ADRENARCHE DURING THE GREAT RECESSION AS AN ENVIRONMENTAL CHALLENGE TO PSYCHOSOCIAL DEVELOPMENT: AN EVOLUTIONARY-DEVELOPMENTAL PERSPECTIVE

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ABSTRACT

Chelsea G. Nehler: Adrenarche During the Great Recession as an Environmental Challenge to Psychosocial Development: An Evolutionary-Developmental Perspective
(Under the direction of Jean-Louis Gariépy)

Adrenarche is an important developmental period to consider in relation to both physical and psychosocial outcomes. The reorganization of the stress response system during adrenarche, understood as physiological adjustment to environments that may vary from safe and supportive to unsafe and unsupportive, not only results in specific physiological patterns of response to stress, but also leads to specific social, sexual, emotional, and parenting behavioral profiles. In this dissertation, I elaborated on the connections between adverse developmental contexts and the development of behavior problems in children and adolescents using the Adaptive Calibration Model of Stress Responsivity. I used the Great Recession of 2007-2009 as a natural window to examine how changes in economic circumstances—the introduction of economic adversity—can affect the life course, especially when experienced during adrenarche. I hypothesized that declining wealth in general and during adrenarche would not only predict behavior problems in adolescence, but it would also affect menarche and physical development, such that sexual maturation would be a mediator of wealth and psychosocial adjustment. To test these hypotheses, I used nationally representative panel data from the Panel Study of IncomeDynamics and child-level information from the Child Development Supplement of the PSID. The final sample included 767 adolescents and their households. When compared with persistently low levels of wealth, declines in household wealth in a "middle class" were associated with behavioral problems among children who experienced the stressor during

adrenarche, and with earlier pubertal timing among children who experienced the stressor in later childhood. The results' implications are discussed both in terms of their practical application to child welfare, their contribution to evolutionary-developmental theory, and their insights regarding wealth inequality in the United States.

To my family: the family I lost, the family I always had,
and the family I found along the way.

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CHAPTER 1: INTRODUCTION

"…children and adolescents have evolved to function competently—to navigate the kinds of challenges and opportunities in their environment that recurrently influenced the fitness of their ancestors—across a variety of contexts" (Belsky, Schlomer, & Ellis, 2012).

Adrenarche is an important developmental period to consider in relation to both physical and psychosocial outcomes. Researchers in developmental science sometimes view middle childhood as a stable or waning period of development in contrast to the dynamic periods of infancy or puberty (Byrne et al., 2017). Development does slow with respect to some domains, but adrenarche, which occurs between the ages of 5 and 10, is a critical period in the reorganization of the stress response system (Campbell, 2006). As with other critical periods, during adrenarche the developmental context has implications for children's bodies and their subsequent behaviors during adolescence and, perhaps, for the rest of their lives.

In this dissertation, I elaborate on the connections between adverse developmental contexts and the development of behavior problems in children and adolescents. The sensitivity of this developmental period to environmental cues is not coincidental, as the dynamic processes occurring in middle childhood lay the groundwork for the individual's social and reproductive future. The evolutionary-developmental theory of the Adaptive Calibration Model of Stress Responsivity (ACM) makes specific predictions regarding how adversity during adrenarche induces adaptive reorganization of the hypothalamic-pituitary-adrenal (HPA) axis and the

sympathetic and parasympathetic nervous systems (Del Giudice, Ellis, & Shirtcliff, 2011). The reorganization of the stress response system during adrenarche, understood as physiological adjustment to environments that may vary from safe and supportive to unsafe and unsupportive, not only results in specific physiological patterns of response to stress, but also leads to specific social, sexual, emotional, and parenting behavioral profiles (Del Giudice et al., 2011). My research specifically focuses on the behavior profiles that are associated with the physiological patterns predicted by the ACM theory.

Internalizing and externalizing behavior problems among young adolescents might emerge because of stressful experiences that occur during adrenarche (Dorn, Hitt & Rotenstein, 1999; Sontag-Padilla et al., 2012). A context such as economic strain poses many challenges to children's development, in part due to the implications of economic duress for parents' ability to provide secure and nurturing environments (Conger et al., 1992; Gordon-Simons et al., 2016). As proximal actors, parents have a great deal of influence on their children's social behavior, but it is also important to understand other mechanisms through which distal factors like the global economy might operate on children's social development. These mechanisms include, but are not limited to, altering the organization of the stress response system and accelerating or slowing the timing and tempo of sexual maturation. Thus, both the developmental period when economic strain is experienced and the degree of hardship it imposes on families may be important factors contributing to the differential development and intractability of adolescent behavior problems.

I review several bodies of literature in the following sections in which I propose a number of hypotheses linking adrenarche, economic hardship, and psychosocial adjustment in young adolescents. I begin with parents' strategies for reproducing and raising their offspring because these are sensitive to changes in the environment and directly influence children's

development. Parenting factors are implicated by the consideration of evolutionary forces, so discussion of these factors is necessary throughout; indeed, parents are parenting in the same context as their children are developing, so they are inseparable from one another. I continue with an explanation of how economic adversity differentially affects the physical and psychosocial developmental trajectories of children depending upon their age and sex, and how the two trajectories are related. Finally, I propose using the Great Recession of 2007-2009 as a natural window to examine how changes in economic circumstances—the introduction of economic adversity—can affect the life course, especially when experienced during adrenarche.

Theoretical Perspectives on Behavior Problems

Internalizing and externalizing behavior problems among disadvantaged children and adolescents have been studied extensively, especially with reference to proximal antecedents. In several studies, parenting factors mediated or moderated the relation between low socioeconomic status (SES) and behavior problems (Conger & Donnellan, 2007; Gordon Simons et al., 2016). Heightened family dysfunction and household chaos, and less parental warmth and monitoring, for example, are associated with poor behavioral outcomes among low-SES children (Diener, Nievar, & Wright, 2003; Mills-Koonce et al., 2016).

Several theories have been proposed to explain how economic strain affects families and the psychosocial wellbeing of children. I focus here on three: the social selection perspective, the social causation perspective, and the interactionist perspective. Originally, the theory of social selection emerged to explain the downward socioeconomic drift of adults with mental illness; in this framework, poverty disproportionately affects individuals with mental illness because their conditions are incompatible with socioeconomic stability (Bradley & Corwyn, 2002). This theory was also used to explain the behaviors of poor children, which strongly resembles the

meritocratic "culture of poverty" model: poor children and their parents are poor and remain poor because of their behaviors and values (see Lewis, 1969). If behavior problems are more common among low-SES children, the social selection perspective explains that those children and their families have self-selected into economic insufficiency through the expression of those behaviors. Evidence has not tended to support this theory and scholars who work in this area do not tend to use it (Dohrenwend et al., 1992).

Conversely, the social causation theory emphasizes the role of the environment. It posits that the behaviors of both parents and their children arise in response to a stressful environment. As opposed to focusing on the impact that individual behavior has on the environment, social causation contends that so-called "problem behaviors" are socially caused adaptations that follow, rather than precede, economic adversity (Dohrenwend et al., 1992). This perspective has been supported in the literature (e.g. Costello, Compton, Keeler, & Angold, 2003; Gennetian & Miller, 2002). I will elaborate on some of those findings in the following sections.

Finally, the interactionist perspective combines the social selection and social causation theories (Schofield et al., 2011). This combination leaves room for evolutionary-developmental principles. The interactionist theory presupposes that grandparents and parents have acquired and transmitted to their offspring adaptive behavioral traits (through socialization or heritability) that allowed them to survive (or thrive) in their environment. It may be those same traits that now prevent the offspring's socioeconomic mobility and limit their adaptive functioning in their particular context. According to evolutionary-developmental theory, aggressive personality traits, for example, can be adaptive phenotypes that support individuals in surviving their environments, establishing themselves within a social hierarchy, and seeking out mates. Researchers have tested the interactionist model looking at socially aggressive personality traits

transmitted through generations and the success of the youngest generation in transitioning into adult roles (e.g. Conger, Martin, Masarek, Widaman, & Connellan, 2015). Adolescents who inherit aggressive personality traits are more likely to be aggressive adults and hostile toward their partners, are more likely to have hostile partners themselves, and are less likely to be economically successful adults (Conger et al., 2015). Intergenerational transmission of traits that were shaped by adverse environments (socially caused) affect the individual's own socioeconomic mobility (socially selected) (Schofield et al., 2011). If children enduring adverse economic conditions display what appear to be behavior problems, the interactionist theory would support the assertion that generations of ancestral adaptations to hardship have led up to that point (Belsky et al., 2012; Schofield et al., 2011).

Economic Adversity and Developmental Outcomes

The Great Smoky Mountain study (Costello et al., 2003) and the experimental Minnesota Family Investment Program (Gennetian & Miller, 2002) both provide evidence for the social causation perspective, and they demonstrate the direct role of adversity in children's development. In a longitudinal study capturing a fortuitous natural experiment, Costello et al. (2003) demonstrated that increasing families' monetary income—and the community's economy (Bullock & Bradley, 2010)—partially relieved behavioral and emotional psychiatric symptoms among youth whose families were elevated out of poverty. Most importantly, this association was fully mediated by only one parenting variable: parental supervision (Costello et al., 2003). The reasons that the authors identified for improved parental supervision among formerly poor families were reductions in numbers of single-parent households, reductions in the number of households with two full-time workers, and reductions in overall time demands on the parents (Costello et al., 2003). Gennetian and Miller (2002) drew similar conclusions, although they did

not test for mediation. Unlike other studies that have highlighted personal characteristics of parents such as warmth, sensitivity, or hostility, these results from the Great Smoky Mountain Study point out a parenting stressor that is driven by the socioeconomic context; the lack of time to supervise is a consequence of living and parenting in an adverse environment that may be relieved when the environment is changed for the better.

The aforementioned studies examined the beneficial influences of microsystemic changes on children's lives: the increase of family income. Conversely, when the environment is changed for the worse, the social causation theory predicts declines in behavioral and mental health. Glen Elder was among the first to examine the harmful effects of macrosystemic disruptions, most notably The Great Depression (e.g. Elder, 1974; Elder, 1981; Elder, Nguyen, & Caspi, 1985; Elder, 1998). Using data collected from 167 children born between 1920 and 1921 and their families, Elder studied the developmental trajectories of children who were transitioning from middle childhood to early adolescence during the Great Depression. He also evaluated the extent of the economic deprivation children experienced as a function of their family's income losses during the Depression, characterizing them as either "deprived" or "nondeprived" (Elder et al., 1985). Elder (1974) found mediating roles of multiple parenting factors that affected children's life courses into adulthood related to the family's deprivation status. He and his collaborators have made similar observations in numerous studies using this and other hardship samples (e.g. Conger et al., 1992; Conger, Conger, Matthews, & Elder, 1999; Conger, Ge, Elder, Lorenz, & Simons, 1994). The economic contexts under investigation by Elder and his collaborators at various points in U.S. history were characterized by scarcity and uncertainty. Ellis, Figueredo, Brumbach, and Schlomer (2009) and Belsky et al. (2012) would argue that these contexts may explain parental disinvestment in children's development.

The research reviewed here found salient differences in the extent to which the environment impacted development by the age, gender, and initial social class of the child. For example, Gennetian and Miller (2002) observed that the beneficial behavioral effect of the income increase was stronger in children who were between the ages of 6 and 9 at the beginning of the intervention, and the effect was stronger for girls than boys. The children of the Great Depression under investigation by Elder (1974) were all around the ages of 8 or 9 years old at the onset of the Depression in 1929. Elder (1981) documented significant life course differences between this cohort and an older cohort who endured the Depression during their adolescence. In many studies Elder and his collaborators noted differences in life course outcomes between boys and girls (Elder et al., 1985; Elder, 1981; Conger, Conger, Matthew, & Elder, 1999), differences among children of various ages at the time of adverse events (Elder, 1981; Elder, 1998), and differences by initial social class (Elder, 1981). Finally, Costello et al. (2003) reported that the psychiatric benefits of income increases were only significant among families who were poor prior to the increase and were lifted out of poverty, but not among those who were never poor, nor among those who remained poor.

In the current study, I will explore how changes in families' wealth, in concert with their initial wealth and children's sex, race, and age, impact children's psychosocial well-being in adolescence. Both the social causation and interactionist perspectives predict significant negative effects of economic strain on children's development, but they cannot provide a sufficient proximal explanation for those associations. Instead, the Adaptive Calibration Model of stress reactivity provides insight into the specific circumstances under which certain phenotypes arise and the mechanisms through which they do so. I next elaborate on the model's premises and its application to the current study.

Environment and Evolution

Ellis et al.'s (2009) elaboration on the fundamental dimensions of environmental risk provides insight into the sources of developmental variation in life outcomes, in particular psychosocial wellbeing. Harsh and unpredictable environments exert evolutionary and developmental pressures on caregivers and their offspring that ensure the continuation of the species. Ellis et al. (2009) argue that harsh and unpredictable conditions differentially impact human beings' reproductive strategies in a context-dependent manner. In the framework used by Ellis et al. (2009) and other theorists, these reproductive strategies are better represented by the term "life history strategies." Life history strategies "are coordinate suites of morphological, physiological, and behavioral traits that determine how organisms allocate resources to key biological activities" including both reproduction and parenting behaviors (Belsky et al., 2012; Del Giudice, 2014, p. 197; see also West-Eberhard, 2005 who introduced the concept). From this perspective, exposure to environmental cues of harshness or unpredictability affect, at a critical developmental switch point, the calibration of the stress response system, physical development, and social and sexual behaviors, with direct effects on life histories and their associated adaptive strategies (Belsky, Ruttle, Boyce, Armstrong, & Essex, 2015; Ellis & Essex, 2007; West-Eberhard, 2003).

Harsh and unpredictable environments may hinder reproductive success through high rates of morbidity or mortality. In such environments, individuals do not know at any moment how harsh conditions might be in the near future. In the literature on child development in developed nations, harshness has been operationalized as small income-to-needs ratio, low SES, poor neighborhood quality, exposure to violence, and maternal and paternal disinvestment or hostility (e.g. Belsky et al., 2012; Ellis & Essex, 2007; Ellis et al., 2009). Unpredictability has

been operationalized as residential changes, mother's male partner transitions, caregiver employment instability, and food insecurity (Belsky et al., 2012).

In societies where competition for scarce resources is high and social support is limited, Ellis et al. (2009) predict that individuals will employ a "fast" life history strategy in which they reach physical maturation and reproduce earlier. Individuals on a fast life history trajectory optimize their reproductive fitness by producing numerous offspring and limiting parental investment in those offspring. Developing nurturing skills and resources and actually nurturing offspring reduces the time available to seek out mates and continue to reproduce. Where there is less competition for scarce resources, or more social support amidst scarcity, individuals are expected to employ a "slow" life history strategy in which physical maturation and reproduction are delayed. Thus, a slow life history strategy is expected of individuals developing in relatively comfortable and predictable environments (Ellis et al., 2009). These parents do not encounter the cost pressures of parenting that individuals on a fast strategy experience, so they are able to develop the skills and acquire the resources necessary to optimally nurture their offspring. The connections among the environment, life history strategies, and psychosocial wellbeing are explained in the next sections.

The Adaptive Calibration Model

The Adaptive Calibration Model of stress responsivity (ACM) is an evolutionary-developmental theory that accounts for individual differences in physical and behavioral patterns of adjustment to the environment. While not diminishing the role of family-level factors, the ACM (Del Giudice et al., 2011) treats psychosocial outcomes and their antecedents as adaptations to two basic dimensions of environmental stress: harsh and unpredictable conditions in the family's immediate and broader ecologies versus support and stability in those ecologies

(Ellis et al., 2009). Del Giudice et al. (2011) propose that behavioral phenotypes traditionally viewed as maladaptive are sometimes natural sequelae arising from the interaction of biological imperatives with harsh and unpredictable environments. When facing such contexts, children modulate their physical and psychosocial development in ways that optimize their reproductive success. These authors do not minimize the harm psychosocial maladjustment can do to children and adolescents' social and emotional well-being; rather, they provide an evolutionary explanation that allows for a different heuristic for research and applied practice (Frankenhuis & Del Giudice, 2012).

Following an intensive review of the literature, Del Giudice et al. (2011) propose four "prototypical" patterns of responsivity to physical and psychosocial stressors: sensitive, buffered, vigilant, and unemotional. The authors define these patterns as resulting from a fine-tuning of activity among the hypothalamic-pituitary-adrenal axis and the sympathetic and parasympathetic nervous systems following exposure to one's specific environment. Because physiological systems encode cues regarding the environment and the challenges it poses, specific observable patterns of social, emotional, and sexual behaviors are also predicted to be uniquely associated with the ACM physiological typology. In the current study, I use the Behavior Problems Index (BPI; Achenbach & Edelbrock, 1981; Del Giudice et al., 2011, p. 1576; Peterson & Zill, 1986) to approximate the behavioral profiles described by Del Giudice, as his profiles map well onto the externalizing and internalizing subscales of the BPI. The externalizing behaviors subscale measures aggressive behaviors such as impulsivity, antisocial behaviors like cheating or lying, and mood swings. The internalizing behaviors subscale measures withdrawn or depressive behaviors such as poor peer relations, worry, and paranoia. These two subscales, in their extremes, describe behaviors of individuals engaged on a fast life history and likely to express

the vigilant phenotype proposed by the ACM described later.

According to Del Giudice et al. (2011), a sensitive pattern emerges in children from protected and safe environments and is correspondingly associated with greater positivity, lower risk-taking, and delayed fertility. The behavioral profile of the buffered pattern is similar to that of the sensitive pattern, but it is thought to emerge from moderate levels of environmental stress. Individuals in these two profiles would score relatively low on both subscales of the BPI, but the sensitive pattern might show slightly more incidences of mood swings or irritability because sensitive children are more labile in their responses to stress, whereas buffered children are less plastic and react more consistently (Del Giudice et al., 2011).

The vigilant pattern develops in dangerous or threatening environmental contexts. This pattern has a complex behavioral profile that is dependent on both sex and age (Del Giudice et al., 2011). In general, the vigilant pattern is associated with greater risk taking, impulsivity, irritability, and earlier sexual onset (Del Giudice et al., 2011). Vigilant-withdrawn behaviors are expected of females, and vigilant-agonistic behaviors are expected of males (Del Giudice et al., 2011). Higher scores on the internalizing and externalizing subscales respectively would be expected for these profiles. Finally, the unemotional pattern is associated with earlier sexual maturation, and some callous-unemotional traits like a lack of empathy or guilt, and aggressive behaviors (Del Giudice et al., 2011). Additionally, the unemotional pattern is believed to be more prevalent in males than females (Del Giudice et al., 2011). At this time, it is unclear how this profile would map onto the BPI dimensions. In self report, parents may perceive children with these traits as more withdrawn, but also more manipulative. The vigilant and unemotional patterns especially might emerge under chronic and severe stress occurring during the

developmental periods known as adrenarche and adolescence, and may do so in a sex-specific way (Del Giudice et al., 2011).

Adrenarche and Puberty

The ACM offers a developmental perspective proposing that there are specific periods during which children are more susceptible to both harmful and beneficial environmental inputs. Times of developmental reorganization called switch points, akin to sensitive periods, are when children are most susceptible to this modulation (Del Giudice, 2014). At these switch points, characteristics of the environment gain new salience as contributors to the development of life history strategies in particular (i.e., placing children on tracks that will eventually lead to either a rapid strategy with early sexual development, activity, and reproduction, or a slow strategy with later sexual development). Evolutionary-developmental theory states that switch points in development enable children to adapt physiologically and socially to changing conditions in their environment (West-Eberhard, 2003). This is a for-better-and-for-worse adaptation, for it enables children to both weather scarcity and capitalize on abundance (Belsky & Pluess, 2009; Ellis & Del Giudice, 2014). The onset of adrenarche is one such period of reorganization preceding puberty, which Del Giudice et al. (2011) point to as crucial to understanding the behavioral phenotypes associated with children who grow up in adverse environments.

Adrenarche is posited as a switch point in the physical and emotional development of human children that occurs during the transition to middle childhood, between 6 and 9 years of age (Del Giudice, 2014). Although it is considered by some as an early stage of puberty (Campbell, 2006), adrenarche is itself a distinct period of physical and social development. During this period, sexually differentiated brain pathways are activated by secretion of dehydroepiandrosterone (DHEA) from maturing adrenal glands. New sex differences between

boys and girls emerge, and pre-existing differences widen in physical, emotional, and social domains. Importantly, DHEA and other adrenal androgens are thought to extend the brain's plasticity through this period, allowing the child to adapt to changing environmental conditions during this important time of reorganization (Campbell, 2011; Del Giudice, 2014).

Del Giudice has argued extensively (e.g. 2014; Del Giudice et al., 2011; Del Giudice, 2009; Ellis & Del Giudice, 2014) that life history strategies are adopted during the period of adrenarche—if only temporarily until another switch point occurs. If children's environments are threatening or unpredictable throughout early childhood, or acutely during adrenarche, life history theory suggests that children may adopt a fast strategy: early sexual onset, promiscuity, and social aggression. Alternatively, if children's environments are predictable and safe, children may adopt a slow strategy: delayed sexual onset, stable relationships, and prosociality. This slow strategy may also emerge despite environmenta harshness, such as food scarcity, when those and other conditions are stable and social support is high (Del Giudice, 2014; Hochberg & Belsky, 2013).

It stands to reason that environmental cues motivating fast life history strategies during or preceding adrenarche would also accelerate pubertal development in the service of earlier reproductive capacity. However, the relation between adrenarche and pubertal timing is not perfectly clear (Belsky et al., 2015). DHEA, which is abundant during adrenarche and increases through puberty, is thought to be interdependent with cortisol, as the two secretagogues are agonized by the same hormone. Belsky et al. (2015) found that high levels of cortisol in early childhood, due to experiences with maternal depression during infancy, predicted earlier onset of adrenarche as indicated by levels of DHEA. However, pubertal timing did not subsequently mediate the association between adrenarche and adolescent health. Most research studies have

only investigated how the *timing* of adrenarche itself consequently affects pubertal timing (e.g. Belsky et al., 2015; Ellis & Essex, 2007; Byrne et al., 2017), but not how or whether exposure to environmental stressors *during* adrenarche influences pubertal timing, which is addressed in the current study. Notably, Hochberg and Belsky (2013) argue from a life history perspective that attachment styles and internal working models formed *during* adrenarche influence the timing of puberty, with insecure attachments during adrenarche motivating faster life history strategies. Whereas poverty itself does not consistently appear to be a strong predictor of poor attachment (Diener, Nievar, & Wright, 2003), SES does predict maternal psychosocial maladjustment, which is associated with maternal insensitivity, children's socioeconomic status in adulthood, and children's behavioral symptoms (Bouvette-Turcot et al., 2017). It is plausible, then, that adrenarche is a sensitive period of development especially in response to maternal cues regarding the stability and safety of the immediate environment. The adaptations during this period affect pubertal timing, attachment styles, and finally, life history strategies.

Variations in Pubertal Timing

Irrespective of adrenarche, the timing of pubertal onset and its tempo are directly affected by harsh and unpredictable early environments. For example, Arim, Tramonte, Shapka, Dahinten, and Wilms (2011) found in a longitudinal study of 8440 Canadian adolescents that family circumstances such as low paternal education and unemployment are significant predictors of earlier puberty for both boys and girls. In another study of the antecedents of early puberty among 262 girls born between 1959 and 1963, James-Todd, Tehranifar, Rich-Edwards, Titievsky, and Terry (2010) found that girl's SES at the age of 7 was positively associated with age at menarche, and change in SES was also positively related to menarche; a 20-unit decrease in SES was associated with a 4-month decrease in age of menarche. Pubertal development is

jointly influenced by environmental, nutritional, hormonal, and genetic factors, but these factors are not independent of one another. Harsh and unpredictable environments may affect the availability of food, and thus the nutritional status of the developing child (e.g. Kimbro & Denney, 2015; Leete & Bania, 2010; Slopen, Fitzmaurice, Williams, & Gilman, 2010). As discussed previously, those same environments may induce a hormonal stress response that interacts with adrenal or gonadal hormones (Belsky et al., 2015). Likewise, emerging animal research on epigenetic control of puberty has uncovered epigenetic alterations of genomic activity in response to environmental cues (Lomniczi, 2013; Rzeczkowska, Hou, Wilson, & Palmert, 2014). There are many points of contact for the environment to activate an evolutionary machinery that either supports a preference to conceive many offspring, or to reap opportunities for better nurturing fewer offspring.

The case of earlier puberty among Black males and females in the United States demonstrates the role of early environments in shaping physical development. Black males and females tend to enter puberty earlier than non-Hispanic White children (Mensah et al., 2013). There are a few explanations for this difference. First, as described earlier, pubertal timing is positively associated with SES, and Black Americans are at a greater risk than Whites of having a low SES (Proctor, Semega, & Kollar, 2016), and therefore an earlier pubertal start. Second, pubertal timing is strongly influenced by Body Mass Index (BMI) and body fat, and Black American children on average have significantly higher BMIs than White American children (Pratt et al., 2017). Third, pubertal timing is affected by exposures to environmental agents such as synthetic estrogens and lead, to which Black American children are disproportionately exposed (Barr, Wang, & Needham, 2005). There may also be genetic predispositions regulating the onset of puberty within these racial groups, but because puberty is so dependent upon

environmental cues, genetic predispositions are unlikely to be driving the whole effect (Hochberg & Belsky, 2013). Researchers evaluating puberty in any way must keep these differences in mind and make conscientious statistical decisions regarding group differences, which I do in the current study.

Across racial groups and for both sexes, the timing of puberty is associated with various psychosocial outcomes that map on to life history strategies. Hochberg and Belsky (2013) argue that early puberty has been treated inappropriately as a risk factor for aggression and delinquency and not fully appreciated as a fitness optimization strategy in response to environmental challenges. Del Giudice et al. (2011) suggest that males on a fast life history track will behave in a high-externalizing manner in the service of mating and risk-taking; these males are reactive to confrontation, impulsive, and irritable, aiming to establish themselves in their peer group as dominant. This description is also sometimes true of males who enter puberty earlier (Mensah et al., 2013). Females on a fast life history track are expected to behave in a high-internalizing manner in the service of tending-and-befriending others to seek protection from external threats in the environment; fast life history females are expected to be more withdrawn, anxious, and irritable while also seeking out sexual partnerships (Del Giudice, 2011). These characteristics are sometimes also found among females who enter puberty earlier (Galvao et al., 2015; James et al., 2012). In the current study, I analyze how antecedents of and problems of psychosocial adjustment differ between boys and girls. These environment, race, and sex differences in adrenarche and pubertal timing are further studied with regard to contextual change during the Great Recession, a societal economic disruption that led to harsh and unpredictable contexts for many families in the first decade of the 21st century.

The Great Recession

The Great Recession in the United States during the early 2000s presents an opportunity to evaluate how sudden and dramatic changes in children's households' economic circumstances interact with their development in the framework of the Adaptive Calibration Model. The Great Recession of December 2007 - June 2009 was the most severe and longest-lasting economic downturn in the United States since the Great Depression. The Recession was precipitated by the collapse of the U.S. housing market, and waves of foreclosures ensued as home values plummeted. The resulting loss of wealth contributed to shrinking the nation's gross domestic product by 5% (Bureau of Labor Statistics, 2012) as the unemployment rate increased from 4.7% to a peak of 10% in the autumn following the Recession (BLS, 2012). In the years during and following the Recession, 7.4 million workers lost their jobs (Kochhar, 2011), and nearly 10 million homes were foreclosed upon (Hall, Crowder, & Spring, 2015) while millions more experienced mortgage distress (Anonymous, n.d.). Enrollment in all public safety net programs increased. During the five-year period capturing the Recession and its recovery, the Supplemental Nutrition Assistance Program (SNAP) caseloads increased 76% to 46 million individuals, and nearly half of enrollees were children (Popkin, Scott, & Galvez, 2016). If employment, homeownership, and safety net usage are barometers of economic well-being in a country, all indications suggest that this was a calamitous period for families across the socioeconomic spectrum.

Whereas recession is a predictable stage of the business cycle, and there have been 10 recessions since 1948 (BLS, 2012), growing inequality between the wealthy and poor exacerbates the consequences of these periodic downturns (McCall, 2013; Pfeffer, Danziger, & Schoeni, 2013). In the United States, 15 million children, 20% of all U.S. children, live below

the official federal poverty level. Their families reap few benefits when the economy is strong, and suffer disproportionately when it declines. Across the country, households lost between 17% and 91% of their wealth during the Great Recession (Rauscher & Elliot, 2016; Friedline, Nam, & Loke, 2014). Households headed by racial and ethnic minorities, women, and singles saw the greatest losses as a proportion of their existing wealth (Friedline et al., 2014; Pfeffer et al., 2013).

During economic downturns such as the Great Recession, families already living in poverty are more vulnerable to shocks to their income, employment status, food security, and housing (e.g. Leete & Bania, 2010; Chen, Miller, Yu, & Brody, 2016); readers will recall that these indicators are harshness and unpredictability operationalized. For many families and children, this period was just that—harsh and unpredictable. Schneider, Waldfogel, and Brooks-Gunn (2015) found significant increases in internalizing and externalizing behaviors, alcohol and drug use, and vandalism among 9-year-old sons of single-parents due uniquely to parents' uncertainty about the national economy; these increases were only partially explained by parenting factors.

Numerous other studies have been published in the last three years on the effects of the Great Recession on children, families, and adults. Overall, losses in housing wealth alone accounted for significant increases in psychological distress and maladaptive changes in health behaviors among adult homeowners (Yilmazer, Babiarz, & Liu, 2015). Among African American youth, sustained downward mobility during the Recession was associated with epigenetic aging, increased allostatic load, and poor self-reported health (Chen et al., 2016). In a systematic review of literature on the health effects of foreclosures on adults, which included several studies published following the Great Recession, Downing (2016) found that experiencing foreclosure personally or living near foreclosures was associated with poor

psychological well-being and more antisocial behaviors including child abuse (Wood et al., 2012; as cited in Downing, 2016). Finally, Amin et al. (2011) found that fathers' unemployment status was a significant predictor of early puberty for girls, and low paternal education was a predictor of early puberty for boys. Taken together, these studies demonstrate that the Great Recession was a time of uncommon environmental challenge that affected many families and children on social, emotional, and biological levels. Less than a decade after the Recession officially ended, it remains to be seen whether there have been lasting effects on children who lived through it.

The Current Study

The current study builds upon the extant literature by elucidating the connections among early life stress, developmental switch points, puberty, and adolescent psychosocial wellbeing from the perspective of the Adaptive Calibration Model. Using nationally representative longitudinal panel data, I model how the long-term stability or instability of household wealth affected children's physical development and their subsequent psychosocial wellbeing in adolescence.

The proposed study has five primary purposes. The first is to characterize the changes in household net wealth in this sample during the decade containing the Great Recession. The second is to investigate the long-term impacts on adolescent psychosocial functioning associated with changes in households' net wealth during macroeconomic downturn. The third is to explore whether pubertal timing plays a mediating role in the association between economic strain during childhood and behavior problems in adolescence. The fourth and fifth are to understand the circumstances under which these relationships may vary: whether children were in adrenarche or older during the event and whether they are male or female.

Hypotheses

1. **Wealth Changes**: I predict that a three class solution will best characterize the patterns of net wealth changes in the data. The first will be a high-income and stable group, the second will be a middle-income and declining group, and the third will be a low-income and declining group.
2. **Wealth and Behavior**: I expect that children in households with declines in wealth during the Recession will exhibit more internalizing and externalizing behaviors as adolescents regardless of age during the event or their sex.
3. **Pubertal Timing**: I expect that pubertal timing will partially mediate the relation between declines in wealth and internalizing and externalizing behaviors, such that earlier puberty will be associated with more behavior problems.
4. **Developmental Timing**: I expect that pubertal timing will partially mediate the relation between changes in wealth and internalizing and externalizing behaviors of adolescents who were in adrenarche during the economic event, and the relation will not be as robust among adolescents who were older at the time.
5. **Girls and Boys:**
    1. I expect that for girls, declines in wealth during adrenarche and earlier puberty will correspond to higher levels of internalizing behavior problems. This relation will be weaker among girls who were older during the economic event.
    2. I expect that for boys, declines in wealth during adrenarche and earlier puberty will correspond to higher levels of externalizing behavior problems. This relation will be weaker among girls who were older during the economic event.

CHAPTER 2: METHODS

Dataset

The Panel Study of Income Dynamics (PSID) is the longest-running national survey of families in the United States. Its objective was initially to track income and poverty dynamics during the War on Poverty. The PSID began collecting data in 1968 from a nationally representative sample of 3000 households (response rate = 76%) as well as an additional low-income sample of 2000 households from the Survey of Economic Opportunity. Both samples are probability samples, but their combination resulted in an unequal probability distribution that is addressed using sample weights for census region, head of household race/ethnicity, sex, and age, and the family's total income. PSID interviewed these families annually until 1996 and biennially thereafter. PSID followed successive generations of PSID families as they split off and started their own households. The current PSID dataset contains information from 75,000 individuals and up to 6 generations of families. Re-interview and re-contact rates for the current study period range from 89%-95%.

The Child Development Supplement (CDS) is a supplemental study of a subset of families from the core sample of Panel Study of Income Dynamics (PSID) households. The first CDS study occurred from 1997 to 2007 with three data collection waves from a selected cohort of PSID children. A new sample was selected in 2014, and they will be interviewed again in 2019 and 2024. The aim of the second CDS was to collect information from all children residing in all participating PSID households. These participants comprise a sample of children who are descended from original 1968 PSID families, which is nationally representative once sample

weights of the child's race/ethnicity, sex, age, and census region are considered. The CDS data collection included interviews with primary and other caregivers, interviews with children and adolescents, and in some cases interviews with teachers as well as an in-home assessment. The current study only makes use of data collected from primary caregivers and their adolescents.

Participants

Adolescents whose families had participated in the 2013 Core PSID survey and whose birth year was between 1997 and 2013 were eligible for participation in CDS. In total, 5,816 children were deemed eligible by PSID primary investigators, and 4,333 children residing in over 2,500 households comprise the final CDS sample. The current study makes use of a subset of those data. Adolescents who were between the ages of 5 and 10 at the beginning of the Recession (i.e., in 2007) and between 12 and 17 during the 2014 CDS data collection (N = 1098) were age-eligible for the current study; 832 of age-eligible adolescents had consented to participate in the child interview portion of the CDS, which was necessary for the current study. Additionally, of those adolescents who were interviewed, only those who reported their race/ethnicity as Black or White *(*N = 777) were eligible for the current study. However, the sample was again reduced due to methodological constraints requiring sufficient covariate data; 10 adolescents and their households were excluded (by Mplus) due to irreconcilable patterns of missingness. The final sample is approximately evenly divided between Black (45%; n = 342) and White (55%, n = 425), and male (50%; n = 385) and female (50%; n = 382) youth. The average 2014 age of the sample was 14.4 years old (SD = 1.65).

The heads of household were evenly divided between male (n = 383; 50%) and female (n = 384; 50%) and approximately evenly divided between White (n = 369; 49%) and Black (n = 316; 42%) heads, with other groups comprising the remaining 9%. Note that the heads of

household may not have been the primary caregivers of the study children.

Procedure

Core PSID biennial interview. The current study examines core household data collected in 2003, 2005, 2007, 2009, 2011, 2013, and 2015. These data were collected with reference to the family circumstances during the prior year, so the current study concerns household wealth trends from 2002 to 2014. Interviews were mostly conducted by phone; in the years under investigation, 96-98% of responses were collected by phone. The average interview length in 2003 was 72 minutes and has remained between 70 and 80 minutes since.

The biennial interview collects information about household members' employment, wages and income, other assets, mortgage and other debts, education, and other variables not used in this study. Specific PSID measures used in the current study are described later.

Primary caregiver interview. During the 2014 CDS study, primary caregivers were interviewed by phone about themselves, their households, and each child in their households. They responded to a battery of measures assessing the physical health, psychological well-being, personalities, and social behaviors of their custodial children and adolescents. On average, interviews took 75 minutes to complete.

Child interview. All adolescents in the current study were interviewed in 2014 by telephone regarding their general physical health, mental health, and physical development. Because of the sensitive nature of some of the questions, for example those regarding pubertal changes, adolescents responded to interviewers using interactive voice response technology (IVR) to ensure privacy and minimize response bias. The child interviews took 30 minutes on average.

Measures

All study measures where applicable appear in the Appendix.

Net wealth. A continuous and time-varying measure of wealth was calculated using data from households' responses in each of the seven biennial waves regarding their financial assets in home equity, checking and savings accounts, bonds, CDs, stocks, mutual funds, retirement wealth, investments trusts, ownership in farms and/or businesses, real estate, and vehicles. In addition, net wealth takes into account debts including credit cards, student loans, and mortgages. Therefore, household net wealth was calculated by summing households' assets and subtracting their debts. The PSID used hot deck imputation to replace any missing wealth indicators for the purpose of computing households' net wealth (PSID Main Interview User Manual: Release 2017, 2017). Random hot deck imputation uses the response probabilities of individual indicators derived from the sample's complete data and randomly selects a value within the probable range to impute. It is possible for households to have negative and zero values for wealth, so an inverse hyperbolic sine transformation was used to adjust for skewness and to retain both negative and zero values (see Friedline, Masa, & Chowa, 2012) after inflating values to 2014 prices based on the Consumer Price Index (CPI). Net worth data from 2003 to 2015 were examined in the latent class growth modeling in the current study to capture pre-Recession stability, changes during the Recession, and post-recession recovery (if any). In this case, wealth is a more valid assessment of a household's ecology during the Great Recession than income because it is more dynamic in response to macroeconomic disruptions. In particular, losses in home equity and investment wealth coupled with increasing loan debt through this time period are best captured in the net wealth variable.

Marital status. At each time point, heads of household reported their current marital status. They responded whether they were currently married or permanently cohabiting with a partner in the family unit. For this study, this response was coded as "1". All other responses were collapsed as non-married, or "0". These included *never married*, *widowed*, *divorced*, and *separated*, all of which stipulated that there was no spouse or partner present in the household.

Homeownership. At each time point, heads of household reported whether they owned, rented, or neither owned nor rented their homes. This trichotomous response was collapsed into either homeowner (1) or non-homeowner (0).

Education. At each time point, heads of household reported how many years of education they had completed. Twelve years indicated that they received a high school diploma, and years exceeding 12 included community college, 4-year college, and post-baccalaureate education. The current study treated education as a continuous variable.

Household size. At each time point, heads of household reported on how many minors and adults in the family unit lived in the household at the time of the interview. The current study treated this as a continuous variable.

Total family income. The taxable and social security income of the head of household, spouse of the head, and other family unit members were summed to provide a value of the total family income earned or received during the year preceding each of the biennial interviews. This value then inflated to 2014 values using the CPI and transformed using the Inverse Hyperbolic Sine transformation.

Adrenarche. Because biological samples for participants from the year 2007 are not available, whether adolescents had entered adrenarche during the Recession was approximated by their age during the crisis. Adolescents who were around the age of adrenarche during the

Great Recession (i.e., between the ages of 5 and 7 in 2007) were placed in the adrenarche group. Adolescents who were between 8 and 10 comprised the non-adrenarche group. Adolescents' age at the time of the 2014 interview was compute by the CDS/PSID based on caregivers' report of their date of birth. I calculated adolescents' age at the time of the onset of the Great Recession in years by subtracting 7 years from their computed age in 2014. Because birthdates are not publicly available, I was unable to calculate a more precise age.

Physical development. In the 2014 interviews, adolescents self-reported their physical development in response to sex-specific questions. Girls were asked whether their breasts had begun to grow (1 = *not yet begun to grow;* 4 = *growth that seems complete*) and whether and at what age they first began menstruating. Boys were asked whether they had begun to grow facial hair (1 = *not yet begun to grow;* 4 = *growth that seems complete*) and if their voices had deepened (1 = *not yet started changing;* 4 = *changed completely*). Both boys and girls rated their physical development relative to their peers on a 5-point scale (1 = *younger than most*: 5 = *older than most*). The items measured on 4- and 5-point scales were treated as indicators of a latent variable of physical development, and the age of menarche was treated separately.

Internalizing and externalizing behavior problems. The Behavior Problems Index (BPI; Achenbach & Edelbrock, 1981; Peterson & Zill, 1986) was administered to primary caregivers in 2014 to measure the frequency, range, and type of behavior problems among children and adolescents. The BPI contains 30 items regarding behaviors that load onto internalizing and externalizing factors. The internalizing subscale contains 14 items (e.g. *child feels worthless or inferior"*), and the externalizing subscale has 17 items (e.g. *"child is impulsive or acts without thinking"*). Caregivers indicated whether the behavior described in the item is untrue, sometimes true, or often true of the target child. Those responses were collapsed into

dichotomous responses as either present (*sometimes true* or *often true*) or absent (*untrue*). None of the items were reverse scored. Subscale scores were obtained by summing the relevant items; higher scores indicate higher levels of behavioral disorder. Cronbach's alphas for the full sample of all CDS-eligible children with sufficient data (N = 3460 – 3869) indicated strong reliability for each of the internalizing (α = .84) and externalizing (α = .88) subscales.

Race. Primary caregivers reported their adolescents' race/ethnicity and adolescents also self-reported their own race/ethnicity during the 2014 interviews. Both were given a list of options, but were not permitted to select multiple races or ethnic groups (1 = *White*; 2 = *Black, African-American, or Negro*; 3 = *American Indian or Alaska Native*; 4 = *Asian*; 5 = *Native Hawaiian*; 5 = *Pacific Islander*; 7 = *Other-specify*). Only children who selected White or Black as their primary racial or ethnic group are included in this study (their PCGs could be of any racial/ethnic group). This requirement encompassed 93% of the CDS study sample, so a small portion were excluded due to their race. Some adolescents reported their race/ethnicity two or three times in the course of the interview, however. This resulted in a race/ethnicity answer change in 55 cases. For these youth, their race/ethnicity was designated as the most frequent response across parent and adolescent reports of the adolescent's race/ethnicity (n = 32). In cases where there was a tie, the adolescent's first answer was retained and subsequent answers disregarded (n = 21). Of the 55 cases, 2 were dropped due to a change from an eligible race/ethnicity to ineligible.

CHAPTER 3: RESULTS

Before any hypotheses were tested, descriptive statistics, bivariate correlations, and missing data were examined. Ten adolescents were dropped from the initial sample because data were missing for multiple physical or psychosocial outcomes, or their households were missing several covariates necessary to classify their latent class trajectory. Thus, the sample for the final analyses is 767 children. Over 90% of these households had complete net wealth data for the seven time periods modeled.

Means and standard deviations of the key child-level study variables are presented in the first column of Table 2, and correlations among key child-level variables are in Table 3. The indicators of physical development show some individual variability, especially among those specific to boys (facial hair and vocal changes). On average, boys reported that their facial hair had barely begun to grow (M = 2.3, SD = 0.8) and their voices had definitely begun to change (M = 2.8, SD = 0.9), while girls reported that their breasts had begun to grow (M = 3.0, SD = 0.7). Boys and girls both reported that their physical development relative to their peers was "about average" (M = 3.1, SD = 1.1). Very small but significant correlations were observed between comparative physical development and both types of behavior problems such that the parents of adolescents who were more developed relative to their peers indicated slightly more internalizing (r(735) = .09, $p < .05$) and externalizing ($r(737) = .10$, $p < .01$) behavior problems.

Tables 4 and 5 present univariate statistics for each time point and document mean changes in wealth across time. Values for wealth and income were inflated to 2014 values based

on the CPI and then transformed using the inverse hyperbolic sine function in order to account for the positive skew. Mean and median wealth and income trended downward across this time period with marked drops between 2007 and 2011.

Latent Class Growth Models of Wealth

To test Hypothesis 1, I estimated unconditional latent class growth models (LCGM) using the Mixture Model add-on for Mplus 8 (Muthén & Muthén, 2017). I evaluated model fit throughout the current study using CFI, RMSEA, and Chi-Square. Excellent model fit is indicated by a CFI greater than or equal to .90 (Hu & Bentler, 1999), an RMSEA value less than or equal to .06 (Browne & Cudeck, 1993), and a normed Chi-Square no greater than two-times the degrees of freedom for the model (Tabachnick & Fidell, 2007). Taking into account the large sample size, adequate model fit would be indicated by a normed Chi-Square of 3.0 (Kline, 2005). I first fit an initial linear latent growth model (LGM) with no latent classes to confirm that an approximately linear change process with respect to household wealth was indeed occurring. This model fit the data serviceably, given that this was a probative model not used for further analyses ($X^2(23) = 188.12$, $p < .001$; CFI = .918, TLI = .925; RMSEA = .096). The latent intercept and slope accounted for significant variance in the values of household wealth across time; however, as expected, the results suggested a great deal of variability in both starting points and rates of change over time. This model supported both further exploration into the linear change process as well as mixture modeling to discern whether latent classes were contributing to the variance around the intercept and slope parameters.

I proceeded with the LCGM as indicated in Curran and Bauer (personal communication, 2015) and the methods established in prior research using the PSID with similar aims (i.e. Friedline et al., 2013). I first tested a one class unconditional LCGM as a baseline for

comparison. The null hypothesis was that there were not multiple latent classes present, so additional classes were tested against this assumption. Table 7 describes the model fit statistics for the 1, 2, 3, 4, and 5 class models of wealth trajectories tested. The Lo-Mendell-Rubin likelihood ratio test (LRT) provides a comparison of the improvement to model fit of an added class to a model with c-1 classes (Lo, Mendell, & Rubin, 2001). Five classes failed to further improve the model, so retaining 5 classes was not justified. Three and four class solutions were both preferable over a two-class solution, contrary to the results reported by Friedline et al. (2013) who used a different subset and time range of the PSID data. The Lo-Mendell-Rubin LRT indicated that the fourth class significantly improved model fit over three, but the entropy value, an indicator of the statistical ability to distinguish between classes, declined. Additionally, the four-class solution added a class with few households (n = 58, 7.5%). Therefore, I retained the three-class solution for further analyses because of the issues identified, and because three classes were initially hypothesized. Figure 1 depicts the sample mean wealth trajectories for each class across time. I will discuss these in greater detail later.

In order to assign households to the best class representing their wealth trajectories, I used the optimal three class solution as the basis for a conditional model with time invariant and time varying covariates. The fit for the conditional model is also provided in Table 7. Including the covariates and predictors of class membership resulted in an expected decrement to the AIC and BIC.

Figure 2 presents the path diagram for the model. Family income and household size did not appear to change significantly over time (confirmed in the case of family income by a linear LGM), so I averaged family income across the study period (as recommended in Killewald, Pfeffer, & Schachner, 2017) and included that value with head of household race, sex, and 2003

age as time invariant predictors of class, the intercept, and the slope. Education did change significantly over time (also confirmed by a linear LGM). Marital status and homeownership both changed repeatedly for some households, while others remained constant. Among those with complete data across the seven time points, 44% always reported being married while 23% always reported being unmarried, and 30% of the sample changed status at least once in the time range investigated. Likewise, 39% of households always reported owning their homes, 22% never owned their home, and homeownership status changed at least once among 39% of households. Given the presence of change in at least one third of households in marital status and homeownership, these indicators along with head of household education were estimated as time varying covariates. Employment status was intended to be included as a covariate, but the pattern of missingness within this subsample would have prohibited the majority of households from being modeled, so it was excluded from analyses. Friedline et al. (2013) also excluded employment information from their model of net wealth. Employment is collinear with income as well as education, so the dichotomous indicator of employed/unemployed would not have made a substantial contribution to the model.

Households were assigned to one of the three classes previously enumerated as a function of this model. The household-level characteristics of the three classes are described in Table 8. I named the classes *low stable* (n = 244), *middle declining* (n = 204), and *high stable* (n = 312). The stable classes did not change significantly across time, but they differed significantly in their initial wealth levels. The *middle declining* class changed significantly in a downward linear fashion (slope = -0.81, $p < .01$). An investigation of the sample means indicates a steep decline during the years of the Great Recession, with wealth of the *middle declining* class dropping below the level of the *low stable* class in 2013 reports of wealth. The classes also appear to differ

with regard to other key variables including age, the race of the head of household, wealth, marriage, and homeownership (see Table 8).

In preparation to test the hypotheses regarding class membership and children's physical and psychosocial outcomes, I also examined differences among classes with regard to the adolescent-level data. This information is in Table 2. Adolescents in the *low stable* group were predominantly Black (*n* = 191, 76% of group), and adolescents in the *high stable* group were predominantly White (*n* = 239, 76% of group). Across the three classes, adolescents did not appear to differ with respect to their physical development. However, the mean values for parent-reported internalizing and externalizing behavior problems seemed to be higher among adolescents in the *middle declining* class (*M* = 2.9, *SD* = 3.3; *M* = 5.2, *SD* = 4.5 respectively) compared to the other two groups.

Structural Equation Modeling of Wealth and Physical and Psychosocial Development

I began the model building steps to test Hypotheses 2-5 by constructing a latent variable of physical development using adolescents' reported comparative physical development, breast development, voice changes, and facial hair growth. I excluded age of first menstruation from the latent factor because it did not correlate with the other variables. The other physical development variables are physical changes that appear more gradually, whereas menarche marks a discrete shift in girls' physical changes. Age at first menstruation also provides separate timing and tempo information about girls' physical development, so it was included in the model separately as a unique manifest variable. The model fit the data well ($X^2(17) = 47.23$, $p < .001$; CFI = .965, TLI = .936; RMSEA = .048), so I retained the latent factor for the rest of the analyses.

According to Hypothesis 2, children in households with steep declines in wealth during the Recession would exhibit more internalizing and externalizing behavior problems regardless of their age or sex. I tested this hypothesis using a single-group structural equation model (SEM). Class membership was dummy-coded and two classes were regressed on physical development, menarche, and internalizing and externalizing behavior problems using a third class as the reference group to avoid the dummy variable trap. This process was conducted three times in order to use each class as a reference group and make all the relevant comparisons. Internalizing and externalizing behavior problems were permitted to correlate, as well as physical development and menarche. Race and sex were included as controls and also regressed on physical development, menarche, and behavior problems. This model fit the data well ($X^2(20) = 46.44$, $p < .001$; CFI = .969, TLI = .930; RMSEA = .042). Figure 3 shows the path diagram for this model using *low stable* as the reference class. The declining group exhibited more internalizing ($\beta = .17$, $p < .05$) and externalizing ($\beta = .20$, $p < .05$) behavior problems than the *low stable* group.

The third hypothesis posited that pubertal timing would partially mediate the paths between wealth class and behavior problems. However, wealth class did not affect physical development or menarche significantly, and there were no direct paths from either physical development or menarche to behavior problems, so indirect effects were unlikely to be observed. To test this expectation, I used the "Model Indirect" command in Mplus to obtain estimates of conventional direct and indirect effects. The paths between the *middle declining* class and internalizing and externalizing behavior problems were not mediated by either the physical development or menarche indicators of puberty.

The Role of Developmental Timing in Moderating Hardship

To address my fourth hypothesis regarding the role of developmental timing, I first tested the invariance of the model with respect to the child's age group during the Recession. The child's age group during the Recession was determined by subtracting 7 years from their 2014 age in years. Adolescents who were between 5 and 7 during the Recession were categorized as in adrenarche (1), and adolescents who were between 8 and 10 during the Recession were categorized as post-adrenarcheal (0). A test of full invariance estimates the groups' models separately, but with each parameter constrained to be equal across the groups. Poor fit resulting from this model would indicate that the two groups differ significantly with respect to the relations among the variables modeled, and therefore should be free to vary. The test of full invariance yielded an ill-fitting model, $X^2(63) = 191.27$, $p < .001$; CFI = .847, TLI = .735, RMSEA = .073. In particular, the adrenarche group contributed the most to the model misfit (indicated by a larger chi-square contribution relative to the older group), suggesting that the model fit especially poorly for this group.

I next allowed the parameters to vary between the two groups. The path diagram for the adrenarche group is Figure 4, and the path diagrams for the older group are Figures 5a and 5b. All estimated paths are shown in these diagrams, and significant paths ($p < .05$) are indicated by solid black lines with partially standardized parameter estimates. Among adolescents who were around the age of adrenarche during the Recession, membership in the *low stable* wealth class predicted fewer internalizing (β = -.27) and externalizing (β = -.29) behavior problems and less physical development than membership in the *middle declining* class. Additionally, in this group Black adolescents were significantly less physically developed than their White counterparts (β =

-.39). Moreover, girls tended to be significantly more physically developed than boys in this group (β = -.44).

Among adolescents who were older during the Recession, the pattern of results is different. Membership in the *low stable* class predicted higher levels of physical development in 2014 compared with the *high stable* class (β = .35). Membership in the *middle declining* class predicted an earlier onset of menarche than in the *low stable* class (β = -.39) which, in turn, predicted higher levels of both internalizing (β = -.18) and externalizing (β = -.21) behavior problems across all classes. Black adolescents also reported earlier menarche (β = -.36), but also fewer internalizing problems (β = -.34). Once again, I used the Mplus "Model Indirect" command to obtain tests of indirect effects, or mediation, between wealth class and behavior problems through menarche, and also between race/ethnicity and behavior problems through menarche. These tests were not significant. Neither physical development nor menarche mediated the relations observed between wealth class and behavior problems, nor race/ethnicity and behavior problems.

The fifth hypothesis posited that the age-dependent models would also differ by sex. A 4-group multiple group SEM was proposed, but this model was unable to converge due to the sex-specific patterns of missingness (within the latent variable and for menarche). It was thus not possible to make direct comparisons between boys and girls with respect to the current model.

CHAPTER 4: DISCUSSION

The current study used emerging evolutionary-developmental theories such as the ACM to examine how childhood hardship may affect long-term physical development and its behavioral correlates. I aimed to characterize American households' changes in wealth across the decade containing the Great Recession and to use that characterization to predict children's later physical and psychosocial outcomes. Moreover, this study aimed, and is among the first, to evaluate recent claims that adrenarche is a sensitive period during which children are particularly susceptible to changing environmental conditions. Results suggested that there are marked physical and behavioral differences among children who endure chronic hardship, those who endure sudden and acute hardship, and those who do not. Additionally, results indicated that a child's age at the time of exposure does contribute to differential outcomes, but not in the hypothesized manner. In the following sections, I summarize the results of the study and offer some explanations for the unexpected patterns that emerged. I conclude with a discussion of the limitations of the current study and suggest future programs of research that build upon these results.

Characterizing Wealth Changes

The first goal of this study was to characterize the changes in households' net wealth across twelve years with particular attention to changes during the Great Recession. Previous researchers observed multiple possible trajectories among households who participated in the Panel Study of Income Dynamics (Friedline et al., 2013; Rauscher & Elliot, 2015;). With some notable differences, the results obtained here basically replicated this previous research. Overall,

25% of households lost at least 75% of their wealth, and more than 50% of households lost 25% of their wealth (Pfeffer, Danziger, & Schoeni, 2013). Using a modeling strategy similar to the current study, Friedline et al. (2013) identified two latent classes: *high stable* and *declining*. I predicted that a three class model would be a better fit, with the additional class dividing Friedline's "declining" group into *middle declining* and *low declining* classes. Figure 1 appears to depict these two hypothesized groups; however, the group with the lowest intercept is not significantly changing over time, so this group was named *low stable* and represented households that consistently had relatively little wealth throughout this time period.

In the present study, the *middle declining* class began with more wealth than the *low stable* class, but eventually dropped to match the *low stable* class. The magnitude of wealth losses in the *middle declining* group was significant, but also noteworthy is this group's sluggish recovery following the Great Recession. On average, households in the *middle declining* class lost 91% of their wealth between 2003 and 2013, and had only recovered 39% of their 2003 wealth by 2015. Individuals' perceptions of their economic circumstances were not observed in this study. Had they been, it is possible that households in this group perceived their economic circumstances to be more dire than households in the stable groups. They lost more of their wealth and they lost it faster than the average household in the sample. In fact, their losses were more than the average household in the United States (median losses of 28% in the first decade of the 21st century; Pew, 2012).

The stark differences between the high stable and both lesser-wealth groups at the beginning and the end of the study period highlight the profound inequalities in the United States. Although these three classes are simplistic representations of the many trajectories households followed through this decade, it remained clear through the multiple class solutions I

tested that a *high stable* group retained much of its wealth through the Recession, and some households in lower classes endured disproportionate losses. This is largely consistent with what has been reported in previous economic studies of the Great Recession (e.g. Pew, 2012; Pfeffer et al., 2013; Rauscher & Elliot, 2015; Yilmazer et al., 2015). The vanishing wealth of what might be considered the "middle class" in this study is striking and fully consistent with other nationwide studies. Unlike persistently low-income and upper-income groups, wealth is largely stored in home equity among the middle class (Pew, 2012). Apart from investing in homes, this group lacks the significant resources of the upper class to invest in productive assets or to save money, rendering their wealth more vulnerable to shocks due to its non-liquidity and lack of asset diversification (Pew, 2012; Pfeffer et al., 2013). At any time point in the present study, roughly 30% of households were homeowners in the *middle declining* group and about 12% in the *low stable* group. Put another way, 70% of the *middle declining* class owned their homes over this time period, compared to 21% of *low stable* and 83% of the *high stable* classes. Following the Great Recession, when home equity was diminished by catastrophic macroeconomic forces and many homes were foreclosed upon, the net wealth of the middle class began to resemble that of the lower class. In 2007, 64% of homeowners in the sample were members of the *middle declining* group, and at time points during the Recession this share was reduced to 60% in 2009, 59% in 2011, and 56% in 2013. In this respect, the stability of non-homeownership in the *low stable* group might have been protective during the Great Recession, but as I will discuss the wealth poverty experienced in this group was significantly associated with some maladaptive outcomes nonetheless.

With reference to the theoretical frameworks introduced in the first chapter, I will next elaborate on the behavioral and physical adaptations observed in the present study in relation to

the wealth changes described above. Of special relevance is the interactionist model that combines social causation and social selection perspectives. From this perspective, the enduring physical and behavioral adaptations observed among low-SES groups, such as early puberty (Arim et al., 2011; Belsky et al., 2015), obesity (Pratt et al., 2017) and impulsive behaviors (Ackerman, Kogos, Youngstrom, Schoff, & Izard, 1999), may be attributed to pervasive economic inequality in the United States. Inequality does so by creating vulnerability to destabilization in the middle class and by keeping environmental change-for-the-better out of reach in the lower class. The interactionist model posits that the physical and mental health disparities observed between poor and wealthier populations results from a process of social selection that confines specific groups to circumstances devoid of opportunity. I am not the first to make the claim that inequality is at the core of many social ills (e.g. Piketty, 2014), but the current study provides some suggestive evidence for its validity. The interactionist theory along with the Adaptive Calibration Model of stress reactivity provide both proximal and distal explanations for the associations between the lack of wealth and individual development observed in this study and in the extant literature.

The contribution of this study to the greater body of literature is its focus on adrenarche as a sensitive period for the calibration of stress reactivity and middle childhood as a sensitive period for biobehavioral reorganization. This study followed a modified cohort-sequential design with two cohorts. The younger children in the current study were aged 5-7 at the onset of the Great Recession, and aged 12-14 when outcome data were collected. The older children were aged 8-10 at the onset of the Great Recession, and aged 15-17 during outcome data collection. The results indicated that younger children were behaviorally affected by declining wealth, whereas physical development was specifically affected among older children. Notably, the

effects on physical development in the older children were directly related to their wealth group. Specifically, children who were persistently disadvantaged were likely to show more advanced secondary indices of physical development, and female children who experience sudden wealth declines were more likely to begin menstruating at a younger age. Among the older group only, early menarche was significantly associated with a greater incidence of internalizing and externalizing behavior problems, but menarche did not mediate the link between wealth and behavior.

The Effect of Wealth Change on Behavior Problems

In Hypothesis 2, I predicted that adolescents whose families experienced significant declines in wealth during the period containing the Great Recession would exhibit more internalizing and externalizing behavior problems as reported by their caregivers regardless of their age or sex. This hypothesis was partially supported. The single-group SEM revealed significant positive paths between the *middle declining* class and internalizing and externalizing behavior problems. On average, caregivers of adolescents in the *middle declining* class reported .64 more internalizing behaviors and .76 more externalizing problems than caregivers in the *high stable* class. These effects are small and are not likely contributing to children moving in or out of clinically significant ranges of behavior problems. However, the directions of results provide some insight into possible developmental differences between persistent and sudden adversity.

The results for the single-group SEM were not consistent once children's age during the Great Recession was included in the model. Once the two groups were modeled separately, distinct patterns emerged. Only among adolescents who were between the ages of 5 and 7 during the Great Recession did living in households with declines in wealth directly predict more

adolescent internalizing and externalizing behavior problems as compared to the *low* or *high stable* households. However, the effects were small in magnitude. On average, caregivers of adolescents in the *middle declining* group reported .93 more internalizing and 1.21 more externalizing behavior problems than caregivers of adolescents in the *low stable* class. The low incidence of behavior problems (2.6 for internalizing and 4.9 for externalizing) and a large variance (*SD* = 3.1 and 4.4, respectively) in the overall sample likely contributed to the small effect.

For children between the ages of 5 to 7, the *low stable* group stood out as less prone to internalizing and externalizing problems than the *middle declining* class. Although I did not expect lower levels of behavior problems in the *low stable* class compared to the other two, this finding might reflect adjustments to conditions of adversity, class differences in parental expectations of adolescents' behavior, or parental insensitivity to adolescents' behavior and emotional states. It might also be attributable to measurement error. For example, Guttmannova, Szanyi, and Cali (2008) demonstrated that the two-factor configuration of the Behavior Problem Index functions differently across ethnic groups, and that patterns of factor loadings derived from the same sample vary across time within Black and Hispanic ethnic groups. Because Black households (75%) were disproportionately represented in the *low stable* class compared to White households (25%), it is possible that the present finding reflects the effect reported by Guttmannova and colleagues.

Conversely, among older adolescents, wealth was only predictive of markers of physical development and not directly predictive of behavior problems. Declining wealth was associated with earlier onset of menarche, and persistently low wealth was associated with accelerated physical development. In my initial hypotheses, I made no specific predictions about the direct

effects of wealth on behavior problems by age group, except to posit that physical development in the adrenarcheal group would at least partially mediate the pathways between wealth classes and adolescent behavior problem. This hypothesis was not supported for adrenarcheal or post-adrenarcheal children. Instead, physical development appeared to play no role in the development of behavior problems in adrenarcheal children, and wealth appeared to play no role in behavior problems in adolescents who were older. Findings related to physical development are discussed in a later section.

The ACM might provide an explanation for these divergent patterns. Internalizing and externalizing behavior problems were conceived as broad behavioral proxies for the patterns of adaptation postulated by the ACM to be associated with differences in physiological stress reactivity. Specifically, I posited that the behavioral patterns associated of the vigilant-withdrawn and vigilant-agonistic profiles identified by Del Giudice et al. (2011) would correspond to distinct groups respectively prone to develop internalizing and externalizing problems as a result of their distinct developmental histories. Direct paths between declines in wealth and behavior problems were observed in younger children, and older children demonstrated the hypothesized physical changes but did not exhibit more behavior problems. Puberty is a dynamic period of biological reorganization with specific sensitivities occurring and diminishing through the time period, not unlike prenatal development. Indeed, puberty is sometimes conceptually divided into two phases, adrenarche and gonadarche (Dorn, 2006). In the current sample, it's possible that the younger children (ages 5-7) were either entering or in full-fledged of adrenarche, whereas the older children were either entering or in full gonadarche (ages 8-10). According to the Adaptive Calibration Model, adrenarche is specifically a period of reorganization of the stress response system, rendering the SRS more vulnerable to stressors. This would be consistent with the

presence of significant paths from wealth to behavior problems among those children who were younger and not older at the time of the recession. Conversely, gonadarche is characterized by the activation of the hypothalamic-gonadal-axis (HGA), responsible for the primary and secondary physical changes of puberty. Experiencing stressors like wealth shocks during gonadarche, but not adrenarche, might explain the accelerated pubertal development in the older group.

The Mediating Role of Physical Development

In Hypothesis 3, I predicted that associations between wealth declines and behavior problems would be mediated by physical development. Specifically, I predicted that adolescents whose families experienced significant declines in wealth during the period containing the Great Recession would exhibit more outward signs of pubertal changes in 2014 than adolescents in other groups, and that those changes would mediate the causal link between wealth and behavior. The results partially supported the first part of this hypothesis, although the prediction that these effects would be especially robust among adrenarcheal children was not supported.

Wealth had significant effects on physical development, but not menarche, among the children who were in adrenarche during the Great Recession. Among children in the "older" group, however, being in a *middle declining* household predicted earlier menarche for girls by 8.4 months than being in a *low stable* household, and earlier menarche significantly predicted more internalizing and externalizing behavior problems regardless of class. Tests of indirect effects did not provide support for the mediation hypothesis, but the effects were small to begin with, so the proposed mediational pathway might have been undetectable. Additionally, because menstrual age was reported in years and not months, there was probably substantial measurement error that diminished the signal which might have been detected with more granular measures.

For example, a girl who begins menstruating early into her 12th birthday is developmentally similar to the girl who begins shortly before her own 12th birthday; with only age in years available, these girls were considered in the present study menstruating a full year apart, at 11 and 12 years of age respectively.

I also found negative effects of both *high* and *low stable* wealth on secondary physical development adolescents who were in adrenarche during the Recession. Adolescents who were in *low stable* households were less physically developed and had begun menarche later than children in *middle declining* households, and adolescents who were in *high stable* households were also less physically developed than children in *middle declining* households. These results were not specifically hypothesized, but they are consistent with the ACM. Children in stable households (both poor and wealthy) may have adopted slow life history strategies. Among wealthy children, circumstances can reasonably be expected to remain the same, so their physical development is slower and reproductive capacity diminished in the service of acquiring more resources to effectively nurture their offspring. Among children in the *low stable* class, a slow life history strategy might be necessitated by energetic stress, which includes malnutrition, low energy intake, and internal stressors such as disease (Del Giudice et al., 2011). A slow life history strategy might be an optimal adaptation to persistent resource scarcity among low-wealth households. Alternatively, adolescents who were in adrenarche in 2007 were younger during the 2014 data collection than the post-adrenarcheal children, so these results might also be a reflection of those age differences.

These effects were partially reversed among children who were older during the Recession. Physical development and menarche were accelerated among adolescents who were in *middle declining* households. One explanation for the differential results by age within the *low*

stable class is the duration of exposure to adverse circumstances. Children who were classified as older and whose households belonged in the *low stable* group had been exposed to low-wealth (presumably challenging circumstances) longer than children who were younger in the same time period in the same wealth class. The cumulative effects (Holochwost et al., 2016) of enduring persistent economic strain are logically likely to be greater among older children and may explain the more rapid physical development observed among the consistently disadvantaged children in this age group. Again, this may also be a reflection of the age differences between the groups when physical development data were collected (ages 12-14 and 15-17).

Sex and Race

Hypothesis 5 predicted that the associations observed in the first SEMs would differ by sex; specifically, that younger girls would display more internalizing behavior problems as a function of declining wealth, mediated by physical development, compared to older girls. Younger boys were expected to display more externalizing problems as a function of declining wealth, mediated by physical development, compared to older boys. However, the model as specified was ineligible for a multiple groups model comparison between sexes due to the missingness related to sex-specific questions. Specifically, boys contributed more information to the latent variable of physical development than girls, and only girls reported on menarche. The multiple groups model was unable to converge due to these patterns of missingness.

Sex was entered into the initial models as a control variable and all logical paths were estimated (sex was not estimated as a predictor of menarche). Results showed no statistically significant differences between boys and girls except regarding physical development, the path for which also differed between younger and older adolescents. The strong prediction of physical development by sex for adrenarcheal and post-adrenarcheal children follows the expected pattern

(boys are less developed than girls in early adolescence, and in later adolescence they catch up). However, because the physical development latent variable is largely comprised of information from boys, these results may be statistical artefacts.

I had not made specific predictions regarding race/ethnicity; instead, I entered the adolescent's race/ethnicity into the model as a control variable. Older Black adolescents reported earlier menarche, and their caregivers reported fewer internalizing behavior problems compared to older White adolescents. The former finding is consistent with the literature on Black/AA pubertal timing, but the question of race/ethnicity and internalizing behavior problems has not been resolved in the literature. Cultural issues with the measurement of behavior problems were discussed earlier in this section with respect to the *low stable* class, which is comprised of 75% Black adolescents. However, multiple group comparisons of these structural equation models were not conducted, so speculation about differential processes between Black and White adolescents is not indicated. Table 9 shows the means for internalizing and externalizing behavior problems and age of menarche broken down by class, adrenarche group, and race in order to illustrate the pattern of differences by race and age. Future research ought to probe the patterns of associations among wealth, puberty, and psychosocial well-being as they relate to race/ethnicity.

Limitations and Future Directions

There are several limitations to the current study. The first of the limitations is broadly related to measurement of adrenarche, physical development, and behavior problems. Adrenarche is typically operationalized by levels of DHEA and/or DHEA-S (Byrne et al., 2017). The timing of adrenarche, like puberty, varies among children, so using age as an estimate of adrenarcheal status misses this natural variability. Instead, a continuous measure of hormone

levels tends to be more predictive and more closely associated with the neural and physical changes characteristic of the developmental stage (Byrne et al., 2017). It is likely that some children were miscategorized as adrenarcheal or post-adrenarcheal, and larger effect sizes might have been observed with a continuous measure or with properly specified groups.

Physical development was assessed using a shortened form of a validated instrument, the Pubertal Development Scale (PDS; Peterson, Richards, Crockett, & Boxer, 1988). The original instrument queries all participants about growth, body hair, and skin changes in addition to sex-specific questions about breasts, facial hair, voice changes, menstrual status, and relative development. Having the additional information would have helped to further distinguish between different levels of physical development. It also would have enabled a robust multiple groups comparison between boys and girls because both groups would have had more shared information. However, the PDS is also a noninvasive self-report measure of puberty. This might have some disadvantages when compared with a physical evaluation using the Tanner scale or with an instrument that uses illustrations, but concordance studies have yielded mixed results (e.g. Bond et al., 2006).

Additionally, the current study was grounded in the Adaptive Calibration Model, which specifies physiological reactivity profiles that correspond to behavioral archetypes. However, physiological data were not collected in the current study. Information about cortisol, salivary alpha-amylase, and respiratory sinus arrhythmia at basal and reactivity levels, for example, would have allowed precise alignment with theory. The Behavior Problems Index is no substitute for the objective measurement of the coordination of the SRS, although it has consistently demonstrated associations with physiological measures (e.g. Koss, Mliner, Donzella, & Gunnar, 2015; Obradovic, Bush, Stamperdahl, Adler, & Boyce, 2011). As previously discussed, the BPI

might also function differently among different racial and ethnic groups, thus impacting the validity of its use in multi-racial studies. The current study would also be more precisely aligned with the ACM if it had information directly relevant to life history strategies such as sexual activity, sexual risk-taking, and dating. Without that information, the current study can only infer life history trajectories from adolescents' rate of physical development and its association with behavioral strategies.

Another limitation is the measurement and modeling of wealth in this study. The wealth value is a composite of responses to several questions about assets and debts, thus its accuracy relies on complete information. Using wealth data for 2005-2007, Pfeffer and Griffin (2017) observed that in 25% of cases, at least one wealth indicator was imputed; this accumulates across waves such that 38% of cases required imputation for 2005 and 2007 collections combined. In the PSID, missing data is managed through random hot-deck imputation (PSID, 2017), which is not nearly the current gold standard for missing data replacement (Allison, 2003; Arbuckle, 1996). This method derives a probability distribution from complete PSID data associated with possessing the given asset or debt. Based on the probabilities, a "yes" or "no" is randomly assigned. If assigned a "yes", the probability distribution related to the value brackets for the asset or debt (e.g. $50,000—$75,000) is used to assign a bracket. The probability distribution within that bracket is then used to impute the final continuous value for the asset, which is then applied to the final computation of wealth. Unlike other preferable methods like multiple imputation (Frick, Grabka, & Sierminska, 2007), random hot-deck imputation does not take covariates under consideration and consequently results in imprecise values. Pfeffer and Griffin (2017) examined measurement and meaningful contributions to the extreme fluctuations in wealth observed across waves in the PSID and found that the imputation of incomplete data is a

predictor of large wealth fluctuations alongside observed sociodemographic variables, but imputation only accounts for 5% of the variance. Because one aim of the current study was to model fluctuations in wealth, this is a potentially significant source of error. Re-imputing missing wealth indicators using multiple imputation and then re-examining wealth trajectories might be worthwhile before pursuing additional research questions related to wealth fluctuations in the PSID sample.

Finally, latent class growth modeling, a restrictive form of growth mixture modeling, has several limitations. First, determining the number of classes requires a series of judgment calls on the part of the researcher based on statistical fit criteria, theory, and feasibility. The current study used numerous fit indices to arrive at the best solution, but no combination of indices can confirm the "correctness" of the model specification for empirical data. Nyland, Asparahouv, and Muthén (2007) used a simulation study to identify the best performing tests and indices in identifying correct models. They found that the Lo-Mendell-Rubin likelihood-based test used in the current study can be accurate, but when it is wrong it overestimates the number of classes. They also found that the Bayesian Information Criteria index is the superior index in correctly identifying the number of classes, but it is still imperfect. An improvement over the current study would be to use a replication sample and observe whether the same or similar classes are extracted. Finally, if we accept the classes discerned in the current study, the shift of the *middle declining* class from the middle to lower class suggests that a latent transition analysis might be a better method of operationalizing harshness and unpredictability. Instead of using classes defined by rates of change to predict child outcomes, unique information might be gleaned from identifying the number and nature of, and risk for, latent transitions across a period of time. Latent transition analysis is especially adept at identifying at-risk subgroups; risk of descending

from a higher to a lower class represents an enormous stressor for a family, and this might contribute to children's detection of harshness and unpredictability in their environments.

Despite these limitations, the current study makes a few novel contributions to the field. It is unique in a number of ways, but especially in its consideration of wealth and children's physical and psychosocial well-being, as opposed to income, poverty level, or socioeconomic status. Future research should continue to explore the role of wealth, and the lack thereof, in buffering or inducing harsh and unpredictable environments. Although income is also a reliable, but volatile, indicator of economic well-being, wealth communicates a great deal more about a family's financial, material, and intergenerational circumstances that may contribute to the home environment. Future research should also continue to investigate development during middle childhood, which has proven to be a sensitive period of physical and behavioral development in this and other studies. Finally, future research aiming to explain the varieties of human reactions to adversity must consider the role of human evolution in shaping human development; this necessitates a genetic, physiological, behavioral, and environmental perspective that considers not only psychology, but perspectives from biology, economics, and sociology.

TABLES

Table 1 *Operationalization of key theoretical constructs*

Construct	Measure / operationalization		Scoring	Mean (SD)	Median	Range
Adrenarche	Age during Recession	Computed		7.39 (1.64)	7	5-10
Hardship	Net wealth	Computed	Continuous IHS transformed $US value	See Table 3		
Physical development						
	Voice	Self report		2.8 (0.9)	3	1-4
	Facial hair	Self report		2.3 (0.8)	2	1-4
	Breasts	Self report		3.0 (0.7)	3	1-4
	Menses	Self report	Age at first menstruation	12.05 (1.6)	12	7-17
	Comparative	Self report		3.1 (1.1)	3	1-5
Physiological reactivity						
	Internalizing behavior problems	Parent report	Dichotomously scored items summed for total score	2.6 (3.1)	1	0-14
	Externalizing behavior problems	Parent report	Dichotomously scored items summed for total score	4.9 (4.4)	4	0-17

Table 2 *Descriptive statistics for the sample*

		N	Percent	Mean (SD)	Median
Adrenarche age					
	Female	204	50%	13.03 (0.80)	13
	Male	202	50%	13.04 (0.81)	13
Older group age					
	Female	178	49%	15.88 (0.80)	16
	Male	183	51%	15.93 (0.81)	16
HOH age[b]		767		32.85 (8.51)	32
Child sex					
	Female	382	50%		
	Male	385	50%		
HOH sex					
	Female	384	50%		
	Male	383	50%		
Child race					
	AA/Black	342	44%		
	White	425	56%		
HOH race					
	AA/Black	316	41%		
	White	371	49%		
	Other	73	9%		

[a] Adrenarche age was considered as between 5 and 7 in 2007

[b] Age in 2003

Table 3 *Means (SD) of key child-level study variables, overall and by wealth class*

	Overall	Low Stable	Middle Declining	High Stable
N	767	250	204	313
Adrenarche	406 (53%)	135 (54%)	117 (57%)	154 (49%)
Child's age in 2014	14.4 (1.6)	14.5 (1.7)	14.3 (1.6)	14.4 (1.6)
Child race = Black	342 (45%)	191 (76%)	77 (38%)	74 (24%)
Child race = White	425 (55%)	59 (24%)	127 (62%)	239 (76%)
Child gender = male	385 (50%)	132 (53%)	108 (53%)	145 (46%)
Puberty compared to peers[a]	3.1 (1.1)	3.0 (1.2)	3.1 (1.0)	3.2 (1.0)
Breasts[b]	3.0 (0.7)	3.1 (0.7)	3.0 (0.7)	3.0 (0.7)
Menarche (age)	12 (1.6)	12 (1.6)	11.8 (1.8)	12.2 (1.5)
Facial hair[b]	2.3 (0.8)	2.2 (0.8)	2.3 (0.8)	2.3 (0.8)
Voice change[b]	2.8 (0.9)	2.7 (0.9)	2.9 (0.9)	2.9 (0.8)
Internalizing behaviors[c]	2.6 (3.1)	2.6 (3.2)	2.9 (3.3)	2.3 (3.0)
Externalizing behaviors[d]	4.9 (4.4)	5.1 (4.7)	5.2 (4.5)	4.3 (4.1)
Trajectory slope	-0.26 (0.8)	-0.20	-0.81***	-0.06
Trajectory intercept	4.35 (4.6)	0.81	2.51***	8.39***

[a] Range of scale (1-5) [b] Range of scale (1-4) [c] Range of scale (0-14) [d] Range of scale (0-17)
*** $p < .001$

Table 4 *Means, Standard Deviations, and Bivariate Correlations for Child-Level Study Variables*

	Mean (SD)	*n*	1	2	3	4	5	6	7	8	9	10
1. Externalizing behaviors	4.87 (4.39)	763										
2. Internalizing behaviors	2.58 (3.12)	761	0.73***									
3. Comparative physical	3.10 (1.08)	744	0.09*	0.10**								
4. Breasts	3.04 (0.71)	375	-0.05	0.06	0.28***							
5. Menarche (yrs)	12.04 (1.61)	321	-0.06	-0.07	-0.10	-0.14*						
6. Age	14.40 (1.65)	767	-0.10**	-0.07	0.05	0.25***	0.28***					
7. Black	0.45 (0.50)	767	0.04	-0.04	-0.15***	0.04	-0.12*	0.00				
8. Male	0.50 (0.50)	767	0.03	-0.07	0.00	-	-	0.05	-			
9. Adrenarche	0.53 (0.50)	767	0.09*	0.07	-0.07	-0.22***	-0.22***	-	-	-		
10. Facial hair	2.27 (0.83)	378	-0.06	-0.06	0.32***	-	-	0.42***	-0.12*	-	-0.31***	
11. Voice	2.83 (0.90)	379	-0.09	-0.10	0.31***	-	-	0.48***	-0.16**	-	-0.40***	0.53***

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

Table 5 *Twelve years of household net wealth*

Values of net wealth between 2003 - 2015	2003	2005	2007	2009	2011	2013	2015
$ Dollar values[a]							
Median	$26,132	$26,670	$34,456	$19,092	$16,740	$20,800	$30,980
Mean	$132,789	$157,378	$177,299	$164,191	$154,108	$145,075	$172,616
	($365,809)	($570,347)	($482,460)	($672,203)	($577,575)	($429,349)	($586,507)
Inverse hyperbolic sine transformation							
Median	10.864	10.884	11.141	10.550	10.419	10.636	11.034
Mean (SD)	7.79 (7.52)	7.02 (8.29)	7.54 (8.23)	5.90 (9.21)	5.65 (9.48)	6.14 (9.24)	6.73 (8.99)
Changes in net wealth between 2003-2015	2003-2005	2003-2007	2003-2009	2003-2011	2003-2013	2003-2015	2007-2009
Median net wealth							
Change in $ dollar value	+$538	+$8,333	-$7,040	-$9,392	-$5,332	+$4,848	-$15,364
Percent change	+2	+32	-27	-36	-20	+19	-59
Mean net wealth							
Change in $ dollar value	+$24,589	+$44,510	+$31,402	+$21,319	+$12,286	+$39,827	-$13,108
Percent change	+18	+34	+24	+16	+9	+30	-10

[a] Wealth inflated to 2014 values based on the Consumer Price Index

Table 6 *Time varying covariates*

	2003	2005	2007	2009	2011	2013	2015
Total family income[a]							
N	760	767	759	762	762	767	754
Median	$58,776	$59,557	$59,562	$65,057	$60,156	$64,529	$65,880
Mean	$77,052	$76,754	$74,748	$80,161	$75,878	$82,549	$84,735
(SD)	($71,495)	($68,782)	($64,401)	($79,865)	($69,329)	($134,987)	($105,002)
Household size							
N	760	767	759	762	762	767	754
Median	4	4	4	4	4	4	4
Mean	4.19	4.27	4.39	4.42	4.39	4.38	4.27
(SD)	(1.42)	(1.44)	(1.38)	(1.44)	(1.43)	(1.46)	(1.44)
Homeownership							
N	760	767	759	762	762	767	754
Percent own	60%	58%	59%	58%	58%	57%	59%
HOH yrs of education							
N	711	720	719	713	762	767	754
Median	12	12	12	13	13	13	13
Mean	12.89	12.97	13.03	13.31	13.30	13.48	13.58
(SD)	(2.33)	(2.26)	(2.18)	(2.42)	(2.43)	(2.37)	(2.33)
HOH marital status							
N	760	767	759	762	762	767	754
Percent married	62%	61%	61%	59%	59%	61%	59%

[a] Income inflated to 2014 values based on the Consumer Price Index

Table 7 *Latent class growth model fit statistics*

Model		AIC	BIC	Entropy	Lo-Mendell-Rubin LRT	p
Unconditional						
	1 class	38526.232	38568.131			
	2 class	36874.377	36930.242	.975	646.268	.000
	3 class	36406.288	36476.120	.988	451.476	.000
	4 class	35909.512	35993.310	.933	321.094	.005
	5 class	35892.511	35990.275	.912	89.113	.297
Conditional						
	3 class	47366.030	49010.858			

Table 8 *Household-level characteristics by latent class*

	Low Stable			Middle Declining			High Stable		
	n	*Mean* (SD)	Median	*n*	*Mean* (SD)	Median	*n*	*Mean* (SD)	Median
Age	250	29.73 (9.52)	27	204	32.93 (7.98)	31	313	35.28 (7.10)	34
Income[a]	234	4.61 (0.45)	4.69	193	5.05 (0.29)	5.12	304	5.26 (0.30)	5.30
Education	212	12.25 (1.64)	12.00	169	13.28 (2.25)	13.00	288	13.94 (2.16)	14.00
Household size	234	4.07 (1.32)	3.86	193	4.67 (1.14)	4.57	304	4.35 (1.04)	4.00
Wealth[a]	234	2.15 (5.27)	2.50	193	3.37 (5.39)	5.10	304	12.41 (1.30)	12.47
Married	234	1.17 (1.91)	0	193	5.51 (2.11)	7	304	5.84 (2.15)	7
Homeowner	234	1.47 (2.10)	0	193	4.29 (2.58)	5	304	6.00 (1.88)	7
Wealth in 2003	244	3.44 (8.15)	7.68	204	6.42 (8.67)	10.48	312	12.10 (1.59)	12.11
Wealth in 2011	248	1.42 (9.41)	6.41	201	0.56 (10.44)	5.15	313	12.35 (1.57)	12.49
	n	Percentage		*n*	Percentage		*n*	Percentage	
Male head	129	52%		109	53%		147	47%	
Black head	182	75%		77	38%		57	18%	

[a] Average of IHS transformed values across all time points
Note: Values represent the average across all time points.
Marriage and homeownership values reflect the number of times that caregivers reported they were married or a homeowner, respectively, over the 7 time points.

Table 9 *Means and standard deviations of key outcome variables by class, age, and race/ethnicity*

Wealth class	Low Stable				Middle Declining				High Stable			
Age group	Adrenarche		Older		Adrenarche		Older		Adrenarche		Older	
Race	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black
Internalizing	2.6	3.0	3.0	2.1	3.4	3.0	3.1	1.5	2.5	2.0	2.3	2.3
	(3.4)	(3.5)	(2.8)	(2.7)	(3.2)	(3.9)	(2.9)	(2.6)	(2.9)	(2.4)	(3.2)	(3.2)
Externalizing	4.8	6.0	4.0	4.8	5.6	6.1	4.9	3.8	4.7	4.0	4.2	4.6
	(4.6)	(5.0)	(3.8)	(4.5)	(4.3)	(5.5)	(3.9)	(3.8)	(3.9)	(4.0)	(4.0)	(4.8)
Menarche	11.5	11.8	13.1	11.9	11.9	11.2	12.3	11.6	11.7	11.6	12.8	12.8
	(0.8)	(1.2)	(1.4)	(1.9)	(1.1)	(1.9)	(2.1)	(2.1)	(1.3)	(1.6)	(1.2)	(1.7)

FIGURES

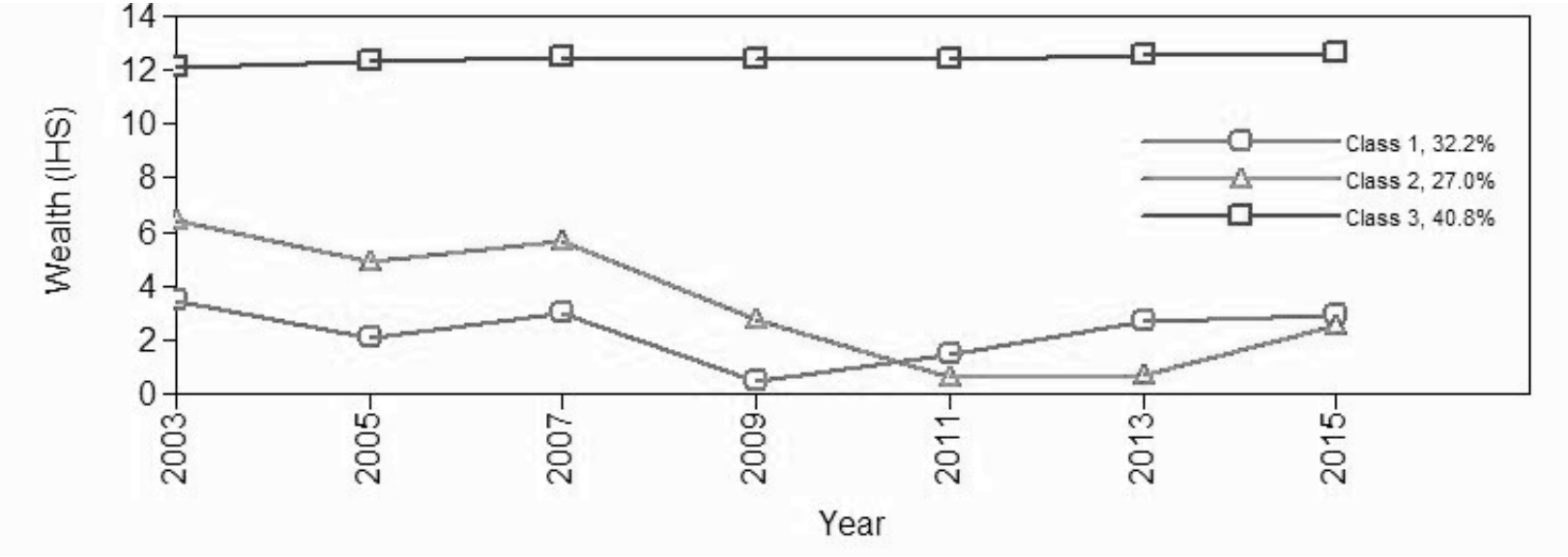

Figure 1 *Latent class sample mean trajectories*

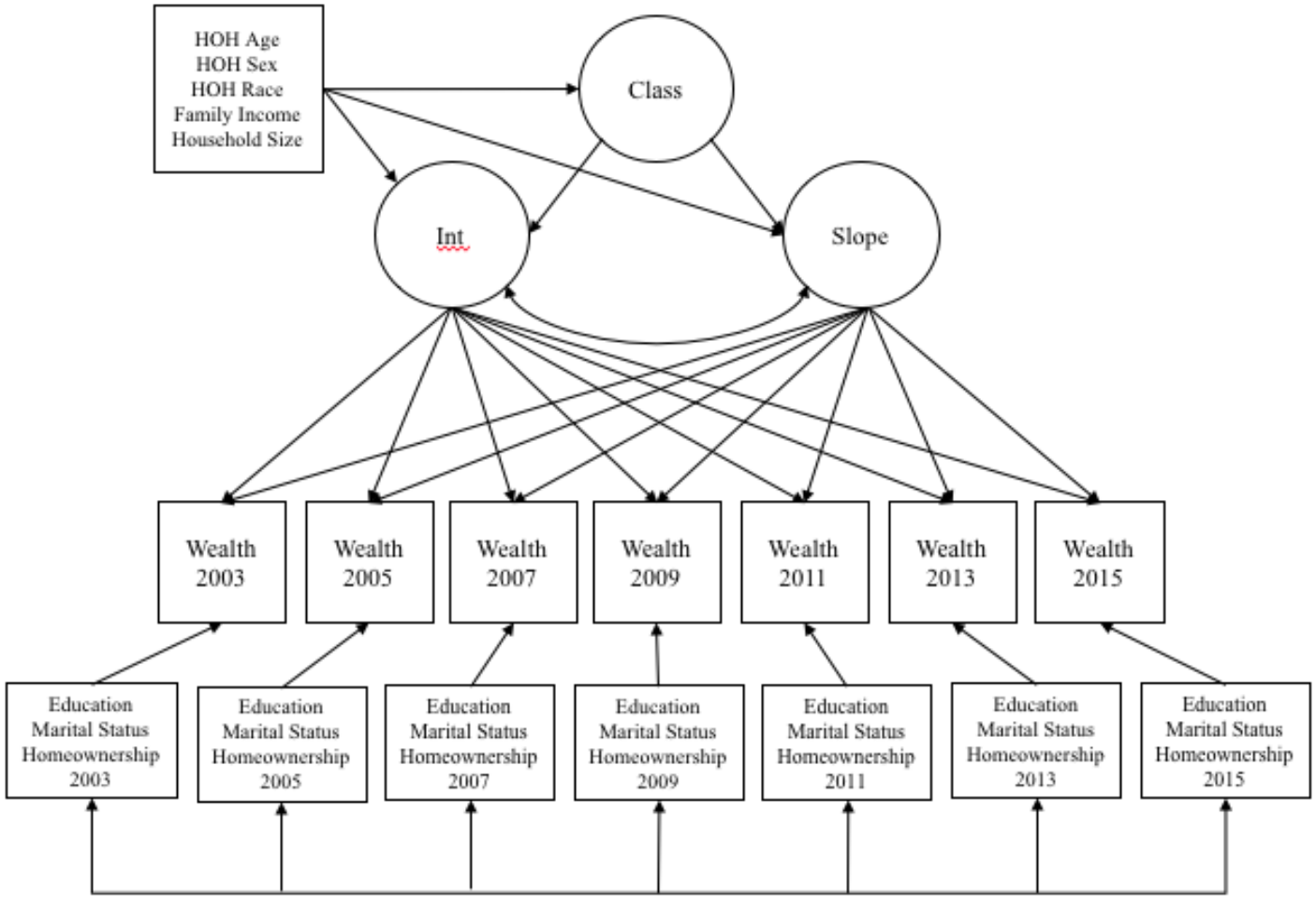

Figure 2 *Conditional latent class growth model*

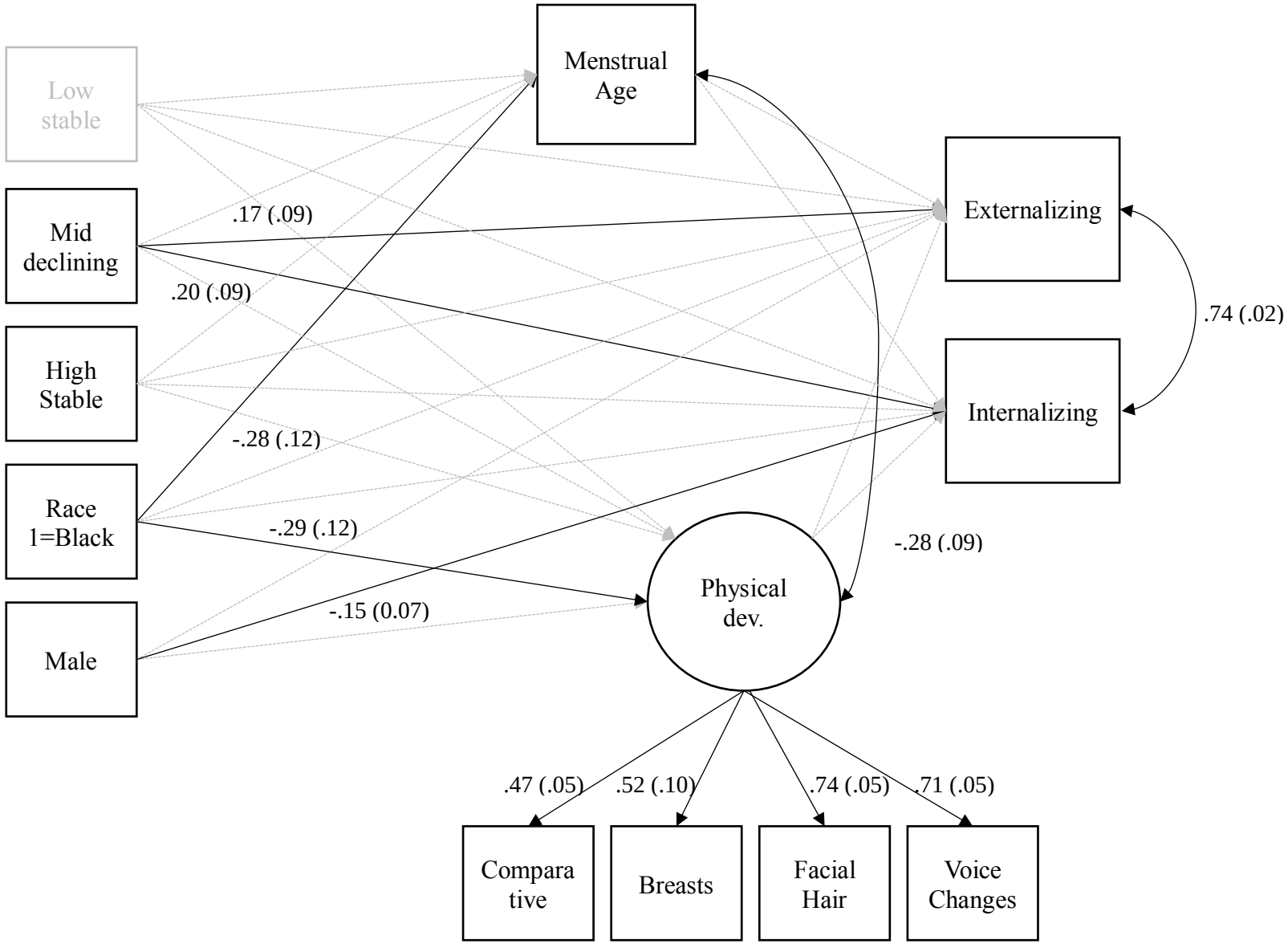

Figure 3 *Single group SEM with low stable as the reference category*

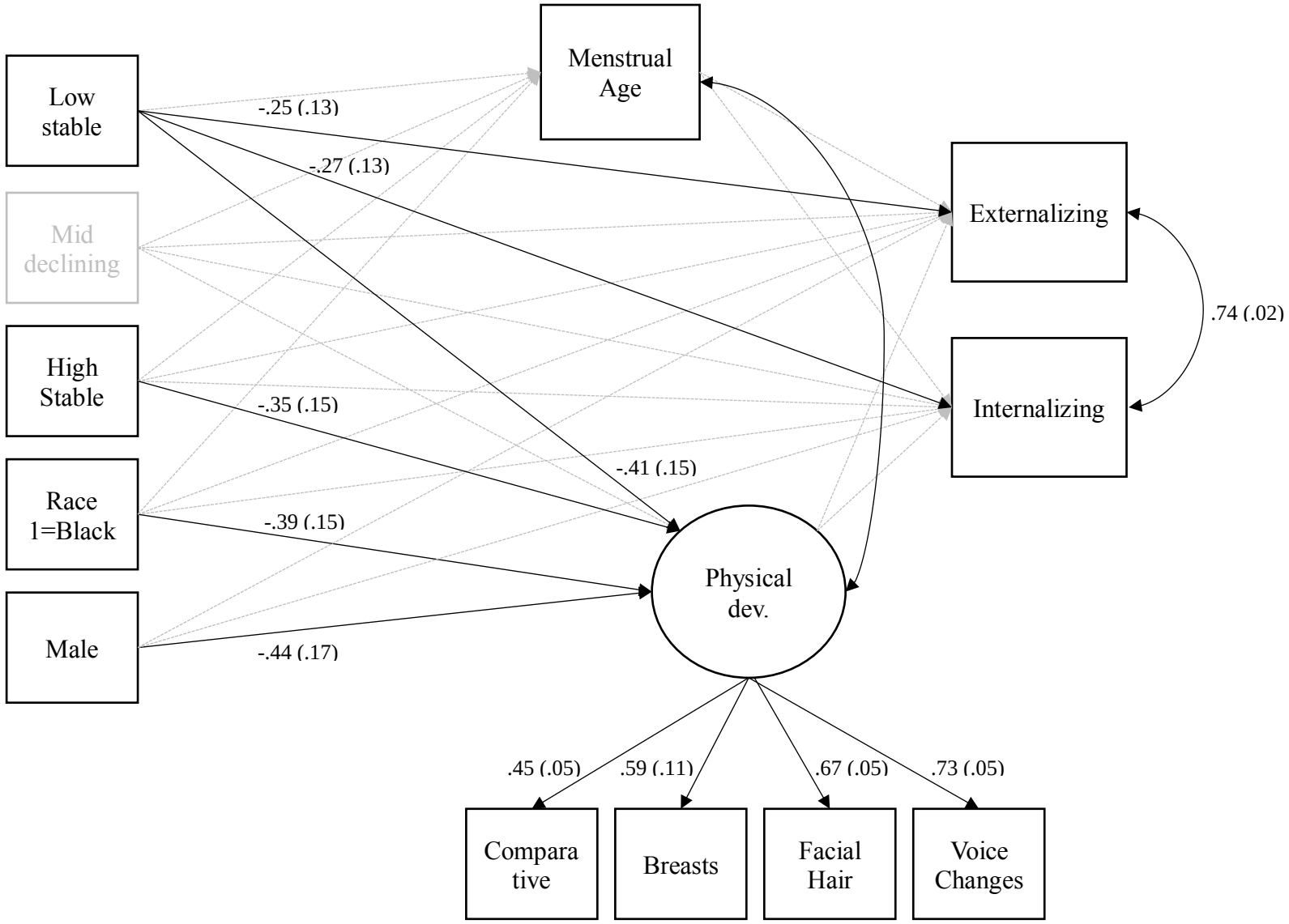

Figure 4 *SEM for adrenarche group (5-7 during Recession) with mid declining as reference category*

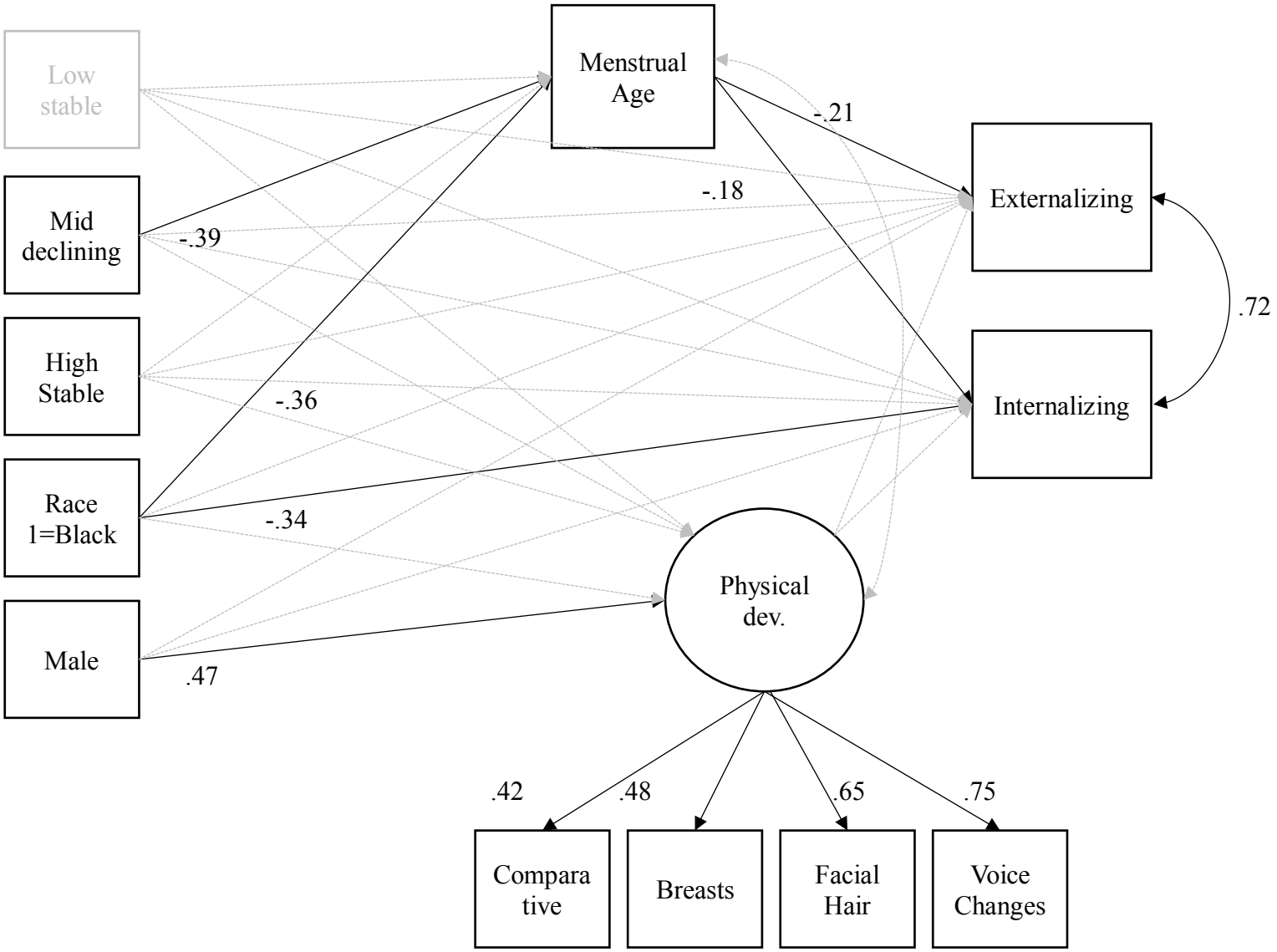

Figure 5a *SEM for older group (8-10 during Recession) with low stable as reference category*

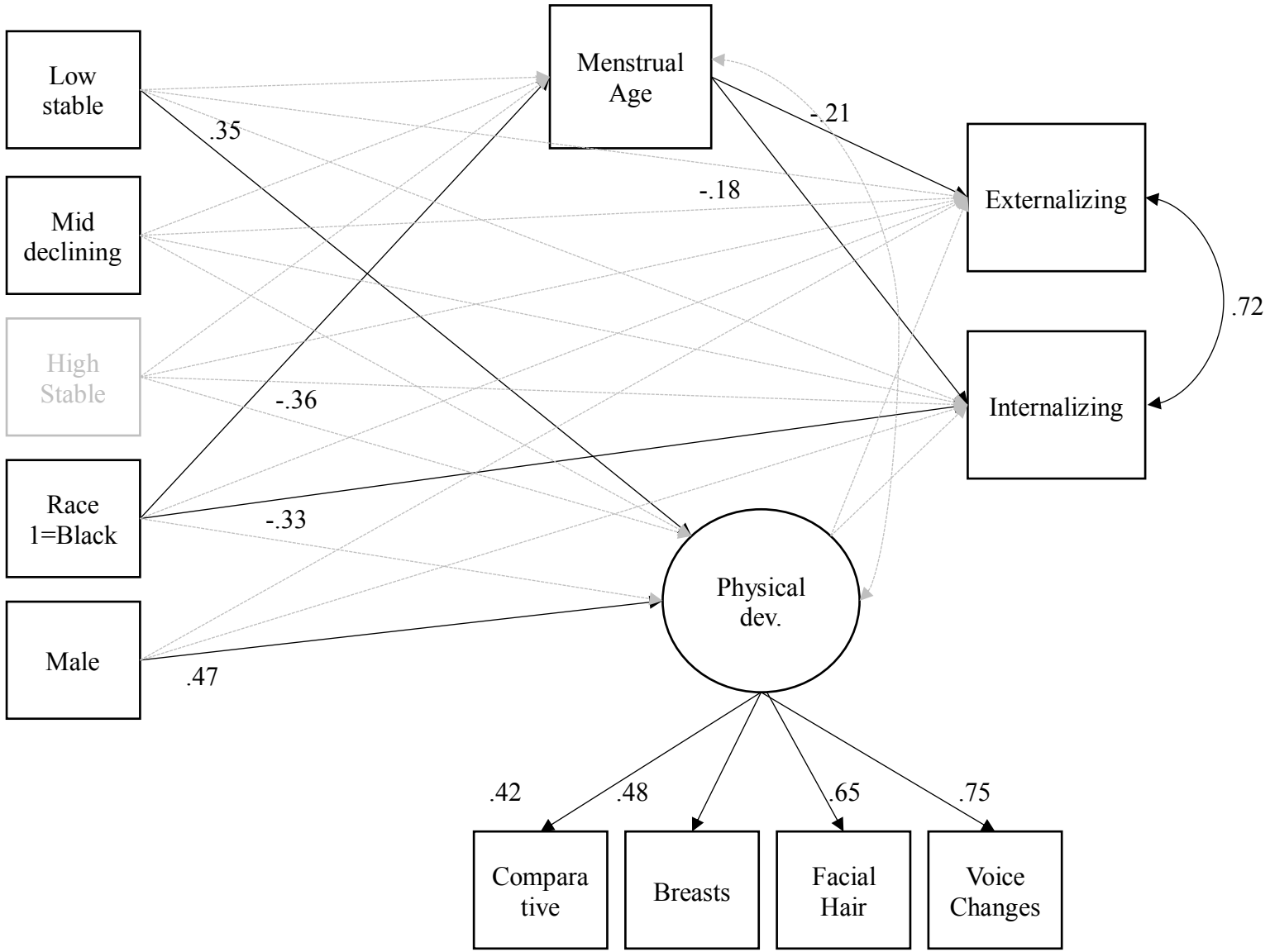

Figure 5b *SEM for older group (8-10 during Recession) with high stable as reference category*

APPENDIX

Study Measures and Questionnaires

Child Development Supplement
Physical Development Scale

for GIRLS only	for BOYS only
Have your breasts begun to grow? 1. Not yet started growing 2. Have barely started changing 3. Breast growth is definitely underway 4. Breast growth seems complete	Have you noticed a deepening of your voice? 1. Not yet started changing 2. Has barely started showing any changes 3. Voice change is definitely underway 4. Voice change seems complete
Have you begun to menstruate or get your period? Yes No If yes, how old were you when you first menstruated or got your period? Age in years	Have you begun to grow hair on your face? 1. Not yet started growing hair 2. Has barely started growing hair 3. Facial hair growth is definitely underway 4. Facial hair growth seems complete

for BOTH sexes

How advanced is your physical development compared to other [girls/boys] your age?

1. I look younger than most
2. I look younger than some
3. I look about average
4. I look older than some
5. I look older than most

Child Development Supplement
Behavior Problems Index (BPI)

Question	External	Internal
For the next set of statements, decide whether they are not true, sometimes true, or often true, of (CHILD)'s behavior. He/She…		
a (He/She) has sudden changes in mood or feeling.	X	
b (He/She) feels or complains that no one loves him/her.		X
c (He/She) is rather high strung and nervous.	X	X
d (He/She) cheats or tells lies.	X	
e (He/She) is too fearful or anxious.		X
f (He/She) argues too much	X	
g (He/She) has difficulty concentrating, cannot pay attention for long.	X	
h (He/She) is easily confused, seems to be in a fog.		X
i (He/She) bullies or is cruel or mean to others.	X	
j (He/She) is disobedient.	X	
k (He/She)does not seem to feel sorry after (he/she)misbehaves.	X	
l (He/She) has trouble getting along with other children	X	X
m (He/She) is impulsive, or acts without thinking.	X	
n (He/She) feels worthless or inferior.		X
o (He/She) is not liked by other children.		X
p (He/She) has difficulty getting (his/her) mind off certain thoughts.		X
q (He/She) is restless or overly active, cannot sit still	X	
r (He/She) is stubborn, sullen, or irritable.	X	
s (He/She) has a very strong temper and loses it easily.	X	
t (He/She) is unhappy, sad or depressed.		X
u (He/She) is withdrawn, does not get involved with others.		X
v (He/She) breaks things on purpose or deliberately destroys (his/her)own or another's things.	X	
w (He/She) clings to adults.		
x (He/She) cries too much.	X	
y (He/She) demands a lot of attention.	X	
z (He/She) is too dependent on others.		X
aa (He/She) feels others are out to get (him/her).		X
bb (He/She) hangs around with kids who get into trouble.		
cc (He/She)is secretive, keeps things to (himself/herself).		X
dd (He/She)worries too much.		X
Number of items	**17**	**14**
Cronbach's Alpha	**0.86**	**0.81**

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