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Developmental Changes in Emotion Regulation during Adolescence: Associations with Socioeconomic Risk and Family Emotional Context

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Abstract

Although theoretical work proposes that emotion regulation development exhibits a positive growth trajectory across adolescence as prefrontal brain regions continue to mature, individual differences in developmental changes of emotion regulation merit elucidation. The present study investigates longitudinal links between the family environment (i.e., socioeconomic risk and family emotional context) and emotion regulation development. The sample included 167 adolescents (53% males) who were first recruited at 13–14 years of age and assessed annually four times. Latent change score analyses identified family emotional context as a mediator between socioeconomic risk and emotion regulation development, such that lower socioeconomic risk (higher socioeconomic status and lower household chaos) at Time 1 was associated with a more positive family emotional context (parent emotion regulation, parenting practices, and parent-

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Authors' Contributions

TH conceived the study, participated in data collection, conducted statistical analyses and interpretation of the data, and drafted the manuscript; BKC participated in conceiving the study; JKS participated in conceiving the study, participated in interpretation of the data, participated in drafting the manuscript, and critically revised the manuscript. All authors read and approved the final manuscript. Toria Herd is a PhD candidate at Virginia Tech. Her major research interests include risk and protective factors, namely parent-adolescent relations and emotion regulation development, as they relate to adolescent adjustment and psychopathology.

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Data Sharing Declaration

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors report no conflict of interests.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Virginia Tech research committee (FWA00000572) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Written informed consent or assent was received from all participants.

adolescent relationship quality), which in turn was associated with larger year-to-year increases in emotion regulation. The findings highlight the important role of the family emotional context as a process explaining how the challenges of growing up in a household laden with socioeconomic risk may be associated with emotion regulation development during adolescence.

Keywords

adolescence; emotion regulation; socioeconomic risk; family emotional context; latent change score modeling

Introduction

Extant literature has identified emotion regulation as an important predictor of adjustment outcomes and a critical mechanism to explore for intervention work in adolescent maladjustment (Silk, Steinberg, & Morris, 2003). However, the elucidation of developmental changes in emotion regulation abilities, particularly during adolescence, is limited. Adolescence is often characterized by the introduction of new and increased intensity in emotions (Morris, Silk, Steinberg, Myers, & Robinson, 2007), greater fluctuations in emotions (Maciejewski, van Lier, Branje, Meeus, & Koot, 2015), as well as brain maturation in the prefrontal cortex that allows for more refined and adaptive strategies of emotion regulation (McRae et al., 2012). Moreover, emotion dysregulation has been linked to a myriad of maladjustment outcomes, including psychopathology (Silk et al., 2003), poor academic outcomes (Gumora & Arsenio, 2002), and poor relationship quality (Farley & Kim-Spoon, 2014) that see increased prevalence during this period. Thus, adolescence is an especially important period for identifying processes contributing to emotion regulation development. Given that emotion regulation development is heavily influenced by family environmental factors (Morris et al., 2007), elucidating how the family emotional context (reflected by parent emotion regulation, parenting practices, and parent-adolescent relationship quality) is related to the development of adaptive or maladaptive emotion regulation may be particularly relevant for preventative interventions targeting negative outcomes associated with emotion dysregulation (e.g., psychopathology). The present study applied a multilevel systems perspective to understand how emotion regulation development is affected by nested sets of contexts, suggesting that more distal family factors, such as socioeconomic risk, may be associated with the more proximal family emotional context, illuminating conditions under which emotion regulation development may be disrupted.

Emotion Regulation

As a construct, emotion regulation has garnered significant attention in the literature given its centrality to understanding both typical and atypical development (Cole, Martin, & Dennis, 2004). Emotion regulation is a complex and dynamic process, which involves cognitive, behavioral, and physiological processes to modify the experience and expression of an emotion in socially and contextually appropriate ways (Thompson, 1994). Prior work suggests that emotion regulation development across childhood and adolescence typically exhibits a positive growth trajectory as a better understanding of emotions is acquired and increased cognitive development occurs (John & Gross, 2004; Zeman, Cassano, Perry-

Parrish, & Stegall, 2006). For example, a study comparing children, adolescents, and young adults reported increasing cognitive reappraisal ability with age (McRae et al., 2012). Similarly, a longitudinal study presented evidence indicating that emotion regulation strategy use becomes more adaptive over time, such that adolescent girls reported less use of suppression as they aged, though there was no significant change in cognitive reappraisal (Gullone, Hughes, King, & Tonge, 2010). Additionally, one recent study investigating within-person changes in parent- and adolescent-reported emotion regulation demonstrated increases from early adolescence into young adulthood (Hardy, Baldwin, Herd, & Kim-Spoon, 2020). In addition to age, some prior studies have found sex differences in emotion regulation. For example, girls report less use of effective emotion regulation strategies and greater emotion regulation difficulties than boys (Neumann, van Lier, Gratz, & Koot, 2010; Suveg & Zeman, 2004). As such, extant research suggests a positive development of emotion regulation across adolescence, though environmental factors that contribute to individual differences in developmental changes of emotion regulation are not yet clearly understood. Considering a multilevel systems perspective, the present study focuses on how family environmental factors, both at the distal level of family socioeconomic risk and the more proximal level of the family emotional context, may be related to emotion regulation development.

Family Emotional Context and Emotion Regulation

Given that current theoretical and empirical research has emphasized the importance of social context, particularly within the family unit, in facilitating emotion regulation development (Morris et al., 2007), this study investigated how the family emotional context—as reflected by parent emotion regulation, parenting practices, and parent-adolescent relationship quality—may be linked to emotion regulation development during adolescence. Because of the dearth of past research linking family emotional context factors to adolescent emotion regulation specifically, included in the review are also prior studies that have examined self-regulation more broadly, given that emotion regulation is considered a subdomain of the broader, more general construct of self-regulation (Nigg, 2017).

Parents' own emotion regulation abilities serve as one of the first mechanisms by which children observe what emotional displays are considered acceptable and in what contexts certain emotions are considered appropriate (Morris et al., 2007). Accordingly, parent emotion regulation abilities may serve as an important factor in children's emotion regulation development. Indeed, it is likely that through social referencing and imitation, youth learn and practice emotion regulation skills displayed by their parents. Research has demonstrated that regulatory supportive parenting (characterized by positive emotions, displays of affection, and communication) during conflict is associated with better self-regulation in adolescents (Moilanen, Padilla-Walker, & Blaacker, 2018). Thus, for parents to be adequate emotion regulation socialization agents for their children, they must exhibit appropriate emotion regulation themselves (Bariola, Gullone, & Hughes, 2011). Furthermore, there may be a genetic predisposition to emotion regulation abilities considering that parent emotion regulation has been previously linked to child temperament, with implications for child emotion regulation development (Rothbart & Sheese, 2007).

With respect to parenting practices during adolescence, parental warmth and monitoring are consistently the two most important dimensions in predicting adjustment outcomes (Baumrind, 1991; Steinberg, 2014). Regarding emotion regulation, extant research has posited that parenting practices characterized by responsive emotional caregiving provides an important context for learning and practicing emotion regulation skills. To illustrate, a one year longitudinal association between parental monitoring and adolescent behavioral self-control indicated that parents who show greater awareness and supervision of their adolescents are more likely to guide and reinforce the development of adaptive regulatory abilities (Farley & Kim-Spoon, 2017). Another study (albeit cross-sectional) reported that parental acceptance predicted better self-regulation, whereas parental psychological control predicted worse self-regulation (Moilanen & Manuel, 2017). Similarly, longitudinal data demonstrated the link between greater maternal discipline and slower development of self-regulation, indicating that negative arousal generated by such parenting practices may interfere with learning to regulate emotions in adaptive ways (Moilanen & Rambo-Hernandez, 2017). Reviewing studies focusing on emotion regulation more specifically, cross-sectional studies demonstrated that parenting practices characterized by invalidation of emotions or psychological control were linked to adolescent emotion regulation difficulties (Buckholdt, Parra, & Jobe-Shields, 2014; Cui, Morris, Criss, Houlberg, & Silk, 2014; Luebke, Bump, Fussner, & Rulon, 2014), whereas high levels of emotional support were associated with better regulation of anger and sadness among adolescents (Criss, Sheffield Morris, Ponce-Garcia, Cui, & Silk, 2016). Finally, autonomy-supportive parenting practices (characterized by clear limits, a warm and responsive climate, and autonomy support) facilitated longitudinal increases in adaptive emotion regulation and decreases in maladaptive emotion regulation (Brenning, Soenens, Van Petegem, & Vansteenkiste, 2015). As such, these studies suggest that positive parenting practices, including parental support, acceptance, and monitoring, are essential for providing a context in which the development of healthy emotion regulation abilities is encouraged and effective.

Turning to parent-adolescent relationship quality, fewer studies have examined its role in emotion regulation development. In a cross-sectional study, there was a positive association between mother-adolescent relationship quality and adolescent self-regulation (Bynum & Brody, 2005). Additionally, higher mother-adolescent relationship quality predicted longitudinal improvements in adolescent self-regulation, even above and beyond parenting practices, indicating a unique additive effect of parent-adolescent relationship quality on self-regulation development (Moilanen, Shaw, & Fitzpatrick, 2010; Moilanen & Rambo-Hernandez, 2017). Taken together, these studies suggest that parent-adolescent relationship quality is an important component of the family emotional context in predicting adolescent emotion regulation.

Socioeconomic Risk and Emotion Regulation

Extant literature indicates that adolescent self-regulatory abilities are associated with family socioeconomic risk. In the present study, family socioeconomic risk is operationalized as a risk factor for emotion regulation development, capturing not only resource scarcity due to low levels of family income and parent education, but also exposure to chaotic living conditions. This operationalization is consistent with the literature highlighting the

importance of household chaos in predicting socioemotional development for children and adolescents living in poverty (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005; Wachs & Evans, 2010). Prior research demonstrates that financial stress has been linked to lower levels of self-regulation (Crandall, Magnusson, Novilla, Novilla, & Dyer, 2017) and a socioeconomic status composite, encompassing both objective (e.g., per capita income) and subjective (e.g., financial satisfaction) measures, has been linked to deficits in self-control during adolescence (Farley & Kim-Spoon, 2017). In addition to socioeconomic status, household chaos captures an important aspect of socioeconomic risk related to adolescent socioemotional development. Low-income households can be viewed as chaotic, as evidenced by crowding, increased noise, poorer quality housing, as well as less structure, routine, and predictability (Evans et al., 2005). Indeed, a recent longitudinal study using a national sample of youth indicated that both low family income and high household chaos were structural home environment factors (as opposed to relational family environment such as parent-adolescent relationship quality) that elicit instability and unpredictability in children and adolescents' environment, resulting in maladaptive self-control development (Holmes, Briant, Kahn, Deater-Deckard, & Kim-Spoon, 2019). While there has been no behavioral study examining the association between socioeconomic risk and adolescent emotion regulation, prior neuroimaging research suggests that high levels of chronic stress produce long-term damage to the developing brain, particularly for circuitry related to emotion regulation. Research by Evans and colleagues has demonstrated disruptions in cognitive strategies of emotion regulation (i.e., reappraisal and shifting attention) among adults as a result of childhood poverty (Kim et al., 2013; Liberzon et al., 2015). More specifically, childhood poverty was related to reduced activity in the prefrontal cortices and increased activity in the amygdala while performing an emotion regulation task. Functional connectivity analyses further revealed difficulties in the suppression of amygdala activity by the prefrontal cortex during emotion regulation, indicating neural deficits that may make emotion regulation challenging (Kim et al., 2013). Taken together, these results illustrate that socioeconomic risk may be negatively related to emotion regulation via its underlying neural circuitry. However, how environmental contexts may explain detrimental effects of socioeconomic risk on developmental changes in emotion regulation during adolescence is not yet clearly understood.

Socioeconomic Risk and Family Emotional Context

The association between distal socioeconomic risk and emotion regulation may be mediated by proximal factors, such as the family emotional context (see Conger & Donnellan, 2007; McLoyd, 1990 for reviews). For example, stress and chaos associated with socioeconomic risk may compromise healthy regulatory abilities in parents that disrupt the socialization process of adaptive emotion regulation in their adolescents (Deater-Deckard, 2014). Indeed, there is converging evidence suggesting that socioeconomic risk impairs optimal parenting. Specifically, mothers with a lower socioeconomic status tend to be more controlling, disapproving, punitive, and less affectionate than mothers with a higher socioeconomic status (Kotchick & Forehand, 2002; Mills-Koonce et al., 2016) and often exhibit less parental monitoring (Bornstein & Bradley, 2003; Farley & Kim-Spoon, 2017). Extant literature further suggests that socioeconomic risk may negatively affect relationship quality between parents and adolescents. For example, higher income was concurrently related to

less anxious attachment styles between youth and their parents (Rawatlal, Pillay, & Kliwer, 2015). Further, poverty status predicted a decline in parent-adolescent attachment relations across a two-year period (Allen, McElhaney, Kuperminc, & Jodl, 2004). Thus, given clear evidence indicating the significant link between socioeconomic risk and the family emotional context, it was hypothesized that socioeconomic risk, a more distal risk factor, would be associated with emotion regulation development via disrupted family emotional context, a more proximal risk factor.

Present Study

The purpose of the present study was to delineate the underlying processes that link socioeconomic risk and emotion regulation development during adolescence. Specifically, this study aimed to elucidate individual differences in developmental changes in emotion regulation during adolescence, hypothesizing that emotion regulation abilities would increase, or become more adaptive overtime, considering previous work suggesting that emotion regulation abilities increase alongside cognitive and brain development (Ordaz, Foran, Velanova, & Luna, 2013). Second, the present study sought to examine the roles of socioeconomic risk and the family emotional context in emotion regulation development. Given that extant theoretical work has proposed pathways from financial strain to adolescent adjustment outcomes through individual variables of parental stress or parenting (e.g., Conger & Donnellan, 2007), it was hypothesized that family emotional context would mediate the association between socioeconomic risk and adolescent emotion regulation, such that high socioeconomic risk would predict a more negative family emotional context which in turn would be related to more maladaptive emotion regulation development across adolescence.

Methods

Participants

The sample included 167 adolescents (53% males) and their primary caregivers (82% biological mothers, 13% biological fathers, 2% grandmothers, 1% foster, 2% other), from a southeastern state in the United States, who participated in annual assessments across four years. Adolescents were 13 to 14 years of age at Time 1 ($M = 14.13$, $SD = 0.54$), 14 to 15 years of age at Time 2 ($M = 15.05$, $SD = 0.54$), 15 to 16 years of age at Time 3, ($M = 16.07$, $SD = 0.56$) and 16 to 17 years of age at Time 4 ($M = 17.01$, $SD = 0.55$). Eighty-two percent of adolescents identified as Caucasian, 12% as African-American, and 2% as other. Median family income was \$35,000 - \$49,999 per year at all time points. Based on an income-to-needs ratio calculation at Time 1, half of the sample was deemed to be “poor” (25% of the sample, with income to needs ratio < 1) or “near poor” (25%, income to needs ratio < 2). Of the remaining “non-poor” families (50%, income to needs ratio ≥ 2), nearly half of these (20% of the total sample) had very high discretionary income (income to needs ratio > 4). At Time 1, 157 families participated. At Time 2, 10 families were added for a final sample of 167 parent-adolescent dyads. Across all four years, 24 families did not participate in at least one of the four time points for reasons including: ineligibility for tasks ($n = 2$), declined participation ($n = 17$), and lost contact ($n = 5$) during the follow-up assessments. More

specifically, at Time 1, 157 adolescents and their primary caregivers participated. At Time 2, 150 adolescents and their primary caregivers participated. At Time 3, 147 adolescents and 148 primary caregivers participated. At Time 4, 150 adolescents and 147 primary caregivers participated. Attrition analyses were performed using general linear model univariate procedure to determine whether there were systematic predictors of missing data. Results indicated that rate of participation (indexed by proportion of years participated to years invited to participate) was not significantly predicted by age, income, parent education, sex, or race ($p = .14 - .86$) or study variables ($p = .05 - .95$).

Procedures

Data included in the present study were collected as part of a larger project. Adolescent participants and their primary caregivers were recruited via email announcements, flyers (at libraries, community centers, parks, clinics, grocery shops, gas stations, etc.), and snowball sampling (word-of-mouth). Data collection was administered at university offices where participants completed self-report questionnaires, behavioral and neuroimaging tasks, and were interviewed by trained research assistants. The study duration was on average five hours for both parents and adolescents, and participants were compensated monetarily for their time. After the first time point of participation, parents and adolescents each received \$75 - \$105 (depending on performance on specific tasks) with a \$5 incremental increase each consecutive year. All procedures were approved by the institutional review board of the university and written informed consent or assent was received from all participants.

Measures

Socioeconomic risk.—The socioeconomic risk composite score was constructed based on primary caregivers' reports to reflect broader risks associated with socioeconomic risk by averaging primary caregiver's and spouse's number of years of education, income to needs ratio (calculated by dividing total household income by the poverty threshold for a family of that size), receipt of public aid (yes or no), household chaos, and a subjective socioeconomic risk composite, all measured at Time 1. Levels of household chaos were assessed using the Confusion, Hubbub, and Order Scale (CHAOS; Matheny, Wachs, Ludwig, & Phillips, 1995). The scale consists of 6 statements about the individual's home environment (from "1 = definitely untrue" to "5 = definitely true") with higher scores indicating higher levels of chaos (e.g., "You can't hear yourself think in our home", "We have a regular morning routine at home"). The scale demonstrates relatively low reliability within the current sample at $\alpha = .59$, which is consistent with previous research (Asbury, Dunn, Pike, & Plomin, 2003; Coldwell, Pike, & Dunn, 2006). Subjective socioeconomic status ($\alpha = .70$) was calculated by averaging three questions asking about financial satisfaction (from "1-very satisfied" to "4-very unsatisfied"), how well off the family is (from "1-very poor" to "5-upper middle class"), and worry about finances (from "1-very often" to "4-never"). Individual measures were standardized before calculating average scores. Previous research has suggested that objective (e.g., income) and subjective (e.g., financial stress) measures of family socioeconomic risk are not perfectly related and may be measuring different aspects of family socioeconomic risk (Newland, Crnic, Cox, & Mills-Koonce, 2013). Thus, by combining objective measures of socioeconomic status with subjective perceptions of socioeconomic status and household chaos, this study sought to create an index of

socioeconomic risk that comprehensively capture the structural home environments into which adolescents from low socioeconomic status families are exposed (e.g., Farah, 2017). Mean correlation between indicators was $r = .34$ (range = $.14 - .53$). Further, correlations of socioeconomic risk between time points ranged from $r = .60 - .82$, indicating relative stability overtime. Scores were reverse coded as needed such that higher scores were indicative of greater family socioeconomic risk.

Family emotional context.—The present study sought to capture a more comprehensive and realistic representation of the family environment in which adolescent emotion regulation development is embedded by combining measures assessing parent emotion regulation, parenting practices, and parent-adolescent relationship quality into a single composite of family emotional context. Each of these measures were assessed at Times 1, 2, and 3.

Parent Emotion Regulation.: Parent emotion regulation was self-reported on the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). Parent participants responded on a 5-point Likert scale (from “1 = Almost Never” to “5 = Almost Always”) about the regulation of emotions in times of distress. Mean scores were calculated across 6 items from the Difficulties Controlling Impulsive Behaviors when Distressed subscale and reverse coded such that higher mean scores were indicative of less difficulties with emotion regulation. The scale demonstrated good reliability within the current sample across the three time points ($\alpha = .82 - .85$).

Parenting Practices: Parental Monitoring and Parental Negativity.: The Parental Monitoring Scale (PMS; Stattin & Kerr, 2000) was used to measure different aspects of parental monitoring such as parental knowledge (9 items), child disclosure (5 items), parent solicitation (5 items), and parental control (6 items). Both adolescents and their parents answered a total of 25 items along a 5-point scale that varies from question to question. A composite score was calculated by averaging the two reporters (range $r = .28 - .29$ across the three time points), with higher mean scores indicating higher parental monitoring. The scale demonstrated good reliability within the current sample across the three time points (parent report: $\alpha = .84 - .88$; adolescent report: $\alpha = .90 - .91$). The conflict subscale of the Parent-Child Relationship Scale (PCR; Hetherington & Clingempeel, 1992) was used at Time 1 to assess the degree of parental negativity, indicating lack of parental warmth. Both adolescents and their parents responded to 9 items on a 5-point Likert scale (from “1 = Extremely” to “5 = Not at all”). Adolescent participants answered each item separately for their mother and father. A composite score was calculated by averaging parent report with adolescent report (about the parent who attended the study; range $r = .27 - .32$ across the three time points) and then was reverse coded such that higher mean scores indicate lower parent-adolescent negativity. The scale demonstrated acceptable reliability within the current sample across the three time points (parent report: $\alpha = .69 - .73$; adolescent report: $\alpha = .72 - .80$).

Parent-Adolescent Relationship Quality.: The short version of the Inventory of Parent and Peer Attachment was measured at Time 1 to determine the degree of adolescents’ perceived relationship quality with their parents (IPPA; Raja, McGee, & Stanton, 1992). Adolescents

responded separately for their mother and father, using a five-point Likert scale (from “1 = Almost Never or Never True” to “5 = Almost Always or Always True”). Higher mean scores were indicative of a better relationship quality. The scale demonstrated good reliability within the current sample across the three time points ($\alpha = .82 - .88$).

Emotion Regulation.—The Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997) was measured at Times 1, 2, 3, and 4, to capture adaptive emotion regulation abilities, including socially appropriate emotional displays, empathy, and emotional self-awareness. Adolescents self-reported on a four-point Likert scale (from “1 = Rarely/Never” to “4 = Almost Always”) about how they respond to different situations. Mean scores were calculated across 8 items that reflected the emotion regulation subscale, such that higher scores were indicative of better emotion regulation. While the subscale demonstrated low reliability ($\alpha = .49 - .63$) in the current sample, this is similar to figures in past research that also used adolescent self-reports ($\alpha = .57$; Zaremba & Keiley, 2011).

Data Analytic Plan.

For all variables, descriptive statistics were used to assess for normal distributions and outliers. Skewness and kurtosis were examined, and levels less than 3 and 10, respectively, were considered acceptable (Kline, 2011). Outliers (identified in each measure at each time point) were classified as values deviating more than 3.29 *SD* (Tabachnick & Fidell, 2001) from the mean (*total N* = 20) and were winsorized to retain statistical power and attenuate bias resulting from elimination (Ghosh & Vogt, 2012). Multivariate GLM analyses indicated that demographic covariates, including age, child and parent sex, and race at Time 1 were not significant predictors of study variables ($p > .05$) and were therefore not included as covariates in analyses.

Models were tested using Structural Equation Modeling (SEM) in *Mplus* statistical software version 8 (Muthén & Muthén, 1998–2018). Model fit was assessed by χ^2 value, degrees of freedom, corresponding *p*-value, Root Mean Square Error of Approximation (RMSEA), and Confirmatory Fit Index (CFI). RMSEA values less than .08 and CFI values greater than .90 were considered an acceptable fit (Bentler, 1990; Browne & Cudeck, 1993). Full information maximum likelihood (FIML) estimation procedure was used to address missing data given its superiority to those obtained with listwise deletion or other ad hoc methods (Schafer & Graham, 2002). The final sample size used in the analyses was 167.

Confirmatory factor analysis was used to validate the family emotional context variable constructed based on theory (Morris et al., 2007). The confirmatory factor analysis model included three indicators of family emotional context: parent emotion regulation (DERS), parenting practices (composite of PMS and PCR), and parent-adolescent relationship quality (IPPA). The average correlation between the three indicators was .35, .30, and .29, for times 1, 2, and 3, respectively. Following construct validation through confirmatory factor analysis, a grand composite of family emotional context was calculated by averaging across standardized scores of the three indicators and used in the analyses.

Regarding the outcome variable, correlations were explored between adolescent and parent reports of emotion regulation to determine whether combining parent and adolescent reports

would be beneficial. The correlations between adolescents' reports and parents' reports were small to moderate ($r = .16 - .34$) with the size of the correlation decreasing across the four time points. Thus, adolescents' reports for emotion regulation were used, rather than a combined parent-child report, given that they may be more accurate reporters of their own behavior at this age across different contexts than their parents are (Ladd, 2005).

Given the present study's interest in changes in emotion regulation across time, latent change scores (McArdle, 2009) were modeled in which the change in emotion regulation was estimated and predicted by baseline socioeconomic risk and repeated measures of the family emotional context. More specifically, time-lagged mediation effects were examined by estimating the effects of socioeconomic risk on changes in emotion regulation mediated by changes in family emotional context. Because family emotional context scores were composites based on standardized scores (i.e., mean = 0), their time series data were constructed as a Markov simplex model (estimated as autoregressions, rather than change scores) based on manifest variables instead of a latent change score model. A significant benefit of latent change score modeling over other longitudinal modeling techniques is the ability to evaluate dynamic longitudinal changes within repeated measures (McArdle, 2009). In such models, latent changes are modeled in two ways: a linear slope which assumes constant or natural change, and the change scores themselves which account for change from the previous time point, denoted as proportional change.

Results

Correlations and descriptive statistics for all study variables are presented in Table 1.

Family Emotional Context Construct Validation

First measurement models of family emotional context at each time point were tested. For Time 1, the measurement model for the family emotional context construct (represented by parent emotion regulation, parenting practices, and parent-adolescent relationship quality) indicated a good fit ($\chi^2 = 1.39$, $df = 1$, $p = 0.24$, RMSEA = 0.05, CFI = 1.00). In this model, the parenting practices indicator had a negative residual variance that was fixed to 0. All freely estimated standardized factor loadings were statistically significant (ranging from .30 to 1.00, all $p < 0.001$). For Time 2, the measurement model for the family emotional context construct was a fully saturated model which did not allow us to assess model fit ($\chi^2 = 0.00$, $df = 0$, $p = 0.00$, RMSEA = 0.00, CFI = 1.00). Nonetheless, all freely estimated standardized factor loadings were statistically significant (ranging from .20 to .94, all $p < 0.03$). Finally, for Time 3, the measurement model for the family emotional context construct indicated a reasonable fit ($\chi^2 = 2.12$, $df = 1$, $p = 0.15$, RMSEA = 0.09, CFI = .98). In this model, the parenting practices indicator had a negative residual variance that was fixed to 0. All freely estimated factor loadings estimates were statistically significant (ranging from .24 to 1.00, all $p < 0.003$). Collectively, for all three time points, the factor determinacy scores indicated high construct validity (= 1.00).

Latent Change Score Model

Time-lagged mediation effects were examined by estimating the effects of socioeconomic risk on changes in emotion regulation mediated by changes in family emotional context. The resulting model fit was excellent ($\chi^2 = 12.56$, $df = 13$, $p = 0.48$, $RMSEA = 0.00$, $CFI = 1.00$; see Figure 1 for unstandardized estimates, standard errors, and p -values). The mean ($b = 3.13$, $SE = 0.03$, $p < 0.001$) and variance ($\sigma^2 = 0.05$, $SE = 0.02$, $p < 0.01$) of the intercept factor were significant. The mean ($b = 2.43$, $SE = 0.96$, $p = 0.01$) of the slope factor was significant but the variance ($\sigma^2 = 0.04$, $SE = 0.03$, $p = 0.16$) was not, suggesting that there was a positive constant change in emotion regulation across time but individual differences in the change rate were not significant. Next, nested model comparisons were conducted to determine whether freeing the parameters for proportional change over time improved the model fit. A chi square difference test indicated that the fit difference was not significant, $\chi^2 = 2.75$, $df = 2$, $p(d) = .25$. This result suggested that the model with fixed parameters was a more parsimonious model than the model with freed parameters. As such, the proportional effects were constrained to be equal and were significant ($b = -0.78$, $SE = 0.31$, $p = .01$). In the presence of a positive constant change, significant negative proportional changes between time points indicated that adolescents with lower emotion regulation scores on the previous occasion changed more than those with higher emotion regulation scores, when accounting for average emotion regulation change, resulting in a slight deceleration of emotion regulation change patterns over time.

Closer inspection of the socioeconomic risk effects on latent change score factors revealed that higher socioeconomic risk at Time 1 negatively predicted family emotional context at Time 1 and Time 3. The association between socioeconomic risk at Time 1 and family emotional context at Time 2 was not significant. Family emotional context at Times 1, 2, and 3 positively predicted changes between Time 1 and Time 2, changes between Time 2 and Time 3, and changes between Time 3 and Time 4, respectively in emotion regulation. Such effects appeared to be consistent throughout adolescence (i.e. similar magnitude), indicating that a more positive family emotional context was related to larger year-to-year increases in emotion regulation. The significance of time-lagged indirect effects was then tested. The indirect effect of socioeconomic risk at Time 1 on the change in emotion regulation from Time 1 to Time 2 through family emotional context at Time 1 was positive and significant ($b = 0.05$, $SE = 0.02$, 95% CI [0.007; 0.097], $b^* = .22$). The indirect effect of socioeconomic risk at Time 1 on the change in emotion regulation from Time 2 to Time 3 through family emotional context at Time 2 (after controlling for family emotional context at Time 1) was in the same positive direction though not statistically significant ($b = 0.004$, $SE = 0.01$, 95% CI [-.013; .030], $b^* = .04$). The indirect effect of socioeconomic risk at Time 1 on the change in emotion regulation from Time 3 to Time 4 through family emotional context at Time 3 (after controlling for family emotional context at Time 2) was positive and significant ($b = 0.02$, $SE = 0.01$, 95% CI [.003; .058], $b^* = .22$). There was a significant cross-sectional association between socioeconomic risk and emotion regulation at Time 1, however, socioeconomic risk at Time 1 was not directly predictive of year-to-year changes in emotion regulation.

It is important to note that the path from socioeconomic risk at Time 1 to the family emotional context at Time 2 was weaker than the paths from socioeconomic risk at Time 1 to family emotional context at other time points, yielding apparent inconsistency in results. To eliminate the possibility that missing data patterns may have influenced the result, the model was tested while only including those participants who completed all four years of the study and results demonstrated the same pattern of significance. Bivariate correlations demonstrated that socioeconomic risk was related to the family emotional context consistently at each time point with medium effect sizes (see Table 1), indicating rather consistent external validity for the family emotional context composites across time.

Statistically, it was more difficult for socioeconomic risk to predict family emotional context at Times 2 and 3 than family emotional context at Time 1, because autoregressive effects were estimated at Times 2 and 3 and these autoregressive effects took into account a substantial amount of variance in the family emotional context. A closer inspection of the Markov simplex model of family emotional context that was included in the hypothesized latent change score model shows that the magnitude of the autoregressive effects was notably higher for the path between Time 1 family emotional context and Time 2 family emotional context [Critical Value (Est./S.E.) = 12.28] compared to the path between Time 2 family emotional context and Time 3 family emotional context [Critical Value (Est./S.E.) = 5.56]. As such, there was limited variance in Time 2 family emotional context to predict after controlling for the autoregressive effects, likely constraining the effects of the external predictor, socioeconomic risk. Moreover, the autoregressive estimate between Time 1 and Time 2 family emotional context involved Time 1 level predicting Time 2 level, whereas the autoregressive effect between Time 2 and Time 3 family emotional context involved Time 2 family emotional context residual score (after controlling for Time 1 autoregression) predicting Time 3 family emotional context level. As such, it appeared that the different nature of autoregressive effects estimated made the path between socioeconomic risk and family emotional context at Time 2 weaker than the path between socioeconomic risk and family emotional context at Time 3. Thus, the indirect effect from socioeconomic risk at Time 1 to emotion regulation changes from Time 2 to Time 3 (i.e., “diff 2” in Figure 1) through Time 2 family emotional context and Time 3 family emotional context (as sequential mediators) was tested. This indirect effect was significant ($b = 0.35$, $SE = 0.18$, 95% CI [0.002; 0.073], $b^* = .33$). Given this finding, the discrepancy in the estimates between socioeconomic risk and family emotional context levels and changes seems to be due to modeling artifacts rather than a reflection of systematic developmental differences.

Discussion

Extant literature suggests increased difficulties in regulating behavior within emotional contexts in adolescence (Hare et al., 2008). To date, however, literature examining developmental changes in emotion regulation and environmental factors related to emotion regulation development in adolescence is limited. Given the importance of family environmental factors on emotion regulation development (Morris et al., 2007), the present study sought to investigate the roles of family socioeconomic risk and family emotional context in emotion regulation development. The results support the mediating role of family emotional context in the association between socioeconomic risk and changes in emotion

regulation, highlighting how the family emotional context may facilitate intraindividual changes in emotion regulation during adolescence as well as illustrating how such proximal factors may be disrupted by more distal factors (i.e., family socioeconomic risk).

Consistent with previous research using growth curve modeling to demonstrate that emotion regulation abilities increase alongside cognitive and brain development (Hardy et al., 2020; Ordaz et al., 2013), the results suggested a positive constant change in emotion regulation across adolescence. In contrast to growth curve modeling that simply delineates the general slope over the entire period of the study, latent change score modeling was used to further decompose developmental changes into a series of change segments (e.g., year-to-year change) while simultaneously estimating constant change (i.e., average slope; Grimm, An, McArdle, Zonderman, & Resnick, 2012). Specifically, results further revealed significant negative proportional change, indicating a slight deceleration of emotion regulation change patterns from one year to the next, highlighting that change in emotion regulation depended on its prior state, such that those whose emotion regulation was higher increased less over time compared to those whose emotion regulation was lower (or, conversely, those whose emotion regulation was lower increased more year to year). The former indicates overall developmental patterns, observed through mean level changes across the sample, and the latter indicates a compensating mechanism, observed through within-person processes, through which adolescents with lower emotion regulation catch up in development.

The present latent change score modeling analyses indicated that family socioeconomic risk was negatively associated with the family emotional context over time. In the meanwhile, higher family emotional context consistently predicted year-to-year increases in emotion regulation at all time points. The findings suggest that a more positive family emotional context (characterized by more adaptive parent emotion regulation, better parenting practices, and higher parent-adolescent relationship quality) may promote emotion regulation development in adolescents. Experiencing such a positive family emotional context may provide a 'secure space' for adolescents to learn and practice adaptive emotion regulation abilities. Considering that baseline socioeconomic risk was associated with disrupted family emotional context concurrently and over time, socioeconomic risk seems to be a risk factor for the family emotional context, which may in turn dampen emotion regulation development in adolescence. This risk factor may be due to the fact that stressful environments associated with socioeconomic risk (e.g., financial scarcity, worrying about finances, and chaotic environment) are less facilitative of a positive family emotional context. These results corroborate previous theoretical and empirical work suggesting that higher socioeconomic status and higher levels of financial satisfaction are associated with better parenting practices (Farley & Kim-Spoon, 2017) and parent-adolescent relationship quality (Conger & Donnellan, 2007), which in turn are related to more adaptive adolescent emotion regulation (Moilanen & Rambo-Hernandez, 2017). Importantly, results of this study provide empirical evidence of developmental pathways through which family socioeconomic risk are related to emotion regulation development: the effects of family socioeconomic risk, a distal family environmental factor, may be carried through the family emotional context, a more proximal family environmental factor, to be linked to adolescent emotion regulation development.

The present study extends the current literature in a few noteworthy ways. First, the examination of patterns in emotion regulation development using latent change score modeling helped to sensitively capture individual differences in developmental changes of emotion regulation. Results demonstrated that the overall mean of emotion regulation abilities increased across adolescence (i.e., positive constant slope) with within-person processes indicating greater year-to-year change among adolescents with lower emotion regulation (i.e., negative proportional change). Second, rigorous testing of time-lagged mediated effects illustrated how two separate but related domains of the family environment (socioeconomic risk and emotional context) interfaced to contribute to emotion regulation development. Results indicated significant indirect effects suggesting that ‘financial scarcity’ (i.e., stress associated with insufficient financial resources) may be related to ‘emotional scarcity’ (i.e., lack of positive family emotional context), which was then associated with developmental changes in emotion regulation. Finally, methodologically, this study attempted to capture the environmental context of “having less” by considering diverse indicators associated with socioeconomic risk in addition to income and education (e.g., subjective socioeconomic status, dependence on public assistance, and household chaos; see Farah, 2017 for review) and used a sample with a diverse socioeconomic status representation (50% poor/near poor with 25% below the poverty threshold) from under-served and under-studied rural, suburban and urban communities.

Furthermore, the present results have implications for intervention work. Individuals may develop emotion regulation skills at different rates, due to family environmental factors, which may result in different consequences for later adjustment. For example, adolescents with delayed growth in emotion regulation may have difficulty responding to challenges in appropriate and adaptive ways, resulting in a vulnerability for behavioral and emotional problems, including psychopathology (Compas et al., 2017). Thus, it is crucial to elucidate the factors related to intraindividual changes in emotion regulation development to prevent such cascading risk. Bearing this in mind, intervention efforts that aim to improve emotion regulation abilities for adolescents from families with greater socioeconomic risk may target the family emotional context as a more proximal factor (i.e., parental monitoring of adolescents, parent role modeling of adaptive emotion regulation, fostering a warm, responsive parent-adolescent relationship). Results also imply that intervention efforts aimed at parenting warrant consideration of broader social, economic, and cultural contexts that certainly affect them (e.g., socioeconomic risk). For example, greater socioeconomic stress has been associated with treatment dropout and poorer outcomes after therapy (Kotchick & Forehand, 2002). Thus, in order for such interventions to be maximally effective, they must take into account such sources of stress for parents.

Several limitations and avenues for future research should be noted. First, study variables were assessed exclusively by self-report, although multiple informants including parent and adolescent reports where relevant. Future studies may benefit from the inclusion of multiple levels of assessments (e.g., observations, interviews, neurobiological measures) to better capture the dynamic process of emotion regulation and to reduce possible bias associated with self-report measures. Second, it should be noted that the alpha for the Emotion Regulation Checklist was relatively low. However, low alphas tend to underestimate effects (Furr & Bacharach, 2008), suggesting that the present findings may in fact be more robust

when using emotion regulation measures of higher reliability. Given the relatively low alphas shown in the current study and a previous study using adolescent reports (Zaremba & Keiley, 2011), future research should examine whether emotion regulation abilities may become multidimensional during adolescence, such that distinct (i.e., not necessarily inter-correlated) manifestations of emotion regulation-related behaviors may be shown across different adolescents. Third, this study sought to examine how aspects of the family emotional context as a whole jointly contributed to emotion regulation, but were limited by particular measures available in the larger study. Future research may consider additional factors that are relevant to the family emotional context (e.g., family expressivity, marital relations). Moreover, the measurement model of family emotional context could have been stronger. For example, models that have negative residual variances or are fully saturated and prohibit us from evaluating model fit are not ideal. Future research should replicate the family emotional context composite with additional samples, added measures (that also tap into this construct), and in more time points of data. Fourth, it is important for future research to consider a bidirectional relationship between family emotional context and emotion regulation. Given the evidence for reciprocal relations between child emotions and parent reactions (Eisenberg et al., 1999), adolescent emotion regulation may not only be affected by the family emotional context, but may also contribute to the family emotional context. Finally, as contexts outside of the family become more important during the developmental period of adolescence, it is crucial to understand how non-familial contexts (i.e., peer, school, neighborhood) may affect ongoing development of emotion regulation.

Conclusion

The present study sought to elucidate how family factors (i.e., socioeconomic risk and emotional context) were linked to individual differences in adolescent emotion regulation development. The use of latent change score modeling allowed for the examination of time-lagged effects between the family emotional context and emotion regulation to determine how variability in the family emotional context at each time point predicted changes in emotion regulation within individuals. The results emphasize adolescence as a developmental period in which emotion regulation development continues to occur, consistent with extant literature suggesting ongoing maturation of prefrontal brain regions (McRae et al., 2012) that make adaptive emotion regulation possible. Furthermore, the developmental pathways through which family socioeconomic and emotional contexts are related to emotion regulation development were revealed. The presence of a positive family emotional context in which adaptive emotion regulation skills are learned and practiced seems to be particularly important for ensuring healthy emotion regulation development during adolescence with implications for adjustment and well-being later on. Finally, the results illustrate the important role of family emotional context as a process explaining how the challenges of growing up in a household laden with socioeconomic risk may be associated with emotion regulation development, and highlight the need for intervention efforts at more proximal levels, such as the family emotional context, for adolescents who face such distal risk factors.

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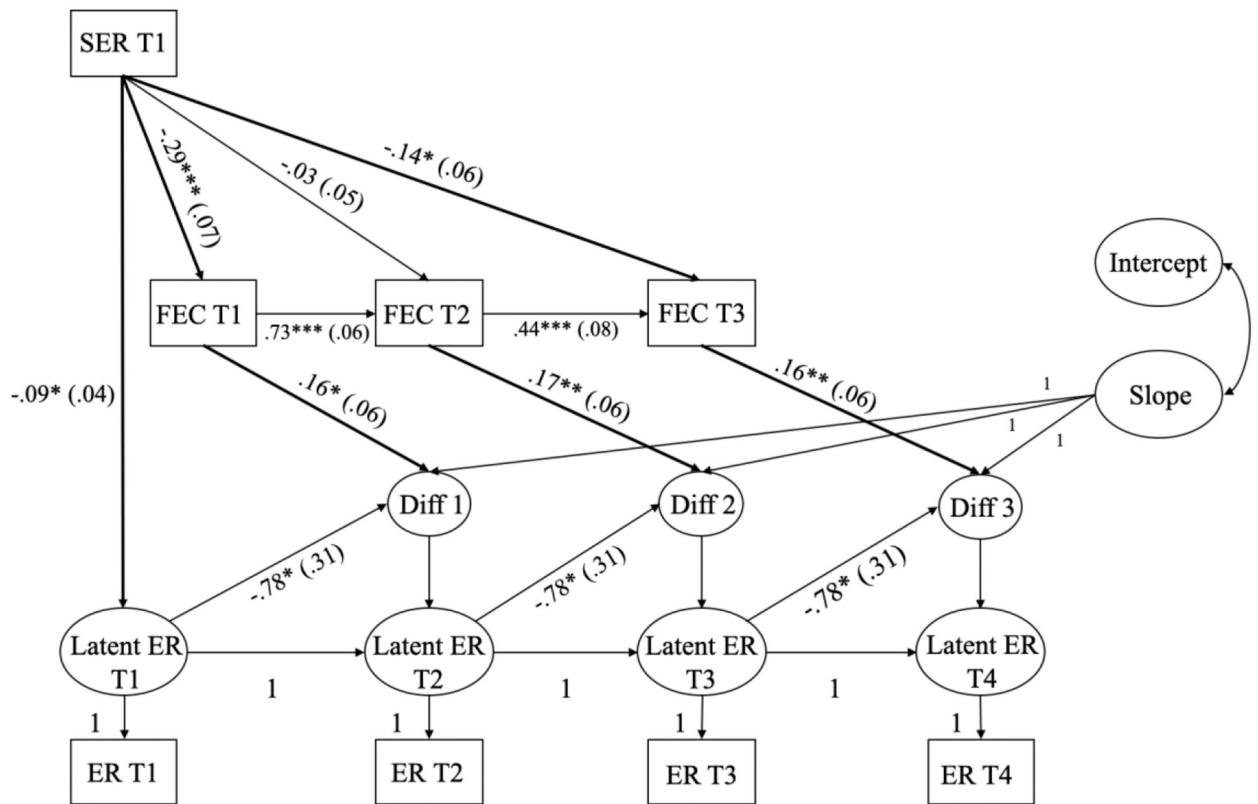


Figure 1. Latent Change Score Model of Socioeconomic Risk Effects on Family emotional context and Emotion Regulation.

Notes. Unstandardized parameter estimates (SE) are presented. SER = socioeconomic risk; FEC = family emotional context; ER = emotion regulation; Diff = latent change score factor; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4. For clarity of presentation, non-significant direct effects between SER and difference scores, residual variances and correlations among variables are not shown. SER → Diff 1, $b = -0.01$, $SE = 0.05$, $p = .79$; SER → Diff 2, $b = -0.05$, $SE = 0.05$, $p = .23$; SER → Diff 3, $b = -0.05$, $SE = 0.05$, $p = .34$; FEC T1 ↔ FEC T3, $b = 0.10$, $SE = 0.03$, $p = .001$; FEC T1 ↔ ER T1, $b = 0.07$, $SE = 0.02$, $p = .001$; FEC T2 ↔ ER T2, $b = 0.04$, $SE = 0.01$, $p = .001$; FEC T3 ↔ ER T3, $b = 0.04$, $SE = 0.01$, $p = .000$).

Model fit: $\chi^2 = 12.56$, $df = 13$, $p = 0.48$, RMSEA = 0.00, CFI = 1.00.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1

Descriptive Statistics and Bivariate Correlations of Study Variables

	1	2	3	4	5	6	7	M (SD)	Min	Max
1. SER	-							0.00 (.74)	-1.93	1.83
2. FEC T1	.34**	-						0.00 (.69)	-2.85	1.19
3. FEC T2	.32**	.74**	-					0.00 (.68)	-2.91	1.10
4. FEC T3	.33**	.68**	.70**	-				0.00 (.67)	-2.50	1.23
5. ER T1	.19*	.38**	.42**	.29**	-			3.13 (.37)	2.25	3.88
6. ER T2	.15	.26**	.38**	.29**	.50**	-		3.10 (.37)	2.00	4.00
7. ER T3	.22**	.35**	.37**	.48**	.51**	.52**	-	3.14 (.41)	2.13	3.88
8. ER T4	.21*	.22**	.25**	.37**	.38**	.52**	.57**	3.15 (.41)	2.13	3.88

Note. SER = socioeconomic risk. FEC = family emotional context; ER = emotion regulation; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4.

* $p < .05$,

** $p < .01$,

*** $p < .001$.