, including substance abuse and self-harm (López-Martínez et al., 2025). In the contemporary digital context, youths exhibiting this maladaptive configuration are at an exponentially higher risk for technological addictions. The reliance on experiential avoidance and maladaptive cognitive regulation leaves these adolescents highly susceptible to smartphone addiction as a compensatory coping mechanism (Gao et al., 2025). Similarly, deficits in cognitive emotion regulation strongly predict the escalation to problematic video gaming (Goagoses et al., 2025), often exacerbated by a lack of perceived offline social support (Naeem et al., 2025). The fear of missing out, a pervasive modern anxiety, also interacts with this emotion dysregulation to fuel intense loneliness and subsequent social media addiction (Türk & Koçyiğit, 2025).

The third profile, designated as the Average Regulators (31%), represents youths who exhibit mean-level scores across nearly all assessed dimensions, displaying neither highly adaptive resilience nor severe maladaptive vulnerability. These adolescents are reflective of the normative developmental trajectory wherein the neurobiological circuitry governing emotional reactivity is still maturing and often outpaces the development of prefrontal cognitive control systems (Seymour, 2025). While not currently in acute distress, these youths may struggle with emotional regulation when faced with intense, novel stressors or high levels of environmental ambiguity (D. Wright et al., 2024). Without proper scaffolding and positive socialization, average regulators remain at risk of drifting toward maladaptive patterns if confronted with chronic adversity, such as unmitigated childhood trauma, highlighting the importance of peer pressure and community social support in shaping their ultimate mental health trajectories (Omopo, 2025).

The demographic analyses revealed a significant association between biological sex and profile membership, with female adolescents being overrepresented in the Maladaptive Regulators profile. This finding is consistent with broader epidemiological data indicating that adolescent females are generally at a higher risk for internalizing disorders, which are heavily characterized by rumination and catastrophizing. This sex disparity underscores the complex role of early socialization, particularly maternal emotion socialization, which can differently impact youths presenting with elevated internalizing symptoms based on multi-informant discrepancies (Zhao et al., 2024). The incongruence in how mothers and adolescents perceive emotional support can exacerbate emotion regulation difficulties, particularly for young females (Zhao et al., 2025). Furthermore, parental socialization of negative emotions acts as a crucial moderator that can either mitigate or worsen the link between baseline impulsivity and subsequent emotion dysregulation (Friedman & Mezulis, 2025). Interestingly, the present study found no significant differences in profile distribution between early and late adolescence. This stability suggests that emotion regulation profiles, once established in early adolescence, may become somewhat crystallized, emphasizing the predictive power of early deficits in executive function and emotion regulation on later emotional and behavioral disorders (T. Wright et al., 2024). This temporal stability is also observed in clinical populations, where emotion dysregulation in youths with obsessive-compulsive disorder remains a persistent, longitudinal vulnerability (Thoustrup & et al., 2024).

5. Conclusion

The identification of these distinct profiles validates the critical need for targeted, specialized interventions. The fact that 27%of the sample falls into a highly maladaptive category necessitates the implementation of broad-based preventive strategies. Mindfulness-based interventions have proven highly effective in randomized controlled trials at improving emotion regulation strategies and reducing symptoms in young adolescents from the general population (Piguet et al., 2025), and incorporating mindful exercises into daily routines shows substantial promise (Lin, 2025). For youths in the maladaptive cluster who may be resistant to traditional therapies, technologically mediated interventions offer innovative solutions. Virtual reality environments can safely improve emotion regulation and executive function in at-risk adolescents (Northrup, 2025), while serious games provide engaging, systematic platforms to support the acquisition of emotional regulation strategies (Gómez-León, 2025). For adolescents whose dysregulation has precipitated severe psychopathology, such as borderline personality disorder, intensive approaches like Emotion-

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Focused Therapy and meta-diagnostic protocols are essential (Shadfar et al., 2025). In instances where dysregulation contributes to acute crisis and suicide risk, such as in bipolar disorder, novel chronotherapeutic interventions targeting the underlying brain circuitry are necessary (Kim et al., 2025).

6. Limitations & Suggestions

Despite the robust analytical framework and comprehensive findings, several methodological limitations must be acknowledged when interpreting the results of the present study. First, the cross-sectional nature of the research design precludes the establishment of temporal precedence or definitive causal relationships. While the latent profiles identified represent distinct configurations of emotion regulation at a single point in time, it is impossible to ascertain whether membership in the maladaptive profile causes subsequent psychological distress, or if pre-existing psychological vulnerabilities drive adolescents to adopt these maladaptive strategies. Second, the reliance on self-report psychometric instruments introduces the potential for common method variance and social desirability bias. Adolescents may underreport the frequency of heavily stigmatized maladaptive behaviors, such as rumination or catastrophizing, or overreport socially desirable adaptive strategies like positive reappraisal, potentially skewing the profile distributions. Finally, the sample was exclusively drawn from urban and semi-urban regions in Greece. While this provided a socioeconomically diverse cohort within that specific national context, the cultural homogeneity of the sample limits the generalizability of the findings to adolescents in non-Western, differently structured cultural, or drastically different socioeconomic environments where the socialization and display rules of emotions may significantly vary.

To build upon the foundational findings of the current study, future research endeavors should prioritize longitudinal, multi-wave study designs to track the developmental trajectories of these latent emotion regulation profiles over time. Longitudinal data modeled through Latent Transition Analysis would allow researchers to investigate the stability of profile membership from early through late adolescence and identify the specific life events, social transitions, or biological milestones that precipitate a shift from an adaptive to a maladaptive profile, or vice versa. Additionally, to circumvent the inherent biases of self-reporting, future studies must integrate multi-informant methodologies. Gathering observational data and standardized reports from parents, teachers, and peers would provide a more holistic and objective triangulation of an adolescent's actual emotional regulation capabilities across diverse psychosocial contexts. Furthermore, integrating physiological measurements, such as heart rate variability or galvanic skin response, alongside functional neuroimaging techniques, would immensely enrich the profiling process. Exploring how these behavioral and cognitive self-report profiles map onto distinct neurobiological and autonomic stress reactivity patterns could unlock deeper mechanistic understandings of adolescent emotional development.

The empirical identification of distinct emotion regulation profiles holds profound implications for educational and clinical practice, underscoring the necessity of moving away from one-size-fits-all mental health approaches. Schools and pediatric primary care settings should implement systematic, universal screening protocols utilizing validated emotion regulation metrics to proactively identify adolescents who align with the maladaptive profile before acute psychological crises, such as self-harm or severe digital addiction, manifest. Once identified, interventions must be carefully tailored to the specific typological needs of the adolescent. For instance, youths in the average profile might benefit sufficiently from general, classroom-based socio-emotional learning curricula focused on basic emotional literacy and stress tolerance. In contrast, those identified within the maladaptive profile require intensive, targeted, secondary or tertiary interventions. Clinical practitioners and school psychologists should focus on explicit cognitive restructuring techniques to actively dismantle ingrained habits of rumination and catastrophizing, while concurrently training these vulnerable adolescents in adaptive replacement strategies like cognitive reappraisal and structured problem-solving. By utilizing person-centered profiles to triage and customize care, practitioners can optimize the allocation of mental health resources and significantly alter the developmental trajectories of at-risk youths.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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