Journal of Youth and Adolescence (2018) 47:1409–1426
https://doi.org/10.1007/s10964-018-0825-6

EMPIRICAL RESEARCH

Dimensions of Short-Term and Long-Term Self-Regulation in Adolescence: Associations with Maternal and Paternal Parenting and Parent-Child Relationship Quality

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Received: 21 September 2017 / Accepted: 8 February 2018 / Published online: 21 February 2018

Abstract
Relatively little is known about the degree to which subcomponents of self-regulation change during early to middle adolescence. This study considered familial predictors (maternal/paternal regulatory support, antagonistic parenting, and parent-child closeness) of rank-order change in behavioral, emotional and cognitive regulation and perseverance over one year. $N = 452$ adolescents ages 11–16 years and their parents completed questionnaires and parent-child discussion tasks (48.7% male; 69.6% white). Results indicated minimal direct effects of parenting, though maternal and paternal parenting and parent-child closeness exerted small effects that were moderated by prior levels of cognitive regulation and perseverance. Parents may contribute to the development of complex regulatory capacities that mature after foundational emotional and behavioral regulation competencies.

Keywords Self-regulation · Maternal parenting · Paternal parenting · Parent-child relationship quality · Longitudinal

Introduction

Self-regulation involves individuals' abilities to control their emotions, attention and behavior so that they may persevere and thus attain short- or long-term goals (Gestsdottir and Lerner 2008; Moilanen 2007). Individuals who are highly capable of self-regulation are advantaged in many spheres of life, demonstrated by high levels of academic achievement and prosocial behaviors and limited involvement in delinquency, substance use, and sexual risk-taking (Bowers et al. 2011; Brody and Ge 2001; Moilanen 2007). While the adjustment-related advantages attributable to high self-regulation are well-understood during adolescence, relatively little is known about the degree to which it develops in the teen years, or about the forces behind such changes.

The present study addresses several gaps in this literature. First, reflecting widespread disagreement about the construct's conceptualization (an issue discussed at further length below), it is uncertain whether regulatory subcomponents develop on unique timetables. The current investigation considers longitudinal change over one year in two short-term elements of regulation (i.e., emotional and behavioral regulation) and two long-term components (i.e., cognitive regulation and perseverance). Considering such disaggregated components is vital because it is similarly vague whether individual changes in each dimension can be attributed to the same socialization processes. Second, to date far less remains known about potential effects of paternal versus maternal parenting, which is problematic in light of initial evidence that mothering and fathering do not have equivalent impacts on adolescents' self-regulatory development (Hoeve et al. 2011; Moilanen et al. 2015). Third, there is similarly limited understanding of potential impacts of the relational context in which parenting occurs on adolescents' self-regulatory outcomes, and this gap is particularly acute for father-child relationships. Finally, it also remains uncertain whether the effects of parenting and

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parent-child relationship qualities on rank-order change in self-regulation are conditional upon youth's initial regulatory abilities. These gaps are addressed in the present study.

The Definition and Development of Self-Regulation

One considerable obstacle to progress in this area is pervasive disagreement concerning the definition and scope of self-regulation, an issue discussed at length elsewhere (e.g., Moilanen and DeLong 2017; Nigg 2017). Scholars disagree about its precise definition throughout the lifespan, and employ abundant synonyms for largely identical constructs. On one hand, many researchers conceptualize it in terms of its discrete subdimensions, and treat the regulation of emotions, behavior, attention and delay of gratification as independent entities. On the other hand, many others view self-regulation or self-control as the sum of these components (i.e., that effective self-regulation requires strategies for regulating attentional focus, feelings and actions in pursuit of personal goals); those who view self-regulation through temperamental lenses often refer to effortful control (e.g., King et al. 2013). Despite this conceptual discrepancy, researchers in both camps rely upon similar assessment methodologies; for example, scholars who take the latter comprehensive approach often use multidimensional composites of the same measures employed in research on discrete regulatory elements. This theoretical diffusion has given rise to ostensibly separate literatures on each element (i.e., studies of two or more subdimensions in adolescence are quite rare), which are also distinct from the literatures on self-regulation as a multidimensional construct, self-control, and effortful control.

This definitional controversy is clearly evident in the adolescence literature, which is further plagued by additional delineation between regulation in short- and long-term temporal contexts (for reviews, see Gestsdottir and Lerner 2008, and Moilanen and DeLong 2017). Children are generally only able to regulate their impulses and behavior in the moment or over short periods of time (e.g., momentary inhibition of impulses, moderation of emotions, and control of attention); for the purposes of the current study, we refer to these organismic aspects as short-term regulation. In contrast, teenagers are theoretically also capable of planning for future events and of purposefully regulating their feelings, actions, and attention over long periods of time in service of personally-selected long-term goals; in the present investigation, we refer to these intentional capacities as long-term self-regulation. As implied above, there are few studies of two or more short- or long-term regulatory subdimensions in adolescence, as most investigations have considered aggregates of subfactors that combine short- and long-term control of emotions, attention, behavior, and/or cognition. An undesirable consequence of this approach is that it precludes exploring whether each subdimension develops independently or in concert.

Despite this lack of consensus, there is growing agreement about the antecedents of individual differences in regulatory abilities (e.g., internal forces such as temperament[1] and executive functioning and environmental influences, particularly variations in parenting during childhood and adolescence; Bridgett et al. 2015; Eisenberg 2015; Morris et al. 2007). Newland's (2015) Theory of Change model, Bridgett et al.'s (2015) self-regulation intergenerational transmission model, and Morris et al.'s (2007) model of emotion regulation in the family context each describe these processes primarily in reference to childhood-era, short-term forms of regulation (i.e., to date there is no theory specific to the period of adolescence or long-term regulatory capacities). Each attributes individual differences in self-regulation to various internal characteristics (e.g., children's temperamental traits, genetics, and neurobiology), and familial socialization experiences. Bridgett et al. (2015) and Morris et al. (2007) concur that parents shape their children's regulation directly via genetic inheritance, and parents' own regulatory capacities also influence the proximal childrearing environment (the latter is acknowledged in terms of general parental mental health as a dimension of global family well-being in Newland 2015). Bridgett et al. (2015) stipulate that this in turn gives rise to children's physiological regulatory infrastructure.

The models vary somewhat in terms of delineating parental socialization mechanisms, although each refers to similar processes. Specifically, the aggregated components of developmental parenting in Newland (2015) and proximal developmental contexts in Bridgett et al. (2015) are delineated into three interrelated components in Morris et al. (2007); notably, this is the only model with explicit bidirectional associations between children's emotion regulation, problem behaviors, and their experiences in the family context that teach children and youth learn how to regulate emotions. First, children learn about regulation via observations of their family members (e.g., parents and siblings model emotional behaviors, which conveys standards for emotional expression and control). Second, discrete parenting practices directly and indirectly impart emotional display rules and emotion regulation strategies, and communicate to children the limits of acceptable behavior (e.g., parents provide positive reinforcement for acceptable behaviors and harsh punishment for unacceptable emotional

[1] Some scholars argue that regulation (i.e., inhibitory or effortful control) and emotionality comprise temperament (e.g., Rothbart and Ahadi 1994). Space limitations prohibit the inclusion of a comprehensive discussion of this theoretical issue.

displays). Finally, the family's emotional climate (e.g., parent-child attachment, conflict, etc.), explicitly impacts children's regulation or dysregulation: unpredictable, tumultuous settings heighten youth's negative affect that requires modulation, while at the same time distracting children from mastering strategies for modulating emotional responses. Youth's emotion regulation abilities mediate familial contextual effects on adjustment outcomes (e.g., internalizing and externalizing problems, social competence, etc.); simultaneously, parents' individual characteristics (e.g., mental health) shape the family context and covary with their children's individual characteristics (e.g., reactivity) that in turn condition the associations between the family context and the child's regulation and adjustment outcomes.

Though informed by Bridgett et al. (2015) and Newland (2015), the present inquiry tested a portion of Morris et al.'s (2007) model. In keeping with previous studies, the parenting practices under examination were maternal and paternal regulatory support and antagonism. The family's emotional climate was operationalized as each parent-child dyad's joint perceptions of closeness with each other (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010). The literature supporting each of these associations is described below, with distinctions made when possible between maternal and paternal parenting and parent-child relationship quality, and between subcomponents of self-regulation (e.g., primarily short-term regulation of emotions and behavior, as well as longer-term elements involving planning, goal directedness and perseverance; below, we use the original terminology employed in each article).

Regulatory support

Parental regulatory support is characterized by behaviors such as support, responsiveness, providing boundaries and engaging in consistent discipline (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010). Such practices may promote the development of self-regulatory skills by helping youth to learn how to manage their negative emotions, which in turn would limit their ability to self-regulate their feelings or behaviors (Baumrind 1991; Brody and Ge 2001; Morris et al. 2007; Sroufe 1996). Parents who provide regulatory support help youth solve problems, and such prompt responses may be able to keep their children from experiencing overwhelming emotional extremes. In turn, this may help children and youth acquire effective strategies for regulating negative emotions and controlling undesirable behaviors (Kochanska and Aksan 1995; Morris et al. 2017). There is consistent empirical support for these assertions during childhood and in early adolescence, albeit to a lesser degree: for example, high levels of maternal and paternal positive parenting were associated with high concurrent levels of effortful control from early childhood to early adolescence (Tiberio et al. 2016). This general pattern has also emerged in cross-sectional research on self-control in adolescence (Crossley and Buckner 2012; Finkenauer et al. 2005), and in studies of latent growth in middle childhood through early adolescence, with maternal or parental warmth and acceptance predicting initial levels but not change in effortful control, impulsivity, and self-control (King et al. 2013; Ng-Knight et al. 2016). Yet in prior studies in two distinct samples, maternal warmth did not predict youth's subsequent levels of self-regulation over and above their prior levels of self-regulation, maternal harsh/antagonistic parenting or mother-child relationship quality (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010). In terms of evidence for paternal parenting, analyses of existing data revealed that higher levels of paternal positive parenting were linked to higher inhibitory control and lower impulsivity in preschoolers (Meece and Robinson 2014). Similarly, Tiberio et al. (2016) demonstrated that high paternal positive parenting at age 7 predicted rank-order improvements in children's effortful control at ages 11–12 years; no parallel effect was demonstrated for mothers. Thus, studies of positive forms of maternal parenting have yielded inconsistent findings, with a similar pattern evident in the few known studies of paternal parenting.

Evidence linking parental regulatory support and comparatively longer-term forms of regulation is scattershot. In one cross-sectional study, high levels of adolescents' perceived parental warmth was associated with high levels of self-reported long-term self-regulation (Moilanen 2007). In their longitudinal analysis of data from a large sample of typically-developing adolescents, Bowers et al. (2011) revealed that youth on favorable intentional self-regulation trajectories reported higher mean levels of maternal warmth in early adolescence than youth on less favorable pathways. Some further support can be extrapolated from the literatures on persistence (e.g., voluntary, continued effort towards a goal) and future orientation (e.g., planning for the future and working towards distal goals), constructs reflected in conceptual definitions of long-term, intentional self-regulation (Gestsdottir and Lerner 2008; Moilanen 2007). In one cross-sectional study of three-year-olds, high levels of observed maternal emotional support were associated with children's task persistence over longer durations of time (Mokrova et al. 2012). In the same adolescent sample used in the present study, high levels of paternal authoritative parenting predicted high levels of youth's perseverance one year later (Padilla-Walker et al. 2013); maternal parenting was not associated with perseverance over time, and rank order stability was not considered. In a rural youth sample, Smokowski et al. (2015) found that high levels of familial support predicted high

contemporaneous levels of future orientation. Cumulatively, these findings suggest that highly supportive parenting will be associated with each dimension of self-regulation, including perseverance.

Antagonistic parenting

Antagonistic or harsh parenting includes such actions as verbal attacks, hostility, coercion, dominance, and excessive or inconsistent discipline. Such parenting practices directly model dysregulated behaviors (Gottman et al. 1996; Morris et al. 2007). Additionally, such antagonism may force children to learn to suppress emotional expressions in order to avoid provoking parental hostility, which limits their ability to learn how to direct their emotions and behaviors appropriately and autonomously (Scaramella and Leve 2004; Sroufe 1996). At the same time, such emotionally-invalidating exchanges are highly upsetting to children, which escalates their levels of negative affect requiring regulation (Barber and Harmon 2001), potentially to the point of undermining the child's physiological regulatory infrastructure (Bridgett et al. 2015). There is relatively ample evidence of the harmful impacts of antagonistic parenting practices on children's and adolescents' contemporaneous short-term self-regulation, but little documentation linked to rank-order change. For example, in a cross-sectional investigation of a small sample of parent-teen dyads, poor emotion regulation in adolescence was predicted by high levels of parental emotional invalidation (Buckholdt et al. 2014). In adolescence, Brody and Ge (2001) reported that children's high levels of short-term self-regulation was contemporaneously related to low levels of both mothers' and fathers' harsh or antagonistic parenting methods; a similar pattern emerged for poor discipline in Tiberio et al.'s (2016) study of effortful control. Moilanen et al. (2010) found that high levels of maternal antagonism were associated with low levels of boys' short-term self-regulation at ages 10 and 11; this finding was replicated for boys' and girls' short-term regulation in Moilanen and Rambo-Hernandez (2017). King et al. (2013) found that high child-reports of maternal physical punishment were associated with low initial levels of effortful control and more rapid decreases in impulsivity over three waves; those who reported high levels of maternal inconsistent discipline also reported more rapid desistence in impulsivity, while high maternal-reported rejecting parenting was predictive of more limited reductions in impulsivity. Finally, Ng-Knight et al. (2016) revealed that high parental discipline was predictive of low initial levels and faster linear growth in self-control over three waves in early adolescence. While there is some support for this pathway between parental antagonism and short-term self-regulation, evidence is lacking for its long-term aspects. To our knowledge, this study represents the first investigation into these possible associations.

Parent-child relationship quality

Some scholars posit that parenting behaviors and parent-child relationship quality have separate effects on children's development: specific parenting practices are directly related to the socialization of children and guidance of their behaviors, whereas the emotional quality of the parent-child relationship provides a context for said socialization to occur (Morris et al. 2007). In the present study, parent-child connectedness was conceptualized as the degree to which each parent and child felt close to one another. Self-regulatory capacities should be enhanced when teenagers feel close and connected with their parents. Importantly, teens should feel emotionally secure in the family environment, which provides a supportive setting to express their feelings (Morris et al. 2017). These homes are also likely stable, predictable environments governed by clear rules and expectations for behavior, conduct, and affective expressions. Such benefits should extend to behavioral and cognitive forms of regulation, as emotionally-secure environments should also be safe places for teens to fall short in terms of controlling their actions and pursuing goals, just as they would be for emotional regulatory failures. Ultimately, the more positive and connected teenagers are to their parents, the less emotional arousal they may experience, which should again provide a context that encourages the development of self-regulatory capabilities. This is demonstrated in early childhood, with maternal attachment security predicting children's later delay of gratification (Gilliom et al. 2002) and task persistence (Drake et al. 2014). To a limited degree, parent-child relationship quality (e.g., high connectedness or low conflict) has been shown to affect adolescents' short-term self-regulatory abilities. For example, Bynum and Brody (2005) linked maternal reports of high quality mother-child relationships to children's and adolescents' better behavior regulation. Similarly, high levels of adolescent-reported negative family relations were associated with low levels of effortful control in a sample of European American and Latino 10-year-olds (Loukas and Roalson 2006). Moilanen et al. (2010) showed that high quality relationships between mothers and boys were associated with high levels of boys' short-term self-regulation at ages 10 and 11, and this same effect was revealed in a sample of boys and girls in a second study (Moilanen and Rambo-Hernandez 2017). Turning to longer-term forms of self-regulation, Hutt et al. (2009) found that mother-adolescent conversational elaboration and agreement promoted rank-order improvements in task persistence over four years. Again, the bulk of the evidence regards mother-child relationships and short-term self-regulation, with little

information available about fathers or long-term self-regulation during the teen years.

Prior Self-Regulation as a Moderator

Socialization is not a unidirectional process, and per Morris et al.'s (2007) theoretical model, children's self-regulation shapes the parenting they receive (Cho et al. 2016) and the quality of the parent-child relationship (Eisenberg et al. 2008). Although exploring bidirectional associations was beyond the scope of the present study, youth's initial self-regulation was explored as a moderator of parental regulatory support, antagonism, and parent-child relationship quality on self-regulation one year later. Though speculation about differential susceptibility is common (i.e., that youth who struggle with self-regulation will be more vulnerable to poor quality parenting and weak parent-child relationships; Slagt et al. 2016), to date few studies have considered whether these parenting and relationship effects are contingent upon youth's initial levels of self-regulation. One exception revealed an interaction between youth's self-regulation and maternal discipline at ages 10–11 years in predicting their subsequent regulation at ages 12–13 years (Moilanen and Rambo-Hernandez 2017): specifically, youth with low initial levels of regulation were relatively unaffected by maternal discipline, while adolescents with high initial levels evidenced faster rank-order growth in the presence of low versus high maternal discipline. In the same study, no interactions with maternal support and mother-child relationship quality were present. To our knowledge, previous investigations have considered moderation only in relation to multidimensional regulatory composites. As it is speculated that regulatory subcomponents mature on unique timetables (e.g., shorter-term forms of emotional and behavioral regulation are mastered prior to longer-term forms of planning and persistence; Gestsdottir and Lerner 2008), it seems possible that the effects of parenting and parent-child relationship qualities may vary by regulatory subdimension. Thus in the present study we explored whether prior levels of regulation moderated these effects for the four regulatory components.

Control Variables

The present study also explored the main effects of child sex, race, age and SES, as these influences are covariates of children's self-regulation, parenting behaviors, and/or parent-child relationship quality. These factors have the potential to shape the parenting methods used by mothers and fathers, as well as parent-adolescent dyadic relationship quality, which in turn may impact self-regulatory development. There are ample data indicating that self-regulation varies by sex, in that females consistently report higher levels of self-regulation during childhood, adolescence, and into emerging adulthood (Jo and Bouffard 2014; Moilanen et al. 2015). There is also strong evidence that self-regulation improves as children age (Bowers et al. 2011; Moilanen et al. 2015). Racial/ethnic differences in self-regulation have emerged inconsistently in previous studies. No ethnic differences emerged in a previous analysis of data from the current study's sample of adolescents when parenting styles and family SES were also controlled (Moilanen et al. 2015). Similarly, ethnicity was not linked to boys' self-regulation levels in Moilanen et al.'s (2010) original analyses, which revealed some small effects for SES. However, young African American adolescents experienced more rapid rank-order change in self-regulation over two years than their Hispanic and European American peers (Moilanen and Rambo-Hernandez 2017). Concerning SES, youth who live in high income families generally have higher self-regulation than those in lower income households (Moilanen et al. 2015), though this association is not necessarily evident when comparatively nuanced measures of SES are employed (Farley and Kim-Spoon 2017) or when other contextual risk factors are controlled (i.e., King et al. 2013). Thus these were included as control variables.

Hypotheses

The present study sought to examine the contributions of observed maternal and paternal parenting behaviors and parent-child relationship quality to rank-order changes in adolescents' self-regulation. Supported by a large, diverse sample of typically-developing adolescent boys and girls, the current investigation involved multiple informants on children's self-regulation and parent-child relationship quality as well as observational measures of parenting attained through parent-child discussion tasks. These methods are improvements over prior studies, which have been limited in terms of sample diversity, exclusive focus on maternal parenting, as well as cross-sectional and/or single-informant survey designs. We expected to observe high rank-order stability in both short- and long-term self-regulation over one year. For both mothers and fathers, we anticipated that high levels of regulatory supportive and low levels of antagonistic parenting would be associated with high levels of both dimensions of self-regulation and rank-order improvements over one year. We predicted that high parent-child connectedness would be associated with high self-regulation and rank-order improvements over one year. Further, we explored initial levels of self-regulation as a moderator, anticipating that youth with high initial levels would benefit particularly from low levels of parental antagonism. No a priori hypotheses were advanced regarding parental regulatory support, parent-child

relationship quality, or for specific regulatory components. Finally, we hypothesized that high self-regulation would be associated with female sex, older age in years, and high SES, while controlling for children's race/ethnicity.

Method

Participants and Procedures

This study utilized data from Waves 3 and 4 of the Flourishing Families Project (FFP). In 2007, families residing in a large city in the northwestern U.S. were randomly selected from a commercial national survey database (i.e., Polk Directories/InfoUSA). All families with a child aged between 10 and 14 living within target census tracts were eligible to participate in the study. Of the 692 eligible families initially contacted, 423 agreed to participate, resulting in a 61% response rate at Wave 1. $n = 77$ additional families were recruited through other means (e.g., fliers, referrals, etc.). $N = 500$ families participated in Wave 1, and were subsequently interviewed on an annual basis.

The analytic sample for the present study was $N = 452$ families. $n = 26$ families did not participate in either Wave 3 or 4. Of the analytic subsample, 95.8% provided data at both waves. Data from an additional 22 families in which fathers identified as the primary caregiver or in which mothers identified as the secondary caregiver were removed from the dataset. The final sample was relatively evenly split by gender (48.7% male), was predominantly white (69.6%) and lived in two-parent households (69.9%). At Wave 3, participating children were between the ages of 11 to 16 years ($M = 13.33$, $SD = 1.05$)[2]. 20% of families made less than $40,000 per year, 44% made between $40,000 and $100,000 a year, and 36% earned more than $100,000 per year. Bias analyses compared this subsample to the full sample, and revealed no significant differences in terms of child sex, race/ethnicity, age in years, or family income.

Each wave of data collection was conducted in the family's home, and involved assessment interviews, videotaped interactions, and surveys. The approximate duration of each study visit was 2 h. At both Waves 3 and 4, parents and youth completed questionnaires about children's self-regulation. At Wave 3, parents and children engaged in video recorded discussion tasks that were coded to reflect parents and children's interactions and behaviors, and parents and children separately completed questionnaires about parent-child connectedness. Informed consent/assent was obtained from all study participants at each wave. Each responding family member received a $100 incentive for participation at each assessment.

[2] At Wave 3, 1.6% of the sample was 11 years old, 21.5% was 12 years, 36.6% was 13 years, 25.0% was 14 years, 14.2% was 15 years, and 1.1% was 16 years old.

Table 1 Study variable descriptive statistics

Variable	*N*	Mean (SD)/%	Range
Male sex	452	48.7%	
White race	437	69.6%	
Child age in years	437	13.33 (1.05)	11.00–16.00
Family income	420	7.22 (3.52)	1.00–12.00
Maternal regulatory support	408	4.15 (.69)	1.90–6.80
Paternal regulatory support	280	4.15 (.69)	2.30–6.70
Maternal antagonistic parenting	408	1.20 (.14)	1.00–2.22
Paternal antagonistic parenting	280	1.18 (.11)	1.03–1.81
Mother-child connectedness	436	.00 (.58)	−2.36–.93
Father-child connectedness	288	.02 (.55)	−2.02–1.06
Emotion regulation wave 3	437	2.93 (.56)	1.20–4.00
Emotion regulation wave 4	446	2.95 (.57)	1.00–4.00
Behavior regulation wave 3	437	2.75 (.50)	1.13–3.88
Behavior regulation wave 4	446	2.75 (.48)	1.33–3.92
Cognitive regulation wave 3	437	2.92 (.48)	1.33–4.00
Cognitive regulation wave 4	446	2.96 (.48)	1.50–4.00
Perseverance wave 3	437	3.37 (.56)	1.56–4.83
Perseverance wave 4	446	3.40 (.56)	1.38–4.88

Measures

Descriptive statistics are provided in Table 1. With exceptions noted, scale scores were calculated by averaging, and high scores correspond to high levels of each construct. For each measure, participants must have responded to at least 75% of items in order for scores to be calculated. There were very little missing data; as interviewers collected each segment of the in-home interview, questionnaires were screened for missing answers and double marking.

Self-regulation

At waves 3 and 4, adolescents' self-regulation was measured using a 12-item questionnaire (Novak and Clayton 2001). Mothers, fathers and children indicated how much they agreed with statements about the adolescent's regulatory abilities, with five items referring to emotion regulation (samples: "My child has difficulty controlling his/her temper" and "I get upset easily"), four referencing behavior regulation (samples: "My child gets fidgety after a few minutes if s/he is supposed to sit still" and "I have a

hard time sitting still during important tasks"), and three concerning cognitive regulation (samples: "Once I have a goal, I make a plan to reach it" and "My child thinks about the future consequences of his/her actions"). Parents and children used a four-point response scale ranging from 1 (*never true*) to 4 (*always true*). Exploratory factor analyses within informant at each wave revealed a consistent three-factor structure. Cronbach's alphas were acceptably high for all subscales across informants and waves (i.e., for emotion regulation, αs ranged from .83 to .89 at Wave 3 and from .80 to .90 at Wave 4; for behavior regulation, αs ranged from .73 to .84 at Wave 3 and from .73 to .77 at Wave 4; for cognitive regulation, αs ranged from .73 to .81 at Wave 3 and from .72 to .82 at Wave 4). Initially separate scores were calculated for each informant and dimension (i.e., nine scores for each wave). Examination of the associations within wave and regulatory dimension revealed moderate to strong positive correlations across informants (i.e., r range = .26–.68; all $ps < .001$). Thus for each dimension and wave, the scores provided by each informant were averaged to form six indices of self-regulation.

Perseverance

At waves 3 and 4, youth's long-term self-regulation was assessed via maternal, paternal and child reports to an eight-item measure of perseverance (Peterson and Seligman 2004). Each respondent rated their agreement with statements about the target child's behavior and characteristics (sample items: "My child always finishes what he/she starts" and "I am a goal-oriented person"), using a response scale from 1 (*never true*) to 4 (*always true*). At both waves, internal consistency was high with αs ranging from .86 to .89 at Wave 3 and from .86 to .89 at Wave 4. Examination of the associations within wave revealed moderate positive correlations across informants (i.e., r range = .25–.56; all $ps < .001$). Consequently, the scores provided by each information were averaged within wave to form two indices of perseverance.

Regulatory supportive and antagonistic parenting

In Wave 3, measures of regulatory supportive parenting and antagonistic parenting were derived from codes of recorded parent-child structured conflict discussion and problem-solving tasks. The target child completed a nine-minute discussions task with each parent. Following the protocols of the Iowa Family Interaction Scale (Melby et al. 1998), mothers, fathers and children completed preliminary questionnaires about topics of family conflict (e.g., money, school grades, curfew; 28 items, with one open-ended question for other sources of conflict). These ratings were used to identify the three most common triggers of conflict or problems, which were then the discussion prompts for the observation. Once each dyad completed discussing the first source of conflict, they moved on to subsequent topics until the discussion period ended. Research assistants coded the recorded observations on dimensions from the Iowa Family Interaction Scale (Melby et al. 1998), using a response scale from 1 (*not at all characteristic)* to 9 (*mainly characteristic*). Child-mother and child-father discussions were coded by different research assistants, with coders randomly assigned to either parent-child observation (i.e., it was not possible for the same research assistant to code both the mother-child and father-child observations within the same family). 25% of the observations were double-coded to check for interrater reliability (κs = .81–.85). The index for regulatory support included 10 items referring to expressing positive emotions (i.e., positive mood, assertiveness), displaying affection and care (i.e., warmth/support, endearment, and escalate warmth/support), using relationship-enhancing communication strategies (i.e., humor, listener responsiveness, communication, and prosocial) and demonstrating positive reinforcement of the adolescent (maternal α = .77, paternal α = .77). The 15-item index for parental antagonism included codes referring to verbal and non-verbal expressions of hostility (i.e., externalized negative emotional expressions, hostility, verbal attack, physical attack, angry coercion, escalate hostility, reciprocate hostility), displays of rejection (i.e., contempt, neglecting/distancing, and avoidant), using relationship-undermining communication strategies (i.e., dominance, lecture/moralize, denial, and antisocial), and demonstrating harsh discipline of the youth (maternal α = .80, paternal α = .69).

Parent-child connectedness

At the third wave, parents and children responded to separate questionnaires assessing their perceptions of the parent-child relationship (Lee et al. 2001). Adolescents responded to six questions separately about their mothers and fathers. Sample items included "I am comfortable with some degree of conflict with my parent" and "I feel so comfortable with my parent that I can tell him/her anything." Responses ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). Nine items measured parents' perceptions, including "I am able to relate to my child" and "I feel understood by my child." Responses ranged from 1 (*disagree*) to 6 (*agree*). For each dyad, there were strong correlations between reporters (i.e., mother-child $r = .66$; father-child $r = .68$), and thus the responses to the 15 items were transformed into z-scores prior to averaging across reporters to form two composites (mother-child α = .86, father-child α = .85).

Table 2 Study variable correlations

Variable		1	2	3	4	5	6	7	8	9	10	11	12
1	Child sex												
2	Child age	.04											
3	Child race/ethnicity	.03	−.04										
4	Family income	.03	−.05	.31[c]									
5	M Regulatory sup.	.01	−.07	.31[c]	.21[c]								
6	F Regulatory sup.	−.11	−.09	.12	.25[c]	.25[c]							
7	M Antagonism	.05	.06	−.20[c]	−.22[c]	−.35[c]	−.13[a]						
8	F Antagonism	.01	−.04	−.06	−.07	−.12[a]	−.24[c]	.22[c]					
9	MC Connectedness	−.05	−.15[b]	.14[b]	.14[b]	.27[c]	.18[b]	−.19[c]	−.16[b]				
10	FC Connectedness	−.08	−.06	.05	.12[a]	.06	.28[c]	−.21[c]	−.15[a]	.46[c]			
11	Wave 3 emotion reg.	.09	.02	.13[a]	.18[c]	.18[c]	.14[a]	−.17[b]	−.11	.31[c]	.31[c]		
12	Wave 3 behavior reg.	−.14[b]	.01	.08	.14[b]	.09	.14[a]	−.11[a]	−.15[a]	.26[c]	.29[c]	.42[c]	

Variable		1	2	3	4	5	6	7	8	9	10	11	12
13	Wave 3 cognitive reg.	−.19[c]	−.01	.01	.10[a]	.13[b]	.20[b]	−.14[b]	−.18[b]	.38[c]	.36[c]	.39[c]	.52[c]
14	Wave 3 perseverance	−.17[c]	−.02	.02	.07	.13[b]	.16[b]	−.15[b]	−.10	.30[c]	.34[c]	.37[c]	.63[c]
15	Wave 4 emotion reg.	.16[b]	.07	.13[b]	.11[a]	.21[c]	.13[a]	−.18[c]	−.08	.24[c]	.22[c]	.81[c]	.36[c]
16	Wave 4 behavior reg.	−.12[a]	.02	.06	.13[b]	.10[a]	.13[a]	−.11[a]	−.13[a]	.22[c]	.37[c]	.35[c]	.79[c]
17	Wave 4 cognitive reg.	−.16[b]	.02	.11[a]	.10	.16[b]	.20[b]	−.15[b]	−.13[a]	.37[c]	.34[c]	.35[c]	.45[c]
18	Wave 4 perseverance	−.13[b]	−.01	.09	.10	.16[b]	.13[a]	−.15[b]	−.08	.28[c]	.31[c]	.34[c]	.58[c]

Variable		13	14	15	16	17
13	Wave 3 cognitive reg.					
14	Wave 3 perseverance	.68[c]				
15	Wave 4 emotion reg.	.27[c]	.27[c]			
16	Wave 4 behavior reg.	.44[c]	.54[c]	.38[c]		
17	Wave 4 cognitive reg.	.71[c]	.59[c]	.35[c]	.49[c]	
18	Wave 4 perseverance	.64[c]	.78[c]	.33[c]	.60[c]	.72[c]

Note: M = mother/maternal, F = father/paternal, Sup. = support, C = child, Reg. = regulation

[a] $p < .05$, [b] $p < .01$, [c] $p < .001$

Analysis Plan

Preliminary analyses included Pearson's correlations (see Table 2). Hypotheses were tested in two-step hierarchical regressions, conducted separately for each parent and dimension of self-regulation. The first step included the control (i.e., sex, race, age, and family income), parenting and parent-child closeness variables; Wave 3 self-regulation and the interactions between Wave 3 self-regulation and the parenting and parent-child closeness variables were added on the second step. Interaction terms were calculated with mean-centered variables, and were probed with simple slopes tests.

Missing data analyses involving Wave 3 variables revealed few differences between participants who were present or absent at Wave 4. Youth who were missing at Wave 4 were older in years and had lower levels of maternal regulatory support at Wave 3 than youth present at both waves. Non-white children were more likely to be missing paternal data at Wave 4 than were white youth (i.e., 57.9 versus 23.0%), and family incomes were lower for teens missing paternal data than for their peers with paternal reports. As these analyses suggested that data were missing at random (MAR), we repeated the regressions described above as path analyses with full information maximum likelihood (FIML) estimation in Mplus v.7.2. The two sets of findings were essentially identical, with a few slight differences restricted primarily to paths with p-values near the conventional $p < .05$ cutoff. As procedures for probing interactions are comparatively straightforward in the

Table 3 Regression analyses with maternal variables

Regulation dimension	Emotion		Behavior		Cognitive		Perseverance	
Predictor/step	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Male sex	.16**	.08**	−.13**	−.01	−.19***	−.05	−.14**	.00
White race	.02	.01	−.01	−.01	−.02	.03	.02	.07^{+}
Age in years	.13**	.06*	.08	.03	.12*	.08*	.05	.01
Family income	.06	−.05	.11*	.03	.07	.04	.06	.00
Regulatory support	.13*	.08*	.03	.04	.06	.04	.07	.05
Antagonistic parenting	−.08	−.03	−.03	−.00	−.04	−.02	−.05	−.00
Mother-child connectedness	.21***	.00	.18**	.00	.31***	.11**	.23***	.06^{+}
Prior self-regulation		.80***		.78***		.68***		.75***
Prior SR × reg. support		.04		.01		−.08^{+}		−.03
Prior SR × antagonistic		−.00		.01		−.09*		.03
Prior SR × connectedness		−.02		−.04		.03		.08*
ΔR^2	.14***	.55***	.08***	.55***	.18***	.38***	.11***	.51***

Note: All regression coefficients are standardized (βs)

Reg. = Regulatory, SR = Self-regulation

$^{+}p < .10$, $*p < .05$, $**p < .01$, $***p < .001$

regression versus in the path analytic framework, we present the regressions below.

Results

Preliminary Analyses

Examination of the bivariate correlations between the parenting, parent-child closeness, and self-regulation variables revealed that most of these factors were modestly but significantly associated (see Table 2). For both parents, high regulatory support corresponded to low antagonism, and high antagonism with low parent-child connectedness; these associations were somewhat stronger for mothers than for fathers. Further, high regulatory support was also associated with high parent-child connectedness, but the correlations were similar across both relationships. High parental regulatory support was associated with high levels of all subdimensions of regulation at both waves (except for maternal support and behavioral regulation at Wave 3). Similarly, low maternal antagonism was associated with high levels of all forms of regulation at both waves; the same pattern was evidenced for paternal antagonism, though the associations were non-significant for emotion regulation and perseverance at both waves. All of the self-regulation subscales were strongly and positively correlated within and across waves.

Maternal Models

Maternal regression models are summarized in Table 3.

Emotion regulation

The first model step explained a significant portion of the variance in emotion regulation at Wave 4, $F(7, 371) = 8.30$, $p < .001$, $R^2 = .14$. High levels of youth's emotion regulation were associated with male sex, older age in years, and high regulatory support and mother-child connectedness. At the second step, additional variance was explained by including prior emotion regulation, $\Delta F(4, 367) = 160.30$, $p < .001$, $R^2 = .69$. High levels of emotion regulation at Wave 4 were associated with male sex, older age in years, high levels of maternal regulatory support and emotion regulation at Wave 3. None of the interaction terms were significant predictors.

Behavior regulation

The first step explained a significant portion of the variance in behavior regulation at Wave 4, $F(7, 371) = 4.58$, $p < .001$, $R^2 = .08$. High levels of youth's behavior regulation were associated with female sex, high family income and mother-child connectedness. At the second step, additional variance was explained by including prior behavior regulation, $\Delta F(4, 367) = 137.73$, $p < .001$, $R^2 = .63$. High levels of behavior regulation at Wave 4 were associated only with high levels of behavior regulation at Wave 3. None of the interaction terms were significant predictors.

Cognitive regulation

The first step explained a significant portion of the variance in cognitive regulation at Wave 4, $F(7, 371) = 11.55$,

$p < .001$, $R^2 = .18$. High levels of youth's cognitive regulation were associated with female sex, older age in years, and high mother-child connectedness. At the second step, additional variance was explained by including prior cognitive regulation and the interaction terms, $\Delta F(4, 367) = 79.25$, $p < .001$, $R^2 = .56$. High levels of cognitive regulation at Wave 4 were associated with older age in years, high mother-child connectedness, and high levels of cognitive regulation at Wave 3. The interaction between prior cognitive regulation and maternal regulatory support attained trend-level significance (see Fig. 1a). In general, youth with high cognitive regulation at Wave 3 had higher cognitive regulation at Wave 4 than those with low initial levels. Simple slope tests revealed that for youth with low initial levels of cognitive regulation, high maternal regulatory support was associated with somewhat higher levels of cognitive regulation at Wave 4, $b = .08$, $SE\ b = .19$, $p > .05$. On the other hand, for those at high initial levels of cognitive regulation, their subsequent cognitive regulation was high regardless of level of maternal regulatory support, $b = -.03$, $SE\ b = .33$, $p > .05$. Additionally, the interaction between prior cognitive regulation and maternal antagonistic parenting was significantly different from zero (see Fig. 1b). Simple slope tests revealed that those with high prior cognitive regulation had high levels at Wave 4, while adolescents with high maternal antagonism had lower levels than teens with low maternal antagonism at Wave 3, $b = -.37$, $SE\ b = .13$, $p = .007$. For those with low initial levels of cognitive regulation, those with high maternal antagonism had marginally-higher cognitive regulation at Wave 4 than did those with low maternal antagonism, $b = -.26$, $SE\ b = .14$, $p = .07$.

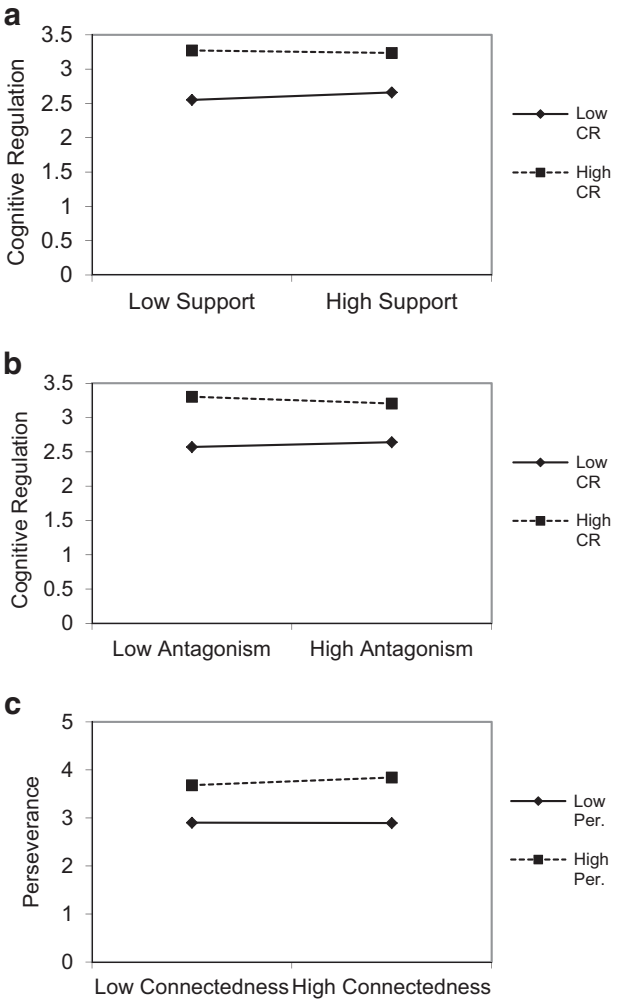

Fig. 1 **a**-**c**. Interactions in maternal models, between (**a**) prior cognitive regulation and maternal regulatory support, (**b**) prior cognitive regulation and maternal antagonistic parenting, and (**c**) prior perseverance and mother-child connectedness

Perseverance

The first step explained a significant portion of the variance in perseverance at Wave 4, $F(7, 371) = 6.74$, $p < .001$, $R^2 = .11$. High levels of youth's perseverance were associated with female sex and high mother-child connectedness. At the second step, additional variance was explained by including prior perseverance and the interaction terms, $\Delta F(4, 367) = 123.51$, $p < .001$, $R^2 = .62$. At trend-level significance, high levels of perseverance at Wave 4 were associated with white race and high mother-child connectedness; there was high rank-order stability in perseverance as well. The interaction between prior perseverance and mother-child connectedness was significantly different from zero (see Fig. 1c). As before, youth with high Wave 3 perseverance had higher levels at Wave 4 than their peers with low initial levels. For adolescents at high initial levels of perseverance, youth with high mother-child connectedness had moderately higher levels of later perseverance than those with low mother-child connectedness, $b = .14$, $SE\ b = .58$, $p > .05$. For those with low initial perseverance, their subsequent levels of perseverance were equivalent, regardless of level of mother-child connectedness, $b = -.01$, $SE\ b = .65$, $p > .05$.

Paternal Models

Paternal regression models are summarized in Table 4.

Emotion regulation

The first model step explained a significant portion of the variance in emotion regulation at Wave 4, $F(7, 252) = 3.20$, $p < .01$, $R^2 = .08$. High levels of youth's emotion regulation were associated with older age in years and high father-child connectedness. At the second step, additional variance was explained by including prior emotion regulation, $\Delta F(4,$

Table 4 Regression analyses with paternal variables

Regulation dimension	Emotion		Behavior		Cognitive		Perseverance	
Predictor/step	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Male sex	.09	.08*	−.18**	−.04	−.26***	−.08^{+}	−.23***	−.07^{+}
White race	.04	.02	−.03	−.00	.05	.05	.06	.07*
Age in years	.13*	.04	.06	.03	.09	.04	−.01	−.06^{+}
Family income	.02	−.06^{+}	.11^{+}	.08*	.04	.03	.04	.01
Regulatory support	.07	.05	−.02	−.02	.06	.05	−.00	−.03
Antagonistic parenting	−.01	.01	−.09	.01	−.06	−.00	−.04	.01
Father-child connectedness	.21**	−.04	.25***	.03	.30***	.07	.28***	.02
Prior self-regulation		.85***		.79***		.71***		.82***
Prior SR × reg. support		.03		.00		−.05		.08*
Prior SR × antagonistic		−.05		−.02		−.13**		−.02
Prior SR × connectedness		.02		−.06		−.02		.02
ΔR^2	.08**	.64***	.13***	.55***	.22***	.40***	.16***	.55***

Note. All regression coefficients are standardized (βs)

Reg. = Regulatory, SR = Self-regulation

$^{+}$ $p < .10$, * $p < .05$, **$p < .01$, *** $p < .001$

248) = 143.46, $p < .001$, $R^2 = .72$. High levels of emotion regulation at Wave 4 were associated with male sex, and high levels of emotion regulation at Wave 3. At trend-level significance, high family income predicted slower rank-order change in emotion regulation between the two waves. None of the interaction terms were significant.

Behavior regulation

The first step explained a significant portion of the variance in behavior regulation at Wave 4, $F(7, 252) = 5.28$, $p < .001$, $R^2 = .13$. High levels of youth's behavior regulation were associated with female sex, high family income (at trend-level significance) and high father-child connectedness. At the second step, additional variance was explained by including prior behavior regulation, $\Delta F(4, 248) = 104.41$, $p < .001$, $R^2 = .68$. High levels of behavior regulation at Wave 4 were associated with high levels of behavior regulation at Wave 3; high income predicted more rapid rank-order change in behavioral regulation between the two waves. None of the interaction terms were significant.

Cognitive regulation

The first step explained a significant portion of the variance in cognitive regulation at Wave 4, $F(7, 252) = 10.00$, $p < .001$, $R^2 = .22$. High levels of youth's cognitive regulation were associated with female sex and high father-child connectedness. At the second step, additional variance was explained by including prior cognitive regulation and the interaction terms, $\Delta F(4, 248) = 65.87$, $p < .001$, $R^2 = .62$. In terms of main effects, high levels of cognitive regulation at Wave 4 were associated with only high levels of cognitive regulation at Wave 3. At trend-level significance, girls experienced more rapid rank-order change in cognitive regulation than did boys. The interaction between prior cognitive regulation and paternal antagonistic parenting was significantly different from zero (see Fig. 2a). As in the maternal model, youth with high prior cognitive regulation had higher subsequent cognitive regulation than those with low initial levels. Simple slope tests indicated that those with initially high levels of cognitive regulation had higher subsequent levels if they also experienced low levels of paternal antagonism, $b = -.47$, $SE\ b = .10$, $p < .001$. For those with low initial levels of cognitive regulation, high antagonism was associated with higher subsequent cognitive regulation, $b = .46$, $SE\ b = .12$, $p < .001$.

Perseverance

The first step explained a significant portion of the variance in perseverance at Wave 4, $F(7, 252) = 6.86$, $p < .001$, $R^2 = .16$. High levels of youth's perseverance were associated with female sex and high father-child connectedness. At the second step, additional variance was explained by including prior perseverance and the interaction terms, $\Delta F(4, 248) = 119.84$, $p < .001$, $R^2 = .71$. At trend-level significance, high levels of perseverance at Wave 4 were associated with female sex and younger age in years. At conventional significance levels, white youth evidenced more rapid rank-order change than did adolescents from other ethnic backgrounds, and there was high rank-order stability over one year. The interaction between prior perseverance and paternal regulatory support was significantly different from

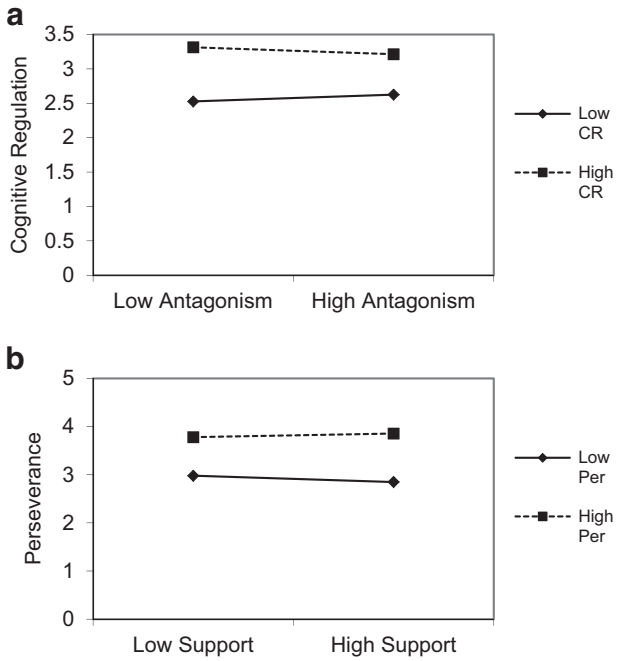

Fig. 2 **a**–**b**. Interactions in paternal models, between (**a**) prior cognitive regulation and paternal antagonistic parenting, and (**b**) prior perseverance and paternal regulatory support

zero (see Fig. 2b). As in the other models, those with high initial perseverance had higher subsequent levels than those with low initial perseverance. For those at high initial levels, those with high paternal regulatory support had somewhat higher subsequent levels than those with low paternal regulatory support, $b = .05$, $SE\ b = .72$, $p > .05$. For those at low initial levels, those with low paternal regulatory support had somewhat higher subsequent perseverance than those with high paternal regulatory support, $b = -.09$, $SE\ b = .72$, $p > .05$.

Alternate Analyses

We report above how we determined our sample size and all measures in the study. The analyses reported above were conducted with all participants in the analytic sample and contained all considered variables.

In order to describe the degree to which parenting and parent-child relationship quality explained significant variance in rank-order change in self-regulation over one year, eight additional three-step regression models were estimated. Demographic control and prior self-regulation were entered on the first step, followed by the parenting and relationship quality variables on the second, and the interaction terms were included on the final step. In two of the maternal models, one of the three variables explained a significant portion of the variance in self-regulation controlling for prior levels, specifically maternal regulatory support in the emotion regulation model (Step 1 $R^2 = .68$, $p < .001$, Step 2 $\Delta R^2 = .008$, $p = .03$) and mother-child connectedness in the cognitive regulation model (Step 1 $R^2 = .54$, $p < .001$, $\Delta R^2 = .011$, $p = .03$).

Discussion

Over the last two decades, scholarly interest in self-regulation has expanded, likely because of its significance in predicting a wide range of adjustment outcomes throughout the lifespan. This has led to new intervention programs targeting regulatory skills and capacities, though the efficacy of these efforts are somewhat mixed in adolescence and emerging adulthood (Murray et al. 2016). This should not be surprising given the lingering gaps in the literature on adolescent-era self-regulation: though it is generally accepted that self-regulation continues to develop during the teen years, few studies have explicitly tested this notion. A further complication is that much of the work on antecedents of developmental change in self-regulation has continued to focus on childhood, with the tacit assumption that such associations may persist into adolescence.

Seeking to fill gaps in the literature, the present study pursued four primary goals. First, we documented the temporal stability in four subdimensions of self-regulation over one year, including two short-term (i.e., emotional and behavioral regulation) and two long-term components (i.e., cognitive regulation and perseverance). We delineated self-regulation in this way owing to the inherent complexities in this messy research area (i.e., that prior studies have focused on both its discrete aspects and comprehensive composites). Consistent with predictions and the literature, there was high rank-order stability in each aspect of self-regulation over the one-year study duration (Bowers et al. 2011; Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010; Ng-Knight et al. 2016; Tiberio et al. 2016). Second, as prior studies have almost exclusively considered maternal parenting, we also explored potential differential effects of observed maternal and paternal regulatory supportive and antagonistic parenting behaviors. Contradicting expectations, few main effects for either parenting dimension emerged. Third, we further illustrated the impacts of the parent-child relational context on adolescents' self-regulatory outcomes; to our knowledge, the present study is also the first to consider potential contributions of father-child relationships. In keeping with hypotheses, there were consistent main effects of parent-child connectedness, though these were mitigated to non-significance in nearly every instance with the addition of prior regulation and the interaction terms. Finally, we also explored whether the effects of parenting and parent-child relationship qualities on rank-order change in self-regulation were conditional upon youth's initial regulatory abilities; again, to our

knowledge, this is the first study to date to consider this for all four regulatory dimensions and in father-child relationships. There was evidence for moderation in the maternal and paternal models predicting cognitive regulation and perseverance; compared to their less-regulated peers, highly-regulated youth were advantaged by high support and connectedness and were disadvantaged by high antagonism. Demographic control variables had inconsistent effects, with most in the anticipated direction. These results are discussed in relation to the literature below.

Rank-Order Stability in Self-Regulation

Overall, when prior levels of self-regulation were controlled, there were few effects of any predictors. All regulatory dimensions evidenced high temporal stability, and these coefficients were comparatively stronger than in prior studies (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010), which may be due to differences in study duration and timing. Regarding duration, prior studies have typically spanned two years (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010), whereas the present study covered just one year; self-regulation may naturally evidence greater stability over shorter versus longer durations. Concerning timing, much of the current study's sample was older at the first wave than in prior investigations (i.e., Moilanen et al. [2010] focused on a high-risk sample of boys at ages 10 and 12, while Moilanen and Rambo-Hernandez [2017] included a high-risk sample of boys and girls at ages 10–11 and 12–13 years). In contrast, approximately 77% of the present sample was at least 13 years old at the study's first wave. It may be that self-regulation is more stable during middle versus early adolescence, limiting the portion of variance that can be explained by other variables.

Parenting Behaviors and Parent-Child Relationship Quality

In their theoretical model, Morris et al. (2007) posited that children's self-regulation is shaped by both the parenting behaviors they experience and the social-emotional context provided by those parent-child relationships. In keeping with Morris et al. (2007) and previous studies' findings, we hypothesized that high levels of regulatory supportive and low levels of antagonistic maternal and paternal parenting would be associated with high levels of all dimensions of self-regulation. We also predicted that high parent-child connectedness would be similarly linked to high regulation. Although these patterns were largely supported in the bivariate correlations, they did not emerge for the parenting variables in the regressions, in which only one main effect was present (i.e., maternal regulatory support in the emotion regulation model). For both maternal and paternal parent-child relationships, high connectedness was consistently associated with high regulation, with only one exception (i.e., the maternal cognitive regulation model); those effects were mitigated to non-significance once prior regulation was added to the model. Thus, the present study provided limited direct support for these hypothesized associations with parenting, and somewhat stronger support for parent-child connectedness, with these four dimensions of self-regulation. Below, we discuss these findings in detail for each parenting practice prior to parent-child connectedness.

Parenting practices

This small effect for maternal regulatory support is consistent with prior studies of maternal parenting (i.e., Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010) and fits with the broader short-term self-regulation and self-control literatures (Finkenauer et al. 2005). When mothers are warm, caring, and provide boundaries, they assist their adolescents as they learn to control their emotions appropriately; teens can learn how to down-regulate their feelings and to master their impulses because their mothers are helping them to do so, which in turn helps them improve their skills in emotion regulation. It is noteworthy that maternal regulatory support does not confer similar benefits for other forms of regulation, nor does paternal regulatory support for any regulatory component. This latter finding is consistent with other studies on self-regulation (e.g., Moilanen and Rambo-Hernandez 2017; Tiberio et al. 2016). Though this cannot be ascertained through the structured parent-child discussion task used in the present investigation, this discrepancy may reflect adolescents' differential involvement with each parent. As when children are younger, mothers tend to have primary responsibility for parenting during adolescence (Phares et al. 2009), while exchanges with fathers tend to focus on recreational endeavors and are more enjoyable than those with mothers (Montemayor and Brownlee 1987). Fathers' support in the context of play will likely not provide the same opportunities to learn emotion regulatory strategies as would maternal support in other contexts, such as when youth's experience frustration with schoolwork. Thus, mother-adolescent interactions may provide a setting for mothers to socialize proper emotional expressiveness, while father-adolescent interactions may be simply a source of amusement.

The absence of main effects for antagonistic parenting was somewhat surprising given the accumulated evidence documenting the detrimental impacts of these practices. Closer examination reveals, however, that prior studies documenting the harms of harsh forms of parenting reveal primarily cross-sectional associations (e.g., Brody and Ge

2001; Buckholdt et al. 2014), which may also indicate child effects, as revealed in Moilanen et al. (2015). In other words, dysregulated teens may elicit relatively elevated levels of parental antagonism in parent-child interactions, but such antagonism ultimately has little direct long-term impact on teens' subsequent regulatory growth. Thus, in keeping with Tiberio et al.'s (2016) interpretations of their own null effects, perhaps by adolescence, variations in harsh parenting practices do little to shift individual differences in regulatory abilities (Kiff et al. 2011). At the same time, however, these null effects may be due to limited variance, as few families displayed high levels of antagonism or acrimony in the observed discussion tasks.

Parent-child connectedness

We also anticipated that high levels of parent-child connectedness would be associated with high levels of self-regulation. In keeping with predictions, across relationships and dimensions of regulation, high levels of parent-child relationship quality were reliably linked to high levels of self-regulation. Thus, the present findings confirm prior studies of maternal parenting (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010), and extend the current literature in demonstrating the potential importance of close mother- and father-child relationships for adolescents' short- and long-term self-regulation. Yet these effects were also consistently mitigated to non-significance when prior regulation and interaction terms were added to the models; in other words, contradicting those same studies (Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010), parent-child relationship quality was not associated with rank-order change in self-regulation. As discussed above in reference to antagonistic parenting, it remains possible that contemporaneous relationship qualities covary with youth's regulatory skills, but that by adolescence, parent-child relations may be shaped by teens' regulation but have limited impact on subsequent regulatory growth (Eisenberg et al. 2008).

Prior Self-Regulation as a Moderator

Although not the first investigation to explore prior levels of self-regulation as a moderator of parenting and parent-child relationship effects, the present study is the first known effort to understand such associations using discrete regulatory subscales. Four significant and one trend-level interaction emerged. All of these were restricted to the maternal and paternal cognitive regulation and perseverance models, which is noteworthy given assertions that such long-term regulatory elements develop later than short-term emotional and behavioral control (Gestsdottir and Lerner 2008). As in previous studies, the current inquiry did not support the notion of differential susceptibility amongst adolescents who struggle with regulation (Slagt et al. 2016). Consistent with Moilanen and Rambo-Hernandez's (2017) analysis with a composite self-regulation index, youth with high initial levels of cognitive regulation were somewhat more sensitive to high maternal and paternal antagonism than were their less-regulated peers. Simultaneously, at trend-level significance, high maternal support was beneficial for those with low initial levels of cognitive regulation. Yet for mother-child connectedness and paternal support, a similar pattern was present for those with high initial levels of perseverance. The following explanations are speculative, as current theoretical models provide little guidance on how these process may function in the context of cognitive regulation and perseverance.

In the models for cognitive regulation, for adolescents who are already highly regulated, parental antagonism may produce emotional dysregulation that actively undermines planning efforts. In contrast, for teens who find planning difficult, parental criticism or control appears to be beneficial, perhaps by motivating adolescents to use forethought and to prepare for eventualities. For this latter type of youth, such associations are in keeping with long-standing notions that parental control efforts assist adolescents in modulating their behaviors in socially-sanctioned ways (Maccoby and Martin 1983). The same line of argument may apply for the trend-level interaction between maternal regulatory support and prior cognitive regulation: for teens who struggle to plan ahead, high maternal support may make potential failures seem less threatening, which may facilitate growth in this area (Sideridis and Kafetsios 2008). In contrast, those who are already well-regulated may not require additional maternal support in order to continue to function highly in this sphere of life.

The storyline changes somewhat in the models for perseverance. In the maternal model, high mother-child connectedness was particularly beneficial for youth with high initial levels. In the paternal model, high regulatory support was similarly beneficial for those at high initial levels, whereas it was somewhat harmful for those at low levels. The discrepancies between the models for cognitive regulation and perseverance may stem from the degree to which each capacity is developed by early to middle adolescence. Successful persistence requires the coordination of multiple regulatory capacities which may not be fully mature until adulthood (Nigg 2017), involving the inhibition of counterproductive behaviors, modulation of emotions and planning for contingencies. Thus, with "more room to grow" in individual capacities for perseverance, teens who are already advantaged in terms of prior perseverance appear to experience comparatively rapid development when they experience supportive family contexts.

Control Variables

We also hypothesized that high levels of self-regulation would be associated with female sex, older age in years, and high SES, while controlling for children's race/ethnicity. A subset of these predictions were supported, albeit inconsistently across the models. Although girls were favored in behavioral and cognitive regulation and perseverance, contradicting expectations, boys had higher levels of emotional regulation. Although consistent with findings from a meta-analysis on emotional expression (Chaplin and Aldao 2013), this association may be an artefact of the selected measure, which considers only the perceived control of negative emotions. The sexes did not vary in terms of speed of change in regulation, and thus these nuanced findings suggest that girls' advantages may not be as pronounced as assumed (Bowers et al. 2011; Moilanen et al. 2015). Few age effects emerged, and these were primarily restricted to maternal models; consistent with hypotheses, older teens evidenced greater rank-order growth in emotion and cognitive regulation than did younger teens. Family income had limited impact, restricted only to higher levels of behavioral regulation in the maternal model and to rank-order improvements in the paternal behavioral regulation model (in line with Farley and Kim-Spoon 2017). Finally, one association emerged for race/ethnicity in the paternal model for perseverance, specifically that white youth evidenced more rapid rank-order change than their peers from other ethnicities. As this finding contradicts other studies with less homogenous samples (e.g., Moilanen and Rambo-Hernandez 2017; Moilanen et al. 2010), this association requires further scrutiny.

Contributions, Limitations and Future Directions

The current study confirmed different elements of the conceptual model (Morris et al. 2007) than in comparable prior studies. Sample differences are one apparent reason for these discrepant findings. In particular, the Flourishing Families Project sample is at lower levels of socioeconomic risk in comparison to those in Moilanen and Rambo-Hernandez (2017), and stressful life circumstances are a known correlate of change in self-regulation during early adolescence (King et al. 2013). Yet, many of the correlations between the self-regulation, parenting and relationship quality variables were actually stronger in the Flourishing Families Project sample than they were in Moilanen et al.'s (2010) sample of at-risk boys and in Moilanen and Rambo-Hernandez's (2017) Children of the National Longitudinal Survey of Youth-1979 participants. A second possibility concerns subtle variations in measurement strategies; direct comparisons of this study to any others are not possible due to the considerable variability in selected measures. The present inquiry was considerably strengthened by the inclusion of nuanced observational parenting measures and multiple reports of self-regulation. Many prior studies have relied exclusively on adolescents' survey reports, which may conflate adolescents' perceptions of parenting behaviors with their subjective evaluations of parent-child relationship qualities (an issue discussed further by King et al. 2013, and Moilanen et al. 2010). Relatedly, to our knowledge this is the first inquiry to date to explore rank-order change in cognitive regulation and perseverance in early to middle adolescence, though prior studies have examined emotional, behavioral and composite indices of self-regulation in such a framework. Concerning the high stability observed in these models, the truncated self-regulation questionnaires adopted for the Flourishing Families Project may be insufficiently sensitive for detecting subtle changes that occur during early to middle adolescence. We were unable to rule out the possibility that such stability is attributable to enduring temperamental characteristics; scholars are advised to consider this issue in future investigations. Further, the self-regulation questionnaires were limited in that they lack explicit references to durations of time, a shortcoming that is by no means unique to these measures or to the present study (Muenks et al. 2017). As is the case in other inquiries, items assessing behavioral and emotional regulation imply control in the immediate moment, while items about cognitive regulation and perseverance refer to planning and working toward future goals. Thus, the measures used in the present study do not fully reflect the full range of either momentary, short-term or intentional, long-term regulatory abilities (Gestsdottir and Lerner 2008; Moilanen and DeLong 2017). Notwithstanding, it remains necessary to validate these findings using comparatively detailed measures of self-regulation, while paying careful attention to potential moderation by sample characteristics, including socioeconomic and contextual risk.

The present study was limited in that we were unable to test the full theoretical model (Morris et al. 2007), including its bidirectional pathways. The Flourishing Families Project was not designed specifically as a study of the development of self-regulation, and no measures were included of youth's observational learning of regulatory strategies in the family context, of the hypothesized mechanisms linking parenting and parent-child relationship qualities to regulatory outcomes (e.g., affect), or of noteworthy parental and adolescent individual characteristics (e.g., parental regulatory abilities and adolescent temperament). It is vital to include these constructs in future studies to facilitate understanding of how these influences operate concurrently during adolescence. Concerning bidirectional effects, Morris et al. (2007) describe how parenting, parent-child relationship quality, and adolescents' self-regulation change in concert, with shifts in one area impacting developments in another. This notion was supported in a prior study with

these data, which suggested that teens' self-regulation played a vital role in shaping adolescents' perceived maternal and paternal parenting practices (Moilanen et al. 2015). Excepting mother-child conflict (Eisenberg et al. 2008), surprisingly little is known how parenting and parent-child relationship qualities shape one another, and if any of these transactional effects have consequences for adolescents' subsequent self-regulatory development. Likewise, it is also uncertain whether parents' perceptions of children's self-regulation are colored by the qualities of the parent-child relationship. Thus, further consideration of bidirectional effects and potential mechanisms involving reports from multiple informants is necessary in order to fully understand how to promote strong parenting, strong parent-child relationships, and optimal self-regulatory growth through evidence-based familial interventions.

Conclusions

This study provides confirmatory evidence that these dimensions of self-regulation are stable over one year in early to middle adolescence. The short-term elements of emotion and behavior regulation were more highly stable than the long-term elements of perseverance and cognitive regulation, which likely reflects the degree to which each of these aspects are developed by middle adolescence. Although the findings for parenting practices were underwhelming, these null effects cast further doubt on the notion that parenting behaviors continue to support the ongoing development of emotion and behavior regulation during early to middle adolescence as in earlier developmental stages (Moilanen et al. 2010; Tibertio et al. 2016). By this point in development, individuals should by highly capable of autonomously controlling their feelings and actions without external support. This was suggested in the present analyses, as the sole predictor of behavioral regulation was prior behavioral regulation, and only a small portion of the variance in rank-order change in emotion regulation was explained by maternal regulatory support. Thus, for regulation of emotions and behaviors in short-term contexts, parenting and parent-child relationship qualities appear to do little to facilitate further developments over one year (Kiff et al. 2011). The clear implication is that family-based intervention efforts targeting short-term aspects of regulation are likely to be of limited efficacy and thus should be implemented prior to this period. In contrast, long-term components are still developing during adolescence, and thus there is somewhat greater potential for familial environmental impacts on rank-order changes. The current inquiry provided novel evidence of small conditional effects of maternal and paternal parenting and parent-child closeness on rank-order change in cognitive regulation and perseverance. Thus, overall, this research provides some support for the tripartite model during adolescence (Morris et al. 2007), particularly of the proposition about how youth's individual characteristics moderate the effects of the familial environment on their subsequent changes in long-term regulatory abilities.

Acknowledgements We recognize the generous support of the many private donors who provided support for this project. We also thank those families who were willing to spend valuable hours with the team in interviews, the many students who assisted in conducting the interviews, and Mike Brown for assisting with the preparation of this manuscript. We thank the Family Studies Center at BYU, the School of Family Life, and the College of Family Home and Social Science at BYU, and we recognize the generous support of the many private donors who provided support for this project. We also thank those families who were willing to spend valuable hours with our team in interviews, the many students who assisted in conducting the interviews, and Mike Brown for assisting with the preparation of this manuscript.

Authors' Contributions K.L.M. conceived of the study, performed the statistical analyses, and drafted the manuscript. L.P.W. participated in the interpretation of the data and helped to draft the manuscript. D.R. B. assisted with manuscript preparation. All authors read and approved the final manuscript.

Funding Data collection for this study was funded by grants to individual investigators and to the collective project at Brigham Young University (BYU; Principal Investigator: Randal D. Day). Donors and funding agencies include the following: School of Family Life Endowment (BYU), Family Studies Center Endowment (BYU), Marjorie Pay Hinckley Endowed Chair (BYU), Mary Lou Fulton Endowed Chair in the Social Sciences (BYU), Mentoring Environment Grant (BYU), LB and LW Smith and Family Foundation, Kreutzkamp Family Foundation, Brent and Cheri Andrus Family Trust, and James W. and Carolyn O. Ritchie Supporting Organization.

Data Sharing Declaration This manuscript's data will not be deposited.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval The Brigham Young University Institutional Review Board (IRB) approved the Flourishing Families Project. The Flourishing Families Project involved human participants who provided informed consent in accordance with the procedures established with the institutional ethics committee. This current study was a secondary data analysis using the Flourishing Families Project data. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. APA ethical standards were followed in this study's conduction.

Informed Consent Informed consent or assent was obtained from all individual participants included in the study at each study wave. All parents acknowledged granting their informed consent for their own voluntary participation and their child's participation in writing; minor children provided assent to participation in writing.

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