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THE ROLE OF PUBERTY IN THE DEVELOPMENT OF COPING

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Abstract

As children transition into adolescence, they demonstrate more sophisticated coping strategies that allow them to more effectively respond to daily and life stressors. These improvements are considered to be aspects of the normative, age-graded development of coping, though there has been little scientific exploration of underlying biological developments that may drive these alterations in coping. This study aimed to (a) create a theoretically-grounded model of coping sophistication; (b) test which developmental factors may predict sophistication of coping using structural equation modeling (SEM); and (c) explore gender differences in the ways in which children cope with stress. Students in 4th and 5th grade (*N=152*) and their parent completed measures of coping practices, psychopathology, stress exposure, and pubertal development. A model of coping sophistication was found to be partially invariant across genders and predictive of psychological wellbeing among boys. Neither age nor pubertal development was predictive of coping sophistication, yet for boys greater stress exposure was associated with poorer coping sophistication. Possible implications of gender differences in coping sophistication are discussed. These findings are important for theoretical models of the development of coping and underscore the need for additional, longitudinal research.

Table of Contents

List of Tables

List of Figures

Introduction

A proliferation of social, academic, and familial challenges in adolescence brings an increased need for adaptive coping strategies, which adolescents may need to implement in greater frequency and number than they had in childhood (Wadsworth et al., 2016). Coping strategies are known to diversify and expand over the course of childhood; as one matures and experiences more stressors, it is adaptive that coping strategies also advance in order to best meet regulatory needs. This expansion and sophistication of coping strategies has been attributed to increases in chronological age. However, the development of coping occurs in coordination with a number of processes that underlie those strategies, such as cognitive ability, physiological reactivity, and socioemotional awareness. These underlying processes develop at various speeds and not necessarily in tandem with chronological age, suggesting that a developmental process such as puberty could be implicated in the sophistication of internal resources that allow for effective and diverse coping skills (Mendle, 2014).

The term *coping* in this paper is conceptualized as the purposeful, goal-oriented strategies that individuals use to adapt to psychosocial stress (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). Coping begins in infancy with temperament and physiological stress reactivity, and builds on learned and innate abilities to regulate behavior, emotions, attention, and cognitions (Derryberry, Reed, & Pilkenton-Taylor, 2003; Gunnar & Quevedo, 2007; Skinner & Zimmer-Gembeck, 2009). A child may be considered effective at coping if the behavioral and emotional responses to a stressor that they make allow them to return to homeostasis (physiological and/or psychological) relatively rapidly. Coping effectively may protect against the harmful effects of stress in adolescence (Blair, 2010; Blair & Raver, 2012), while deficits in coping skills are implicated in the development and maintenance of psychopathology for

children of all ages (Beauchaine, 2001; Carver, Johnson, & Joormann, 2008; King, Lengua, & Monahan, 2013; Nigg, 2006; Rudolph, Troop-Gordon, & Llewellyn, 2013). Thus, understanding how children develop effective coping skills is critical to better buffering them from mounting stressors in adolescence.

Children's coping repertoires undoubtedly expand (in number, type, and effectiveness) as they age. It is generally accepted that biological, emotional, and social changes that occur throughout childhood are responsible for the age-related increases in sophistication of coping strategies (e.g., Skinner & Zimmer-Gembeck, 2009). Little measurement has been done to confirm which systems influence coping skills, at which developmental milestones, and in what ways. In middle childhood, we argue that pubertal development may be the process that best approximates these underlying physical and psychological variations. By *puberty*, we refer to the physical development of the gonads and secondary sex characteristics that generally occurs between the ages of 9-14 for girls and 10-15 for boys, though there is significant variability in the timing and tempo between individuals (German, Shmoish, & Hochberg, 2015).

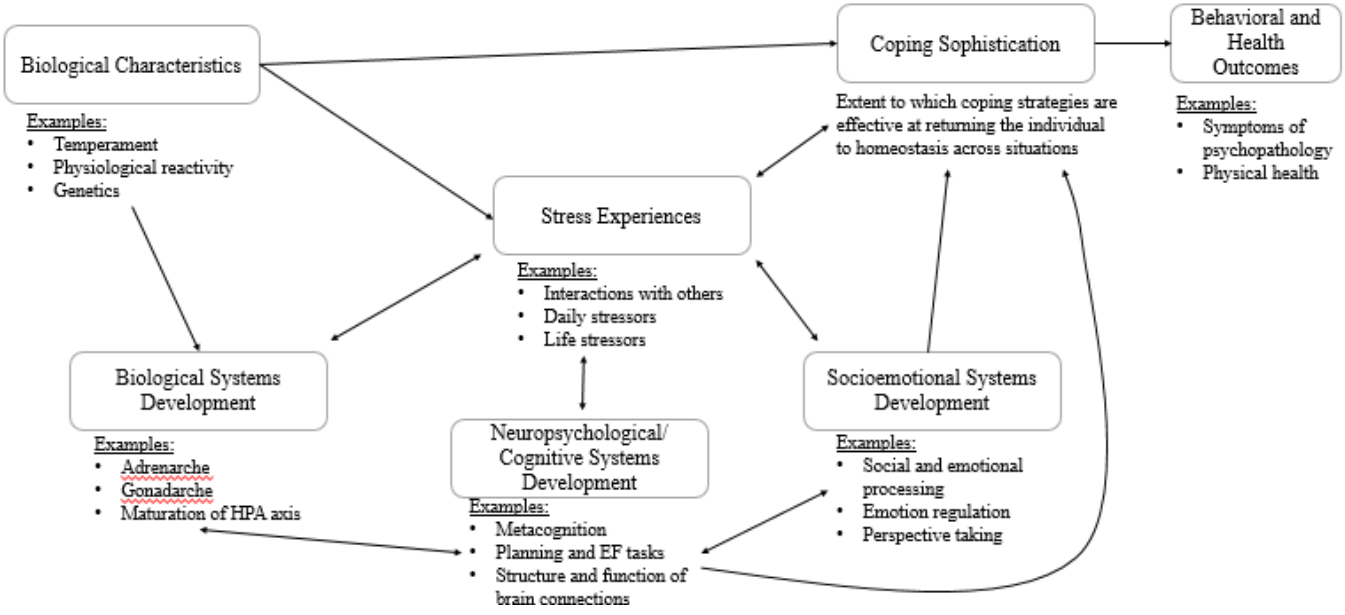
To our knowledge, no previous study has tested whether advances in coping strategies are associated with pubertal status. This paper aims to address this gap, testing the mediating effect of pubertal stage on the quality of coping strategies after accounting for chronological age and stressful experiences in a community sample of preadolescents. First, we will provide an overview of our proposed developmental multi-systemic perspective on the sophistication of coping across the lifespan. Then, we will provide a review of normative changes in coping strategies during our period of interest, i.e., middle childhood to early adolescence. In addition, we describe the physiological, socioemotional, and cognitive changes occurring during this developmental period, arguing that pubertal development may be one of the driving forces of coping development. We will then address the effect of everyday and life stressors on the

development of coping. Finally, we will test a model of the influential factors of coping development, examining the mediating effects of pubertal development on the relationships of age and stress with coping sophistication.

Towards Coping Sophistication: A Developmental Perspective across Multiple Systems

A developmental perspective of coping that incorporates multiple biological systems anticipates that the expansion and sophistication of coping strategies is a normative, adaptive, and iterative process that occurs in conjunction with ongoing biological, socioemotional, and cognitive changes (Zimmer-Gembeck & Skinner, 2016). How coping strategies emerge and evolve over the course of childhood has been the topic of much scholarship (e.g., Compas, Connor, Osowiecki, & Welch, 1997; Eisenberg, Fabes, & Guthrie, 1997; Wadsworth, 2015; Wadsworth et al., 2016; Zimmer-Gembeck & Skinner, 2016), though few current models include multiple systems in the development of coping. Although we do not include direct measures of underlying processes in our study, we believe their inclusion in an overall conceptual model are essential. In Figure 1, we have attempted to provide a multi-level description of the development of coping, with coping sophistication predictive of mental and physical health. This model draws from the theories of adaptive calibration (Del Giudice, Ellis, & Shirtcliff, 2011), the literatures on stress and pubertal development, and the integrative cross-system conceptualization of coping proposed by Zimmer-Gembeck & Skinner (2016). Coping sophistication is conceptualized as the extent to which coping strategies (whether behavioral, cognitive, or otherwise) are reflective of the extent to which coping strategies are effective at returning the individual to baseline, both psychologically and physiologically, in a timely manner, as derived from experience with stressors and mastery of regulatory and problem solving skills.

Figure 1. A multisystemic developmental perspective of the developmental process of coping



Coping methods are influenced from birth by inherited characteristics, including temperament, physiological reactivity, and genetic factors predicting pubertal timing, among others. Individuals experience a myriad of stressors, both daily (short-term, resolvable; e.g., fight with peers, difficulty with schoolwork) and life stressors (long-term, uncontrollable, and possibly overwhelming; e.g., death of a loved one, poverty). Each experienced stressor represents an opportunity to utilize and practice coping skills, gradually increasing in efficacy. The outcomes of these events impact decisions in future experiences, altering both what situations the individual might evoke or put himself in, and how he responds to future stressors. Thus, coping sophistication and stress experiences are reciprocally related.

In addition, bodily systems undergo constant growth and expansion throughout childhood, including biological (e.g., stress and reproductive physiology), socioemotional (e.g., emotion regulation, social-emotion processing centers), and neuropsychological/cognitive (e.g., both structural and functional brain changes, leading to improvements in metacognition and

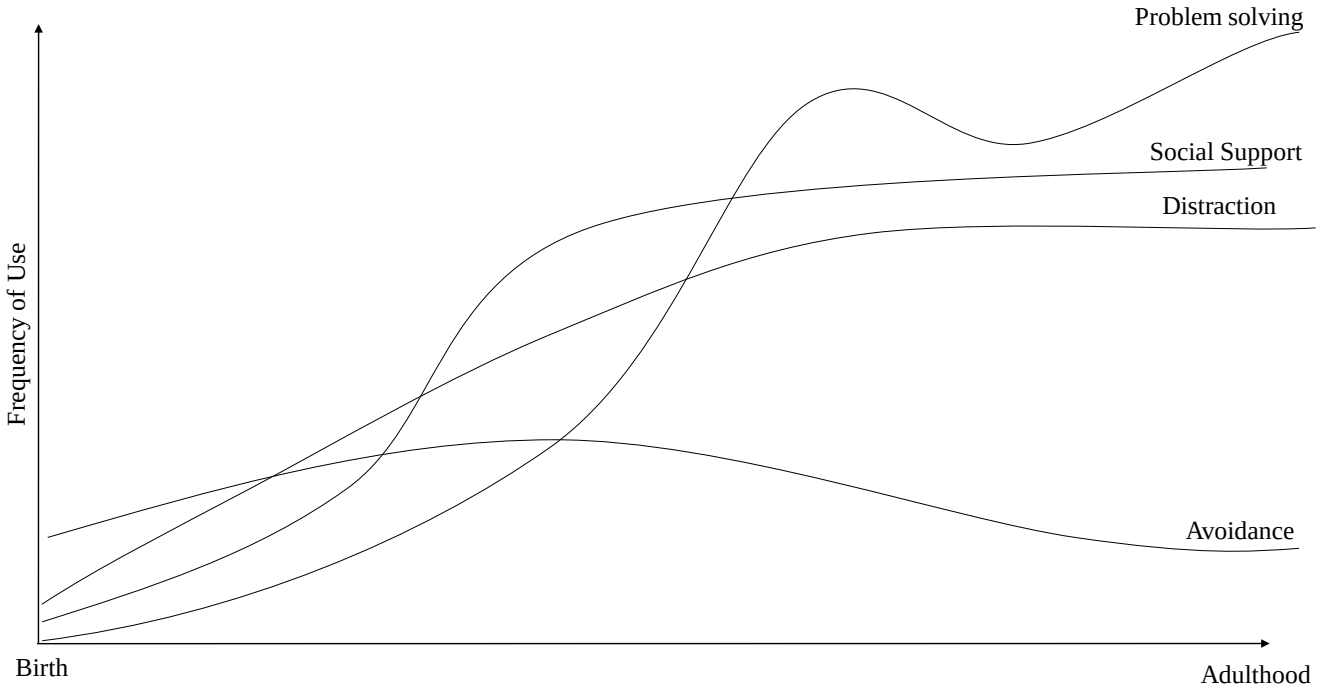
planning) systems. Certain milestones are thought to correspond with a handful of periods of variable growth, often marking the start of speeded development (e.g., gonadarche as a marker of the start of accelerated reproductive and secondary sex characteristics and changes in emotion reactivity and behavioral motivation; Ellis, 2013; Steinberg, 2005). Independently and together, these systems influence the ways in, reasons for, and effectiveness with which one copes. Furthermore, biological, neuropsychological, and socioemotional processes influence the situations in which an individual puts himself or herself, impacting the stressful experiences he or she has. Thus, the developments of bodily systems influence coping sophistication directly and indirectly through stress experiences.

Finally, there are several relevant physical and mental health outcomes that we believe are linked to coping sophistication. Children who demonstrate adaptive and flexible coping strategies across settings are less likely to experience depression, conduct problems, and aggression (Blair & Raver, 2012; Compas et al., 2001; King et al., 2013; Rudolph et al., 2013; Suldo, Shaunessy, & Hardesty, 2008). Effective coping has also been associated with fewer physical health complications overall (e.g., stronger immune functioning, lower risk of cardiovascular disease; Byrd-Craven, Granger, & Auer, 2011; Carver & Vargas, 2011; Shonkoff et al., 2012; Taylor et al., 2008).

To further demonstrate our conceptualization of the course of coping development, proposed frequency counts over childhood are provided for four main categories of coping strategies for a hypothetical individual (reviewed below; Figure 2). Generally, developmental progressions bring increases in the frequency of engagement in problem solving, social support seeking, and distraction. Efforts become more organized, flexible, specific to the problem, and integrated with other coping strategies (Zimmer-Gembeck, Lees, & Skinner, 2011). The success of coping strategies also shifts across development, dictating which coping skills are used by an

individual at that stage. An infant, for example, has limited influence over his or her environment, and thus his or her coping strategies may be constrained to avoidance, such as looking away (Conradt & Ablow, 2010). As the child ages, however, avoidance may no longer be sufficient in the face of stressors such as peer conflict, and thus preferences of employed strategies expand to other coping domains (e.g., seeking help from adults and, later, peers; Amirkhan & Auyeung, 2007). In late childhood, children practice simple problem-focused coping and emotion-focused coping, behavioral and cognitive distraction strategies, social support seeking, and positive self-talk (Aldwin, Yancura, & Boeninger, 2010; Skinner & Zimmer-Gembeck, 2007; Welsh, Pennington, & Groisser, 1991). The expansion of the coping repertoire and the increased ability to choose among the strategies is an important developmental achievement of the transition to adolescence (Aldwin et al., 2010).

Figure 2. Representation of changes in coping sophistication for prototypical individual.



Age-graded Development of Coping

In a series of reviews offering a developmental perspective on empirical studies of age-graded differences in coping, Skinner & Zimmer-Gembeck identified five stages that represent significant shifts in the type and frequency of coping strategies used. These periods include: (a) birth through toddlerhood (ages 0-4 years); (b) early childhood (ages 5-7); (c) late childhood to early adolescence (ages 8-11); (d) early/middle adolescence (ages 12-16); and (e) middle/late adolescence (ages 16-22; Skinner & Zimmer-Gembeck, 2007, 2009, 2011). The use of age-graded stages is endemic in the development of coping literature, despite regular acknowledgement of the role played by ongoing structural and functional alterations in the body and brain. It is the aim of this paper to provide support for the use of other approximations of developmental status other than chronological age to be used in future studies.

For the purpose of this paper, we will limit the focus of our review to the transition across late childhood to early adolescence (stage (c), 8-11 years old), structuring our discussion around the coping domains of support-seeking, problem-solving, distraction, and avoidance. These three domains were chosen because they have been empirically shown to be the coping strategies most commonly and consistently used by this age group (Skinner & Zimmer-Gembeck, 2007). What follows is a summary of the developmental progression of support-seeking, problem solving, distraction, and avoidance from late childhood to early adolescence, followed by a brief summary of gender differences.

Support-Seeking. Social support-seeking, or the pursuance of assistance from outside sources, is perhaps the most commonly used strategy across childhood (Skinner & Zimmer-Gembeck, 2007). Support-seeking can vary widely across contexts in terms of from whom, how, and what support is sought. In general, empirical studies suggest that the adolescent transition (ages 9-12) ushers in greater flexibility in the kinds and sources of social support (Babb, Levine,

& Arseneault, 2010; Skinner & Zimmer-Gembeck, 2009; Zimmer-Gembeck & Skinner, 2011, 2016). Early adolescents seek a wider array of support than those in middle childhood (Fields & Prinz, 1997). For instance, adolescents seek support in the form of comfort, instrumental help, distraction, or advice, and they do so from parents less and from peers more than younger children (Skinner & Zimmer-Gembeck, 2009). Older children also demonstrate increasing ability to identify the best source of support for a given stressor, seeking out a social partner that best fits the current conditions. For example, early adolescents seek more support from adults during situations that are outside of child control (e.g., medical problems), but less support from adults for problems that are within their own control (see Skinner & Zimmer-Gembeck, 2007 for review; Zimmer-Gembeck & Locke, 2007; Zimmer-Gembeck & Skinner, 2016).

Problem Solving. Problem solving encompasses a number of strategies, most prominently taking instrumental action to change the situation or considering alternative ways to deal with a problem. From the time that children gain motor control (i.e. during infancy), instrumental action is frequently used as a coping strategy (Kopp, 1997). Prior to age 8, however, children demonstrate low levels of cognitive problem solving, and participate little in cognitive processes to overcome a problem (e.g., planning). Among studies of children aged 8 to 13, age-graded increases in type and complexity of problem solving strategies were found (as reviewed in Skinner & Zimmer-Gembeck, 2007). As children transition to adolescence and use more problem-solving strategies, they also experience increases in feelings of self-reliance and mastery of coping abilities.

Particularly relevant to school-aged and older youth are social problem solving skills, given the growing importance of peers in their every-day contexts. Social problem solving skills are those that are used to meet personal needs or accomplish goals through interaction with another when the individuals' needs or goals are conflicting (Yeates, Schultz, & Selman, 1990).

These skills are particularly complex, as they require simultaneous perspective-taking and advanced social information processing (Janusz, Kirkwood, Yeates, & Taylor, 2002; Yeates et al., 1990). According to the Interpersonal Negotiation Strategies (INS) model, proposed by Yeates and colleagues (Yeates et al., 1990; Yeates, Schultz, & Selman, 1991), children's ability to constructively problem solve improves from impulsive to collaborative with age as underlying capacities to regulate emotion, adapt to new situations, and empathize with others also advance (Yeates et al., 1991). Given the saliency of peer relations for children in pre- and early adolescence, the development of social problem solving skills are particularly relevant.

Distraction. Strategies of distraction can take two forms, behavioral or cognitive, both with the goal of keeping one's mind from dwelling on the stressor. Behavioral distraction involves actions, such as keeping busy or engaging in a fun activity, that help modulate one's reaction to stressors. Cognitive distraction involves strategies to keep the mind busy, such as thinking about other things (such as something fun) and planning distracting activities. Both forms of distraction require advanced cognition and self-regulation skills to engage in behavioral inhibition and emotion regulation, as well as the social capacity to coordinate one's efforts with others (Skinner & Zimmer-Gembeck, 2007). Studies generally report that behavioral distraction is used more often than cognitive strategies, that behavioral distraction increases in frequency of use from age six to young adulthood, and that by adolescence it is used as often as support seeking. However, it is not until late childhood and early adolescence that individuals are able to engage in cognitive strategies such as cognitive distraction or reappraisal (i.e., thinking about the situation differently). Even once these strategies become accessible, it is likely that they must be practiced in order to be effective in the face of stress (Zimmer-Gembeck & Skinner, 2016). Nevertheless, cognitive distraction, like its behavioral counterpart, is used increasingly in the transition from childhood to adolescence (Skinner & Zimmer-Gembeck, 2007). Importantly, as

children increase the number of strategies in their repertoire and their knowledge of how to use them successfully, their use of such strategies becomes more purposeful and modulated. By adolescence, it is easier for youth to shift between behavioral and cognitive distraction to produce optimal coping outcomes.

Avoidance. Avoidance strategies, which are also referred to as *disengagement coping* (though the terms are not equivalent), are cognitive and behavioral responses that allow for the avoidance of a distressing event or circumstance (Compas et al., 2001; Zimmer-Gembeck & Skinner, 2016). Common examples include ignoring the situation, social withdrawal, and escape (physically or mentally), while disengagement coping can also include denial and wishful thinking (Compas et al., 2001). Generally, disengagement strategies are associated with greater psychological distress and more behavior problems compared to active/engaged strategies (Krattenmacher et al., 2013; Seiffge-Krenke & Klessinger, 2000). When using escape or disengagement strategies, children rely less on mental withdrawal (e.g., wishful thinking, cognitive escape, denial) and more on behavioral avoidance (e.g., social withdrawal, physical avoidance of distressing situations) as they age (Zimmer-Gembeck et al., 2011). Overall, as children transition from middle childhood to early adolescence, researchers have found slight decreases in avoidance behaviors overall (Skinner & Zimmer-Gembeck, 2007). This is likely due in part to increased cognitive abilities, providing children with more ways to deal with problems, and improvements in the effectiveness of their behavioral strategies, especially as they begin to master key social practices (Zimmer-Gembeck et al., 2011).

Gender Differences in Coping. Several studies have sought to explore differences in the use of coping strategies between male and female children and adolescents. The literature has produced inconsistent findings, likely in part due to differences in how researchers define and operationalize coping. Other possible sources of contradiction may be the use of different

stressors (e.g., conflict with parents, conflict with peers, or homework stressor) and various age groups and ranges. The sole consistency across studies of both children and adolescents is that females consistently use support seeking more often than males, in both middle childhood and adolescence (Amirkhan & Auyeung, 2007; Eschenbeck, Kohlmann, & Lohaus, 2007; Francisco, Loios, & Pedro, 2016; Gelhaar et al., 2007; Roecker, Dubow, & Donaldson, 1996; Seiffge-Krenke & Shulman, 1990). Some evidence exists that girls report lower coping self-efficacy levels than boys (Cicognani, 2011; Muris, 2001, 2002), even among depressed adolescents (Tonge et al., 2005), though the concept of coping self-efficacy is not well-studied. One empirical study reported that female adolescents use a wider range of coping strategies than their same-age male peers (Cicognani, 2011). To our knowledge, gender differences in number or variety of coping strategies has not been tested in other studies. Whether there are gender differences for other strategies, and the nature of those differences, is inconsistent across studies. A few studies have found no gender differences in childhood across coping strategies (Reijntjes, Stegge, Terwogt, Kamphuis, & Telch, 2006; Spirito, Stark, Grace, & Stamoulis, 1991). There are mixed findings regarding problem solving, emotion regulation, and avoidance. See Table 1 for a summary of studies examining gender differences for these three strategies.

That inconsistencies are widespread throughout the literature suggests other factors may be at play to produce such contradictory findings. From the onset of puberty, girls report a greater number of stressors in their lives, including more peer problems, school problems, negative self-evaluations, and higher rates of harassment (Nolen-Hoeksema & Girgus, 1994; Zimmer-Gembeck & Skinner, 2008). Gender socialization likely contributes to differences in strategy use, with parents and peers reinforcing rumination among girls and problem-solving or distraction-based strategies among boys (Skinner & Zimmer-Gembeck, 2007; Zimmer-Gembeck & Locke, 2007). Child gender has been found to affect how he or she interprets family

Table 1. Summary of Studies Examining Gender Differences in Coping Strategies of Problem Solving, Emotion Regulation, and Avoidance

	Coping Strategy		
	PS	ER	A
Amirkhan & Auyeung (2007)	M > F	---	---
Augustine & Hemenover (2009)	---	F > M	---
Cicognani (2011)			M > F
Copeland & Hess (1995)	F > M	---	M > F
Eschenbeck, Kohlmann, & Lohaus (2007)	F > M	N/D	---
Eschenbeck & Kohlmann (2002)	F > M	---	---
Francisco, Loios, & Pedro (2016)	N/D	---	N/D
Hampel & Petermann (2005)	N/D	M > F	F > M
Metzke & Steinhausen (2002)	---	---	M > F
Reijntjes et al. (2006)	---	N/D	N/D
Roecker et al. (1996)	---	---	M > F
Seiffge-Krenke & Shulman (1990)	---	---	F > M
Sontag et al.(2008)	---	---	F > M
Spirito et al.(1991)	N/D	---	N/D
Stark et al. (1989)	---	---	M > F
Wadsworth et al. (2004)	---	F > M	---
Zimmer-Gembeck & Locke (2007)	N/D	---	F > M
Zimmerman & Iwanski (2014)	---	N/D	---

PS = Problem solving; ER = Emotion regulation; A = Avoidance; M > F = Males use strategy more than females; F > M = Females use strategy more than males; N/D = No gender differences found.

interaction patterns, takes parental advice, and follows parental modeling, suggesting parent coaching may evoke different responses by gender, and vice versa (Eisenberg et al., 1993; Kliewer, Fearnow, & Miller, 1996). In addition to these social forces, it is possible that the sex-differences in brain organization that emerge during puberty may contribute to the gender differences seen in how children develop sophisticated coping skills (described below).

Chronological Age or Pubertal Development?

Research on the development of coping has primarily focused on changes that are presumed to occur with increases in chronological age. There have been previous calls for the field to identify the underlying developmental changes that contribute to the sophistication of coping (Compas, 1998; Compas, Malcarne, & Banez, 1992; Skinner & Zimmer-Gembeck, 2007). These developmental changes include but are not limited to changes in physiology, cognitive abilities, emotion regulation, and social awareness (Derryberry et al., 2003; Eisenberg et al., 1997; Fields & Prinz, 1997). Despite this, research remains sparse on how normative improvements in regulatory processes impact coping, and particularly among samples of older children. In infants, findings indicate that the development of the stress response system and maturation of brain structures are critical to the emergence of more effective and more diverse coping strategies (Geldhof, Little, & Colombo, 2010). The onset of puberty, which heralds considerable alterations in hormone levels and impacts the structure and organization of the brain and stress response systems, may represent a similar level of full-system changes that have far-reaching effects (Grumbach, 2002; Romeo & McEwen, 2006; Sisk & Foster, 2004; Styne & Grumbach, 2007).

Although pubertal status is correlated with age, they are not unitary or equivalent, and thus age may not be the best predictor of consequent physical changes of puberty (Blakemore,

Burnett, & Dahl, 2010; Goddings, Burnett Heyes, Bird, Viner, & Blakemore, 2012; Parent et al., 2003). The sophistication of coping, in turn, might not best be predicted by chronological age. We propose that among older children and early adolescents, a developmental process associated with physical and socioemotional maturation, such as puberty, is more predictive of the normative developmental shifts in coping strategies than chronological age.

Physiological and Psychological Changes Associated with Sophistication of Coping. The ability to and means with which one copes become more sophisticated with neurocognitive and biological growth. Neurocognitive development enables the regulation of emotion and behavior and the integration of emotion with cognition that are necessary for coping (Aldwin et al., 2010; LeDoux, 1994; Rueda & Rothbart, 2009). Physiological growth within the stress response, endocrine, and immune systems are mutually influential with coping processes; for example, one's ability to maintain biological homeostasis is associated with the success of current and subsequent coping efforts. In addition, coping sophistication is considered to be experience-dependent, and a product of the interactions between the child's physiological, emotional, and social experiences (Aldwin et al., 2010; Skinner & Zimmer-Gembeck, 2007).

Significant changes in brain composition and organization are observed to occur from middle childhood to early adolescence. Synaptic density decreases dramatically, reflecting an increase in efficiency as superfluous neuronal connections are pruned (Andersen, 2003). Similarly, the ratio of white matter (myelin) to grey matter (neurons) in the prefrontal cortext increases during this period. These changes are associated with improvements in attentional and cognitive control, allowing children to suppress unwanted thoughts, better control their behavior, and sustain attention (Casey, Galvan, & Hare, 2005; Casey, Giedd, & Thomas, 2000). As the prefrontal cortex matures during this period, there is increased capacity for planning, perspective

taking, self-evaluation, and identifying and expressing emotions (Aldwin et al., 2010; Compas et al., 2001; Spear, 2009).

Similarly, as a child's ability to identify, articulate, and regulate their own emotional arousal (i.e. emotion regulation) improves with the maturation of the associated brain structures, reinforcement from caregivers, and practice, so too does the child's effectiveness in engaging with and altering their environment in the face of stress. These improvements occur across the domains of support-seeking, problem solving, and escape/distraction behaviors (Skinner & Zimmer-Gembeck, 2007). Throughout childhood, these physiological, social, and emotional changes result in an increase in effectiveness and sophistication of coping strategies, as well as the diversification of an individual's coping repertoire.

As a child experiences more of the world and physical structures mature, the physiological response mechanisms by which a child responds to adversity become more finely tuned and responsive (Gunnar & Quevedo, 2007). Specific to our interests is the hypothalamic-pituitary-adrenal (HPA) axis, which is the major neuroendocrine stress response system by which the organism adapts to environmental changes (McEwen, 2004). During adolescence, both basal and stress-induced HPA-axis activity increases, which is likely caused by pubertal increases in sex steroid levels (Lupien, McEwen, Gunnar, & Heim, 2009).

The transition to early adolescence is marked by significant physiological, social, and cognitive growth that accompanies pubertal development (Gunnar & Quevedo, 2007). These changes engender new stressors as well as new capabilities to cope with them. Overall, findings suggest that early adolescents engage in a greater variety of coping strategies than children and demonstrate an increased ability to "match" coping strategies and sources differentially for different stressors, ultimately increasing the efficacy of their coping. Despite assumptions in the extant literature that the sophistication of coping strategies is tied to chronological age, we argue

that a developmental process such as puberty may be more predictive of coping shifts during the transition from childhood to adolescence.

Puberty as One Possible Driver of Coping Sophistication. There are a number of key physiological and socioemotional changes associated with pubertal development that likely contribute to coping sophistication. Increases in gonadal steroid hormones (e.g., estrogen, testosterone) impact the brain and behavior, likely through the distinct processes of organization and activation (Blakemore et al., 2010; Ladouceur, 2012; Sisk & Foster, 2004; Vetter-O'Hagen & Spear, 2012). Evidence from human studies supports that higher pubertal hormone levels are related to performance on prefrontal cortex (PFC)-dependent tasks (Klapwijk et al., 2013; Ladouceur, 2012; McGivern, Andersen, Byrd, Mutter, & Reilly, 2002; Vuoksimaa, Kaprio, Eriksson, & Rose, 2012), suggestive of ongoing changes in anatomy and connectivity within and around the PFC (Juraska & Willing, 2017). In addition, increases in grey matter volume and density at the onset of puberty suggest a surge of synapse proliferation (Blakemore & Choudhury, 2006; Giedd et al., 1999; Gogtay et al., 2004). Increases in white matter volume is thought to be driven by the release of sex hormones early in puberty (Ladouceur, 2012), leading to improvements in cognitive efficiency across adolescence (Blakemore et al., 2010; Giedd et al., 1999; Juraska & Willing, 2017; McGivern et al., 2002).

Although few studies of adolescent brain development have also directly measured pubertal development (Blakemore et al., 2010; Juraska & Willing, 2017), early findings support the assertion that pubertal development plays a role in reorganizing the structure and function of myriad brain structures. From the animal literature, we expect that changes in the human brain include the reorganization of neural circuits for adult social interactions, as well as alterations in sensory associations and reward-related brain structures (Crone & Dahl, 2012; Goddings, 2015; Romeo & Sisk, 2001; Sato, Schulz, Sisk, & Wood, 2008; Sisk & Foster, 2004). Alterations in

human neural circuits occur in structures related to self-regulation processes and may facilitate more effective coping (Casey et al., 2000; Kuhn et al., 2010; Steinberg, 2008). In addition, changes in cognitive processes reported during adolescence, such as increased social awareness and metacognition, may be due to changes in brain structures (e.g., hippocampus, amygdala, and prefrontal cortex) that occur during puberty (Blakemore et al., 2010; Juraska & Willing, 2017; Romeo, 2010; Sisk & Zehr, 2005). For example, changes in structural volume of the amygdala, hippocampus, and putamen in both sexes are related to pubertal status independent of (and in interaction with) chronological age (Goddings et al., 2014). Additionally, increases in activity in brain regions associated with social-affective processing are associated with increases in sex hormones in pubescent children independent of chronological age (Goddings et al., 2012). To understand further the effects of puberty on the observed changes of adolescence, empirical studies are needed to better document their association.

The way in which the brain is re-organized and re-activated during puberty may contribute to the observed gender differences in coping. The onset of puberty marks the release of gonadal steroids, which leads to significant sex-related alterations to of key brain regions (Blakemore et al., 2010; Sisk & Foster, 2004). The activational effects of testosterone and estrogen elicit adult behaviors, both reproductive and social (Schulz, Molenda-Figueira, & Sisk, 2009). It is possible that the changes driven by the sex-specific release of gonadal steroids also influence sex-specific coping responses that emerge or strengthen during puberty. There is clearly a need for more research focusing on the biological underpinnings of coping development and its sex-specific manifestations.

In addition to changes in brain structures and processes, surges in gonadal hormones that occur in puberty are known to interact with the HPA (Negriff, Saxbe, & Trickett, 2015; Tsigos & Chrousos, 2002), impacting the plasticity, sensitivity, and efficiency of the body's stress

reactivity (Romeo, 2010; Romeo & McEwen, 2006; Ruttle, Shirtcliff, Armstrong, Klein, & Essex, 2013). Specifically, pubertal development is associated with increased physiological reactivity to stress (Dahl & Gunnar, 2009; Gunnar, Frenn, Wewerka, & Van Ryzin, 2009). The extent and duration of an individual's physiological response to a stressor is well established to impact the effectiveness and efficiency of regulatory strategies of coping (Tarullo & Gunnar, 2006; Zimmer-Gembeck & Skinner, 2008). While the body's stress response systems undergo fine-tuning in response to previous experiences and the environment across the lifespan, puberty has been identified as a key period for structures instrumental in stress reactivity to reach adult maturity (Gunnar & Quevedo, 2007).

Adolescents may require more sophisticated coping repertoires because social and emotional contexts of situations take on heightened significance during pubertal development (Klapwijk et al., 2013; Steinberg, 2005). Social-emotion contexts are made more salient to children experiencing puberty via the reorganization of reward processing systems during hormonal changes, which result in an increased sensitivity to social and emotional stimuli (Klapwijk et al., 2013; Steinberg, 2005). Pubertal development is also associated with greater emotional reactivity, or physiological responses to emotion-relevant stimuli, as well as with greater sensitivity to social stimuli and reward processing (Carlo, Crockett, Wolff, & Beal, 2012; Silk et al., 2009; Steinberg, 2005). Coping strategies are shaped by social relationships and contexts, which themselves undergo dramatic change during adolescence (Zimmer-Gembeck & Skinner, 2008). Despite greater reactivity to emotional and social stimuli, pubertal children demonstrate better emotional control than prepubertal children (Eisenberg et al., 1997).

Advancements in coping efficacy between the ages of 9 and 12 may be better explained by the underlying physical development of brain and limbic structures that are associated with puberty than with chronological age. Although coping strategies may increase in diversity and

flexibility with age, there is evidence that pubertal adolescents may face greater emotional challenges that require these improvements in coping.

Individual Differences in Pubertal Development. There are differences in the onset and course of pubertal development within and between sexes. In girls, puberty from the onset of gonadarche (the development of the gonads) lasts on average 4.5 years, though individual experiences of puberty range from 1.5 to 6 years (Lalwani, Reindollar, & Davis, 2003). The onset of breast development (thelarche) is often the first visible sign, occurring between the ages of 8 and 13 (Dyk, 1993; German et al., 2015; Strasburger & Brown, 1991), though in some cases pubic hair development (pubarche) may occur before breast development (starting on average between 9 and 10 years in U.S. and European samples; Biro, Huang, Daniels, & Lucky, 2008; Herman-Giddens et al., 1997; Mouritsen et al., 2013). Finally, menarche occurs approximately 2 years after the onset of breast development, at an average age of 12.8 years for Caucasians (Chumlea et al., 2003; T. Wu, Mendola, & Buck, 2002).

Boys enter puberty later than girls (typically 0.8 years earlier; Buckler, 1990; Lindgren, 1996; Mul et al., 2001), as indicated by testicular growth (Parent et al., 2003). On average, male gonadarche begins between 11.5 and 12.1 years old among Caucasian boys (Lindgren, 1996; Mul et al., 2001; Persson et al., 1999; Strasburger & Brown, 1991; Tanner & Davies, 1985). Pubic hair development occurs shortly after gonadarche around 12 years old for Caucasian males (Herman-Giddens, Wang, & Koch, 2001), and is followed by spermarche (or the first production of sperm) at age 13 (Nielsen et al., 1986).

Individual characteristics, including genetic factors, race, and life history, also influence the course of puberty (Wu, Mendola, & Buck, 2002; Herman-Giddens, Wang, & Koch, 2001). Twin studies have found variations in pubertal timing to be largely genetic for both boys and girls; however, variations in environment, early life experiences, and available resources are also

thought to contribute (Arım, Tramonte, Shapka, Dahinten, & Willms, 2011; Belsky et al., 2007; Corley, Beltz, Wadsworth, & Berenbaum, 2015; Ellis & Garber, 2000). There are racial differences in the onset of puberty, with Caucasian children progressing through puberty on average later and slower than African Americans and Latinos (Chumlea et al., 2003; Mul et al., 2001; Persson et al., 1999; T. Wu et al., 2002). It may be that these racial differences in onset and timing are due to environmental (e.g., stress exposure, poverty, diet) as well as heritable factors.

Life history theory proposes that pubertal timing (or pubertal status relative to the same-sex, same-age peers) is influenced by early life environment, such that psychosocial stress (e.g., quality of family relationships, parental investment) impacts when individuals reach sexual maturity (Ellis, 2004). Studies testing this model have found evidence that indicates prenatal stress, parental supportiveness, depression, and financial stress are each predictive of early sexual maturation among females (Belsky, Ruttle, Boyce, Armstrong, & Essex, 2015; Ellis & Essex, 2007; Ellis & Garber, 2000; Ruttle et al., 2013). In contrast, among males, experiencing a high stress family environment significantly predicts delayed puberty (Semiz, Kurt, Kurt, Zencir, & Sevinç, 2009), though poverty may predict accelerated puberty in both boys and girls (Arım et al., 2011). However, there is a paucity of male-specific studies to examine this connection; more research on the impact of adverse early experiences on pubertal development is needed, particularly for boys.

Stress Exposure Critical to the Development of Coping

According to the adaptive calibration model (ACM; Del Giudice et al., 2011), exposure to life stress—an inherent and permanent aspect of the human experience—is necessary and beneficial to the individual, directing the body's physiological (autonomic, immune,

neuroendocrine, and metabolic) responses to current and future environments (Ellis & Del Giudice, 2014). Exposure to stressors in childhood that are challenging yet resolvable within the context of supportive relationships are thought to contribute to growth and later resilience. However, too much stress (especially long-lasting, uncontrollable stressors like poverty or maltreatment) is considered toxic, often contributing to significantly poorer physical and mental health in adulthood (Shonkoff et al., 2012). Following this and the ACM model, the effects of life stress may have a curvilinear (inverted u-shape) effect on one's ability to cope, where moderate levels are beneficial to coping development while too much or too little can increase risk for adverse outcomes.

Normative Exposure to Stress Promotes Adaptive, More Effective Coping. For all individuals, stress in an unavoidable part of daily life. A certain level of surmountable stress is normal and necessary for learning and optimal performance. Low to moderate levels of stress allow children to develop skills and strategies for coping with future and potentially dangerous situations. With practice and support from caregivers in the face of positive stress (short-lived adverse experiences; e.g., meeting new people) or more intense tolerable stress (serious life-disrupting but short-lived stressors, experienced with the support of a caring adult; e.g., death of a loved one), children learn to respond to stress in physically and psychologically healthy ways (Middlebrooks & Audage, 2008; National Scientific Council on the Developing Child, 2014). The experience of successfully dealing with and learning how to overcome stress builds coping self-efficacy and is a fundamental part of the development of coping.

Stress, when surmountable, is essential to the development of effective and adaptive coping strategies. When children lack social support and face stressors that are overwhelming and ongoing, however, they are at risk for developing coping repertoires that are limited in scope and/or populated by maladaptive strategies. Those who don't gain experience successfully

contending with and prevailing over daily stressors or who learn they are helpless due to the overwhelming nature of stress are at greater risk for developing problems later in life as they contend with new and potentially dangerous situations. Thus, children who face very low or very high levels of stress may be at greater risk of experiencing adverse outcomes that those who have experience managing and overcoming acute challenges of everyday life.

Unsurmountable Stress Inhibits Healthy Development of Coping. Chronic and toxic stress, the result of ongoing, uncontrollable, and overwhelming adverse experiences, can physiologically and psychologically inhibit a child's ability to deal with everyday stressors (Chen, Cohen, & Miller, 2010; Evans & Kim, 2013; Middlebrooks & Audage, 2008) and elevate the risk for developing psychopathology (e.g., Compas et al., 2001; Shonkoff & Phillips, 2000; Weber et al., 2008). Children who experience early and long-lasting adverse experiences are more likely to exhibit problems with emotion regulation and behavioral inhibition, serving as a possible link between chronic stress and psychopathology (Blair, 2010; Blair & Raver, 2012; Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005; Hackman, Farah, & Meaney, 2010).

Exposure to stress in childhood may interfere with the development of self-regulation and coping skills by overwhelming the child's physiological stress response systems (Wadsworth et al., 2016; Wadsworth & Compas, 2002). Frequent, uncontrollable stressors in childhood place pressure particularly on the HPA axis, impairing the system's ability to efficiently respond to and rebound from acute stressors. Over time, the inability to efficiently react to and recover from stressors disrupts the development of effective coping strategies and other self-regulatory skills (Evans & Kim, 2013). This may occur because of the context of overwhelming stress; constant exposure to uncontrollable and inescapable stressors (e.g., poverty, abuse, discrimination) may discourage or interfere with the learning of coping strategies that involve engaging with the environment and trying to exert change. Family-level stressors may also impact parenting

practices that in turn contribute to deficits in self-regulation, executive control, and cognitive abilities (Blair, 2010; Blair & Raver, 2012; Evans et al., 2005; Hackman et al., 2010). Thus, chronic stress delivers two blows: first by overwhelming and dysregulating the physiological stress responses, then by hindering the child's efforts to develop coping strategies that require advanced cognitive and emotion regulation skills (e.g., problem solving).

We expect life stress exposure to have a curvilinear effect on coping sophistication, such that children who have experienced very high or very low levels of stressful life events will have less mature coping repertoires than others who have experienced moderate levels of stressful life events. To our knowledge, this interaction has not yet been empirically tested within the coping literature.

Stress Impacts the Timing and Progressions of Pubertal Maturation. Stress is known to influence pubertal timing, or pubertal status relative to same-age, same-sex peers. Specifically, early life stress predicts experiencing early pubertal timing among boys and girls (Arım et al., 2011; Bleil et al., 2013; Ellis, Shirtcliff, Boyce, Deardorff, & Essex, 2011). From the animal and human literature, the HPA axis is known to interact with the hypothalamic-pituitary-gonadal (HPG) axis, the system within which reproductive maturation occurs (Negriff et al., 2015; Tsigos & Chrousos, 2002). When the HPA axis is disrupted over long periods of one's childhood, through economic hardship, maltreatment, or domestic violence, for example, the pace and timing of pubertal development may be impacted, either hindering or accelerating pubertal development depending on the timing (onset, duration, and frequency) of the stress exposure (Andersen, 2003; Parent, Franssen, Fudvoye, Gerard, & Bourguignon, 2015).

As mentioned above, early life stress contributes to a dysregulated psychosocial stress response, including under/over-arousal of the HPA axis (Evans & Kim, 2007; Halligan, Herbert, Goodyer, & Murray, 2007). While children who experience early life stress (i.e., from birth to 5

years old) are generally noted to go through pubertal development earlier (e.g. Ellis & Essex, 2007), children who experience high levels of stress more closely preceding pubertal onset may be more likely to have delayed puberty (Parent et al., 2015). Although the mechanism for this is not yet known, findings from research on the coupling of the HPA and HPG systems suggest that perhaps a history of childhood stress may accelerate the process by which the HPA and HPG axes become coupled. This would explain the impact of hyperactive stress response system on the timing and pace of pubertal development.

We expect that stress experiences and age interact in their relationship with pubertal status, such that children who have experienced fewer stressful life events will experience a stronger relationship between age and pubertal status, while children who experience more stressful life events will be more physically developed (i.e. greater pubertal status) than others their age and sex.

Measuring Puberty

The gold standard for measuring pubertal status is a physical evaluation by a clinician of the body's developmental stage, specifically the staging of genital development for boys, breast development for girls, and pubic hair development for both (Dorn, Dahl, Woodward, & Biro, 2006; Marshall & Tanner, 1969, 1970). However, due to concerns of the intrusiveness of this method and participant burden, other less invasive measures than examination and palpation are more commonly used (Dorn & Biro, 2011). Hormone concentrations do not reliably reflect pubertal status, given temporal and individual variability across all pubertal stages for both sexes, and thus cannot be used to determine pubertal status (Dorn et al., 2006). Researchers therefore have turned to self- and parent-reports, or perceptions of developing secondary sex characteristics, to provide noninvasive approximations of pubertal stage.

The most widely used measure of self-report is the Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988), despite criticism regarding low reliability of self-reports of pubertal status. The correlation between ratings from a physician's exam and self-reported PDS among 11-13 year old girls in previous research has been found to be between .61 and .67 (Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987). Parent and school discomfort with researchers asking children questions about sensitive body regions has led to the adaptation of the PDS from self- to parent-report. In a study comparing the consistency of self- to parent-report on the PDS, Carskadon & Acebo (1993) found that reporters found internal consistency between reporters, and overall significant correlations between parent- and self-report for both 5th and 6th grade boys and girls. While measuring pubertal status via a trained clinician's physical examination is the gold standard for the field, due to sensitivity to participating families' comfort level many researchers choose to use the adapted version of the PDS for parent-report. This measure has been established as an acceptable measure of pubertal status in previous studies (Y. Wu, Schreiber, Klementowicz, Biro, & Wright, 2001).

Coping Sophistication

In the present study, we sought to study the development of coping amongst a community sample of 4th and 5th grade preadolescents taken from a larger study on stress reactivity and coping. Thus, we required a way to rate how developed a child's coping was based on how comfortable and effective he or she was at dealing with psychosocial stressors. Because no instrument exists to measure the development of coping, we created a theoretically-grounded construct termed the *sophistication of coping (SOC).* Ultimately, SOC is the extent to which an

individual has mastered coping strategies that allow him or her to effectively return to homeostasis following a stressor, with the assumption that knowledge and mastery evolve through experience and practice. Thus, we view SOC as a latent construct comprised of four related indicators of effective coping. SOC is composed of 4 index scores from multiple instruments: *breadth*; *efficacy*; *disengagement;* and *emotion regulation*.

Individuals' breadth of coping is defined as the combination of the number and variety of coping strategies that the individual suggests for psychosocial stressors. The coping strategies that children utilize are known to differentiate and grow in number during the transition from middle childhood to adolescence (Cicognani, 2011; Compas et al., 2001; Zimmer-Gembeck & Skinner, 2011). Increases in diversity and complexity of coping skills are associated with increases in self-reliance and flexibility (Compas, Jaser, Dunn, & Rodriguez, 2012; Zimmer-Gembeck & Skinner, 2011). Although not all gains in coping repertoires may be adaptive (i.e., new strategies learned may include maladaptive stress reactions, including rumination, venting, and verbal aggression), increases in coping breadth are generally considered normative and beneficial, as greater breadth provides greater flexibility in the face of stressors.

Coping self-efficacy, or the judgement of his or her capacity to successfully bring about desired outcomes when dealing with stressors, is often associated with more positive outcomes in the face of adversity (Benight & Bandura, 2004; Cieslak, Benight, & Lehman, 2008; Singh & Bussey, 2011). High coping efficacy may reflect a history of successful coping attempts, and as such reflects greater capacity to handle stress (Zimmer-Gembeck & Skinner, 2016). Children with greater coping sophistication may feel more able to deal with psychosocial stressors and report higher levels of coping self-efficacy.

As described by Compas and colleagues (2001), disengagement coping (DC) is defined as responses to stressors that are aimed away from the situation, or removing one's self and/or

thoughts from the stressor. It includes wishful thinking, denial, and physical or cognitive avoidance (Compas et al., 2001). DC is considered to be oriented on the opposite end of the spectrum from engagement coping, which includes problem solving, seeking support, or thinking positively about the situation, such that one's thoughts or actions are directed towards the source of stress (Compas et al., 2001). DC is also associated with higher levels of internalizing and externalizing behavior problems in adolescents (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000; Thomsen et al., 2002; Wadsworth & Compas, 2002). Thus we expect children who have developed more sophisticated coping, in terms of breadth, flexibility, and effectiveness, will report less disengagement coping than their less sophisticated peers.

Finally, the use of emotion regulation within coping is included in our model of coping sophistication. Emotion regulation in itself is both part of and greater than coping; as a strategy, it is critical to the individual's ability to engage in behavioral and cognitive coping efforts. Emotion itself is involved in each stage of the coping process, influencing threat vigilance, detection, and appraisal, and directing and coordinating responses to stressors. Yet coping is not constrained to positive emotions or emotional suppression, and instead incorporates a broad range of emotions to better engage others and activate internal resources (e.g., sadness to enlist the aid of others; anger to engage the "fight" response; Holodynski & Friedlmeier, 2006). Thus successful coping requires successful emotion regulation, in conjunction with the coordination of other regulatory systems—behavioral regulation, attention control, emotional expression, and impulse control (Skinner & Zimmer-Gembeck, 2007). As children develop, their ability to engage regulatory systems improves as their mastery of more emotion regulation strategies increases. With these improvements comes the bolstering of perceptions of self-reliance. In addition, strong emotion regulation skills are associated with lower indicators of psychopathology, particularly internalizing disorders (Skinner & Zimmer-Gembeck, 2007;

Zimmer-Gembeck & Skinner, 2016). We anticipated that children with more sophisticated coping would report making more efforts to stay calm or not let their emotions interfere with other coping efforts.

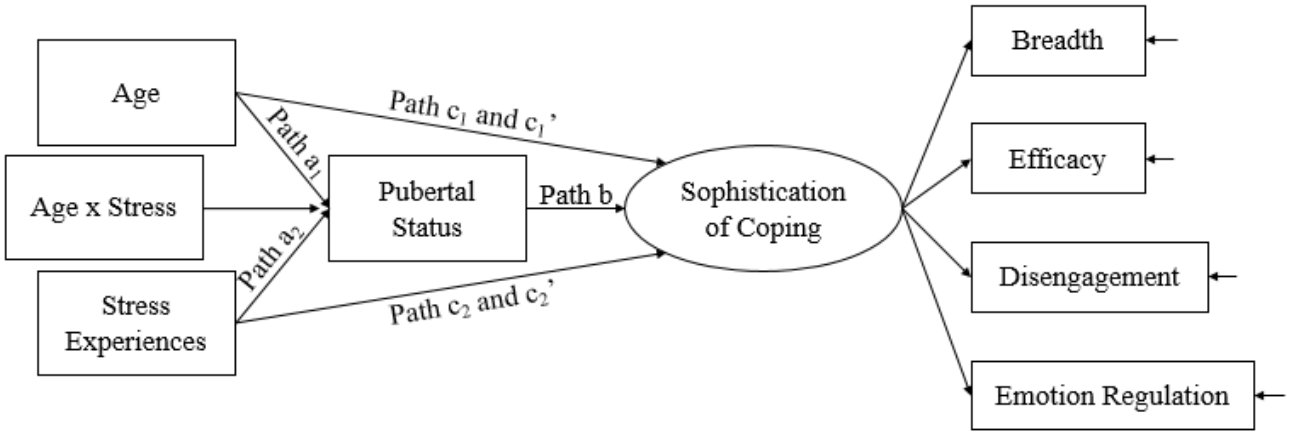
Thus, the composite of SOC is based on empirical findings of the ways in which coping strategies change from middle childhood to early adolescence, as outlined in several papers, as well as factors that predict greater psychological wellbeing (e.g., Aldwin et al., 2010; Amirkhan & Auyeung, 2007; Cheng, Lau, & Chan, 2014; Compas et al., 2001; Sandler, Kim-Bae, & MacKinnon, 2000; Zimmer-Gembeck & Skinner, 2016). A confirmatory factor analysis will be performed to confirm the appropriateness of these four factors.

The Current Study and Summary of Study Hypotheses

Given the findings in the extant literature, we aim to explore whether pubertal status mediates the effect of age and stress experiences on coping sophistication. Previous theories on the development of coping identify age-graded stages to group differences in strategy use and competency. Progression through the stages is driven by experience as well as the maturation of biological structures that underlie emotion regulation, planning, social perspective taking, and behavioral inhibition, among other processes. As it stands, age serves as a proxy for the maturation of these structures; however, *given the variability in which children physically and emotionally mature, pubertal status may be a better proxy of the development of these processes*. During the transition from childhood to adolescence, the body undergoes dramatic organizational and structural changes in the brain and stress-response systems, which lead to improvements in the selection and execution of coping strategies. The biological transformations that occur between middle childhood and early adolescence are not driven solely by age and experience, however; it is likely they are linked to the abrupt release of gonadal steroids that are

characteristic of puberty. Thus, this study aims to test whether pubertal status mediates the relationship of age and experience (and their interaction) with coping sophistication in a community sample of fourth and fifth grade boys and girls (Figure 3).

Figure 3. Hypothesized mediating model of pubertal status on the relationship between stress, age, and sophistication of coping.



Note. Following specifications of MacKinnon, Krull, & Lockwood (2002), pathways a and b must be significant before testing path c'.

In summary, this study will test a mediation model in which pubertal status mediates the relationship between age, stress, and their interactions with coping sophistication among a community sample of early adolescents. Thus, in this analysis, we will seek to determine if pubertal status serves as the pathway through which age and stressful life events influence the development of coping strategies. Based on a review of the literatures on puberty and development of coping, we offer these hypotheses:

Hypothesis 1 (H1): Age is positively associated with sophistication of coping, such that older children demonstrate more sophisticated coping (i.e., greater number of strategies,

lower percentage of disengagement strategies, greater use of emotion regulation strategies, and greater confidence in their own efficacy) than younger children.

Hypothesis 2 (H2): Stressful life experiences are related positively to coping sophistication in a curvilinear fashion, such that exposure to a medium level of stress predicts greater coping sophistication than low or high stress exposure. Compared to those who are low and high in stress experiences, those who have experienced a medium amount are more likely to demonstrate more advanced coping skills. Stress exposure will be measured via parent and child report of daily hassles and lifetime stressors.

Hypothesis 3 (H3): Pubertal status is associated with coping sophistication, such that children who are more physiologically mature will demonstrate more sophisticated coping. Physiological maturity will be measured via parent-reported pubertal status.

Hypothesis 4 (H4): Age, stress exposure, and an interaction between the two will predict pubertal status. The age x stress interaction will be such that age has a weaker association with pubertal status after experiencing a high number of stressful life events.

Hypothesis 4a (H4a): It has been well documented that girls on average begin puberty earlier than their male peers (Lee & Styne, 2013). Therefore, a sub-hypothesis (H4a) is that girls will be more developmentally advanced than boys in this sample, both physically and behaviorally (i.e., more advanced pubertal status and coping sophistication).

Hypothesis 5 (H5): Pubertal status partially mediates the effect of age, stress experiences, and their interaction on the development of coping. Thus, age and stressful life events exert their effects on early adolescents' coping repertoires in part through the physiological, hormonal, and emotional changes of puberty.

Little concrete information is known of gender differences in coping sophistication in middle childhood and early adolescence. For two of the factors that comprise SOC (i.e., disengagement, emotion regulation), findings in the literature are too mixed to draw conclusions or make gender-related predictions of our data. For the other factors (i.e., breadth and efficacy), there is some evidence to suggest that girls may be able to provide a greater number and variety of coping strategies in response to a hypothetical situation, and that boys will report higher coping efficacy. What this suggests regarding coping sophistication is unclear. Therefore, our tests of gender moderation will be largely exploratory.

Methods

Data for this analysis were collected from a larger study on the coping strategies children use to deal with acute interpersonal stressors. For more information on the larger study, see Wadsworth et al., 2016. A brief overview of details relevant to the present analysis is given below.

Participants

Students in fourth and fifth grade (*N = 152*, M_{age} = 10.31 years, SD = 1.72, 52% male) and a parent (86% mothers) were recruited from elementary schools in a large metropolitan area in the western U.S. (*n = 30*) and a semi-rural area in the northeastern U.S. (*n = 122*). Participants predominantly identified as Caucasian (92% of children and caregivers). The sample had, on average, an income-to-needs ratio (INR) of 4.18 (SD = 5.61), with 29% of families living below the poverty line (i.e., INR below 2.0). Median annual household income for the sample was $105,657. Individuals were excluded due to missing pubertal status data (n = 5) or for not completing the coping interview (n=3). Adolescents whose parents provided pubertal data did not differ significantly from adolescents whose parent did not provide pubertal data in terms of their age, race, gender, or family's income-to-needs ratio. Similarly, children who did not complete the coping interview were not significantly different in age, gender, race, stress exposure, or family's income-to-needs ratio from those who did complete the interview. The final analysis sample of the current study included 144 children (52% male) who were 10.5-years old (SD = 0.76). Twenty percent of males (n=15) and 10% of females (n=7) had not yet started puberty, according to parent report. See Table 2 for more demographics of the final sample.

Table 2. Descriptive statistics by gender, for participants included in the study (n =144)

	Total (n = 144)		Male (n=75)		Female (n=69)		
	M or %	*SD*	*M* or %	*SD*	*M* or %	*SD*	*t*(*df*) or χ^2
Age (years)	10.52	0.76	10.55	0.83	10.50	0.67	.157 (129)
Female caregiver	87.5%	--	86.7%	--	88.4%	--	0.15
Hispanic	2.8%	--	4%	--	1.4%	--	0.86
Caucasian	97.2%	--	98.7%	--	95.7%	--	0.13
Northeastern U.S.	79.2%	--	81.3%	--	76.8%	--	0.39
Household income [a]	$111.60	$164.28	$85.47	$78.12	$139.59	$219.87	-1.75 (73.33)[α]
INR [b]	4.36	5.98	3.48	3.67	5.31	7.64	-1.63 (83.66)
Below 2.0 INR	25.4%	--	26.1%	--	24.6%	--	0.06
Stress Exposure	--	--	--	--	--	--	--
Child report [c]	4.06	2.96	4.08	2.84	4.04	3.11	-0.06 (142)
Parent report [d]	4.72	2.81	4.67	2.51	4.79	3.13	0.16 (142)
Pubertal status	1.69	0.54	1.44	0.32	1.96	.60	6.22 (103.02)***

[a] Income reported in thousands of dollars; [b] INR = income-to-needs ratio; [c] Child report of stress exposure = number of total daily hassles child reported on RSQ; range: 0-15; [d] Parent report of stress exposure = composite of total number and stressfulness of child's stressful life events in past 12 months, reported by parent; range: 0-25

[α] *p < 0.1, * p < .05, ** p < .01, ***p < .001*

Procedures

Families were recruited for the study from qualifying elementary schools through brochures, flyers, and classroom demonstrations of procedures between 2012 and 2016. Interested parents enrolled their child, provided consent, and completed questionnaires online. Researchers administered in-person structured interviews with the children, collected seven saliva samples, and directed participants through a social stress task. The interviews consisted of questionnaires surrounding the child's coping strategies, relationship quality, and socioemotional functioning at school. Experimenters debriefed children after the experiment and families

received $50 for participating. The Pennsylvania State University Institutional Review Board approved all study procedures.

Measures

Demographics. A primary caregiver answered questions online regarding their child's age, sex, family income, and caregiver and child ethnicity and race prior to the child's participation.

Psychopathology. Children completed the Behavioral Assessment System for Children, 2nd edition, Self-Report of Personality—Child Version (BASC-2 SRP-C; Reynolds & Kamphaus, 2004), a questionnaire assessing problem behaviors at home and at school, as well as an adaptive scale of personal adjustment. The BASC-2 has been shown to have adequate validity and reliability based on concurrence with similar scales (e.g., Child Behavioral Checklist, CBCL; Achenbach, 1991). The child version of the BASC-2 for children aged 6-12 years contains 139 questions, split into two types of questions: True/False and a 4-point frequency scale from "Never" (1) to "Almost Always" (4). The items describe specific behaviors and comprise composite scales of school problems, internalizing problems, inattention/hyperactivity, emotional symptoms index, and personal adjustment. For all composites, except personal adjustment, an increased score indicates greater impairment.

Stress Exposure. Parents completed an adapted 31-item version of the Child and Adolescent Survey of Experiences (CASE-P; Allen, Rapee, & Sandberg, 2012) during the online questionnaire portion of the study. The CASE-P, a 38-item questionnaire designed to parallel a standardized clinical interview of life events, the Psychosocial Assessment of Childhood Experiences (PACE; Sandberg et al., 1993), provides a measure of acute positive and negative stressful life experiences that the child or adolescent experienced in the past 12 months. Items

from the CASE-P were omitted during data collection to reduce participant burden and avoid sensitive questions. Parents were asked about events across broad areas of life events, including parental employment events, people entering/leaving the household, deaths and illnesses, conflicts, family and peer relationships, witnessing an upsetting event, and significant achievements. Respondents reported whether the event had happened during the indicated time period and rated how stressful the event was for the child on a 4-point scale from 0 (not at all) to 3 (very stressful). CASE-P scores were created by summing the number of stressful events (possible range: 0-31) and the ratings of stressfulness (possible range: 0-93) separately to create two items, the total number of parent-reported life stressors in the past year, and total stressfulness.

Children also answered questions regarding the types of daily hassles they had experienced as part of the Response to Stress Questionnaire (RSQ; Connor-Smith et al., 2000). Respondents indicated how often (never, 1-3 times, 4-6 times, or more than 6 times) they had experienced problems with peers in the past school year (sample items: "Another child was rude or inconsiderate to me", "I got into an argument or fight with another child"). Children's daily hassle score was computed by summing across all 7 items.

Parents' CASE-P scores and children's daily hassle scores were converted to z-scores and averaged to create a stress exposure composite for each participant. Scores from the CASE-P were significantly correlated with RSQ daily hassles in this sample ($r = .28$, $p < .01$) and internal validity for the construct was acceptable (*Cronbach's alpha = 0.72*). Correlations between stress exposure and psychological problems were similar across informants, with CASE-P more highly correlated to parent reports of child problems and daily hassle scores more highly correlated with self-reports of child problems. Overall, correlations suggest that the two measures captured similar constructs.

Pubertal Status. Perceived pubertal status was assessed via parent report of child physical development using a version of the Pubertal Development Scale (PDS; Petersen et al., 1988), a widely used and clinically validated questionnaire, adapted from self- to parent-report. For girls, caregivers indicated on a Likert-type scale from 1-4 (with higher scores indicating more advanced development) the progression of the daughter's physical changes (growth spurt, growth of body hair, and breast development) and whether she had begun to menstruate (no = 1; yes = 4). Parents of males rated their son's development of height (growth spurt), body hair, facial hair, and voice deepening on similar Likert scales from 1-4. Scores were averaged and then centered at the mean to create a pubertal development score for each child. Scores in the current sample ranged from 1 to 3.25 (M_{males} *= 1.44, SD = 0.32, Cronbach's alpha = 0.35;* $M_{females}$ *= 1.96, SD = 0.60, Cronbach's alpha = 0.72*).

Sophistication of coping. Using structured equation modeling, a latent variable for the sophistication of coping (SOC) was created using four variables derived from interview and questionnaire items. The interview addressed coping strategies that the child used during an *in vivo* coping task, and prompted the child to provide suggestions for children faced with hypothetical interpersonal stressors (e.g., being laughed at by peers or fighting with a friend). Vignette responses were coded for breadth, or the *quantity* (number of distinct responses) and *variety* (number of types of distinct responses) of coping suggestions made. Because quantity and variety were strongly correlated (r = .85), a composite score was created by standardizing the product of the two variables. For more information on vignette coding and how coping responses varied, see Appendix.

To estimate of the proportion of coping strategies used involving either emotion regulation or disengagement, ratio and factor scores were derived from the RSQ. The subscale Emotion Regulation is a sum of three items that address how often the child deliberately controls

their emotional expression, for example, to avoid making a problem worse. A ratio score was calculated to represent what proportion of coping strategies identified entailed emotion regulation efforts and standardized (Cronbach's alpha = .61). Disengagement Coping is a factor derived from the subscales of Denial, Avoidance, and Wishful Thinking (comprised of 3 items each). A ratio score for Disengagement Coping was calculated and standardized (Cronbach's alpha = 0.80).

Finally, *coping efficacy* is a 4-item measure of how well the child thought he or she had been able to cope with performing the stress task (e.g., "How did you cope with or handle the stress of preparing the speech and talking in front of the audience? How well did it work?" from 1 "not at all" to 5 "worked great!"). A composite of the 4-items was created using the mean of their scores and standardizing them (Cronbach's alpha = 0.79).

Data Analyses

Descriptive statistics and correlations among indicators were obtained. Latent variable analyses were conducted in three stages. First, a confirmatory factor analysis (CFA) was conducted to evaluate the measurement model. The CFA included variables of coping quantity, perceived efficacy, disengagement, and emotion regulation skills to predict an overall SOC latent variable. Second, measurement invariance was tested for SOC with sex as the grouping variable. Third, multi-group structural equation modeling (SEM; grouping by sex) was conducted to evaluate the relation of stress and age on SOC, whether the association differed by sex, and tested the mediating role of pubertal status in the association between stress and age on SOC.

According to guidelines established by MacKinnon, Krull, & Lockwood (2000), the data must support two hypotheses before mediational pathways can be tested: (1) The independent variable(s) should predict the proposed mediator; and (2) the mediator should predict the

dependent variable. If both of these hypotheses are supported, we would then test the significance of indirect mediated effect by using bias-corrected bootstrapping procedure, as described by Tofighi & Thoemmes (2014), calculating confidence intervals in *Mplus* (Version 7.4; Muthen & Muthen, 1998-2016). If the calculated 95% confidence interval for the mediated effect does not include zero, the mediated effect is considered significant. In addition, the moderation effect of gender was investigated.

The CFA and SEM were estimated in *Mplus* v7.4. All variables in the SEM model were standardized. Missing value analyses were conducted for all key demographic and study variables used in the present set of analyses, testing for patterns of missingness using SPSS Missing Values Analysis (MVA). Little's MCAR (missing completely at random; Little, 1988) test was not significant ($\chi^2 = 9.916$, $p = .128$), thus we assumed the data are MCAR and that missingness is not relevant for the analysis. We then used the *Mplus* feature for full information maximum likelihood (FIML) estimation (Graham, 2003). FIML procedures estimate parameter values of interest using all available data.

Model fit was assessed by examining a chi-square test, comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root-mean-square residual (SRMR). Good model fit was reflected by a CFI greater than .95 (acceptable fit: CFI greater than .90), RMSEA less than .05 (acceptable fit: RMSEA less than .08), and a SRMR less than .05 (acceptable fit: SRMR less than .08; Kline, 2016).

Results

Descriptive Statistics

Pearson correlations, means and standard deviations of observed study variables and latent variable indicators are reported in Table 3. Self-reported feelings of efficacy had statistical associations to two other proposed variables of Sophistication of Coping (i.e., proportion of disengagement coping, r = -0.15, emotion regulation, r = 0.30). Efficacy was also associated with the number of strategies provided during the coping interview (*r = 0.19*, *p = .03*). These findings suggest that children who feel more effective at coping are likely to be able to suggest more coping strategies, demonstrate emotion regulation more often, and take a more engaged approach to coping than their peers who report feeling less effective. In addition, children who reported less disengagement coping (i.e., less avoidance, wishful thinking, and denial, and greater proportion of other strategies, such as problem solving, distraction, or support seeking) were likely to demonstrate greater emotion regulation than their peers reporting greater disengagement (r = -0.27). Pubertal status and age were significantly associated (r = 0.33), as was pubertal status and gender (r = 0.47). Boys were less likely to report disengagement coping and more likely to report a greater breadth of strategies and more attempts at emotion regulation than girls (with males as the default, r = -0.16, r = 0.18, r = 0.23).

Step 1: Confirmatory Factor Analysis

The results of the final pooled-sample CFA, including the observed variables and latent variable, suggested the fit between the data and the model was good, χ^2 (3) = .43, p > .05; CFI > 1.00, RMSEA = .00 (90% C.I. = 0.00 - .04), SRMR = .01. When a model's degrees of freedom

Table 3. Intercorrelations, means, and standard deviations among CFA and SEM variables

Variable	1	2	3	4	5	6	7	8
1. Age	--							
2. Stress Exp.	< 0.01	--						
3. Pubertal Status	0.33**	-0.01	--					
4. Efficacy	-0.09	-0.10	-0.11	--				
5. Breadth	< 0.01	-0.10	0.02	-0.04	--			
6. Disengagement	-0.03	0.04	-0.07	-0.15$^{\alpha}$	0.05	--		
7. Emotion Regulation	-0.03	-0.09	0.12	0.30**	0.06	-0.27**	--	
8. Male	0.02	0.01	0.47**	-0.09	0.18*	-0.16 $^{\alpha}$	0.23**	--
Mean	10.55	0.00[1]	1.67	3.26	8.02	0.15	0.06	0.48
SD	0.72	0.81	0.54	0.97	2.59	0.03	0.01	0.50

$^{\alpha}$ *p < 0.1. * p < .05. ** p < .01. ***p < .001.*
[1] *Composite created by average of three standardized variables.*
Exp = Exposure

are larger than its chi-square value, RMSEA is computed to have a value of less than 0.001, indicating good fit (Schermelleh-Engel, Moosbrugger, & Müller, 2003). Factor loadings for all variables were statistically significant and standardized coefficients ranged from -0.41 to 0.65 (see Table 4). Follow up analyses revealed that SOC predicted significant association with self-reported emotional symptoms and personal adjustment on the BASC-2, but only for boys (boys: β_{emo} = -0.97, *p < 0.01*; β_{adj} = 0.35, *p < 0.001;* girls: β_{emo} = -0.80, *p = 0.25*; β_{adj} = 0.08, *p = 0.81*).

Table 4. Factor loadings from the confirmatory factor analysis model

Factor/Indicator	*B*	S.E.	β
Coping Sophistication	--	--	--
Efficacy	1.00[r]	0.12	0.44
Breadth	0.71	0.12	0.31
Disengagement	-0.92	0.11	-0.41
Emotion Regulation	1.51	0.14	0.65

Note 1.0[r] = reference indicator fixed for scaling purposes. All factor loadings were statistically significant ($p < .05$).
b = unstandardized coefficient, S.E. = standard error, β = standardized coefficient

Step 2:Measurement invariance (multiple-group CFA)

Separate analyses were conducted for each sex separately before beginning invariance testing. Results suggested a good-fitting model for both males ($\chi^2 (3) = 1.14, p > 0.05$; *CFI > 1.00, RMSEA = .00 (90% C.I. = 0.00 - .13), SRMR = .03)* and females ($\chi^2 (3) = 2.23, p > 0.05$; *CFI > 1.00, RMSEA = .00 (90% C.I. = 0.00 - .18), SRMR = .05).* Next, a multiple group model was run, with no differences in the models between the groups, computing and comparing chi squares for configural, metric, and scalar models. To summarize Dimitrov (2010), groups with configural invariance hold the same pattern of factors and loadings across groups; groups with scalar (strong) invariance have invariant factor loadings and intercepts, while groups with metric (weak) invariance have only invariant factor loadings. Results from invariance testing suggested that the measure of SOC had configural invariance, but could not claim scalar (strong) invariance ($\chi^2 (2) = 6.82, p = 0.03$).

To determine the source(s) and extent of non-invariance, we conducted additional tests in which the intercept of each of the four variables were freed one by one across groups and

compared to scalar models where no intercepts were freed. These results indicated that only coping efficacy was invariant across groups (χ^2 *(1) =6.05, p= 0.01)*; thus, we adjusted our model to allow the efficacy intercept to remain free in the female sex group in our final model. The resulting multiple group model demonstrated good fit with the data, χ^2 *(10) = 7.29, p > 0.05; CFI > 1.00, RMSEA = .00 (90% C.I. = 0.00 - .10), SRMR = .07*. Factor loadings for the pooled sample and by group are listed in Table 5. Findings provide evidence that the SOC variable is partially invariant. However, full invariance may not be a necessary condition in order for comparisons to be valid; in fact, when non-invariance is limited to a sufficiently small percentage of parameters (i.e., less than 20%; Dimitrov, 2010) it may not be problematic (Byrne, Shavelson, & Muthén, 1989; Dimitrov, 2010; Steenkamp & Baumgartner, 1998). Thus further analyses will include testing for gender differences.

Table 5. Factor loadings from the confirmatory factor analysis of Sophistication of Coping accounting for metric invariance.

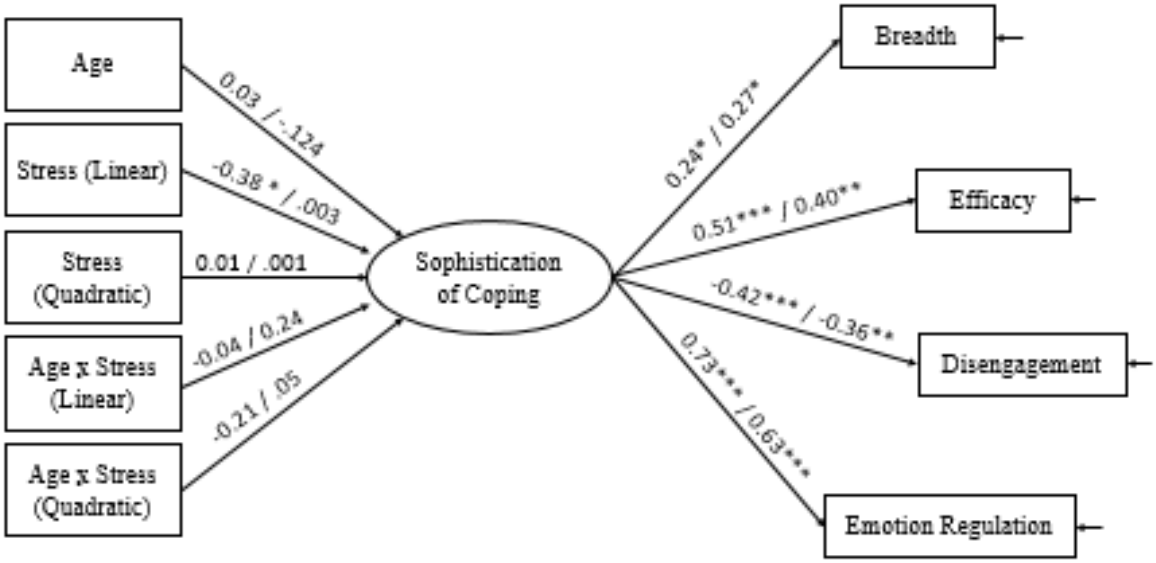
	Males			Females		
Factor/Indicator	*b*	S.E.	β	*b*	S.E.	β
Efficacy	1.0[r]	0.14	0.55	1.0[r]	0.12	0.43
Breadth	0.52	0.11	0.24	0.52	0.11	0.27
Disengagement	-0.76	0.11	-0.40	-0.76	0.11	-0.35
Emotion Regulation	1.37	0.13	0.71	1.37	0.16	0.63

Note 1.0[r] = reference indicator fixed for scaling purposes. All factor loadings were statistically significant ($p < .05$).
b = unstandardized coefficient, S.E. = standard error, β = standardized coefficient

Step 3: Structural Equation Modeling Analysis

A structural equation model analysis was first conducted to test how stress, age, and the interaction between them were associated with coping sophistication (*H1* and *H2;* see Figure 4). SEM demonstrated good fit to the data, χ^2 (40) = 33.02, p > .05; CFI ≥ 1.00, RMSEA = .00 (90% C.I. = 0.00 - 0.06), SRMR = .06. The results indicated that for males, stress was significantly associated with coping sophistication, such that boys who had experienced fewer reported stressful events were likely to demonstrate more sophisticated coping, $\beta_{stress} = -0.38$, $p_{stress} = 0.04$. Age, stress x stress, and the age by stress interactions were not significant for males in this sample ($\beta_{age} = 0.03$, $p_{age} = 0.86$; $\beta_{stress\ sq} = 0.01$, $p_{stress\ sq} = 0.98$; $\beta_{age\ x\ stress} = -0.04$, $p_{age\ x\ stress} = 0.82$; $\beta_{age\ x\ stress\ sq} = -0.21$, $p_{age\ x\ stress} = 0.63$). For females, age, stress, and stress x stress, as well as their interactions, were not associated with SOC ($\beta_{age} = -0.124$, $p_{age} = 0.58$; $\beta_{stress} = 0.003$, $p_{stress} = 0.99$; $\beta_{stress\ sq} = 0.01$, $p_{stress\ sq} = 0.96$; $\beta_{age\ x\ stress} = 0.24$, $p_{age\ x\ stress} = 0.23$; $\beta_{age\ x\ stress\ sq} = -0.05$, $p_{stress\ sq} = 0.83$).

Figure 4. Results for the structural equation model testing the effects of age and stress on SOC.



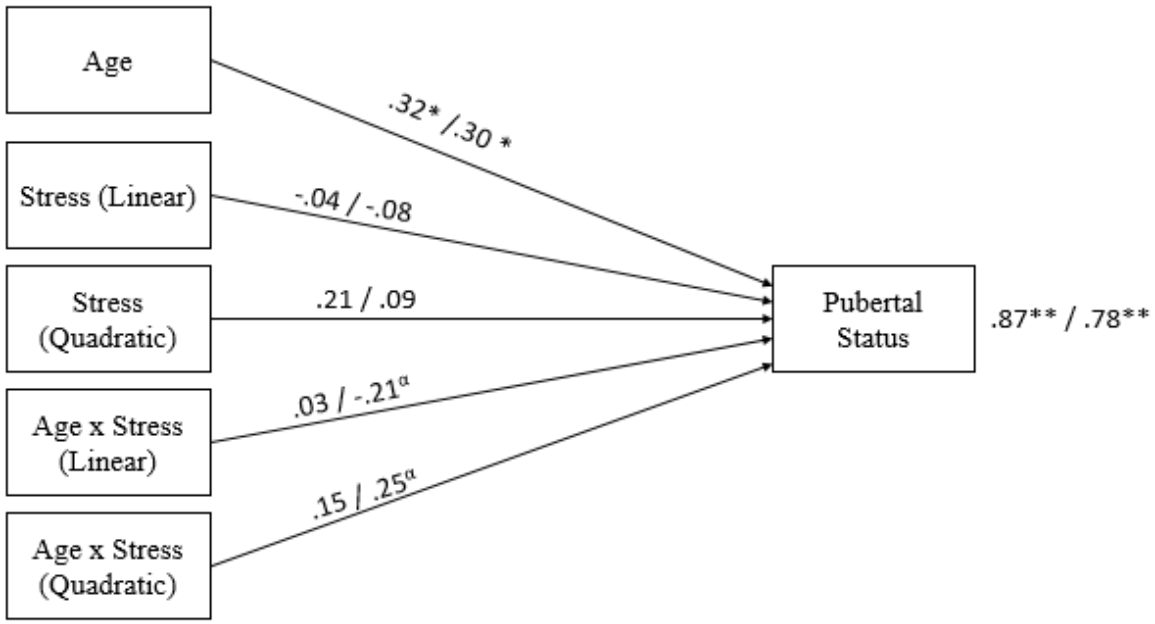
SOC = sophistication of coping. Male/Female standardized coefficients.
$^{\alpha}$ *p < 0.1. * p < .05. ** p < .01. ***p < .001.*

Before testing a mediation model, two prerequisites must be met: the independent variables must predict the proposed mediator, and the mediator must predict the dependent variable. These paths were tested separately.

The direct effects of stress and age (independent variables) on parent-reported pubertal development (proposed mediator) by sex (*H4*) are displayed in Figure 5. Results indicated that for males and females, age was associated with pubertal status, $\beta_{males} = 0.36$, $p_{males} = .02$; $\beta_{females} = 0.30$, $p_{females} = .02$. Neither stress nor the interaction of stress and age were associated with pubertal development for boys or girls. Together, the predictors explained 34% of the variance of parent report of pubertal development in this sample ($p < .001$).

Unstandardized and standardized estimates of the direct effect of pubertal status (proposed mediator) on SOC by gender are displayed in Figure 6. The SEM demonstrated

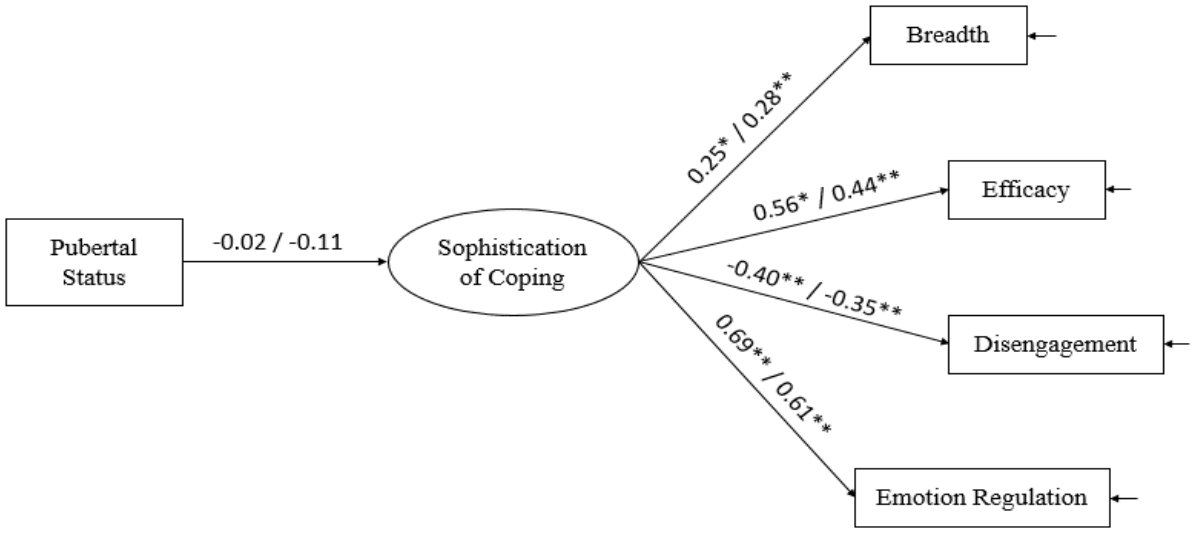
Figure 5. Effects of age, stress, and their interactions on pubertal status.



Note. Male/Female standardized coefficients.
α *p < 0.1.* * *p < .05.* ** *p < .01.* ***p < .001.*

acceptable fit to the data, χ^2 (16) = 18.77, p > .05; CFI = 0.90, RMSEA = 0.05 (90% C.I. = 0.00 - 0.12), SRMR = 0.08. Results indicated that pubertal status was not significantly associated with SOC for males or females (β_{males} = *-0.02, p = 0.90;* $\beta_{females}$ = *-0.11, p = 0.54).* Because this pathway was not significant, the mediation analyses (H5) were not conducted.

Figure 6. Effect of pubertal status on sophistication of coping.



Note. Male/Female standardized coefficients.
$^{\alpha}$ *p < 0.1. * p < .05. ** p < .01. ***p < .001.*

Discussion

The goals of the present study were to establish a theoretically-grounded measure of coping sophistication for 4th and 5th graders, and to examine the relationships between the development of coping and age, stress, and pubertal status. Effective coping in the face of uncontrollable and often ongoing stress is protective against many adverse outcomes, including depression, anxiety, substance use disorders, poor academic achievement, and deviant behavior in adolescence (e.g., Blair & Raver, 2012). Better understanding of the processes that underlie the development of coping is essential to promote the use of effective strategies and ultimately to foster psychological wellbeing, particularly among youth at risk for developing psychopathology.

Our results indicate that boys and girls differ in the ways in which they cope and may achieve coping sophistication through different pathways. Coping sophistication was partially invariant between boys and girls, with coping efficacy as the source of non-invariance. There was no significant difference in reports of coping efficacy by gender, however. In addition, SOC was significantly associated with recent stressful experiences and predictive of self-report psychopathology and wellbeing only for boys, but not for girls. Across both boys and girls, age was not associated with SOC, suggesting that the construct created was not representative of age-graded coping advances predicted in the literature, though it was associated for some with positive outcomes indicative of more effective coping. Finally, pubertal development was not significantly associated with SOC, suggesting other factors at play in the sophistication of coping.

Sophistication of Coping

In this sample, age was not significantly associated with coping sophistication (H1), nor with any of the variables used to create the sophistication of coping variable. There are a few possible explanations for this. One, there may be issues with construct sensitivity: SOC is a theoretically grounded construct aimed at measuring how advanced a child's coping strategies are; it is not known how sensitive the measure is to minor advancements in skill that may be present across a narrow age range. Furthermore, the sample was limited in variability by age (range: 8.96 – 12.07 years). It is unknown how much between-individual variability in coping sophistication there is for children within this span. According to the literature on the development of coping, the period from ages 8 to 12 represents a significant shift in strategy and rise in effectiveness. However, children in this sample did not differ by age on preferred coping strategies reported on the RSQ. Given the cross-sectional nature of this study, however, drawing conclusions about causality should be limited.

Pubertal development was not associated with coping sophistication in this sample (*H3*). It may be that our measurement of pubertal development was not optimal for reflecting changes to biological processes that underlie the sophistication of coping. A common criticism of the PDS is insufficient sensitivity to early signs of pubertal development, with many of the items addressing events or processes that occur later in puberty (e.g., menarche, appearance of facial hair; Dorn et al., 2006). In a previous study, however, parent- and self-reports on the PDS were overall significantly correlated for 5th and 6th grade boys and girls, suggesting that parents are able to provide rough yet reliable ratings of pubertal development (though for a slightly older group of children; Carskadon & Acebo, 1993; Y. Wu et al., 2001). In the Carskadon & Acebo (1993) study, children (especially boys) tended to score themselves as more physically mature than their parents did, suggesting parent-report PDS may be an underestimate of actual pubertal

development. Given our sample consisted of 4th and 5th graders for whom pubertal development had only just begun, it may be that parent-report of PDS did not capture sufficient variability and was sensitive only to the most apparent physical changes. Parent reports of pubertal status do provide estimates of social views of pubertal status, which can impact the way children are treated by peers and adults and in turn influence their own behaviors, including coping strategies (Dorn & Biro, 2011). Evidently the coping sophistication of the children in this sample was not impacted by their parents' views of their pubertal status. Further testing of the relationship between coping sophistication and pubertal development is warranted among older students representing a wider swath of pubertal development.

Our prediction that children who had experienced very high or very low levels of stress would exhibit more sophisticated coping (*H2*) was partially supported. For boys, stress had a significant linear relationship with coping sophistication, such that boys who experienced fewer stressful events on average demonstrated more sophisticated coping. Our measure of stress was limited to stressors experienced in the past year. It may be that recent stressors affect coping abilities linearly, while accumulated stress has the potential to have a u-shaped effect on coping, with an optimum level of stress predicting more effective coping repertoires and too much or too little stress predicting less effective coping. Unfortunately, our measure of stress exposure was limited in scope, both in terms of sources of stress and the interval of time included. Further research into the differential effect of the timing or accumulation of stress is needed, however. In addition, other physiological indices of stress (e.g., hair cortisol concentration, morning awakening salivary cortisol) and regulation (e.g., cortisol reactivity or recovery to a stress task) may better predict SOC than self- and parent-reports of stress.

Gender Differences Found in Coping

Gender differences were found in how boys and girls report responding to stressors, as well as in sophistication of coping. Boys reported utilizing less disengagement coping and more emotion regulation than girls, and suggested a broader array of strategies as well. These findings are consistent with those of Hampel & Petermann (2005), in which they compared coping strategies between boys and girls in a sample of 8 to 14 year olds. The authors found a significant gender effect on both adaptive and maladaptive coping strategies, such that girls scored significantly higher on social support seeking and maladaptive coping skills (i.e., rumination, avoidance, and aggression). According to Frydenberg and Lewis (1993), girls' tendency to engage in these maladaptive strategies may indicate a "perceived lack of empowerment." In turn, boys' tendency to engage in more active strategies (e.g., problem solving, distraction) has been argued to be an attempt to gain control over stressful situations, attempts which are discouraged in girls (Compas, Orosan, & Grant, 1993). These differences in coping have been linked to disparities in psychopathology (e.g., higher rates of depression and externalizing behavioral problems in adolescent girls and boys, respectively; Compas et al., 1993; Seiffge-Krenke, 1993). The gender effects in this study mirror these trends, suggesting that coping efforts in early adolescence may set the stage for later mental health problems.

Boys' coping sophistication was significantly associated with recent stress exposure; **a**mong females in this sample, however, stress exposure did not have any significant relationship with coping sophistication. Girls and boys did not differ in the number of stress exposures they or their parents reported over the past year. It may be that how girls effectively cope with stress is less sensitive to recent life experiences and peer stress than boys' strategies. Alternatively, gender differences in the effects of stress may be related to differences in socioeconomic status; on average, household income was moderately associated with gender ($p < .1$). It may be that

differences in socioeconomic status contributed to gender differences in coping sophistication, such that boys were exposed to more long-term chronic stressors (not measured by our recent stress exposure measure) that influenced coping strategies. This would suggest that either early experiences or chronic stressors influence the development of more sophisticated coping repertoires in a way that recent stressors do not.

In addition, it may be that individuals reach coping sophistication through separate gender-specific pathways; that is, that coping sophistication may look different for girls and boys. First, there is evidence to support that boys and girls experience different outcomes despite using the same strategies. Wadsworth & Compas (2002) found gender differences in the outcomes related to different forms of coping. For example, disengagement coping was related to more symptoms of aggression and anxiety for boys, but not for girls, while primary control coping (problem solving, emotion regulation, emotional expression) was negatively associated with aggressive behavior problems for boys, and negatively associated with anxiety and depression symptoms for girls. Thus, one size coping strategy may not fit all. Second, as discussed above, gender differences in psychopathology emerge in early adolescence, particularly among anxiety and mood disorders. Predominant theory of these differences contend that girls and boys rely on different coping skills, with girls socialized to favor rumination and disengagement strategies, while boys are socialized to suppress their emotions or find alternative outlets.

It is possible that because of gender socialization, coping sophistication may look different for boys and girls. Our findings that the SOC latent variable was associated with internalizing disorders and personal adjustment for boys alone suggest that the combination of factors comprising SOC may not represent effective coping for girls. Future analyses evaluating coping sophistication among girls might seek how social support, secondary control coping (i.e.,

positive thinking, acceptance, cognitive restructuring, and distraction), and emotional expression contribute to a female-specific latent variable.

Pubertal Development

Age was significantly associated with pubertal status (*H4*), and girls were significantly more developed than boys (*H4a*), as predicted. Stress exposure did not have a direct effect on pubertal status for either gender. Other studies measuring biological markers of stress and pubertal development have found that indicators of greater stress exposure (e.g., attenuated cortisol, experiences of maltreatment) predict subsequent faster pubertal tempo, or the pace of development (Negriff et al., 2015; Saxbe, Negriff, Susman, & Trickett, 2015). That our findings were not consistent with these previous findings may be due to the limitations of our measures of stress and puberty. To better test the interaction of age and stress on pubertal development, longitudinal and highly sensitive measures of puberty should be used, as well as more extensive measures of stress that include biological indicators of stress, particularly of accumulated stress exposure.

Limitations

The current findings should be considered in light of several limitations. First, as mentioned above, the methods and sample used in this study to measure pubertal status may not have been optimal for exploring this study question. Measurement of pubertal stage via parent report relies on aspects of development that are visible (e.g., growth of breasts or facial hair) and therefore may not reflect the stage of less-developed children. In addition, parent report of puberty may be especially insensitive to biological processes that are impacted by stress

exposure (e.g., pubic hair growth). Children in the study were limited to early puberty, with 15% of the sample reported to have not yet started the process. A more precise measure of early puberty would be necessary to test the relationship between coping and pubertal development, while the inclusion of older children, for whom puberty may be well underway, would reveal more of the trajectory of coping sophistication.

Similarly, reports of stressful experiences were limited to exposures from the past 12 months; research on the effects of stress on pubertal development suggest that experiences early in life are influential to pubertal onset, while more recent stress may be more likely to influence the tempo of development (Parent et al., 2015; Saxbe et al., 2015). In addition, the cross-sectional nature of this study prohibits drawing causal conclusions. Longitudinal studies on the sophistication of coping throughout the transition to adolescence are critical to understanding development and adjustment. Despite these limitations, this study offers an important first step in elucidating potential pathways to coping sophistication, understanding how those pathways may differ by gender, and points to the need for additional research in this area.

Appendix

Coping Interview Coding Manual

Adapted Celina Joos, March 2017, from "Responses to Stress Coding Manual for *in vivo* Coping;" developed by Martha E. Wadsworth, Ph.D.

Coding Instructions

A. Coding:

For each variable to be coded, do the following:
Step 1: Count # of distinct responses
Step 2: Code each response according to the constructs described and using the number-letter codes on pages 2-3
Step 4: For codes you are unsure about, please make note of the subject ID#, the item #, which response it is, and what the issue is
General Instructions:

- Asking or talking to other kids is one strategy. Asking them or telling them *to stop* or *do something* is a separate strategy. They are **both** primary control.
- **Not** be around that person or people is one strategy (avoidance, disengage). Seek out someone else is another (distraction, secondary). **Talk** to someone else is primary control.
- In V3, apologize and talk/work it out/convince are two separate strategies but **both** are primary control
- In V3, having a friend over is distraction, secondary

B. Data Entry

For each variable that was coded, do the following:
Step 1: Enter in the total number of separate coping responses that were coded by the coder.

Step 2: count up the number of each type of coping code assigned by the coder (e.g., if the child gave three coping responses for item 8A, and two were coded 1c and one was coded 3b, you would enter 2 for "N8AResp1c" and 1 for "N8AResp3b"

Step 3: Enter "0" if the child gave no response. Jot down the child ID and item number for any responses the coder was unable to code.

C. Calculation of Matching Percentage

Vignette 1: A same-sex peer sees a group of children looking at him/her and thinks they are laughing at him/her. What would you recommend that your peer do?
Optimal Coping Strategy: Secondary Control Engagement Coping (SCEG)
Coding: Sum 2a-2d, then divide by the total number of strategies.

Vignette 2: A same sex peer is never picked to play soccer by his/her peers. What would you recommend that your peer do?
Optimal Coding Strategy: Secondary Control Engagement Coping (SCEG)
Coding: Sum 2a-2d, then divide by the total number of strategies.

Vignette 3: A same sex-peer gets into an argument with his/her best friend, and is now uninvited from his/her best friend's sleep over. What would you recommend that your peer do?
Optimal Coding Strategy: Primary Control Engagement Coping (PCEG)
Coding: Sum 1a-1c, then divide by the total number of strategies.

Coping Strategies

I. Primary Control Engagement Coping (PCEG)

1a Problem Solving

- Think of a way to make things better/change the situation/fix the problem
- "I did […..] to solve the problem"
- Try to come up with a strategy for what to do.
- Make a plan of action.

1b Emotional Regulation

- Waiting until an appropriate opportunity to act presents itself
- I took a deep breath
- Tried to calm down

1c Emotional expression

- Let feelings out [by talking, crying, screaming, venting]
- I let someone or something (e.g., god) know how I feel
- I ask other people for help or for ideas about how to make the problem better.
- I get sympathy, understanding, or support from someone

II. Secondary Control Engagement Coping (SCEG)

2a Positive thinking:

- Think about positive aspects of the situation
- I think about happy things to take my mind off the problem or how I'm feeling.
- I tell myself that I can get through this, or that I'll do better next time.
- Tell myself everything would be alright

2b Cognitive restructuring

- Think about things that can be learned from the situation
- Think about something good that will come of it
- Think about the situation in a different way

2c Acceptance

- Realize that I just have to deal with the way things are
- I decide I'm okay the way I am, even though I'm not perfect.
- I just take things as they are, I go with the flow.

2d Distraction

- Keep my mind off the problem by doing something else
- I keep my mind off disagreements by doing something I enjoy.

III. Disengagement Coping

3a Avoidance

- Avoid being around situation, person, or thinking about the feelings
- I **try** not to think about it, to forget all about it.
- Try to forget all about it
- Try to stay away from people/things that make me feel upset or remind me of problem

3b Denial

- Try to convince myself that nothing ever happened
- Tell myself it isn't real
- Believe it didn't happen

3c Wishful thinking

- Wish the problem would go away
- Wish/hope that everything would/will work itself out
- Wish that I were stronger, smarter, or more popular so that things would be different

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