PARENTING AND INTERNALIZING SYMPTOMS IN EARLY ADOLESCENCE:
THE MODERATING ROLE OF VAGAL TONE

BY

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THESIS

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Abstract

The present study investigated baseline respiratory sinus arrhythmia (RSA) as moderator of the prospective association between parenting and internalizing symptoms among a group of typically developing adolescents across the transition to middle school. At Time 1 (5th grade; spring before middle school transition), participants included 100 young adolescents (53% boys; 57% European American; Mage = 11.05 years, SD = .33) and their mothers (Mage = 41.25 years, SD = 6.22; 96.0% biological). At Time 2 (6th grade; fall after middle school transition), 89 adolescents and their mothers returned. To address study aims, a multi-informant, multi-method, longitudinal design was used. At Time 1, mothers reported on monitoring knowledge and psychological control, and adolescents' baseline RSA was measured during a resting baseline period. At Times 1 and 2, adolescents reported on three indices of internalizing symptoms (depressive symptoms, social anxiety, loneliness and social dissatisfaction). Results from multiple regression analyses revealed that lower levels of maternal monitoring knowledge and higher levels of psychological control were predictive of higher levels of depressive symptoms and loneliness. Further, among boys, lower baseline RSA exacerbated the link between maternal psychological control and higher levels of depressive symptoms and loneliness, whereas higher baseline RSA attenuated the effect. Overall, findings were consistent with prior evidence of lower baseline RSA as a risk factor and higher baseline RSA as a protective factor against psychopathology, contributing the growing literature on the effects of the interplay between parenting and youth ANS functioning on youth mental health.

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Chapter One: Introduction and Literature Review

Early adolescence (ages 10 – 13 years) is a critical and often challenging time in the life course. It is during adolescence that most major mental health problems begin and often persist into adulthood. Many youth suffer from a wide range of mental health problems including social, emotional, and behavioral problems as they transition to adolescence (Kieling et al., 2011). Studies worldwide have shown that 10-20 percent of adolescents will experience mental health problems (Kieling et al., 2011). Findings from a nationally representative sample of youth in the U.S. found that over 1 in 5 teens (ages 13-18 years) will develop a chronic mental disorder that will lead to severe mental health impairment in adulthood (Merikangas et al., 2011), with anxiety, behavioral, and mood disorders among the most common. Thus, it is important to understand what impacts mental health during this transitional period.

Parenting is crucial to fostering successful adaption during adolescence, potentially promoting or hindering adolescent mental health. Of particular interest in this study are parental monitoring knowledge and psychological control. Parental monitoring knowledge refers to the knowledge that parents have about the whereabouts of their adolescents (Stattin & Kerr, 2000). Psychological control refers to parents' use of intrusive parenting techniques to control adolescent's activities and emotions (Barber, 1996; Barber & Harmon, 2002). Both parental monitoring knowledge and psychological control have been linked with adolescent mental health, which may be due in part to the emotional climate these parenting processes create and/or the extent to which monitoring and control promote or hinder autonomy development, a key developmental task during adolescence (Lansford et al., 2014).

Yet, based on the person x environment framework, the effect of the environment (e.g., parenting) may depend on individual attributes (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). One related theory proposes biological or autonomic processes as individual attributes that may interact with environmental factors in the prediction of adjustment (Belsky & Pluess, 2009; Boyce & Ellis, 2005). In the present study, we examined adolescent physiological activity, specifically baseline vagal tone, as a moderator of the association between parenting and adolescent mental health. Baseline vagal tone (measured as baseline *respiratory sinus arrhythmia;* baseline RSA) is a measure of parasympathetic nervous system (PNS) regulation on heart rate during resting states, which is widely viewed as the trait-like capacity for flexible physiological self-regulation (Beauchaine, 2001; Porges, 2007). Previous studies, supportive of baseline RSA as a moderator of negative environmental contexts, have revealed that low baseline RSA serves as a risk factor and high baseline RSA serves as a protective factor in contexts of high family conflict (El-Sheikh & Erath, 2011). However, very few studies have explored the role of baseline RSA in the context of parental monitoring knowledge and psychological control, which could provide a better understanding of how parenting may promote or hinder adolescent

mental health based on adolescents' characteristics. Thus, the present study aimed to explore the interaction between parenting and baseline RSA in the prediction of adolescent internalizing symptoms.

Utilizing a multi-informant, multi-method, longitudinal design, the present study addressed the following aims: (1) to examine the unique contributions of maternal monitoring knowledge and psychological control in the prediction of adolescent internalizing symptoms, and (2) to examine adolescent baseline RSA as a moderator of the prospective association between parenting and adolescent internalizing symptoms. As an exploratory aim, we propose to examine whether the moderating role of baseline RSA on the prospective association between parenting and adolescent internalizing symptoms varied by gender. Aims were tested with a sample of typically developing adolescents and their mothers.

Internalizing Symptoms in Early Adolescence

Internalizing symptoms are characterized by disturbances in emotion or mood, such as anxiety and depressive symptoms (Kovacs & Devlin, 1998; Zahn-Waxler, Klimes-Dougan, & Slattery, 2000), which are often comorbid (Brady & Kendall, 1992; Cole, Peeke, Martin, Truglio, & Seroczynski, 1998; Schleider & Weisz, 2017). Depressive symptoms include profound sadness and inability to experience pleasure, making individuals likely to experience self-recriminations, social withdrawal and even suicidal ideations (Maria Kovacs & Devlin, 1998). Anxiety symptoms include extreme fear or worry. A form of anxiety common during early adolescence is social anxiety, which is a persistent, unrealistically intense fear of social situations that inhibits or impedes adolescents' interpersonal functioning (La Greca & Lopez, 1998). Moreover, heightened feelings of loneliness often occur during early adolescence and are comorbid with depressive and anxiety symptoms (Cavanaugh & Buehler, 2016; Ladd & Ettekal, 2013).

A number of stressors pile up in early adolescence, which might contribute to the development of internalizing symptoms. Previous research suggests that developmental changes (e.g., early pubertal maturation, advancing cognitive abilities; Ge, Conger, & Elder, 2001; Ge & Natsuaki, 2009; Kovacs & Devlin, 1998), stressful life events (e.g., child maltreatment, victimization, and transition to middle school) and changes in adolescent's interpersonal relationships (peer relationships and parent-adolescent relationships) might influence the prevalence of internalizing symptoms in early adolescence (Grant et al., 2003; Leadbeater, Kuperminc, Blatt, & Hertzog, 1999). Moreover, compared with boys, girls exhibit a greater increase in internalizing symptoms around the transition to adolescence (Hankin, 2015; Hankin & Abramson, 2001).

Parents may be particularly crucial to young adolescents' successful adaptation, even though adolescents are gradually shifting their sources of social support from parents to peers, because parents still exert a tremendous influence on adolescence (Lansford et al., 2018). Yet, parents and adolescents may be negotiating adolescent autonomy and parents' desires to remain involved (via guidance and supervision) in adolescents' lives (Smetana, Crean, & Campione-Barr, 2005). Thus, understanding the

role of parental monitoring knowledge and psychological control in contributing to adolescent internalizing symptoms during early adolescence is critical for promoting adolescent mental health.

Parenting and Adolescent Internalizing Symptoms

Parents are important socialization agents, even into adolescence. Parents may engage in behaviors that support and promote or hinder youth mental health. During adolescence, parental monitoring knowledge, which is defined as the information parents obtain regarding adolescents' whereabouts, activities, and associates (Anderson & Branstetter, 2012; Stattin & Kerr, 2000), becomes especially salient given adolescents' increasing independence and autonomy. In contrast, parental psychological control, which refers to parents' use of coercive and hostile parenting techniques, such as guilt induction, love withdrawal, instilling anxiety, and invalidation of adolescents' perspective to control their expression of thoughts and emotions (Barber, 1996; Smetana & Daddis, 2002), could directly interfere with key developmental tasks.

Compared to the established evidence that monitoring knowledge serves as a protective factor against externalizing symptoms (e.g., Hoeve et al., 2009; Kerr & Stattin, 2000; Mann, Kretsch, Tackett, Harden, & Tucker-Drob, 2015), the association between monitoring knowledge and internalizing symptoms has received less attention (Fröjd, Kaltiala-Heino, & Rimpelä, 2007; Yap & Jorm, 2015; Yap, Pilkington, Ryan, & Jorm, 2014). Further, our review of literature revealed that there is inconsistent pattern among these few existing studies. For instance, some studies, using samples of youth in early- to mid-adolescence, found that monitoring knowledge was negatively related with internalizing symptoms (Fröjd et al., 2007; Hamza & Willoughby, 2011; Jones et al., 2008; Kerr & Stattin, 2000; Kim & Ge, 2000; Weaver & Kim, 2008). It was reasoned that monitoring knowledge might reflect a warm, trusting relationship where adolescents are disclosing to parents (thus, resulting in greater monitoring knowledge) and/or where adolescents may perceive parental monitoring as supportive rather than restrictive or controlling, thus promoting positive adolescent outcomes (Fröjd et al., 2007; Smetana, 2008; Smetana, Metzger, Gettman, & Campione-Barr, 2006; Waizenhofer, Buchanan, & Jackson-Newsom, 2004). In contrast, non-significant results were reported in others studies (Garthe, Sullivan, & Kliewer, 2015; Vazsonyi & Belliston, 2006; Weaver & Kim, 2008). The different pattern of findings across studies might be due to differences in sample ages (effects found for early but not late adolescent samples; Vazsonyi & Belliston, 2006; Weaver & Kim, 2008), as well as cultural context (Vazsonyi & Belliston, 2006) and method of assessment or informant (Garthe, Sullivan, & Kliewer, 2015). Thus, more work is needed to further clarify the inconsistent patterns of associations, especially in early adolescence where the parent-adolescent relationship is beginning to undergo changes (De Goede, Branje, & Meeus, 2009).

As compared to literature on monitoring knowledge and internalizing symptoms, there is a clearer pattern of findings documenting association between psychological control and higher levels of

internalizing symptoms (for a review, see Barber & Harmon, 2002). A meta-analysis conducted by Pinquart (2017) showed that among nine parenting dimensions (e.g., parental warmth, autonomy granting, harsh control), psychological control was the most robust predictor of concurrent internalizing symptoms, with particularly strong effects in older adolescents. This may indicate that identifying and addressing psychological control during early adolescence could have benefits in late adolescence. Similar patterns have also emerged using other methods of assessment (e.g., longitudinal, daily diary, observational), such that higher psychological control was associated with poorer mental health among youth (ages 7-12) (Aunola, Tolvanen, Viljaranta, & Nurmi, 2013; Kunz & Grych, 2013; Rogers, Buchanan, & Winchell, 2003). Psychological control may create a coercive or negative parent-adolescent relationship and emotional climate, as well as have adverse effects on how adolescents perceive themselves (Morris, Silk, Steinberg, Myers, & Robinson, 2007; Smetana & Daddis, 2002; Steinberg, 2005). Early adolescence is a critical period for autonomy and self-identify development; thus, parents who are psychologically controlling may impede or undermine these key developmental tasks, resulting in increased risk for psychological and emotional maladjustment (Soenens et al., 2008).

Parental monitoring knowledge and psychological control have typically been examined separate of one another. In the present study we conceptualize monitoring knowledge and psychological control as potentially opposing parenting processes with regards to the parent-adolescent emotional climate (warmth/trust vs negative/hostile, respectively) and role in adolescent autonomy (support vs hinder, respectively; Lansford et al., 2014). The combined effects may provide a more comprehensive picture of parenting contributions as these parenting practices do not occur in isolation.

Only two studies (same sample; ages 12-17) examined monitoring knowledge and psychological control simultaneously in the prediction of internalizing symptoms one year later (Lansford et al., 2014; Pettit, Laird, Dodge, Bates, & Criss, 2001). These studies reported that both mother- and youth- reported high psychological control had unique effects for more internalizing symptoms (Lansford et al., 2014; Pettit et al., 2001), especially for girls (Pettit et al., 2001). Further, youth-reported high monitoring knowledge predicted less internalizing symptoms among boys one year later (Lansford et al., 2014). Collectively, these findings indicated that higher levels of psychological control were predictive of higher levels of internalizing symptoms, especially for girls, whereas higher levels of monitoring knowledge appeared to be protective against internalizing symptoms among boys.

By examining parental monitoring knowledge and psychological control together, we can get a better understanding of the degree to which different dimensions of parenting could have a stronger influence on adolescent mental health, and during which developmental time frame. This may be especially important given prevalence of depressive symptoms, anxiety, and sense of loneliness during adolescence.

Adolescent Physiological Activity: Vagal Tone

In addition to parental contributions to adolescent internalizing symptoms, individual attributes, such as physiological activity may also contribute to adolescents' experiences of internalizing symptoms. Vagal tone, as a "trait-like" characteristic, is proposed to play a role in adolescent psychopathology (Beauchaine, 2001, 2015). Vagal tone is an index of autonomic nervous system (ANS), which measures parasympathetic nervous system (PNS) regulation on heart rate. ANS as a stress response system reflects how individuals respond to their environmental demands. As a branch of ANS, PNS serves "rest and digest" functions (Porges, 2007). One measure of vagal tone is *respiratory sinus arrhythmia* (RSA), which refers to the variation in cardiac rhythms across the respiratory cycle. RSA during resting states (baseline) represents the parasympathetic influence (to calm down), via vagus nerve, on the heart. Thus, the vagus serves as a "brake" to decelerate heart rate. According to Polyvagal Theory (Porges, 2007), an individual's perceptions and how they process cues in their environment can impact their physiological state, which in turn change their behaviors to meet environmental needs. When stressful events occur, the vagus can be withdrawn (withdrawal of parasympathetic influence), resulting in an increase in arousal and metabolic output to deal with the environmental demands. The focus of the present study is on baseline RSA or vagal tone.

Baseline RSA is widely viewed as the capacity for flexible physiological and attentional self-regulation (Beauchaine, 2001, 2015; Porges, 2007), which is recognized as a stable trait in older children and early adolescents (El-Sheikh, 2005). High baseline RSA provides sufficient capacity to regulate physiological activity under stressful events, whereas low baseline RSA reflects limited capacity for self-regulation (Beauchaine, 2001, 2015). High baseline RSA contributes to a calm state and provides a greater range of regulation so that RSA withdrawal may occur without intriguing extreme levels of cardiovascular arousal (Beauchaine, 2001, 2015). Thus, high baseline RSA has been linked with less internalizing symptoms as well as appropriate engagement and emotional regulation (Beauchaine, 2001, 2015). Low baseline RSA, in contrast, may create a decreased threshold to stressors, making individuals prone to experiencing hyper-arousal and negative emotionality (Beauchaine, 2001, 2015). Thus, low baseline RSA has been linked with mental health problems such as elevated level of internalizing symptoms, especially in adults (Kemp et al., 2010). Among studies of adolescents, although low baseline RSA is found to confer risk for clinically depressed youth, the effect is less clear in typically developing youth (Koenig, Kemp, Beauchaine, Thayer, & Kaess, 2016).

Vagal Tone as a Moderator of Parenting

As previously discussed, parenting behaviors and adolescent physiology both contribute to the psychological outcomes of adolescents. Parenting is a key environmental component that is critical to youth development, yet individual attributes like adolescent physiology also contribute to youth mental health. The interaction between nature and nurture (person x environment) is influential to the mental health of adolescents (Collins et al., 2000), which means the effect of one may depend on the other. Applying El-Sheikh and Erath's (2011) model of family conflict x ANS functioning to parenting specifically, we propose that adaptive ANS functioning may attenuate the effects of negative parenting, whereas maladaptive ANS functioning may exacerbate the effects of negative parenting, consistent with El-Sheikh and Erath's (2011) propositions.

Very few studies have examined the interaction between parenting and baseline RSA regarding youth mental health. Dyer, Blocker, Day, and Bean (2016) examined adolescent baseline RSA as a moderator of the association between parent-reported parenting style and adolescent externalizing behaviors one year later (*M*age = 15.3). The highest levels of externalizing symptoms were found among boys with low baseline RSA, specifically when they experienced low levels of authoritative parenting (i.e., high demandingness and responsiveness; Dyer et al., 2016). Similarly, among a group of preschoolers (*M*age = 3.5), low baseline RSA exaggerated the impact of high maternal protective overcontrol on high social wariness six months later, whereas high baseline RSA attenuated the effect (Hastings et al., 2008).

Additional evidence of the moderating role of baseline RSA has been found in other studies investigating non-supportive parenting, marital conflict, and adverse environment/stress (e.g., child abuse, community violence exposure, peer victimization, and traumatic events) in samples of youth ranging from 8 to 15 years old (El-Sheikh & Erath, 2011; El-Sheikh, Harger, & Whitson, 2001; El-Sheikh, Keiley, Erath, & Dyer, 2013; McLaughlin, Rith-Najarian, Dirks, & Sheridan, 2015; Mezulis, Crystal, Ahles, & Crowell, 2015). In these studies, high levels of baseline RSA operated as a protective factor against environmental stressors. In contrast, low levels of baseline RSA were found to be a risk factor for youth mental health in negative environmental contexts.

Thus, youth with low baseline RSA appear to be more strongly affected by parenting styles characterized by low warmth and high control (Dyer et al., 2016; Hastings et al., 2008) as well as by other adverse environmental contexts. It is possible then that the effect of low parental monitoring knowledge and high psychological control on internalizing symptoms may be exacerbated among youth exhibiting low baseline RSA.

Moreover, due to the different social-developmental experiences (El-Sheikh & Whitson, 2006) and the influence of sex hormones on various aspects of stress response systems (Oldehinkel & Bouma,

2011), there might be gender difference in the responsiveness to environmental stressors, contributing to the gender difference found in the prevalence of internalizing symptoms among adolescents (Hankin & Abramson, 2001). Several aforementioned studies also revealed some evidence for gender difference of the moderating role of baseline RSA between negative environmental context and adolescent psychological maladjustment, such that the association was attenuated for boys with high levels of baseline RSA, but not girls (Dyer et al., 2016; McLaughlin et al., 2015).

To conclude, based on the person x environment framework, the effect of parenting on adolescent mental health may depend on the physiological traits of adolescents. The impact of low monitoring knowledge and high psychological control on internalizing symptoms may vary depending on adolescent baseline RSA because baseline RSA reflects the capacity for flexible physiological adjustment to satisfy environmental demands (Beauchaine, 2001, 2015). Thus, low baseline RSA may place youth at greater risk for, whereas high baseline RSA may be protective against, maladjustment and specifically internalizing symptoms, in the context of negative parenting. Given some evidence of gender difference in the prevalence of internalizing symptoms and the patterns of associations among negative environmental context and internalizing symptoms in adolescence, the moderating of baseline RSA may also vary across gender.

The Present Study

Contemporary developmental perspectives (El-Sheikh & Erath, 2011) and growing empirical evidence (Dyer et al., 2016; Hastings et al., 2008) provide support for the moderating role of youth ANS functioning (i.e., baseline RSA) in the association between family/parenting processes and youth mental health. Using a multi-method, multi-informant, longitudinal design of typically developing adolescents and their mothers, the present study sought to investigate the following aims:

Aim 1: To examine the unique contributions of maternal monitoring knowledge and psychological control in the prediction of adolescent internalizing symptoms over time. Hypothesis 1: Both low maternal monitoring knowledge and high psychological control would make unique contributions in predicting more internalizing symptoms.

Aim 2: To examine adolescent baseline RSA as a moderator of the prospective association between parenting and adolescent internalizing symptoms. Hypothesis 2: Lower baseline RSA would exacerbate the positive association linking low maternal monitoring knowledge and high psychological control with more internalizing symptoms, whereas higher baseline RSA would attenuate the effect, over time.

Exploratory aim: To examine whether the moderating role of baseline RSA on the prospective association between parenting and adolescent internalizing symptoms varies by gender. Given the limited previous findings, we have no specific hypothesis for this aim.

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Chapter Two: Method

Participants

Data for the proposed study comes from a longitudinal study focused on mother-youth interactions about adolescent stress across the transition to middle school (The Transition to Middle School Project). At Time 1 (T1), before the middle school transition (spring of 5th grade year), families were recruited from elementary schools in the Midwestern United States across two cohorts (1 year apart). Eligibility criteria included youth in fifth grade, families who spoke English, and youth with no diagnosis of developmental delays or chronic illness.

The sample of participants included 100 young adolescents (53% boys; M_{age} = 11.05 years, SD = .33) and their mothers (M_{age} = 41.25 years, SD = 6.22; 96.0% biological) at T1. At Time 2 (T2), after the middle school transition (fall of 6th grade), 89 of 100 adolescents (51.1% boys; 51.1% European American; M_{age} = 11.65 years, SD = .32) and their mothers (M_{age} = 41.56 years, SD = 5.59; 95.6% biological) returned.

Among the 100 families, 86% were two-parent families. Approximately 57% of adolescents were reported by their mothers as European American, 11% were African American, 14% were Hispanic, 6% were Asian, and 12% were other (e.g., biracial). Approximately 62.9% of families had annual household income over $75,000; 18.6% had between $50,000 and $75,000; 14.4% had between $25,000 and $50,000; 4.1% had less than $25,000. Approximately 76% of mothers had a bachelor's degree or higher. This is a predominantly middle-class sample with diverse racial/ethnic background and relatively high education level and income.

T-tests and chi-square tests across all study variables were conducted to determine differences in participants who did and did not return at T2. No difference on study demographic and primary study variables emerged between participants who did and did not return at T2. Moreover, no difference on primary study variables emerged between participants from two cohorts.

Procedures

The study was approved by the institutional review board of University of Illinois at Urbana-Champaign. Before and after the middle school transition, adolescents and their mothers visited the university laboratory. At T1, adolescents and their mothers participated in a laboratory session during which adolescent physiological responses (baseline RSA) was measured. After the laboratory session, mothers and adolescents completed surveys in separate rooms to maintain confidentiality. Mothers reported on parental monitoring knowledge and psychological control, adolescents reported on internalizing symptoms. For a majority of adolescents, research assistants read through the survey questions with them. Adolescents also reported on internalizing symptoms in the laboratory at T2.

Measures

        Parental monitoring knowledge (T1). Mothers reported on parental monitoring knowledge using a 9-item scale developed by Stattin and Kerr (2000) (e.g., "Do you know the friends your child spends time with during his/her free time?" "Do you usually know when your child has an exam or paper due at school?" "Do you know where your child goes when he/she is out with friends?"). Each item was rated on a 5-point Likert-like scale (0 = *No, not at all* to 4 = *Yes, definitely*). The Cronbach's alpha was .73.

        Psychological control (T1). Mothers completed the psychological control subscale of Parent Behavior Inventory (Barber, 1996). Ten self-report items (e.g., "If my child really cared about me, he/she would not do things to cause me to worry;" "I would like to be able to tell my child what to do all the time;" "I am always trying to change my child") were rated on a 3-point scale (1 = *not like/false*, 2= *somewhat like/somewhat true*, 3 = *like/true*). The scale has demonstrated reliability and validity in many studies (e.g., Pettit et al., 2001; Wang, Pomerantz, & Chen, 2007). The Cronbach's alpha was .81.

        Baseline RSA (T1). RSA data were collected and cleaned following standard guidelines (Berntson et al., 1997) using MindWare data capturing equipment and software (MindWare Technologies, Inc., Gahanna, OH). During the laboratory session, well-trained research assistants placed disposable Ag-AgCl electrodes on the right clavicle and lower left and right ribs of adolescents. Electrocardiography (ECG) data was collected using MindWare BioLab during a 3-minute baseline period where mothers and adolescents were asked to sit calmly and not talk to each other. Then RSA scores (units = ln [ms^2]) were analyzed in 1-minute intervals using MindWare HRV analysis software and composited into a single score, with the very few artifacts manually corrected following standard procedures (Berntson et al., 1997).

        Depressive symptoms (T1 and T2). Adolescents completed Children's Depression Inventory (Kovacs, 1992). Twenty-six self-report items (e.g., "0 – I am sad once in a while, 1 – I am sad many times, 3 – I am sad all the time"; "0 – I do most things OK, 1 – I do many things wrong, 2 – I do everything wrong") were reported on a 3-point scale (1 = *absence of symptom* to 3 = *presence of symptom*). The item regarding suicidal ideation was not collected in this study. Cronbach's alphas were .81 and .85 for T1 and T2, respectively.

        Social anxiety (T1 and T2). Adolescents completed Social Anxiety Scale for Adolescents (La Greca & Lopez, 1998). Twelve self-report items (e.g., "I feel shy around people I don't know," "I worry about what others say about me," "I'm quiet when I'm with a group of people.") were rated on a 5-point scale (1 = *not at all*, 5 = *all the time*). Cronbach's alphas were .93 and .89 for T1 and T2, respectively.

        Loneliness and social dissatisfaction (T1 and T2). Adolescents completed Loneliness and Social Dissatisfaction Scale (Asher & Wheeler, 1985). Sixteen self-report items (e.g., "Do you feel alone

at school?"; "Do you have lots of friends at school?"; "Do you feel left out of things at school?") were rated on a 3–point scale (0 = *no*, 1 = *sometimes*, 2 = *yes*). Cronbach's alphas were .88 and .85 for T1 and T2, respectively.

Plan of Analysis

To answer the research questions, we first looked at the descriptive statistics, checked for outliers and skew, calculated the mean, standard deviation, and percentage of missing data of each study variable. We also conducted *t*-tests and chi-square tests to examine gender and ethnic minority status differences among study variables. Next, bivariate correlations between study variables were computed using Pearson's *r*.

Next, a series of multiple regression analyses were conducted in AMOS to examine the independent and interactive associations between T1 parenting constructs and youth baseline RSA in the prediction of T2 youth depressive symptoms, T2 social anxiety and T2 loneliness and social dissatisfaction, controlling for T1 outcomes. Models were fitted separately for each outcome. Full information maximum likelihood estimation was used to handle missing data (Acock, 2005).

First, a model with covariates were examined, which included gender, ethnicity, age and T1 internalizing symptoms. Second, to address Aim 1, the main effects of T1 parenting were examined. Specifically, a model including covariates, T1 maternal monitoring knowledge and T1 psychological control was tested to predict T2 youth depressive symptoms, T2 social anxiety and T2 loneliness and social dissatisfaction. Next, the main effect of baseline RSA was added into the model.

To address Aim 2, the interactions between each parenting index and baseline RSA were added into the model. Although main effects of maternal monitoring knowledge and psychological control were included together in the model, we only tested one interaction term at a time. Separate models were fitted for each outcome variable. For example, in order to examine baseline RSA as a moderator of the association between T1 maternal monitoring knowledge and T2 depressive symptoms, the model included covariates, T1 monitoring knowledge, T1 psychological control, T1 baseline RSA, and T1 monitoring knowledge x T1 baseline RSA. Significant interactions were probed using tests of simple slopes (Aiken & West, 1991; Preacher, Curran, & Bauer, 2006). These analyses yielded intercepts and slopes representing the relationship between the predictor (parenting) and outcome (internalizing symptoms) at low (-1 *SD*) and high (+1 *SD*) levels of moderator (baseline RSA).

To address the exploratory aim, three-way interactions between T1 parenting, T1 baseline RSA and gender were conducted. Similar to two-way interactions, one three-way interaction term was tested at a time, and separate models were fitted for each outcome variable. For example, in order to examine gender differences of baseline RSA as a moderator between maternal monitoring knowledge and T2 depressive symptoms, the model included covariates, T1 monitoring knowledge, T1 psychological

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control, T1 baseline RSA, gender, T1 monitoring knowledge x T1 baseline RSA, T1 monitoring knowledge x gender, T1 baseline RSA x gender, and T1 monitoring knowledge x T1 baseline RSA x gender. Significant interactions were probed using tests of simple slopes (Aiken & West, 1991; Preacher et al., 2006). Probes of significant interactions are presented in Figures 1 and 2 (pages 18-19), which represent the association between the predictor (parenting) and outcome (internalizing) at low (-1 SD) and high (+1 SD) levels of baseline RSA for boys and girls.

Chapter Three: Results

Preliminary Analysis

Table 1 summarizes descriptive statistics and correlations among study variables. Maternal monitoring knowledge and psychological control were modestly and negatively correlated. Additionally, monitoring knowledge was negatively correlated with T2 depressive symptoms, whereas psychological control was positively correlated with depressive symptoms at T1 and T2, as well as T1 social anxiety and T2 loneliness and social dissatisfaction. Internalizing symptoms were relatively stable across the two waves. *T*-tests examining gender differences revealed that compared with girls, boys had higher baseline RSA, $M_{girls} = 6.23$, $SD = 1.14$; $M_{boys} = 6.85$, $SD = 1.07$; $t(97) = -2.766$, $p < .01$. Additionally, *t*-tests examining ethnicity differences revealed that ethnic minority mothers, as compared with European American mothers, reported higher levels of psychological control, $M_{EA} = 1.35$, $SD = .28$; $M_{minority} = 1.52$, $SD = .35$; $t(96) = -2.76$, $p < .01$.

Table 1

Descriptive Statistics and Correlations among Parenting Behaviors, Baseline RSA and Internalizing Symptoms

	1	2	3	4	5	6	7	8	9	M (SD)
1 T1 Monitoring knowledge	-									3.51 (.38)
2. T1 Psychological control	-.25*	-								1.42 (.32)
3. T1 Baseline RSA	-.17	-.03	-							6.56 (1.14)
4. T1 Depression	-.06	.21*	-.04	-						1.23 (.19)
5. T1 Social anxiety	.03	.25*	-.16	.45***	-					2.51 (.90)
6. T1 Loneliness	.01	.08	-.25*	.57***	.54***	-				.31 (.32)
7. T2 Depression	-.22*	.34**	-.06	.54***	.32**	.39***	-			1.25 (.21)
8. T2 Social anxiety	-.07	.16	.03	.23*	.38***	.22*	.49***	-		2.40 (.70)
9. T2 Loneliness	-.13	.26*	-.08	.45***	.45***	.67***	.63***	.43***	-	.30 (.10)

Note. T1 = data collected at Time 1. T2 = data collected at Time 2. Gender coded as 0 = female, 1 = male. Race/ethnicity coded as 0 = European American, 1 = minority.

*p < .05. **p < .01. ***p < .001.

Parenting and the Prediction of T2 Youth Internalizing Symptoms

Results from regression analyses are reported in Table 2.

T2 Depressive symptoms. As shown in Table 2, among covariates, T1 depressive symptoms were positively associated with T2 depressive symptoms. In addressing aim 1 regarding the unique contributions of the parenting indices, consistent with hypothesis, main effects of maternal monitoring knowledge and psychological control emerged, controlling for the other. Specifically, higher levels of T1 monitoring knowledge predicted lower levels of T2 depressive symptoms, whereas higher levels of T1 psychological control predicted higher levels of T2 depressive symptoms. This model explained 5% of the unique variance in T2 youth depressive symptoms.

Further, although a main effect of youth baseline RSA did not emerge, support for our exploratory aim was evident with a three-way interaction among T1 psychological control, baseline RSA, and gender emerged to predict T2 youth depressive symptoms, explaining 6% of the unique variance. As shown in Figure 1, tests of simple slopes revealed that psychological control predicted higher levels of T2 depressive symptoms among girls exhibiting lower baseline RSA, $B = .20$, $SE = .07$, $p < .01$, and high baseline RSA, $B = .27$, $SE = .08$, $p < .001$, as well as among boys exhibiting lower baseline RSA, $B = .42$, $SE = .14$, $p < .01$. However, no association emerged among boys exhibiting higher baseline RSA, $B = -.02$, $SE = .14$, $p = .89$. Thus, consistent with hypothesis, higher baseline RSA served as a protective factor against more depressive symptoms for boys when maternal psychological control was high.

T2 Social anxiety. Among covariates, T1 social anxiety was positively associated with T2 social anxiety. Inconsistent with hypotheses, no main or interaction effects among monitoring knowledge, psychological control, or baseline RSA emerged (Table 2).

T2 Loneliness and social dissatisfaction. As shown in Table 2, among covariates, T1 loneliness and social dissatisfaction was positively associated with T2 loneliness and social dissatisfaction. In addressing aim 1 regarding the unique contributions of the parenting indices, partially consistent with hypothesis, higher levels of T1 psychological control predicted higher levels of T2 loneliness and social dissatisfaction, controlling for monitoring knowledge; main effects of T1 monitoring knowledge did not emerge. This model explained 2% of the unique variance in T2 youth loneliness and social dissatisfaction.

Further, although a main effect of youth baseline RSA did not emerge, support for our exploratory aim was evident with a three-way interaction among T1 psychological control, baseline RSA, and gender emerged to predict T2 youth loneliness and social dissatisfaction, explaining 2% of the unique variance. As shown in Figure 2, tests of simple slopes revealed that psychological control predicted higher levels of T2 loneliness and social dissatisfaction among girls exhibiting lower baseline RSA, $B = .24$, $SE = .10$, $p < .05$, and higher baseline RSA, $B = .22$, $SE = .10$, $p < .05$, as well as boys exhibiting lower baseline RSA, $B = .77$, $SE = .18$, $p < .001$, but not among boys exhibiting

higher baseline RSA, $B = -.01$, $SE = .18$, $p = .97$. Thus, consistent with hypothesis, higher baseline RSA served as a protective factor against more loneliness and social dissatisfaction for boys when maternal psychological control was high.

Table 2

Unstandardized and Standardized Regression Coefficients for the Independent and Interactive Effects of Monitoring Knowledge, Psychological Control and Baseline RSA Predicting Three Indices of Internalizing Symptoms

	T2 Internalizing symptoms					
	T2 Depression		T2 Social anxiety		T2 Loneliness and social dissatisfaction	
	B (SE)	β	*B (SE)*	β	*B (SE)*	β
Step 1: T1 Controls						
Gender	-.06 (.04)	-.15	-.17 (.14)	-.12	.02 (.05)	.03
Ethnicity	-.03 (.04)	-.06	-.06 (.14)	-.04	-.02 (.05)	-.03
Age	-.07 (.06)	-.11	-.04 (.21)	-.02	-.06 (.07)	-.07
T1 Internalizing symptoms	.61 (.10)***	.54	.28 (.08)***	.36	.67 (.08)***	.70
R^2	.33		.15		.49	
Step 2: T1 Predictors						
Monitoring knowledge (MK)	-.10 (.05)*	-.17	-.16 (.18)	-.08	-.05 (.06)	-.06
Psychological control (PC)	.17 (.06)**	.26	.23 (.22)	.10	.20 (.07)**	.21
R^2	.38		.16		.51	

Note. T1 = data collected at Time 1. T2 = data collected at Time 2. Gender coded as 0 = female, 1 = male. Race/ethnicity coded as 0 = European American, 1 = minority. Separate models are fitted for each outcome and interactions terms were tested separately for monitoring knowledge and psychological control.

*p < .05. **p < .01. ***p < .001.

Table 2 (cont.)

	T2 Internalizing symptoms					
	T2 Depression		T2 Social anxiety		T2 Loneliness and social dissatisfaction	
	B (SE)	β	*B (SE)*	β	*B (SE)*	β
Step 3: T1 Moderator						
Baseline RSA	-.00 (.02)	-.02	.08 (.06)	.12	.01 (.02)	.04
R^2	.38		.18		.52	
Monitoring knowledge models						
Step 4						
MK x baseline RSA	.02 (.05)	.03	-.06 (.18)	-.03	-.02 (.06)	-.03
R^2	.38		.19		.52	
Step 5						
MK x gender	-.09 (.06)	-.13	.30 (.22)	.13	-.16 (.08)*	-.16
Baseline RSA x gender	.02 (.02)	.06	.02 (.09)	.02	.02 (.03)	.05
R^2	.38		.21		.54	
Step 6						
MK x baseline RSA x gender	.05 (.06)	.06	.32 (.23)	.13	.05 (.08)	.05
R^2	.39		.24		.55	

Note. T1 = data collected at Time 1. T2 = data collected at Time 2. Gender coded as 0 = female, 1 = male. Race/ethnicity coded as 0 = European American, 1 = minority. Separate models are fitted for each outcome and interactions terms were tested separately for monitoring knowledge and psychological control.

*p < .05. **p < .01. ***p < .001.

Table 2 (cont.)

	T2 Internalizing symptoms					
	T2 Depression		T2 Social anxiety		T2 Loneliness and social dissatisfaction	
	B (SE)	β	*B (SE)*	β	*B (SE)*	β
Psychological control models						
Step 4						
PC x baseline RSA	-.06 (.05)	-.10	-.01 (.19)	-.01	-.11 (.06)	-.13
R^2	.39		.18		.53	
Step 5						
PC x gender	-.08 (.08)	-.08	.38 (.32)	.11	.06 (.11)	.04
Baseline RSA x gender	.02 (.02)	.06	.02 (.09)	.03	.02 (.03)	.05
R^2	.41		.19		.53	
Step 6						
PC x baseline RSA x gender	-.22 (.07)**	-.24	.32 (.29)	.11	-.33 (.10)***	-.25
R^2	.47		.20		.55	

Note. T1 = data collected at Time 1. T2 = data collected at Time 2. Gender coded as 0 = female, 1 = male. Race/ethnicity coded as 0 = European American, 1 = minority. Separate models are fitted for each outcome and interactions terms were tested separately for monitoring knowledge and psychological control.

*p < .05. **p < .01. ***p < .001.

Figure 1. The association between T1 maternal psychological control and T2 depressive symptoms at low (-1 *SD*) and high (+1 *SD*) levels of baseline RSA among boys and girls.
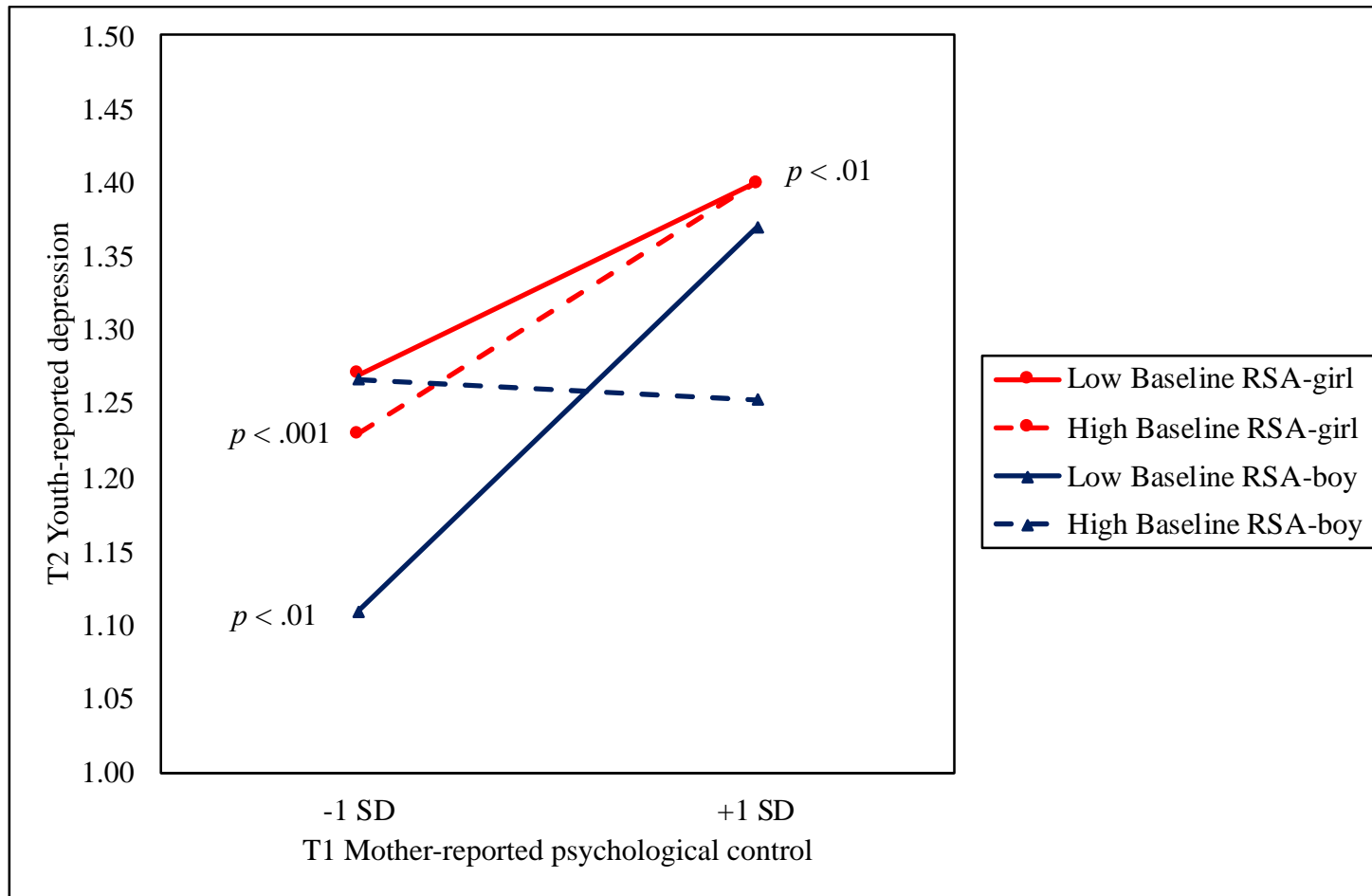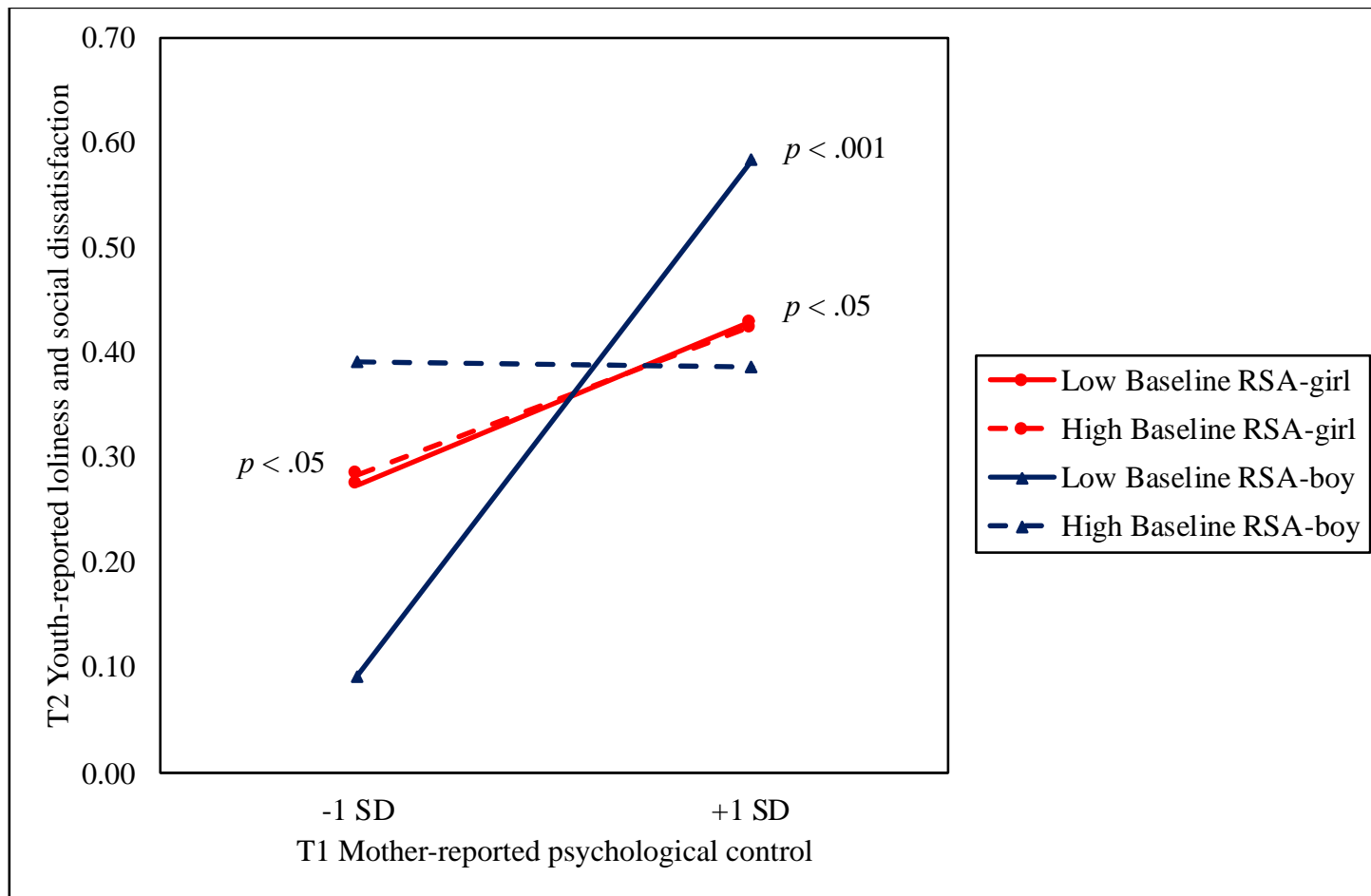
Figure 2. The association between T1 maternal psychological control and T2 loneliness and social dissatisfaction at low (-1 *SD*) and high (+1 *SD*) levels of baseline RSA among boys and girls.

Chapter Four: Discussion

Exposure to negative parenting such as high psychological control and low monitoring knowledge is a potential risk for elevated internalizing symptoms in adolescents (Fröjd et al., 2007; Pinquart, 2017). These associations maybe especially evident for youth exhibiting physiological risk (El-Sheikh & Erath, 2011). Using a multi-informant, multi-method, longitudinal design, the present study investigated whether adolescents' baseline RSA moderated the associations linking maternal monitoring knowledge and psychological control with three indices of internalizing symptoms (i.e., depressive symptoms, social anxiety, loneliness and social dissatisfaction) across the transition to middle school. Consistent with our hypothesis, both lower levels of maternal monitoring knowledge and higher levels of psychological control uniquely predicted higher levels of depressive symptoms. Further, partially supportive of hypotheses, under conditions of high maternal psychological control, lower baseline RSA appeared to function as a risk factor for boys and girls, whereas higher baseline RSA served as a protective factor for boys but not girls. For girl, maternal psychological was positively associated with internalizing symptoms regardless of baseline RSA levels.

Regarding the unique contributions of monitoring knowledge and psychological control, we found that both maternal monitoring knowledge and psychological control predicted youth depressive symptoms in the expected direction across the middle school transition, which highlights the importance of promoting supportive parenting and reducing negative parenting during a critical transitional period in early adolescence. Monitoring knowledge may be beneficial to early adolescents because monitoring knowledge reflects a warm, trusting relationship between a parent and adolescent which can promote positive adolescent outcomes (Smetana et al., 2006). In contrast, psychological control in early adolescence can have detrimental effects on adolescent mental health (Pinquart, 2017) because psychological control may be reflective of a coercive, negative parent-adolescent relationship. The emergence of monitoring knowledge as a unique predictor of lower levels of depressive symptoms, after accounting for psychological control, is novel given findings from previous studies with older adolescents in which the effect of monitoring knowledge was not evident across the whole sample when accounting for psychological control (Lansford et al., 2014). One potential explanation may be that monitoring knowledge is especially important during early adolescence, as opposed to later adolescence, during a transitional period where positive parenting may be key to youth achieving developmental tasks.

Beyond the direct associations linking parenting and adolescent internalizing symptoms, a three-way interaction among psychological control, baseline RSA, and gender emerged in the prediction of youth-reported depressive symptoms and loneliness and social dissatisfaction. Across these two outcomes, high maternal psychological control was associated with more internalizing symptoms for girls

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regardless of baseline RSA levels. However for boys, lower baseline RSA exacerbated the association linking higher levels of psychological control with higher levels of depressive symptoms and loneliness and social dissatisfaction, whereas higher baseline RSA served as a protective factor against the detrimental effect of psychological control. This pattern of associations was consistent with a previous study by McLaughlin and colleagues (2015), where higher baseline RSA attenuated the association between higher stress exposure (e.g., community violence, peer victimization, traumatic events) and higher levels of internalizing symptoms for adolescent boys but not girls (ages 13-17). McLaughlin and colleagues (2015) reasoned that higher vagal tone was associated with improved physiological recovery following stress, which helped to buffer boys from stress-related internalizing symptoms.

Similarly, we reason that higher baseline RSA may serve a protective function because it enables a calm state for individual to cope with environmental stressors without intriguing extreme levels of arousal, whereas lower baseline RSA may create a decreased threshold to stressors (Beauchaine, 2001, 2015). Thus, boys with higher baseline RSA may have greater capacity to regulate despite negative parenting environment. In contrast, boys with lower baseline RSA may be more vulnerable to stressors such as psychological control, exacerbating the negative association between psychological control and depressive symptoms as well as loneliness and social dissatisfaction. Yet, under low maternal psychological control condition, boys with lower baseline RSA appeared to have lower levels of depressive symptoms and loneliness and social dissatisfaction compared to their higher baseline RSA counterparts. This pattern appears in line with the differential susceptibility theory (Belsky & Pluess, 2009) which proposes that youth who possess an indicator of susceptibility obtain the most benefits (i.e., less internalizing symptoms) under supportive environments (i.e., low psychological control), but the worst outcomes under negative environmental conditions (i.e., high psychological control). Thus, our patterns of findings suggest that lower baseline RSA may be considered a susceptibility factor, especially given the associations with negative emotionality and difficult temperament (Eisenberg et al., 2012), which have been conceptualized as susceptibility factors within this theory (Belsky & Pluess, 2009). However, findings should be interpreted with caution as our sample reported, on average, low levels of internalizing symptoms and psychological control, indicating need for additional research with clinical or at-risk samples to better determine whether lower baseline RSA might be a susceptibility factor linking parenting with psychopathology in early adolescence.

In the present study, higher baseline RSA did not emerge as a protective factor for girls. This may be partially explained with previous literature suggesting that adolescent girls experience greater mental health consequences of environmental stressors in general as compared with boys (Hankin, 2015; Hankin & Abramson, 2001; McLaughlin et al., 2015). Considering that adolescent girls as compared with boys are more relationship-oriented, have greater sensitivity to interpersonal relationship stressors/ threats

(Coyne, Archer, & Eslea, 2006; Guyer, McClure-Tone, Shiffrin, Pine, & Nelson, 2009), as well as more cognitive vulnerability characterized by negative inferential style (Hankin & Abramson, 2001), they may be more vulnerable to negative parenting, which may override the potential benefits of higher baseline RSA. Of note, it is also possible that mean-level gender differences in the present study, with boys exhibiting higher baseline RSA on average than girls, could partially influence the pattern of gender differences found. Although similar patterns of gender differences in the moderating role of baseline RSA have been previously observed (Beauchaine, 2001; Dyer et al., 2016; McLaughlin et al., 2015), additional research is needed to replicate these patterns of associations and further explicate potential mechanisms involved in the associations among parenting, PNS functioning, mental health, and youth gender (e.g., Dyer et al., 2016; McLaughlin et al., 2015).

Unexpectedly, neither maternal monitoring knowledge nor psychological control was predictive of social anxiety. Results in the current study might indicate that social anxiety may be less likely to be affected by parenting, with other salient factors, such as peer influences, perhaps having a greater influence (Hardy, Bukowski, & Sippola, 2002; Kingery, Erdley, & Marshall, 2011).

Additionally, although we found direct associations linking higher levels of maternal monitoring knowledge with lower levels of youth depressive symptoms, monitoring knowledge was not associated with other indices of internalizing symptoms and the effects were not moderated by baseline RSA. It is possible that there might be other moderating variables for monitoring knowledge, such as peer affiliations. Further, we assessed monitoring *knowledge* rather than actual monitoring *behavior* (Stattin & Kerr, 2000), which could have different effects on adolescent mental health.

The notable strengths of the study include the assessment of both positive and negative parenting constructs, utilizing multiple informants (mother reports of parenting, youth reports of internalizing symptoms) and multiple methods (e.g., survey and physiological data), as well as a longitudinal study design with a sample of typically developing early adolescents across the transition to middle school. Despite the strengths of the study, there are several limitations and directions for future work. First, mothers' parenting was the focus of the present study, yet fathers' perspective should also be considered (Lansford et al., 2014). Compared with mothers, fathers are found to be less knowledgeable on adolescents' whereabouts and less psychologically controlling (Barber & Harmon, 2002; Crouter & Head, 2002), which could have different implications for adolescent mental health. Future studies would benefit from considering variations in fathers' contribution to adolescent mental health. Second, although the current study provided some evidence for the moderating role of youth PNS functioning on the link between parenting and adolescent internalizing symptoms, additional work is needed to provide further evidence about the moderating role of other indices of youth characteristics/physiology, as well as the moderating role of baseline RSA in the context of other positive/negative parenting constructs (e.g.,

parental warmth, behavioral control). Whereas the present study focused on a physiological "trait-like" characteristic, future studies may consider examining youth temperament (e.g., individual behavioral differences; Nigg, 2006) to corroborate findings. Also, observations of parenting behaviors as opposed to parent reports on surveys could provide more objective assessments and different insights about links with adolescent mental health. Third, youth in our sample were relatively well-adjusted and had mothers who reported low levels of negative parenting. Thus, the results of the current study, which revealed the protective function of higher baseline RSA (for boys only) and the vulnerability factor of lower baseline RSA (boys and girls) in the context of negative parenting, may not be generalized to youth who experience more extreme negative parenting or at high risk for psychopathology. Future studies addressing these associations with at-risk or higher-risk samples would be particularly informative for intervention purposes.

Despite the limitations, the present study contributes to the growing literature about the interplay between parenting and youth ANS functioning on adolescent mental health during early adolescence. Extending this literature, higher baseline RSA protected against the negative effects of maternal psychological control among boys (but not girls), whereas lower baseline RSA exacerbated the association between maternal psychological control and internalizing symptoms for boys and girls. These results may have implications for a multifaceted approach of intervention to protect youth from negative mental health consequences. In efforts to promote better mental health among boys and girls, the findings from the present study suggest focusing on building positive mother-adolescent relationships and open communication, specifically reducing negative parenting behaviors, as well as promoting regulated PNS functioning through the use of biofeedback or other intervention methods.

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