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Research paper

Application of the actor-partner interdependence model in parent-adolescent emotion regulation and depression

Jennifer C. Wolff[a,*], Sarah A. Thomas[b], Erik Hood[c], Alexandra H. Bettis[d], Christie J. Rizzo[c], Richard T. Liu[b]

[a] Rhode Island Hospital and Alpert Medical School of Brown University, United States
[b] Bradley/Hasbro Children's Research Center and Alpert Medical School of Brown University, United States
[c] Northeastern University, United States
[d] Alpert Medical School of Brown University, United States

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ABSTRACT

Background: The family environment is an important context for the development and maintenance of depressive symptoms within families. In this study, we evaluated whether parent and adolescent self-reports of emotion regulation constructs are linked with their own (actor effects) and each other's (partner effects) depressive symptoms.

Methods: Participants were 123 adolescent-parent dyads, recruited from adolescent inpatient and partial hospitalization programs, who completed self-report assessments of emotion dysregulation and depression.

Results: Using the Actor-Partner Interdependence Model (APIM), results revealed expected actor effects for emotion regulation strategies, but not impulsiveness. A significant partner effect for parents' impulsiveness and adolescents' depressive symptoms was observed, demonstrating the interdependent nature of these characteristics in the sample. Interpretation of APIM model coefficients indicated that greater parent impulsiveness was associated with less adolescent depression symptom severity.

Limitations: Limitations include a small sample of primarily Caucasian adolescents who were receiving intensive psychiatric services making generalizability more challenging. The sample also consisted of largely mothers which is important to consider given there are known gender differences in rates of depression and sensitivity to interpersonal processes.

Conclusions: Overall, findings shed light on the nature of these characteristics within the families of depressed adolescents and the role of emotion regulation in the parent-child relationship. Implications of this work and future studies are discussed.

Depression is a major problem for adults and adolescents alike. According to recent data released by the National Institute of Mental Health, 6.7% of American adults and 12.8% of American adolescents experienced at least one episode of depression over the past year (National Institute of Mental Health, 2017). Adults and adolescents with depression are at greater risk for negative mental and physical health outcomes, as well as poorer social functioning, academic functioning, and quality of life (Hawton et al., 2013; Jaycox et al., 2009; Johnson et al., 2014; Lai et al., 2015; Morrison et al., 2015; National Institute of Mental Health, 2019; Schmitz et al., 2014).

Both individual and dyadic processes may contribute to the development and maintenance of depression; for developing individuals like adolescents, the family provides an important context to understand depression risk (Daches et al., 2018). Specifically, family psychiatric history and parental depression, primarily maternal depression, are associated with a child's risk for developing depression (Beardslee et al., 2011; Hammen et al., 2008; Olino et al., 2016). Several mechanisms have been explored in an attempt to understand the transmission of depression from parent to child, including genetic heritability, dysfunctional neuroregulatory mechanisms, and family processes including hostile and withdrawn parenting, low parental warmth and parental monitoring, and perceived rejection (Elgar et al., 2007; Frye and Garber, 2005; Goodman, 2007; King et al., 2016; Lovejoy et al., 2000; Yap et al., 2014). Further, research suggests that processes involved in

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* Corresponding author: Department of Psychiatry and Human Behavior, Alpert Medical School of Brown University, 1011 Veterans Memorial Parkway, East Providence, RI, 02915. United States.
E-mail address: Jennifer_Wolff@brown.edu (J.C. Wolff).

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the transmission of depression risk may be bidirectional, such that parent and adolescent processes influence one another and contribute to greater depression risk within families (Joiner and Coyne, 1999; Yap et al., 2014). That is, the interactions between family members may maintain and alter the course of their depression (Garber, 2005). In one study using a child sample, depressed mothers with children exhibiting more aggressive behaviors at age 5 reported significantly more depressive symptoms a year later compared to depressed mothers with children exhibiting fewer aggressive behaviors (Gross et al., 2008).

These processes may be particularly salient in the context of acute and chronic disorders in youth. Illustrating the potential strain on caregivers, parents of youth with chronic illness exhibit elevated symptoms of depression and post-traumatic stress (Bemis et al., 2015; Jaser et al., 2014), and parents and teens with chronic illness show concordance with regard to depression symptoms (Quittner et al., 2014). Relatedly, youth with chronic and acute psychiatric problems may have parents who experience psychopathology. For example, in youth with a history of non-suicidal self-injury, one study found that adolescent self-harming behavior was associated with parental psychopathology and parent personality traits indicative of higher self-dysregulation (Gromatsky et al., 2017). More research is needed to explore dyadic processes in the development and maintenance of depression, and to understand processes that may function as bidirectional mechanisms of risk between adolescents and their caregivers.

Emotion regulation and depression. In order to understand the dyadic processes that may explain a bidirectional association between parents and youth depression, specific interpersonal processes must be investigated. One candidate process that may negatively impact interactions between parents and youth and facilitate increased depressive symptoms is deficits in *emotion regulation*. Emotion regulation is described as a multifaceted process beginning with awareness of one's experience and moving toward engaging in strategies to regulate specific emotions (Gross, 2014), and these skills are central to models of risk and resilience for depression and related psychopathology (Aldao et al., 2010; Compas et al., 2017; Gross, 2015).

Difficulties in emotion regulation may serve as both an intra- and interpersonal process that contributes to depression in both adolescents and adults. There is a large body of research indicating deficits in emotion regulation are associated with internalizing psychopathology broadly, and depressed individuals specifically demonstrate less ability to regulate their emotions than their non-depressed counterparts (Aldao et al., 2010; Compas et al., 2017; Joormann and Siemer, 2014). Research also shows the development of effective emotion regulation strategies is an important factor in reducing vulnerability to psychopathology among children of depressed parents (Compas et al., 2010; Silk et al., 2006). Evidence suggests access to and use of a repertoire of emotion regulation strategies is adaptive, whereas a limited array of strategies is associated with poorer outcomes (Bonanno and Burton, 2013; Wolff et al., 2019). Additionally, impulsive behavior when confronted with negative affect may be a manifestation of poor emotion regulation, and has been associated with a variety of negative mental health outcomes, including depression (Carver et al., 2013).

Prior research also suggests that specific emotion regulation strategies or deficits in the emotion regulation process may serve a social function and therefore may influence interpersonal interactions (Barthel et al., 2018; Hofmann, 2014). Considering the parent-child relationship, it is plausible then that a parent or child's ability to regulate emotional responses may influence the others' psychological state (Yap et al., 2007). Research in early childhood suggests infants and young children rely on their caregivers' to regulate their emotional responses, and caregivers' modeling of appropriate regulation may influence the development of healthy emotion regulation patterns in their child (e.g., Lunkenheimer et al., 2007). This is thought to extend into late childhood and adolescence. In one study of school-age children and their caregivers, parental difficulties in emotion dysregulation were associated with elevated child internalizing psychopathology (Han et al., 2016). Relatedly, in a study assessing children's tolerance of distress during a computerized task, parental difficulties in emotion regulation was associated with lower distress tolerance, and lower distress tolerance was associated with elevated levels of child depression (Doan et al., 2018).

Adolescent emotion regulation may also influence caregivers' emotional state. Indeed, research shows that when adolescents engage in more effective emotion regulation during difficult conversations with their depressed parent, the conversations include more mutual positive engagement (Connell et al., 2011). Dysregulation in adolescents may serve as a source of uncontrollable stress for caregivers, thereby facilitating elevated levels of depression. However, no research to date has examined whether there are bidirectional links in families whereby self-reported adolescent emotion regulation is associated with parental depression and similarly whether parental emotion regulation is associated with adolescent depression. This is important, because the experience and regulation of emotions occurs in the interpersonal context (Barthel et al., 2018; Hofmann, 2014). Therefore, understanding the influence of both parents and their adolescent simultaneously provides insight into the dyadic nature of the relationship between emotion regulation and depression.

The actor-partner independence model framework. A potential barrier to investigating the bidirectional associations of emotion regulation and depression in parent-adolescent dyads is the difficulty in conducting these analyses, given that these data violate assumptions of non-independence in regression. However, the actor-partner interdependence model (APIM) is a statistical method that accounts for the interdependent nature of family member pairs (i.e., dyads; Kenny et al., 2006). This method allows us to better understand the unique contributions of parents and adolescents' own emotion regulation to their own ("actor effect) and each other's ("partner effect") depressive symptoms. Past studies have used this model to examine the intrapersonal and interpersonal effects in dyads such as couples, parent-child, and patient-caregiver (Driscoll et al., 2012; Liu et al., 2013; Maroufizadeh et al., 2018a, 2018b; Thomson et al., 2012). These studies have applied APIM to study factors such as family characteristics (e.g., family functioning, family cohesion, relationship quality), coping and emotion regulation (Compas et al., 2015), and depression outcomes in parents and their children (Gutiérrez-Colina et al., 2016; McWey et al., 2015; Milan et al., 2017). Yet, no APIM study has investigated depression and emotion regulation in youth with acute psychiatric concerns and their parents using this framework. Therefore, the APIM provides an innovative methodological approach that accounts for the interdependence of parents and adolescents and allows for a more advanced understanding of interpersonal factors related to depression that occur within the parent-adolescent dyad.

1. The current study

The current study examines emotion regulation and depressive symptoms among a sample of psychiatrically hospitalized adolescents and one of their parents. The aim of the current study was to investigate the intrapersonal and interpersonal association between emotion regulation and depressive symptoms using methods designed to explicitly address interdependence in parent-child relationships. Focusing on the dyad as the unit of analysis, we used the APIM to probe the extent to which one's own emotion regulation is associated with one's own depressive symptoms, and how one's emotion regulation is associated with family members' depressive symptoms. Although emotion regulation is conceptualized as a multifaceted construct, the extant literature points to two facets, impulsivity and access to regulation strategies, as particularly relevant to interpersonal interactions (Gonçalves et al., 2019; Mazursky-Horowitz et al., 2015) and thus will be the focus of this paper. To our knowledge, this is the first study to test both the intrapersonal and dyadic associations between depression and emotion regulation in a sample of depressed adolescents and their

caregivers.

It was hypothesized that: (1) poorer self-reported parent emotion regulation abilities will be linked to greater parent depressive symptoms (actor effect), (2) poorer self-reported adolescent emotion regulation abilities will be linked to greater adolescent depressive symptoms (actor effect), (3) poorer self-reported parent emotion regulation abilities will be linked to greater adolescent depressive symptoms (partner effect), and (4) poorer self-reported adolescent emotion regulation abilities will be linked to greater parent depressive symptoms (partner effect).

2. Method

Participants in this cross-sectional study were 123 adolescent-parent dyads drawn from a larger baseline sample. Participants were recruited from adolescent inpatient or partial hospitalization programs at a southern New England university-affiliated psychiatric hospital between 2014 and 2018. Consistent with the level of care in these settings, participants were typically admitted to the hospital due to severe psychopathology or being a danger to themselves or others. Inclusion criteria were: 1) parent and adolescent spoke English or Spanish and were able to give consent/assent, 2) adolescent received treatment in the inpatient or partial hospitalization setting, and 3) adolescent met criteria for current major depressive disorder (MDD) on the K-SADS-PL. Exclusion criteria for adolescents were cognitive or developmental delays, an autism spectrum diagnosis, or psychosis. See Table 1 for demographics and diagnostic information. It should be noted that 70.7% of the parent-teen dyads were the same sex (e.g., mother-daughter) and 29.3% were discordant (e.g., mother-son).

2.1. Procedure

The Institutional Review Board approved all study procedures (Reference number: 249360). Prospective participants were initially identified and screened through a medical record review. Parents of adolescent participants provided informed written consent for their and their child's participation; adolescent participants provided written assent. All participants were notified that they could withdraw from the study at any time and that their decision to participate would not impact their child's clinical care. Eligible dyads were given self-report measures and a diagnostic interview was conducted with the adolescent during the index hospitalization. Measures were primarily completed during hospitalization, but some were completed up to one week post-discharge.

Table 1
Demographic and diagnostic data of adolescents and parents.

	Adolescents	Parents
Age		
Mean (SD)	15.02 (1.28)	45.24 (7.77)
Range (years)	12-17	29-63
Female	81.3%	84.6%
Race[a]		
Black[b]	9.8%	7.3%
White[b]	89.4%	87.8%
Native American[c]	1.6%	3.3%
Asian[c]	5.7%	2.4%
More than one[c]	5.7%	4.9%
Hispanic/Latinx[c]	15.4%	11.4%
Current KSADS Diagnoses[d]		–
Anxiety[e]	65.9%	–
Post-traumatic stress disorder[f]	19.5%	–
Conduct Problems [g]	17%	–
Attention-deficit/hyperactivity disorder [f]	35%	–

[a] Percentages add to more than 100% because participants could choose more than one race category.
[b] Reports are missing for three parents.
[c] Reports are missing for two parents.
[d] KSADS= Kiddie-Schedule for Affective Disorders and Schizophrenia for School-Age Children
[e] Comprised of generalized anxiety disorder, panic disorder, and social phobia; 4 adolescents were missing data
[f] 5 adolescents were missing data
[g] Oppositional Defiant Disorder or Conduct Disorder; 2 adolescents were missing data

2.2. Measures

Beck Depression Inventory-II (BDI-II; (Beck et al., 1996). The BDI-II measured parent depression. It is a 21-item self-report questionnaire widely used to assess depression symptoms during the preceding two weeks. Each item asks about a symptom of depression; respondents choose a statement that best reflects their experience with that symptom. In the current sample, internal consistency was excellent (Cronbach's $\alpha = 0.93$). Higher scores indicate greater severity of symptoms.

Children's Depression Inventory-2 (CDI 2; Kovacs, 2010). The CDI-2 measured adolescent depression. The CDI-2 is 28 item self-report measure used to assess cognitive, affective, and behavioral signs of depression in youth ages 7-17. As in the case of the BDI-II, each item asks about a particular symptom of depression and respondents choose a statement that best reflects their experience with that symptom. Internal consistency for our sample was excellent (Cronbach's $\alpha = 0.89$). Higher scores indicate greater severity of symptoms.

Kiddie-Schedule for Affective Disorders and Schizophrenia for School-Age Children – Present and Lifetime Version (K-SADS-PL; Kaufman et al., 2000)**.** The K-SADS-PL is a semi-structured diagnostic interview that was used to assess the presence of MDD. Ratings were based on child report of symptoms. Post-baccalaureate research assistants, masters-level clinicians, and post-doctoral fellows were trained in K-SADS administration by a clinical psychologist with extensive experience with this interview. Kappa coefficients of agreement were computed between these raters and an experienced, licensed psychologist who randomly selected and listened to 20% of audio-taped interviews. Kappa was 0.90.

Difficulty in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004). Parents and adolescents each completed this 36-item self-report measure reflecting their own difficulty with emotion regulation. Each item is rated from 1 (Almost Never) to 5 (Almost Always), with higher scores indicating more difficulty. Given the dyadic nature of the current study, we focused on aspects of emotion regulation that are more observable within interactions and more likely to impact parent-child functioning. Therefore, two subscales from the DERS were chosen to assess difficulty in emotion regulation processes associated with interpersonal interactions: strategies and impulsivity. The *Strategy* subscale measures difficulty accessing strategies for feeling better when distressed (e.g., "When I'm upset, I believe there is nothing I can do to feel better"; items 15, 16, 22, 28, 30, 31, 35, 36). For both parents and adolescents, the internal consistency within this sample was excellent (parents: Cronbach's $\alpha = 0.90$; adolescents: Cronbach's $\alpha = 0.84$). The *Impulse* subscale reflects difficulty avoiding impulsive behavior when experiencing distressing emotions and behaving in a way that aligns with one's goals when experiencing negative affect. (e.g., "When I'm upset, I become out of control"; items 3, 14, 19, 24, 27, 32). This subscale also showed good internal consistency for both parents ($\alpha = 0.85$) and adolescents ($\alpha = 0.88$). We refer to these as Strategy and Impulse in the tables, results and discussion sections.

2.3. Statistical analysis

For descriptive statistics and preliminary analyses, we used IBM SPSS Statistics for Mac, Version 25.0 (IBM Corp., 2017). First, we reviewed each variable for normality and missingness. Parents' Impulse violated distributional assumptions by deviating from absolute values

Table 2
Means (M) and Standard Deviations (SD) for depressive symptoms and emotion regulation domains, and comparison between adolescents and parents.

Variable	Adolescent *M* (*SD*)	Parent *M* (*SD*)	*t*(*df*)[h]	95% CI *LL*	*UL*	*p*	Cohen's *d*
Depressive Symptoms[a]	25.56 (9.80)[b]	12.89 (10.56)[b]	–	–	–	–	–
Strategy	28.12 (6.70)[c]	15.00 (6.33)[d]	16.02(117)	11.33	14.52	<0.001	1.99
Impulse[e]	18.86 (6.01)[f]	10.54 (4.61)[g]	12.68(115)	0.93	1.28	<0.001	1.59

Note. CI = confidence interval of the difference; LL = lower limit of 95% CI; UL = upper limit of 95% CI

[a] Depressive symptom values are self-reported depression symptom total scores on the Children's Depression Inventory-2 and Beck Depression Inventory-II for adolescents and parents, respectively.

[b] $n = 123$

[c] $n = 119$

[d] $n = 121$

[e] Impulse mean and standard deviation are untransformed for ease of interpretation; values used in statistical inference tests are square-root transformed.

[f] $n = 118$

[g] $n = 120$

[h] Results from paired *t*-tests comparing parent and adolescent emotion regulation responses.

of approximately 1 for skewness and kurtosis. A square root transformation was used such that after transformation, skewness and kurtosis were within acceptable ranges (Tabachnick and Fidell, 1996). We also transformed adolescents' Impulse for consistency. We conducted APIM analyses with both square-root transformed and untransformed values, and the model effects and significance are the same (with one exception, which we note in parentheses). For ease of interpretation, we present results from APIM models based on the untransformed values. Second, there were significant positive correlations between sex and depression for both parents ($r = 0.21$, $p = 0.021$) and adolescents ($r = 0.31$, $p = 0.001$), as well as a significant negative correlation between adolescent age and parent emotion regulation strategies ($r = -0.23$, $p = 0.013$). Therefore, sex and age were entered as covariates in the APIM model. All predictor and covariate variables were centered using the program implementing the APIM, described below.

Implementation of the actor-partner interdependence model. To account for the non-independence of parent and adolescent dyads and to test our hypotheses on the intrapersonal and interpersonal nature of emotion regulation and depressive symptoms, we used the APIM (Kenny et al., 2006). The overall goal of using the APIM analysis was to investigate the unique influence of adolescent and parent domains of emotion regulation on their own depressive symptoms ("actor effect") and on the depressive symptoms of the other member of the dyad ("partner effect"). Specifically, the link between adolescent deficits in emotion regulation and their own depressive symptoms (actor effect) can be examined as well as the link between parent's deficits in emotion regulation on the adolescent's depressive symptoms (partner effect). Similarly, the link between parent deficits in emotion regulation on their own depressive symptoms (actor effect) and their adolescent's deficits in emotion regulation on parent's depressive symptoms (partner effect) can be examined. Actor effects are estimates that control for the partner effects, and vice versa (Kenny et al., 2006). It is a partner effect that indicates the interdependent nature of the relationship between deficits in emotion regulation and depression; furthermore, when both dyad members have a significant partner effect, this demonstrates the bidirectional nature of the relationship (Kenny et al., 2006).

To test the main model, structural equation modeling (SEM) was used as implemented in web-based R analysis using lavaan ("APIM_SEM", available at https://apimsem.ugent.be/shiny/apim_sem/; (Rosseel, 2012; Stas et al., 2018)). In our model, the two domains of emotion regulation (Strategy and Impulse) were simultaneously entered as independent variables, and the total score for depressive symptoms was entered as the dependent variable. This allowed us to test the relation between an emotion regulation domain and depression, controlling for the influence of the other emotion regulation domain. APIM analyses can be conducted by treating members of the dyad as indistinguishable (e.g., same sex roommates), in which the intercepts, actor effects, partner effects, and outcome variances are set to be equal (Stas et al., 2018), or by treating dyad members as distinguishable by belonging to separate categories and analyzing actor and partner effects separately by role (e.g., husbands and wives, parents and adolescents; (Ledermann and Kenny, 2017)). In the current study, dyad members were treated as distinguishable given the theoretical distinctions between age and role between parents and adolescents within the family system (Kenny et al., 2006). SEM is recommended for the use of distinguishable dyads, over other methods like multi-level modeling (Stas et al., 2018). APIM_SEM provides an empirical test of distinguishability using a chi square statistic.

SEM uses Full Information Maximum Likelihood estimation method, which can account for missing data (e.g., one dyad member is missing a score (Ledermann and Kenny, 2017)). Our model included those who had complete data for both parents' and adolescents' depressive symptoms for all 123 dyads. For Strategy, 119 adolescents and 121 parents had complete data, and for Impulse, 118 adolescents and 120 parents. Therefore, all 123 dyads were analyzed despite some missing scores as noted. We present both standardized and unstandardized estimates, with the former taking into account missing data (Ledermann and Kenny, 2017).

Lastly, specific details of the APIM_SEM model are provided as implemented through R's program lavaan (Rosseel, 2012). The SEM model was run using maximum likelihood estimation, with alpha set to 0.05 and coefficient tests as Z tests. Effect sizes for actor and partner effects are provided as partial correlations. Unlike in non-dyadic SEM analyses, goodness-of-fit statistics are not provided for SEM as implemented in APIM_SEM because the model that includes the measured predictor and outcome variables is saturated, and thus will generate the same variance-covariance matrix (Ledermann and Kenny, 2017).

3. Results

3.1. Preliminary analyses

To examine if parents and adolescents presented similar patterns of self-reported emotion regulation and depression, paired sample *t*-tests were conducted on the studied variables (see Table 2). Results show that parents reported significantly less difficulty with Impulse and Strategy than adolescents and the effect sizes were large. Bivariate correlations examining the relationships between study variables are presented in Table 3.

3.2. Primary analyses

APIM Analyses. A single APIM SEM model was tested (for model results, see Table 4 and Fig. 1) including both Strategy and Impulse as

Table 3
Bivariate correlations of parent and adolescent depressive symptoms and emotion regulation domains.

	Adolescent Strategy	Parent Strategy	Adolescent Impulse	Parent Impulse	Adolescent Depression	Parent Depression
Adolescent Strategy	—	—	—	—	—	—
Parent Strategy	0.10	—	—	—	—	—
Adolescent Impulse	0.54***	0.22*	—	—	—	—
Parent Impulse	0.03	0.64***	0.03	—	—	—
Adolescent Depressive Symptoms[a]	0.44***	0.03	0.29**	-0.17	—	—
Parent Depressive Symptoms[a]	0.04	0.54***	0.06	0.37***	-0.05	—

[a] Depressive symptom values are self-reported depression symptom total scores on the Children's Depression Inventory-2 and Beck Depression Inventory-II for adolescents and parents, respectively. Adolescent and parent Impulse values are square-root transformed.

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

predictor variables and self-reported depressive symptoms as the outcome. Including both predictor variables in the same model allowed us to test the unique contribution of each emotion regulation domain by controlling for the influence of the other domain. As the first step in the APIM analysis, we conducted a test of distinguishability based on the dyad member's role (parent or adolescent) by comparing a model with distinguishable dyads to indistinguishable dyads using a chi square statistic. Results indicated participants are distinguishable by family role ($\chi^2 = 198.57$, $df = 35$, $p < 0.001$).

The lavaan SEM model converged after 243 iterations. The error variance for adolescents was 64.31 and for parents it was 75.28. The partial intraclass correlation (an indicator of non-independence) for depression, controlling for other predictor variables, was not statistically significant (-0.06, $p = 0.552$), indicating there is no clear trend in symptom ratings for both adolescents and parents. In other words, their depression symptom scores do not appear dependent on one another.

When looking at the individual contribution of each predictor (i.e., Impulse and Strategy), there were no observed actor effects for adolescents and parents on self-reported Impulse. This suggests that self-reported levels of impulsive behavior in response to strong emotions are not significantly related to one's own rating of depressive symptoms. However, the adolescent partner effect was significant such that parents' Impulse was associated with adolescents' symptoms of depression. Counter to our hypothesis, results indicated a negative relationship. The model interpretation was that greater parent self-reported Impulse was associated with less adolescent depression symptom severity. There was no significant partner effect for the association between adolescents' Impulse and parent's symptoms of depression. The adolescent and parent partner effects were found to be significantly different from one another ($p = 0.043$; using square-root transformed values this difference was not significant, $p = 0.146$), and the overall partner effect was significant (-0.42, $p = 0.002$).

When considering the emotion regulation Strategy scale, significant actor effects were observed for adolescents and parents, indicating that greater difficulty accessing emotion regulation strategies was related to higher self-reported symptoms of depression. The adolescent and parent actor effects were not significantly different from one another ($p = 0.114$), but the overall actor effect was significant (0.71, $p < 0.001$). No significant partner effects were observed, and adolescent and parent partner effects were not significantly different from one another ($p = 0.232$).

Lastly, we examined the covariates of sex and age. Sex was significantly related to depression symptoms for both adolescents (5.93, overall standardized effect 0.24, $p = 0.002$) and parents (4.48, overall standardized effect 0.15, $p = 0.043$), such that females had greater depressive symptom severity. Age was not significantly associated with depression for both adolescents (0.70, overall standardized effect 0.09, $p = 0.241$) and parents (0.05, overall standardized effect 0.04, $p = 0.649$).

Table 4
Actor-Partner interdependence model estimates for the relation between emotion regulation domains and depressive symptoms by role of adolescent and parent

Effect	Role	Estimate	95% CI[a]	*p*-value	$\hat{\beta}(s)$[b]	$\hat{\beta}(o)$[c]	r[d]
Impulse							
Intercept	Adolescent	31.67	[13.21, 50.14]	< 0.001			
Actor		0.05	[-0.24, 0.35]	0.719	0.03	0.16	0.30
Partner		-0.70	[-1.10, -0.29]	< 0.001	-0.33	-0.37	-0.21
Intercept	Parent	18.38	[14.31, 22.45]	< 0.001			
Actor		0.07	[-0.38, 0.51]	0.776	0.03	0.03	0.37
Partner		-0.15	[-0.49, 0.19]	0.384	-0.09	-0.08	0.05
Strategy							
Intercept	Adolescent	31.67	[13.21, 50.14]	< 0.001			
Actor		0.54	[0.28, 0.80]	< 0.001	0.37	0.35	0.44
Partner		0.31	[-0.00, 0.62]	0.050	0.20	0.20	-0.01
Intercept	Parent	18.38	[14.31, 22.45]	< 0.001			
Actor		0.88	[0.55, 1.21]	< 0.001	0.53	0.57	0.54
Partner		0.05	[-0.23, 0.34]	0.707	0.03	0.03	-0.02

Note. R^2 for teens is 0.324 and R^2 for parents is 0.318. Results controlled for age and sex, which are not presented.

[a] CI = confidence interval

[b] $\hat{\beta}(s)$ = a standardized estimate calculated using separate parent and adolescent standard deviation values. This allows for within person comparisons between actor and partner effects.

[c] $\hat{\beta}(o)$ = a standardized estimate using the overall standard deviation across both parents and adolescents, which enables comparison of these estimates across parents and adolescents.

[d] r represents the partial correlation which provides the effect size for individual actor and partner effects

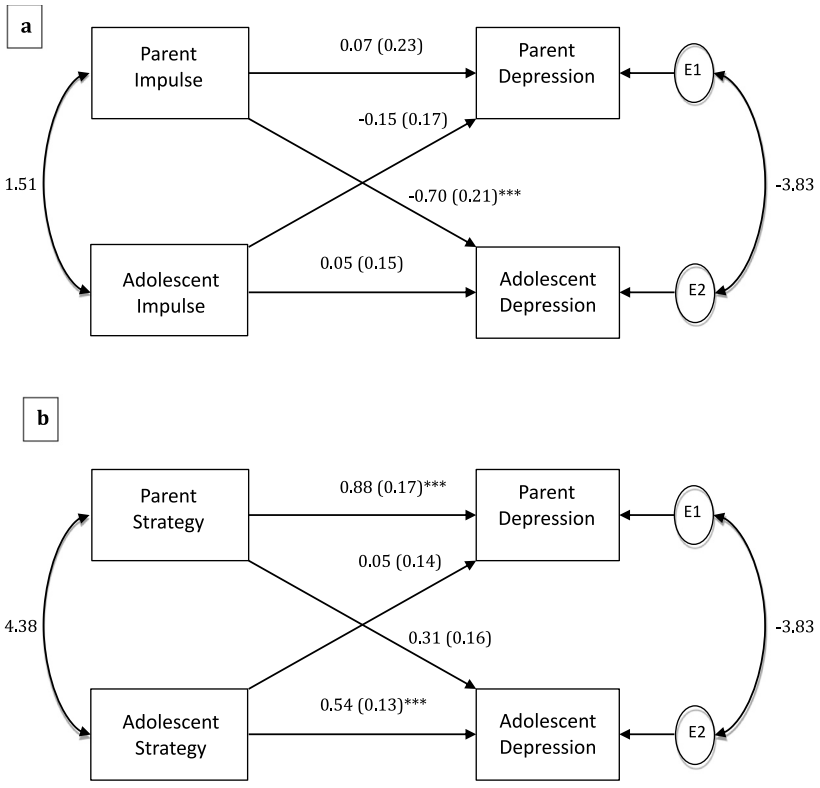

Fig. 1. (a) Unstandardized parameter estimates of actor and partner effects for parent and adolescent impulsiveness in relation to self-reported depression while controlling for the effects of adolescent and parent emotion regulation strategies, age, and sex (age and sex parameters not included in figure; emotion regulation domains depicted separately but originate from one APIM model). (b) Unstandardized parameter estimates of actor and partner effects for parent and adolescent emotion regulation strategies in relation to self-reported depression while controlling for the effects of adolescent and parent impulsiveness, age, and sex (age and sex parameters not included in figure; emotion regulation domains depicted separately but originate from one APIM model).
Standard errors are presented in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

4. Discussion

The current study examined individual and dyadic processes within the adolescent-parent relationship to understand depression. The study utilized the APIM to investigate the independent and interdependent relationships between emotion regulation and depressive symptoms in depressed adolescents and their parents. Although both actor and partner effects were identified, findings reveal complex and sometimes unexpected results. More specifically, expected actor effects were found for emotion regulation strategies, but not impulsiveness. In addition, a significant partner effect was found for parents' impulsiveness and adolescents' depressive symptoms. This study advances the literature by using the APIM to investigate interdependence within adolescent-parent relationships in the context of psychiatric hospitalization for depressed adolescents.

With regard to impulsiveness when experiencing distressing emotions and self-reported depressive symptoms, no significant actor effects were observed. That is, there was no significant relationship between one's own impulsive behaviors in response to strong emotions and depressive symptoms while controlling for difficulty accessing coping strategies. However, a significant partner effect for parents' Impulse and adolescents' depressive symptoms was observed, demonstrating the interdependent nature of these factors in the sample. Impulsiveness when experiencing distressing emotions refers to difficulty controlling *behavior* when experiencing emotion rather than difficulty controlling the emotions themselves (Gratz and Roemer, 2004). This suggests that not only are parents' challenges regulating their emotions related to their adolescents' experiences of depression, but also difficulty managing the associated behavioral responses. Because the model controlled for coping strategies, it may be that these parents experience more out of control feelings and may have more volatile mood symptoms. We also predicted greater parent Impulse would be associated with greater depression, however, the partner effect relationship was contrary to our hypotheses. The significant negative association indicates when adolescent depression is higher, parent Impulse is lower, and when adolescent depression is lower, parent Impulse is higher. Importantly, this cross-dyad effect, indicating interdependence, is controlling for effects of all the other variables in the model.

Although these results were unexpected, there are several possible interpretations for this inverse partner effect. First, adolescents may perceive parents' impulsive behavior when experiencing strong emotions as demonstrating parents are more engaged in the parent-child relationship, thereby reducing adolescent feelings of depression. Considering the reverse, whereby high adolescent depressive symptoms are associated with low parental impulsive responding, it is possible that parents are dampening their impulsive response to emotional situations to accommodate their adolescents' depressive presentation. On the other hand, it is also plausible that parents of depressed adolescents are emotionally less responsive overall, which could lead to feelings of invalidation in the adolescents. In line with this hypothesis, literature on expressed emotion in parents and outcomes in adolescents suggests that parental emotional expression, both positive and negative, is a predictor of positive adjustment in youth (Bariola et al., 2011; Greenberg, 1999). Our findings may also fit with Coyne's (Coyne, 1976) interactional theory of depression and a relationship erosion perspective (Branje et al., 2010; Joiner and Coyne, 1999), which suggest that high symptoms of depression in adolescents may initially elicit more supportive parental behaviors. Eventually, however, adolescents high in depression are assumed to set into motion a process of support erosion in which the initially supportive parent–adolescent interaction becomes increasingly rejecting and constraining (Branje et al., 2010; Nelemans et al., 2014). Greater symptoms of depression may thereby eventually erode the parent–adolescent relationship over time, which is not captured in this cross-sectional examination. Furthermore, given that the cross-sectional nature of our study impedes our ability to determine causality, future research addressing these hypotheses is warranted.

With regards to emotion regulation strategies and depressive symptoms, only significant actor effects were observed. Contrary to hypotheses, this suggests that access to effective strategies when experiencing negative emotions appears more related to one's own depression and does not seem to have an influence on one's family

members. Use of these strategies may be more observable than some other emotion regulation processes, but still relies on some internal processes that may not be easily observed in interactions, and may explain why we observed significant actor effects but not partner effects. Perceptions of ability to manage emotions through effective strategies provide a sense of control over dealing with intense emotional experiences. This is in line with prior research suggesting emotional self-efficacy, or the perceived capability to cope with negative emotions (Muris, 2001), is significantly associated with adolescent depression (Muris, 2002). It is also possible that because some strategies used to manage intense emotions are unobservable (e.g., suppression or avoidance), the strategy one considers and uses may not be primary to affecting the interpersonal interaction.

Further, it is notable that depressed adolescents in the current sample reported significantly greater difficulties in emotion regulation overall than their parents. One explanation for this discrepancy may be accounted for by the fact that all adolescents met criteria for current MDD, whereas parents did not have to meet this criterion. Furthermore, some adolescents had other psychiatric diagnoses (see Table 1). In addition, it is possible that these differences are due in part to developmental processes. Emotion regulation skills are thought to develop over the course of childhood and adolescence, with both the diversity and complexity of skills increasing linearly with age (Gullone et al., 2010; Thompson and Goodman, 2010).

Overall, in our examination of emotion regulation factors associated with depression in parent-teen dyads, results support the independence of the use of emotional strategies and the interdependence of impulsiveness. Family dynamics play a key role in affecting depression within individual members and specific family member characteristics appear to contribute to depression over and above individual level factors (Daches et al., 2018). Although most prior research on parents' role in adolescent depression has focused primarily on specific parenting behaviors (Elgar et al., 2007; Frye and Garber, 2005; King et al., 2016; Yap et al., 2014), our results suggest parenting behaviors are only one piece of fully understanding the complex nature of depression in the family. Moreover, results show that in this unique sample, there was actually little concordance between parent and teen depression and there was little dyadic similarity. Still, by examining both the independent and interdependent nature of these interactions findings extend what we know about the relationships between these factors in families.

One specific application where this is especially important is psychosocial treatment approaches for adolescents. Oftentimes treatment is provided to the individual adolescent outside of the family context and without consideration for how other family members' behaviors and characteristics may maintain adolescent psychopathology. However, treating the individual adolescent only accounts for a portion of what maintains their depression. Engaging parents in adolescent depression treatment is needed, with an emphasis on helping parents to model effective, appropriate emotion regulation strategies in the family context.

It is important to acknowledge a number of limitations to our study. First, although APIM could address actor and partner effects during the dyadic relationship, this model is not able to reveal more complex mechanisms, such as the role of genetics, that may exist between adolescents' and parents' emotion regulation and depression. Specifically, our cross-sectional model is not able to illustrate transactional factors and underlying mechanisms over time including ways adolescent and parent depression and emotion regulation may directly and indirectly reinforce each other. Relatedly, because data was collected from only one parent, it does not account for the role of additional caregivers who may play a large role. Second, the small sample size may have limited the ability to detect significant findings. Third, the sample consisted of primarily Caucasian adolescents who were receiving intensive psychiatric services, and some of whom had additional psychiatric disorders. Thus, findings may not generalize to other populations, including community-based samples of adolescents, adolescents experiencing depression only, or minority groups. In particular, given the severity of presentations in the inpatient setting, the sample includes some subgroups of parents who have limited family ability to care for the psychiatric needs of their adolescents. The parent's ability to care for the adolescent's needs likely plays a role in the likelihood that they are hospitalized and subsequently their inclusion in our sample. Still, these findings may provide important information for those who work with clinically referred adolescents and their parents. Due to the cross-sectional design, temporal relationships could not be determined among the variables examined. A future longitudinal study could examine causal pathways in these relationships. In addition, while it is a strength that the study includes both mothers and fathers, only one parent was included for each dyad. Therefore, the study does not account for the effects of depression or emotion regulation in co-parents, or account for the family system as a whole. The study also consisted of self-report questionnaire measures only. Studies examining emotion regulation processes at multiple levels, such as psychophysiological regulation, will be important next steps in this research. Finally, there are known gender differences in rates of depression and sensitivity to interpersonal processes. Future studies should be specifically powered to examine gender differences.

Despite these limitations, this work provides an important look into family member factors that relate to adolescent depression. Families are complicated systems where members continuously affect and are affected by each other. Continued work should examine and account for these dyadic relationships rather than simply looking at isolated individual factors. By using the dyad as the unit of analysis, future research can account for unique individual contributions from multiple members of an interaction and provide a more complete understanding of factors linked to depression in families.

Contributors

All authors made substantial contributions to this work. All authors participated in the conception and refinement of the manuscript objectives, literature review, and manuscript writing and editing. Dr. Thomas and Mr. Hood conducted all statistical analyses.

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Declaration of Competing Interest

The authors have no real or potential conflicts of interest to declare.

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