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Childhood Socioeconomic Status: Distinct Correlates Of Specific Types Of Experience

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Abstract

Childhood socioeconomic status (SES) is often studied alongside a number of related constructs, such as subjective SES, race/ethnicity, and childhood maltreatment. At times, these and other constructs are considered together as measures of 'cumulative risk' or 'early life stress.' However, little is known about their similar or distinct impact on development. The present research was aimed at better understanding the ways that childhood SES and related constructs predict a range of developmental outcomes. Chapter 1 examined the relations between childhood SES, childhood maltreatment and the structure of the hippocampus and amygdala in young adulthood. Childhood maltreatment, but not childhood SES, predicted smaller hippocampal volumes. The research in Chapter 2 examined the relationship between childhood SES, race, and parent and teacher report of ADHD symptoms in two samples of school-aged children. Results showed that these relationships differed depending on whether parents or teachers were reporting symptoms: lower SES and African American race were associated with higher levels of symptoms as reported by teachers, but not by parents. Chapter 3 examined objective SES and subjective SES as predictors of academic achievement in a diverse sample of high school seniors. Analyses revealed that objective SES and subjective SES showed opposite relationships with achievement: while adolescents from higher SES backgrounds, as measured objectively, showed higher achievement on a range of measures, those who perceived themselves as higher SES earned lower grades and standardized test scores and were less likely to be enrolled full-time in college after high school. Collectively, these results suggest that childhood SES and related experiences show distinct relationships to a range of behavioral and neural outcomes.

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CHILDHOOD SOCIOECONOMIC STATUS: DISTINCT CORRELATES OF SPECIFIC TYPES OF EXPERIENCE

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ABSTRACT

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Childhood socioeconomic status (SES) is often studied alongside a number of related constructs, such as subjective SES, race/ethnicity, and childhood maltreatment. At times, these and other constructs are considered together as measures of 'cumulative risk' or 'early life stress.' However, little is known about their similar or distinct impact on development. The present research was aimed at better understanding the ways that childhood SES and related constructs predict a range of developmental outcomes. Chapter 1 examined the relations between childhood SES, childhood maltreatment and the structure of the hippocampus and amygdala in young adulthood. Childhood maltreatment, but not childhood SES, predicted smaller hippocampal volumes. The research in Chapter 2 examined the relationship between childhood SES, race, and parent and teacher report of ADHD symptoms in two samples of school-aged children. Results showed that these relationships differed depending on whether parents or teachers were reporting symptoms: lower SES and African American race were associated with higher levels of symptoms as reported by teachers, but not by parents. Chapter 3 examined objective SES and subjective SES as predictors of academic achievement in a diverse sample of high school seniors. Analyses revealed that objective SES and subjective SES showed opposite relationships with achievement: while adolescents from higher SES

backgrounds, as measured objectively, showed higher achievement on a range of measures, those who perceived themselves as higher SES earned lower grades and standardized test scores and were less likely to be enrolled full-time in college after high school. Collectively, these results suggest that childhood SES and related experiences show distinct relationships to a range of behavioral and neural outcomes.

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GENERAL INTRODUCTION

Childhood adversity is associated with a range of deleterious life outcomes, including risk for psychopathology, physical health problems, and low academic achievement (Evans, Li, & Whipple, 2013; Felitti et al., 1998; McLaughlin et al., 2012). Emerging evidence suggests that this may be in part because childhood disadvantage becomes embedded in biological systems (Miller, Chen, & Parker, 2011) and in neurobiological functioning (Hackman, Farah, & Meaney, 2010). Low socioeconomic status (SES) in childhood is one aspect of disadvantage that has received attention as a contributor to health and achievement disparities (e.g., Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010; Reardon, 2011; Reiss, 2013). At times, low SES and other forms of childhood adversity are considered together as measures of 'cumulative risk' or 'early life stress.' However, is becoming increasingly apparent that 'childhood disadvantage' may consist of a number of separate but related constructs, each of which show distinct relationships to distinct outcomes**.**

The term socioeconomic status (SES) is used to refer to a family's access to economic and social resources. Objective SES is typically estimated using verifiable indicators, including measures of income, educational attainment, and occupational prestige (Diemer, Mistry, Wadsworth, López, & Reimers, 2013). In the case of children, SES is typically measured using the education and occupation of the child's parents, as well as family income. Measures of childhood SES differ from 'childhood poverty' measures in that they capture the entire socioeconomic spectrum, and because factors such as education and occupation vary less from year to year than income (Diemer et al.,

2013). Importantly, childhood SES is generally considered a marker for a number of factors that vary along SES gradients, including exposure to stressors, parenting practices, school quality, and neighborhood characteristics (Hackman, Farah & Meaney, 2010).

Socioeconomic status may also influence development through one's perception of being relatively advantaged or disadvantaged. For instance, an individual who perceives himself as low SES, regardless of his objective education and income, may experience heightened stress and perceive less control over his environment, compared to a peer who perceives himself as relatively higher SES (e.g., Adler, Epel, Castellazzo, & Ickovics, 2000). This difference is captured by measures of subjective socioeconomic status, which rely on individuals' subjective reports of where they stand in the social hierarchy. Subjective SES is commonly measured using an instrument that presents a pictorial "social ladder" and asks the respondent to indicate their relative standing in society (Adler & Stewart, 2007). This dissertation examined the distinct roles of objective and subjective SES in students' academic achievement.

Additionally, childhood SES is often considered alongside other forms of childhood adversity such as childhood maltreatment, the experience of abuse and neglect during childhood. Indeed, poverty and maltreatment are sometimes considered together as 'early life stress' (e.g., Hanson et al., 2015), and it is often assumed that these forms of experience exert similar influences on development, both mediated by the effects of stress on the developing brain. However, there may be reason to believe that the experiences associated with childhood SES and maltreatment are qualitatively different,

varying in the intensity, duration and chronicity of stress exposure (e.g., McLaughlin, Sheridan, & Lambert, 2014). The dissertation work to follow used the anatomical sequelae of childhood SES and maltreatment to distinguish the effects of these factors.

Research on childhood SES also needs to carefully consider children's race/ethnicity. In the United States, race and ethnicity tend to be confounded with objective socioeconomic status, regardless of the SES measure used (LaVeist, 2005; Williams, Priest, & Anderson, 2016). Research generally finds that SES and race/ethnicity independently predict health and achievement outcomes (e.g., Duncan & Magnuson, 2005; LaVeist, 2005; Williams, Priest & Anderson, 2016), which is often attributed to the fact that racial minorities experience elevated rates of psychosocial stressors (Sternthal, Slopen, & Williams, 2011) and the added exposure to racism (Pager & Shepherd, 2008). However, it has also been argued that observed racial/ethnic differences may reflect unmeasured socioeconomic differences (Braveman et al., 2005).

While childhood SES and related constructs are clearly associated with disparities in broad outcomes such as 'health' and 'achievement,' it may also be valuable to identify more specific factors, such as neurocognitive systems, that vary with SES. These offer more precise targets for intervention and for the examination of specific environmental factors that mediate these disparities.

Further, the measurement of these outcomes matters. For instance, the way a neurocognitive system is measured, who reports on a child's behavior, or the specific measure of academic achievement examined all may be relevant to understanding the magnitude of and reasons for socioeconomic disparities. This dissertation examined the

effects of both race/ethnicity and SES on the measurement of symptoms of Attention Deficit Hyperactivity Disorder (ADHD).

Collectively, the current set of studies examined how childhood SES and related constructs predict a range of developmental outcomes. Chapter 1 investigated the relations between childhood SES, childhood maltreatment and the structure of the hippocampus and amygdala in young adulthood. Do childhood SES and maltreatment show a similar or distinct pattern of associations with these brain structures? Chapter 2 examined the relationship between child SES, child race and parent and teacher reports of ADHD symptoms in school-aged children being evaluated for ADHD. Do race and SES relate to ADHD symptom levels? Are the relations different depending on who is reporting on the symptoms? Finally, Chapter 3 examined objective SES and subjective SES as predictors of academic achievement in a diverse sample of high school seniors. Might objective and subjective SES relate to achievement in distinct ways?

CHAPTER 1: CHILDHOOD SOCIOECONOMIC STATUS AND CHILDHOOD MALTREATMENT: DISTINCT ASSOCIATIONS WITH BRAIN STRUCTURE

Abstract

The present study examined the relationship between childhood socioeconomic status, childhood maltreatment, and the volumes of the hippocampus and amygdala in early adulthood. We found that childhood maltreatment, but not childhood SES, related to smaller volumes of the left and right hippocampus. No relationship was observed between these factors and amygdala volume. Furthermore, when current SES and recent interpersonal stressful events were also considered, we found that recent interpersonal stressful events predicted smaller hippocampal volumes over and above childhood maltreatment. Finally, in exploratory analyses examining the interactions between these factors and sex, we found a significant sex by childhood SES interaction. Taken together, these results have a number of implications for our understanding of how different forms of adversity relate to brain structure.

Childhood poverty and maltreatment both have lasting effects on cognitive development and mental health. Although the two forms of adversity presumably differ from one another (Sheridan & McLaughlin, 2014), both have been explained by the effects of stress on the developing brain. In the case of maltreatment, both neglect and abuse would be expected to increase children's stress. In the case of poverty, insecurity related to food, shelter, safety and other concomitants of low socioeconomic status would also presumably increase stress. However, the experiences associated with childhood poverty and maltreatment differ in many ways, including the threat of harm, frequency of exposure, and chronicity (e.g., McLaughlin, Sheridan, & Lambert, 2014), and it may not be appropriate to assume that both sets of experiences affect the developing brain through the same mechanisms.

Growing literatures examine the structural correlates of childhood maltreatment during childhood and in adulthood (e.g., Hanson et al., 2015; Pechtel, Lyons-Ruth, Anderson, & Teicher, 2014; Samplin, Ikuta, Malhotra, Szeszko, & DeRosse, 2013; Teicher, Anderson, & Polcari, 2012). Similarly, the correlates of childhood poverty have been studied in the child and adult brain (e.g., Jednoróg et al., 2012; Luby et al., 2013; Noble et al., 2015; Staff et al., 2012). However, there is a dearth of studies directly comparing childhood maltreatment and childhood socioeconomic status (SES). Although there is ample evidence for the involvement of stress in both, more direct comparisons are needed to determine the extent to which these experiences affect brain development through similar or distinct pathways. The present study examines the association between childhood SES, childhood maltreatment and hippocampal and amygdala volume

in early adulthood in order to examine the similar or distinct correlates of childhood SES and maltreatment.

The most-studied aspect of brain structure in childhood adversity is the hippocampus, which is sensitive to stress experiences as well as playing a role in the regulation of the stress response (Lupien, McEwen, Gunnar, & Heim, 2009). Its neighbor in the medial temporal lobe, the amygdala, has also been found to correlate with childhood maltreatment and poverty in some studies (e.g., Hanson et al., 2015; Pechtel et al., 2014). We focus the present investigation on the volumes of these structures in early adulthood.

Concerning childhood maltreatment and the structural development of the hippocampus, a recent meta-analysis found that, across 49 studies of children and adults, experiences of maltreatment were associated with significantly reduced hippocampal volume (Riem, Alink, Out, Van Ijzendoorn, & Bakermans-Kranenburg, 2015). However, evidence of reduced hippocampal volume following childhood maltreatment is more consistent in adulthood (e.g., Samplin et al., 2013) than during childhood (e.g., McLaughlin et al., 2014; Sheridan, Fox, Zeanah, McLaughlin, & Nelson, 2012). Indeed, in the aforementioned meta-analysis, when studies of children and adults were examined separately, the overall effect size for studies of adults was significant, but the effect size for studies of children was not (Riem et al., 2015).

More recently, researchers have started to examine the relationship between childhood SES and hippocampal volume. The literature is remarkably consistent, showing smaller hippocampi in children living in lower SES environments (Hanson et al.,

2015; Hanson, Chandra, Wolfe, & Pollak, 2011; Jednoróg et al., 2012; Luby et al., 2013; Noble et al., 2015; Noble, Houston, Kan, & Sowell, 2012), a finding that has been interpreted in terms of the child's experienced stress (see Luby et al., 2013, for particularly direct evidence for this interpretation).

It is not clear, however, the extent to which these differences persist into adulthood. In a study of middle-aged adults, childhood poverty was unrelated to hippocampal volume, although financial hardship in adulthood did relate to smaller hippocampal volume (Butterworth, Cherbuin, Sachdev, & Anstey, 2012). However, another study observed a positive association between childhood SES and hippocampal volume in late adulthood (Staff et al., 2012). Consistent with the idea that SES differences in hippocampal volume may re-emerge in later adulthood, Noble et al. (2012) found that education moderated age-related decreases in hippocampal volume, such that differences in hippocampal volume associated with education were observed in older, but not younger, adults (Noble, Grieve, et al., 2012).

For the amygdala, findings on effect of childhood maltreatment are less consistent. Studies have reported larger amygdalae in children who experienced early institutional deprivation, which could be considered a form of child neglect (Mehta et al., 2009; Tottenham et al., 2010) and in adults with exposure to childhood maltreatment (Pechtel et al., 2014). Other reports have noted smaller amygdala in maltreated children (Edmiston, 2011; Hanson et al., 2015), and still others have reported no differences in amygdala volume associated with childhood maltreatment (McLaughlin, Sheridan, Winter, et al., 2014; Sheridan et al., 2012; van Harmelen et al., 2010).

Similarly, findings on childhood SES and amygdala volume are inconsistent. Published studies have found no significant relationship between SES and amygdala volume (Hanson et al., 2011; Noble et al., 2015), a negative correlation such that higher SES is associated with a smaller amygdala (Noble, Houston, et al., 2012), and a positive correlation such that higher SES is associated with a larger amygdala (Hanson et al., 2015; Luby et al., 2013).

While the neurobiological correlates of maltreatment and poverty have largely been considered separately, a recent study bridges these literatures by considering the structural correlates of both experiences, conceptualized as different forms of early life stress (Hanson et al., 2015). This study compared hippocampal and amygdala volumes among four groups: children who experienced early neglect, children who experienced physical abuse, children from low-SES households, and children who experienced none of these adversities. The three early life stress groups showed qualitatively similar reductions in the volume of the left and right hippocampus and the left amygdala, compared to the comparison sample. Further, for children exposed to any form of early life stress, higher levels of cumulative life stress predicted smaller volumes of the left amygdala and the hippocampus. These results suggest similar mechanisms are at work among these different forms of early life stress (Hanson et al., 2015).

The present study takes a different approach to the question of whether childhood maltreatment and low SES affect the brain by common or distinct mechanisms. We studied the neural correlates of childhood SES and childhood maltreatment in a single sample. Childhood SES and childhood maltreatment tend to be correlated in the general

population (e.g., Herrenkohl, Klika, Herrenkohl, Russo, & Dee, 2012), but are often examined separately, without controlling for the other. As such, the separate contribution of each construct to differences in brain structure, and the extent to which these factors operate similarly or differently, is not yet clear. To assess the lasting correlates of these potentially distinct factors, we measured childhood maltreatment and childhood SES in young adult participants. To assess the extent to which *childhood* maltreatment and SES are themselves distinct from similar experiences in adulthood, which would also be expected to influence the adult brain, we conducted additional analyses including measures of recent SES and interpersonal stressors. We employ structural MRI data from a socioeconomically diverse sample of young adults, an age range that has been understudied regarding childhood SES and brain structure. Based on the extensive literatures on stress and the hippocampus and amygdala, we focus on the volumes of these limbic structures, and examine the similar or distinct correlates of childhood SES and childhood maltreatment.

Method

Participants

The sample included $N = 46$ young adults (50% male) between the ages of 25 and 36 (mean age = 28.15; SD = 2.76) recruited from the Philadelphia area. Participants were recruited through advertisements on Facebook, Craigslist and flyers placed in public places around Philadelphia. The sample was intentionally recruited to have a wide range of current educational levels, from less than high school to graduate degrees. To avoid racial confounds, the sample was limited to participants who self-reported their race

Caucasian. 44 participants identified as non-Hispanic Caucasian, and 2 participants (both male) identified as Hispanic Caucasian

Individuals were also excluded from participation if they were pregnant, had a body mass index (BMI) over 40, reported contraindications to MRI scanning, had a history of any neurological disorder, experienced a traumatic brain injury or concussion with loss of consciousness, had ever received a diagnosis of bipolar disorder or any psychotic disorder or had ever taken an antipsychotic medication. Participants were also removed if they indicated excess drinking for more than 6 months (3 drinks per day for men, 2 drinks per day for women) or use of any drug other than cannabis more than 6 times.

Two subjects who completed the scan were excluded from the sample. In one case, an incidental finding that required medical follow-up was discovered. In the second case, the participant's behavior was erratic (e.g., illogical and incoherent speech) and elicited concern from the MRI technician. Results were similar when these subjects were included.

Measures

Childhood SES. Three components of childhood socioeconomic status were measured: parental education, parental occupational prestige, and childhood financial circumstances. These variables were *z*-standardized and averaged to create a childhood SES composite measure.

Parental education. Participants reported on the educational attainment of their parents/guardians at the time they were born. Each parent's education level was assigned

a value from 1 to 6 (Less than High School = 1, High School = 2, General Education Diploma (GED) = 3, Some College/Associates Degree = 4, 4-year College Degree = 5, Graduate Level = 6). Educational levels for the first and second parent/guardian were *z*-standardized and were averaged to compute the parental education variable. When a participant reported that there was no second parent/guardian, the *z*-standardized education level of the first parent/guardian was used. For 44 subjects (95.7%) the first parent/guardian was a mother. For 36 subjects (78.3%) the second parent/guardian was a father.

Parental occupation. In a semi-structured interview, participants described each parent/guardians occupation during the first 5 years of the child's life. Occupations were scored using the Hollingshead index (Hollingshead, 1975). Occupational prestige scores for the first and second parent/guardian were *z*-standardized and were averaged to compute the parental occupation variable.

Childhood financial circumstances. Childhood financial circumstances were measured by five questions. Three questions ("My family usually had enough money for things when I was growing up," "I grew up in a relatively wealthy neighborhood," and "I felt relatively wealthy compared to other kids in my school") were answered on a 7-point Likert scale (Singh-Manoux, Richards, & Marmot, 2005). Two questions ("When you were a child, was your father or mother unemployed when they wanted to be working?" "When you were a child, did your family have continuing financial problems?") were answered with yes/no (Yanagisawa et al., 2013). Scores for each question were *z*-standardized and reverse scored as appropriate such that higher scores indicate higher

levels of childhood financial security and the five questions were averaged together to compute the childhood financial circumstances variable. The scale had good internal consistency ($\alpha = .81$). An additional yes/no question ("When you were a child, did your family have a car?") was included in the questionnaire but removed from the final scale because of a low item-total correlation ($r = .25$).

Childhood maltreatment. Participants completed the Adverse Childhood Experiences (ACE; Felitti et al., 1998) questionnaire, which asks individuals to indicate whether or not they experienced each of ten possible adverse events as a child. Not all of these adverse events constitute maltreatment. Therefore, a subset of the ACE questions was used to measure childhood maltreatment, specifically the six items that assess childhood abuse, neglect, or exposure to domestic violence. In order to reduce violation of normality assumptions, this variable was square root transformed for use in analyses.

Current SES. Two components of current socioeconomic status were measured: current educational attainment and current financial security. These variables were *z*-standardized and averaged to create an adulthood SES composite measure. Current SES was measured in as similar of a way to childhood SES as possible, given that the construct of SES differs between childhood and adulthood.

Current education. Participants reported on their current educational attainment. Each individual's education level was assigned a value from 1 to 6 (Less than High School = 1, High School = 2, General Education Diploma (GED) = 3, Some College/Associates Degree = 4, 4-year College Degree = 5, Graduate Level = 6).

Financial security. Participants completed a questionnaire assessing their current level of financial strain. Six questions, all of which indicated current difficulty affording necessities and have been used in prior studies of financial strain, were used. Five questions ("How hard is it for you and your family to pay for the basics like food, medical care, and heating?" "How well does your income cover your needs?" "How difficult have you found paying bills lately?" "In the past two years, how often have you decided not to buy something you or your family needed because you couldn't afford it?" and "In the past two years, how often have you borrowed money from family or friends to pay bills or to make ends meet?") were answered on four-point Likert scales (McLoyd, Jayaratne, Ceballo, & Borquez, 1994; Puterman, Adler, Matthews, & Epel, 2012; Szanton, Thorpe, & Whitfield, 2010). Scores for each question were *z*-standardized and reverse scored as appropriate such that higher scores indicate higher levels of financial security; the six questions were then averaged together to compute the current financial security variable. The scale had excellent internal consistency ($\alpha = .97$).

Recent negative interpersonal events. Participants completed a modified version of the Life Events Questionnaire (Sarason, Johnson, & Siegel, 1978). This measure provided a list of 44 major life events (e.g., death of a close family member, major personal illness or injury); participants were instructed to indicate whether each event had occurred to them in the past year, and, if so, to rate the impact it had on their lives (on a 7-point Likert scale from extremely negative to extremely positive). We obtained a negative events score by summing the impact rating for those events rated as having a negative impact by the subject. Additionally, we created a negative

interpersonal events score by calculating the negative events score for the subsample of 21 events that are inherently interpersonal in nature. This score was used in analyses in order to use a measure that is as comparable as possible to childhood maltreatment, which is inherently interpersonal in nature. Results were similar when the total negative events score was used.

Covariates. Four variables that might reasonably be expected to correlate with hippocampal or amygdala volume include age, sex, BMI and total brain volume. The inclusion of total brain volume as a control variable allows us to examine specific associations between the factors examined and our regions of interest, above and beyond any more global effects. To assess the effects of childhood maltreatment and childhood SES independent of these factors, they served as covariates in the analyses to be reported. In secondary analyses to be reported, the interaction of sex with maltreatment and SES is also considered.

Image Processing

All images were acquired on a Siemens Trio 3.0 Tesla MRI scanner. At the start of each scanning session, patient position was determined using a rapid coronal T1-weighted scan. This was followed by a T1-weighted structural scan with TR (repetition time) = 1810 ms, TE (echo time) = 3.51 ms, slice thickness: 1 mm, in-plane resolution: 0.9375 x 0.9375 mm and field of view (FOV) 192 x 256 x 160 mm.

The T1 imaging data were preprocessed using the open-source Advanced Normalization Tools (ANTs; Avants et al., 2011). The provided antsCorticalThickess.sh script performed automated brain extraction as well as inhomogeneity correction

(Tustison et al., 2010). The right and left hippocampus was segmented using multi-atlas label fusion with error correction (Wang et al., 2011), implemented as the AHEAD tool (https://www.nitrc.org/projects/ahead/). AHEAD includes a library of manually segmented hippocampi to label individual subjects via image registration and joint label fusion. The error correction is specialized for hippocampus only. For the amygdala segmentation, we used a general label fusion algorithm implemented in ANTs. The atlases for this procedure were 24 healthy adults from the OASIS project (Marcus et al., 2007), segmented manually by Neuromorphometrics, Inc. (http://Neuromorphometrics.com/) and provided under academic subscription as part of a segmentation workshop (https://masi.vuse.vanderbilt.edu/workshop2012/index.php/Main_Page). We selected the youngest 24 of the 30 available atlases, to better match the age of the subjects in this study. The subset consists of 16 females and 8 males (mean age = 25; range 18-45).

The automated segmentations were reviewed and corrected manually. This resulted in edits to hippocampus segmentations for 7 individuals and amygdala segmentations for 5 individuals. The median volume change after editing was 2% for both structures.

Statistical Approach

Analyses used hierarchical linear regression to predict volume in each region of interest. Two-tailed *p* values are reported. Control variables (age, sex, BMI, total brain volume) were entered in Step 1. In Step 2, Childhood SES and childhood maltreatment were added separately, and then examined simultaneously.

Next, to examine the specific importance of *childhood* SES and maltreatment, independent from current SES and recent stress, we repeated the Step 2 models also including current SES and recent negative interpersonal events as current covariates. To examine the possibility that maltreatment exacerbates the effect of recent stress on the hippocampus and amygdala (e.g., consistent with the stress sensitization model; Hammen, Henry & Daley, 2000), we also estimated exploratory models including an interaction between recent negative interpersonal events and childhood maltreatment.

Finally, in Step 3, interaction terms between the variables of interest and sex were added. When a significant interaction was identified, regression models were estimated separately for each sex group.

Results

Participant Characteristics

The sample was diverse in terms of both childhood SES and maltreatment exposure. Not surprisingly, given that participants were recruited to have widely varying adult SES as measured by educational attainment, the childhood SES of these participants also varied widely. The mean Hollingshead occupation score for the first parent/guardian was 5.44 (*SD* = 1.86; range: 1 to 8) and the mean Hollingshead occupation score for the second parent/guardian was 5.63 (*SD* = 2.51; range 1 to 9). 45.7% of first parent/guardians and 39.1% of second parent/guardian's did not have educational attainment beyond a high school degree. Childhood maltreatment, abuse and exposure to domestic violence also varied in this sample, with 47% of the sample endorsing one or

more items from the 6-item abridged ACE questionnaire. Descriptive statistics are displayed in Table 1.

Correlations

Correlations between the variables of interest and covariates are displayed in Table 2. Note that childhood SES and childhood maltreatment, whose distinctive effects we are examining, are only weakly correlated (r = -.28, p = .06).

Regression Results

Main effects.

Hippocampus. When childhood SES was added to the model along with covariates (age, sex, BMI, total brain volume), childhood SES did not significantly predict volume of the left hippocampus (β = .06, p = .62) or right hippocampus (β = .14, p = .21). In the model with childhood maltreatment and covariates, higher levels of childhood maltreatment significantly predicted smaller volumes of the left hippocampus (β = -.27, p = .03) and the right hippocampus (β = -.24, p = .03). Similarly, when childhood SES and childhood maltreatment were added to the model simultaneously, childhood SES did not significantly relate to the volume of the left or right hippocampus, but higher levels of childhood maltreatment significantly predicted smaller volume of the left hippocampus (β = -.28, p = .03) and the right hippocampus (β = -.22, p = .048). These results are shown in Table 3.

Amygdala. Neither childhood SES nor childhood maltreatment related to the volume of the amygdala, either alone or in the fully adjusted model. These results are shown in Table 3.

Role of current SES and recent stress exposure.

Hippocampus. Table 4 shows the results of analyses in which current SES and recent negative interpersonal events were added to the model along with childhood SES and childhood maltreatment and covariates. Recent negative interpersonal events had a significant negative relationship with the volume of the right hippocampus (β = -.29, p = .02) and a marginally significant negative relationship with the volume of the left hippocampus (β = -.26, p = .06). Current SES was not significantly associated with left (β = .19, p = .19) or right (β = .19, p = .13) hippocampal volume. Childhood maltreatment remained a significant negative predictor of hippocampal volume for the left and right hippocampus when these covariates were included in the model. Scatterplots of the relation between childhood maltreatment and left and right hippocampal volume are shown in Figure 1.

We also examined the interaction between recent negative interpersonal events and childhood maltreatment. This interaction term did not significantly predict hippocampal volume.

Amygdala. Using the same covariates, recent negative interpersonal events had a marginally significant positive relationship with the volume of the right amygdala (β = .21, p = .08) and did not predict the volume of the left amygdala (β = .02, p = .18). Current SES did not predict the volume of the right (β = -.22, p = .10) or left (β = -.10, p = .48) amygdala. These results are shown in Table 4.

We also examined the interaction between recent negative interpersonal events and childhood maltreatment. This interaction term did not significantly predict volume of the amygdala.

Sex interaction. Given the robust evidence for SES effects on hippocampal volume in childhood, we were somewhat surprised by the absence of a childhood SES effect on the hippocampus in the present data. To more thoroughly assess this relationship we examined it as a function of sex.

Hippocampus. We next added interaction terms for sex with each of the four variables of interest (childhood SES, childhood maltreatment, current SES, recent negative interpersonal events). The interaction between sex and childhood SES was significant for the model predicting left hippocampal ($\beta = -.42$, $p = .01$) and right hippocampal ($\beta = -.32$, $p = .03$) volume. The interaction terms between sex and childhood maltreatment, current SES, and recent negative interpersonal events were not significant. These results are shown in Table 4.

Sex subgroups were then examined separately. In the female subgroup, childhood SES was not significantly related to right ($\beta = .27$, $p = .11$) or left ($\beta = .25$, $p = .20$) hippocampal volumes. In the male subgroup, childhood SES had no significant relationship to right hippocampal volume ($\beta = -.32$, $p = .15$) and a marginally significant negative relationship to left hippocampal volume ($\beta = -.43$, $p = .08$). Scatterplots of the relation between childhood SES and left and right hippocampal volume, split by sex group, are shown in Figure 2.

Amygdala. For completeness we used the same model, with sex interactions, to predict amygdala volume. Both the interaction between sex and current SES (β = .42, *p* = .04) and the interaction between sex and childhood maltreatment (β = -.30, *p* = .03) were significant for the model predicting the right amygdala. None of the interaction terms significantly predicted the volume of the left amygdala. These results are shown in Table 4.

In the female subgroup, current SES had a significant negative relationship to the left amygdala volume (β = -.48, *p* = .03). In the male subgroup, current SES did not relate to the left amygdala volume (β = .21, *p* = .43).

Discussion

Low SES and maltreatment reduce children's hippocampal volume, a parallel that has been attributed to the role of stress in both. In the present study we found evidence that these effects of childhood experience diverge in adulthood. Only childhood maltreatment showed a main effect on hippocampal volume and only childhood SES showed an interaction with sex. These differing patterns of relationship, in the same sample of participants, suggest that the two forms of childhood adversity relate to brain structure through distinctive mechanisms.

Recent interpersonal stress in adulthood, in addition to childhood maltreatment, was associated with smaller hippocampal volumes. Most evidence linking adulthood stress to hippocampal volume comes from samples with stress-related psychopathology (Lupien et al., 2009). An important exception to this is a study by Gianaros and colleagues (2007), in which they found that chronic life stress was associated with

decreased grey matter volume in the right hippocampus in a sample of healthy postmenopausal women (Gianaros et al., 2007). The current results extend these findings by showing an association between recent stressful life events and hippocampal volume (again on the right, although borderline significant on the left as well) in a sample of healthy young men and women.

While the results regarding interactions with sex emerged from an exploratory analysis, the finding that childhood SES and sex interact to predict hippocampal volume is interesting in light of other work on sex differences in the development of stress regulation systems and the associated neurobiology. The absence of main effects on amygdala volume is not unexpected, given the inconsistences in the literature reviewed earlier. Although Hanson et al. (2015) found that automatically segmented amygdala volumes did not reveal relationships with early life stress, manually corrected segmentations were used in the present study, giving the present null results more weight.

These results also speak to important questions about the impact of the timing of adverse experiences. Does childhood adversity, independently from adversity in adulthood, shape adulthood outcomes? Is childhood is a period of particular vulnerability to adversity? Does childhood adversity potentiate the impact of adulthood stress? While the current study is not designed to answer these questions conclusively, the results are most consistent with a model in which childhood and adulthood stress independently shape brain structure in early adulthood. Indeed, we observed significant main effects of childhood maltreatment and recent stress, but not an interaction between these factors.

While there are a number of compelling similarities between outcomes after childhood poverty and childhood maltreatment (e.g., Hanson et al., 2015), the current results support the possibility that these forms of early life stress may operate through distinctive mechanisms. Indeed, maltreatment and poverty may have distinct associations with a number of experiences, such as the intensity and duration of threat exposure, and the amount of nurturance and cognitive stimulation received. For example, maltreatment may be uniquely associated with the intense and overwhelming threat that has been shown in animal models to impact hippocampal development (e.g., Ivy et al., 2010), whereas poverty may a marker for the experience of chronic but lower intensity stressors as well as a lack of exposure to cognitively complex environments (McLaughlin, Sheridan, & Lambert, 2014). Future research should examine potential mechanisms by measuring these proximal factors, in addition to childhood SES and maltreatment.

There are a number of limitations to the current study. First, the measures used for childhood SES and childhood maltreatment differed from the measures used for adulthood SES and adulthood interpersonal stressors. As such, it was not possible to conclusively separate the effects of the timing of SES and stress experiences from the impact of the measurement approach. However, it is important to note that the experiences related to SES and maltreatment/interpersonal stress are inherently distinct between childhood and adulthood; as such, it is appropriate to measure these constructs differently. Similarly, it is possible that childhood maltreatment may have been measured with more reliability than childhood SES. Importantly, however, more items were used in the measurement of childhood SES than childhood maltreatment.

The current study used data from a single time point, a limitation that precludes strong conclusions about the developmental trajectory of brain development in relation to childhood and adulthood adversity. Finally, the study is limited by its relatively small sample size and the associated limited power. This is a particular concern when interpreting null results (e.g., the lack of main effect observed between childhood SES and hippocampal volume); however, it is important to note that, in the same model with the same sample, childhood maltreatment did relate to hippocampal volume.

Despite these limitations, the current study advances the literature on early life stress and brain development by measuring childhood maltreatment and childhood SES within the same young adult sample, which encompassed an unusually wide SES range. The results suggest that childhood maltreatment and SES likely impact the brain through distinct pathways.

Tables

Table 1

Sample Characteristics

Variable	***n* (%)**
First parent/guardian education	
Less than High School	3 (6.5)
GED	1 (2.2)
High School Graduate	17 (37.0)
Some College or Associates Degree	7 (15.2)
4-Year College Degree	17 (37.0)
Graduate Degree	1 (2.2)
Second parent/guardian education	
Less than High School	2 (4.3)
GED	3 (6.5)
High School Graduate	13 (28.3)
Some College or Associates Degree	6 (13.0)
4-Year College Degree	14 (30.4)
Graduate Degree	4 (8.7)
No secondary caregiver or unknown	4 (8.7)
Maltreatment score	
0	29 (63.0)
1	6 (13.0)
2	5 (10.9)
3 or greater	6 (13.0)

Note. GED = General Education Diploma

Table 2

Correlations

Indicator	1	2	3	4	5	6	7	8	9	10	11	12
1. Childhood SES	1											
2. Childhood maltreatment	-.28+	1										
3. Current SES	.27+	-.36*	1									
4. Recent negative interpersonal events	.11	-.22	.53**	1								
5. Male	.35*	-.18	-.24	-.15	1							
6. Age	.05	.33*	-.28+	-.07	.17	1						
7. Body mass index	-.12	.19	-.06	.13	.01	.42**	1					
8. Brain volume	.24	-.12	-.11	.09	.60**	.03	-.05	1				
9. Volume of the left hippocampus	.23	-.30*	.03	-.03	.48**	.09	.07	.68**	1			
10. Volume of the right hippocampus	.31*	-.29+	.04	-.03	.51**	.04	.03	.77**	.89**	1		
11. Volume of the left amygdala	.17	-.16	-.14	.06	.52**	.04	.07	.74**	.68**	.70**	1	
12. Volume of the right amygdala	.16	-.18	-.23	.09	.66**	.07	-.06	.73**	.55**	.63**	.88**	1

Note. SES = socioeconomic status.

*$p < .05$. **$p < .01$ +$p < .1$

Table 3

Hierarchical Linear Regression Models With Childhood SES, Childhood Maltreatment

	Region of interest							
	Left hippocampus		Right hippocampus		Left amygdala		Right amygdala	
Predictor	Δ R^2	β	Δ R^2	β	Δ R^2	β	Δ R^2	β
Step 1	.48**		.60**		.57**		.61**	
Control variables								
Step 2	.06+		.05+		.01		.02	
Childhood SES		-.01		.08		-.05		-.13
Childhood maltreatment		-.28*		-.22*		-.09		-.10
Total R^2	.54**		.65**		.58**		.63**	
N	46		46		46		46	

and Control Variables

Note. SES = Socioeconomic Status.

** $p < .01$ * $p < .05$ + $p < .1$

Table 4

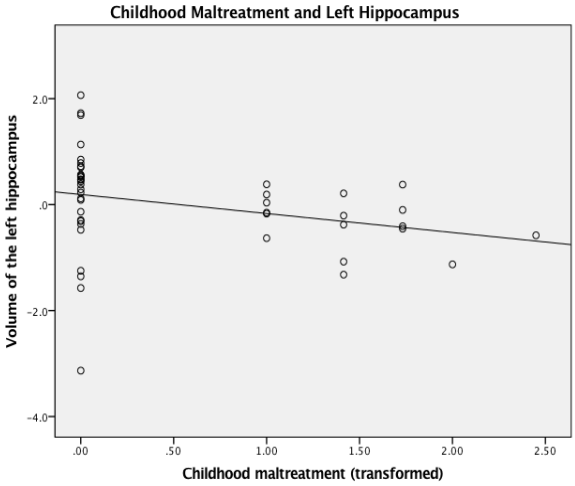
Hierarchical Linear Regression Models With Childhood SES, Childhood Maltreatment, Current SES, Recent Negative Interpersonal Events, Interactions With Sex and Control Variables

	Region of interest							
	Left hippocampus		Right hippocampus		Left amygdala		Right amygdala	
Predictor	Δ R^2	β	Δ R^2	β	Δ R^2	β	Δ R^2	β
Step 1	.48**		.59**		.57**		.61**	
Control variables								
Step 2	.11+		.11*		.01		.05	
Childhood SES		-.04		.06		-.02		-.09
Childhood maltreatment		-.29*		-.24*		-.12		-.11
Current SES		.19		.20		-.10		-.22
Recent negative interpersonal events		-.26+		-.29*		.02		.21+
Step 3	.10+		.05		.05		.06	
Sex x Childhood SES		-.42*		-.32*		-.15		-.03
Sex x Childhood maltreatment		-.05		-.04		.23		.30*
Sex x Current SES		-.10		.25		-.15		.41*
Sex x Recent negative interpersonal events		.52		-.21		-.04		-.38
Total R^2	.68**		.75**		.77**		.73**	
N	46		46		46		46	

Note. SES = Socioeconomic Status.
** $p < .01$ * $p < .05$ + $p <$

Figures

a)



b)

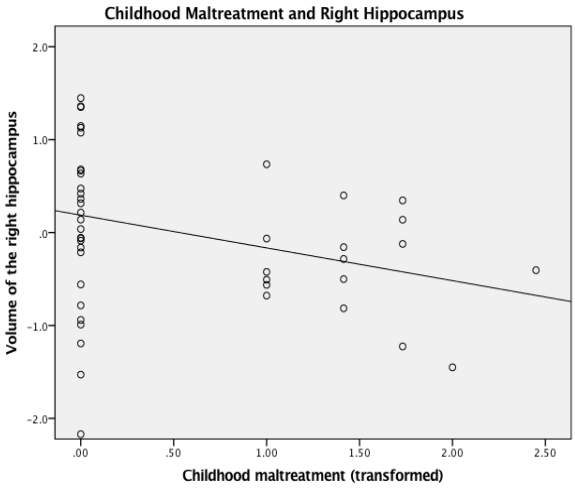


Figure 1. Childhood Maltreatment Predicting Hippocampal Volume. (a) Plot of childhood maltreatment predicting standardized left hippocampal volumes, controlling for childhood SES, current SES, recent negative interpersonal events, sex, age, total brain volume, and BMI (n = 46) (b) Plot of childhood maltreatment predicting standardized right hippocampal volumes, controlling for childhood SES, current SES, recent negative interpersonal events, sex, age, total brain volume, and BMI (n = 46).

a) b)

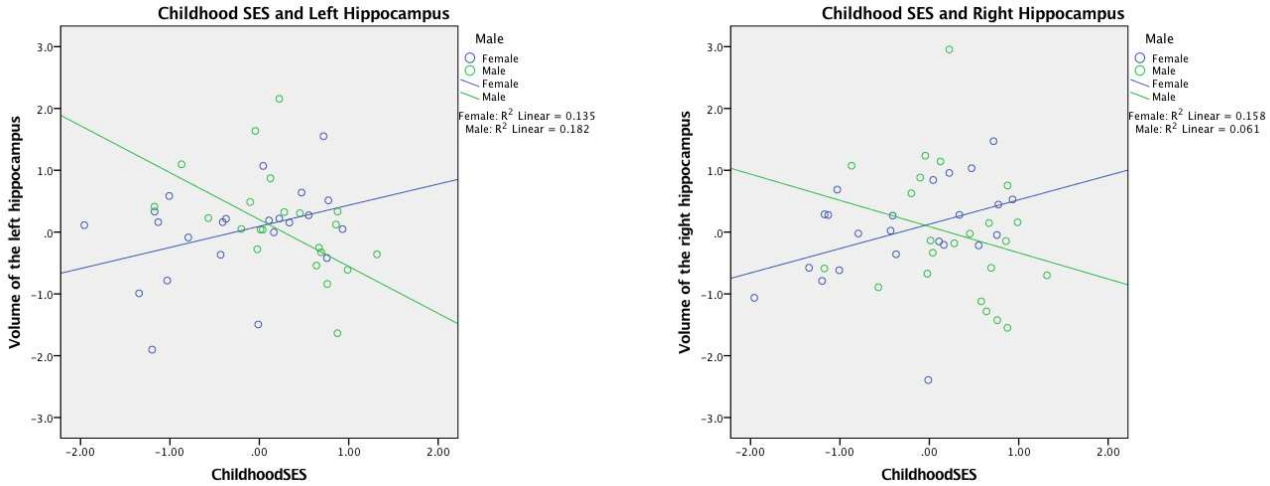


Figure 2. Sex X Childhood SES Predicting Hippocampal Volume. (a) Plot of childhood SES predicting standardized left hippocampal volume, split by sex group, controlling for childhood maltreatment, current SES, recent negative interpersonal events, age, total brain volume, and BMI (n = 46) (b) Plot of childhood SES predicting standardized right hippocampal volume, split by sex group, controlling for childhood maltreatment, current SES, recent negative interpersonal events, age, total brain volume, and BMI (n = 46)

CHAPTER 2: DO PARENT AND TEACHER REPORT OF ADHD SYMPTOMS IN CHILDREN DIFFER BY SES AND RACE?

Abstract

Parent and teacher reports of symptoms of ADHD in children often differ from each other. These informant report differences may occur in systematic ways that vary by child SES and race, but little is known about how SES and race relate to parent and teacher report of ADHD symptoms in school-aged children. We examined the relationship between child SES, child race and parent and teacher reports of ADHD symptoms in two samples of school-aged Caucasian and African American children being evaluated for ADHD (N = 1056; N = 317). Multivariate regression was used to predict parent and teacher reports of ADHD symptoms from child SES, race, age and sex. The Wald test of parameter constraints was used to test the contrast between the predictors of interest and parent and teacher report of symptoms. In the second sample, we also examined observer report measures of ADHD symptoms during one-to-one testing and in the classroom. In both samples, lower SES was associated with higher levels of inattention symptoms, as reported by teachers, but not by parents. Lower SES was also associated with higher levels of hyperactivity/impulsivity symptoms, as reported by both teachers and parents. In both samples, African American race was associated with higher levels of inattention and hyperactivity/impulsivity symptoms reported by teachers than reported by parents. Investigating how children's SES and race influence cross-informant agreement on ratings of children's behavior may lead to the development of better assessment practices and more accurate diagnoses for diverse child populations.

The use of multiple informants' reports in the diagnostic evaluation of Attention Deficit Hyperactivity Disorder (ADHD) is highly valued and has become standard practice. However, concordance between parent- and teacher- reports of ADHD symptoms among community and clinic-referred samples of children is typically relatively poor (e.g., Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000; Wolraich et al., 2004), consistent with general findings of significantly lower cross-informant agreement for different types of informants (e.g., parents versus teachers) than for similar types of informants (e.g., two parents or two teachers; Achenbach, McConaughy, & Howell, 1987). Discrepancies among informant's reports present substantial challenges for research, as conclusions drawn using one informant's report may conflict with conclusions drawn using another informant's report (De Los Reyes et al., 2011), as well as clinical practice, as the diagnosis given may differ depending on the approach used to integrate informant's reports (Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000).

Recent evidence suggests that informant discrepancies reflect more than measurement error (Achenbach, 2011; De Los Reyes et al., 2015). Instead, they may indicate true situational differences in behaviors (e.g., inattentive behaviors at school but not at home) and/or meaningful differences in informants' perceptions of the behaviors. According to the Attribution Bias Context (ABC) model, informants have different attributions about the causes of a child's problem and different perspectives about whether or which of a child's behaviors warrant treatment; when an informant is reporting on a child's behavior, these attributions and perspectives may affect what information is recalled from memory and how it is interpreted (De Los Reyes & Kazdin,

2005). As such, it may be expected that differences between parent and teacher report of children's symptoms vary in systematic ways.

In particular, the social and cultural context in which a child lives, including the socioeconomic status (SES) and race/ethnicity of a child, may play an important role in explaining informant differences in symptom ratings. These contextual factors may affect children's behavior in home or school settings (i.e., true situational differences), as well as informants' perceptions of the same behavior. For example, stressful conditions at home may lead to children from lower SES families showing more externalizing behaviors at home as compared to at school (e.g., Harvey, Fischer, Weieneth, Hurwitz, & Sayer, 2013), a true situational difference in behavior. Alternatively, stressful conditions may affect parent's expectations for, interpretations of, or tolerance of the child's behavior (e.g., Stone, Speltz, Collett, & Werler, 2013), creating a difference in informant's perceptions.

The present study examined the relationships between SES, race, and the level of agreement or disagreement between parent and teacher ratings of symptoms of ADHD. Examining relations between SES and race and inter-informant agreement is important for several reasons. First, identifying the demographic predictors of informant differences provides a foundation for generating and testing hypotheses about reasons for these differences (including true situational differences in children's behavior and differences in informant's perceptions). It also provides a basis for future studies examining more proximal factors (e.g., parenting stress) that may influence behavior expression or reporting patterns. Furthermore, evidence suggests that ADHD may be

under-identified among minority children (e.g., Miller, Nigg, & Miller, 2009). Lower levels of cross-informant agreement for ratings of behavior of minority or low-SES children may contribute to the under-identification and treatment of ADHD for these children. Thus, determining how children's SES and race influence cross-informant agreement on ratings of children's behavior may provide important practical information to improve assessment practices and contribute to more accurate diagnoses in diverse populations.

In their meta-analyses, Achenbach et al. (1987) found significantly higher levels of cross-informant agreement for parent and teacher ratings of "undercontrolled" (externalizing) behavior than for "overcontrolled" (internalizing) behavior. Additional evidence suggests that patterns of discrepancies between parent and teacher reports of externalizing symptoms may differ by race. Using data from the Pittsburgh Youth Study, Youngstrom, Loeber, and Stouthamer-Loeber (2000) calculated parent minus teacher difference scores for internalizing and externalizing problems as reported on the Achenbach Child Behavior Checklist (Achenbach, 1991a) and Teacher Report Form (Achenbach, 1991b). They found that difference scores between parent and teacher reports of externalizing problems differed by race. Teachers rated African American youth, compared to Caucasian youth, as showing more externalizing behaviors than reported by parents. Lau et al. (2004) extended these findings by utilizing a sample of youth ages 11 to 17 years; they found that teachers of African American youth, compared to those from the other racial groups, reported higher externalizing problems compared to parents. There were no significant effects of race on internalizing difference scores (Lau

et al., 2004; Youngstrom, Loeber, & Stouthamer-Loeber, 2000).

Additionally, Stone and colleagues (2013) examined SES in relation to discrepancies on parent and teacher reports of internalizing and externalizing symptoms in a community sample of 5-12 year-old children. They found that lower family income was associated with higher odds of discrepancies in which mothers reported higher symptom levels than teachers for both internalizing and externalizing problems.

More relevant to the issue of differences between informants' report of ADHD symptoms, several recent studies have examined the relationship between race or SES and discrepancies between informants' reports of hyperactivity and inattention symptoms. However, to the best of our knowledge, current evidence is limited to early childhood samples. Phillips & Lonigan (2010) compared parent and teacher reports of hyperactivity and inattention among 3- and 4-year old children in classrooms serving predominantly children from low-income or middle-income families. They found that parent-teacher agreement was lower for children from the low-income group than for children from the middle-income group for both hyperactivity and inattention symptoms. In particular, teacher ratings of inattention and impulsivity were significantly higher for children in the low-income group than in the middle-income group, but parent ratings did not significantly differ between the low-income and middle-income groups. Another study examined predictors of discrepancies between parent and teacher ratings of 3-year-old children's attention problems and hyperactivity. They found that African American mothers were more likely to rate their children lower on hyperactivity and attention problems than did teachers, but Latina mothers were more likely to rate their children

higher on hyperactivity than did teachers. In this sample, family SES did not emerge as a significant predictor of informant discrepancies (Harvey et al., 2013), although this may have been due to a relatively small sample size ($N = 125$ with measures from the mother and teacher) or a relatively limited SES range.

The above studies provide initial evidence that children's SES and race may relate to differences in informant report of ADHD symptoms, but several important questions remain. First, while evidence suggests that these variables relate to differences in informant report of ADHD symptoms among early childhood samples, these relationships have not been identified in school-aged samples, the age at which ADHD diagnosis are most commonly made (Visser et al., 2014). Second, most extant studies examine informant differences between racial groups (e.g., Lau et al., 2004) or SES groups (e.g., Phillips & Lonigan, 2010) separately, but do not examine race and SES, which tend to be confounded, simultaneously. As such, the independent contributions of race and SES to differences in informant report are not currently known.

Additionally, most current studies on this topic utilize standardized difference scores (e.g., the difference between parent report and teacher report), which present a number of interpretive challenges and validity problems (see Laird & De Los Reyes, 2013). In particular, difference scores, obtained from subtracting one informant's score from the other's score, are often less reliable than either of the component measures, and it has been argued that they are inherently ambiguous because they combine two measures into a single score (Edwards, 1994). Furthermore, difference scores impose mathematical constraints on the relation between the component scores and the variable

of interest. In particular, using a directional difference score constrains the coefficients on the informant's reports to be equal in magnitude but opposite in sign; this is particularly problematic in the study of informant discrepancies because informant's reports tend to correlate positively (Laird & De Los Reyes, 2013).

While some prior research suggests that discrepancies between parent and teacher reports of child externalizing behavior might be greater for ethnic minority children (e.g., Youngstrom, et al, 2000; Lau, et al, 2004) and for children of low SES (Stone et al, 2013), there is mixed evidence regarding the effect of race and SES on reports of preschool ADHD; one study found that SES was an important predictor of differences in parent and teacher reports (Phillips & Lonigan, 2010) while another found that race, not SES, was an important predictor of discrepant reporting (Harvey, et al, 2013). Given the evidence that ethnic minority children with ADHD might be underdiagnosed, the possible role of informant discrepancies in causing this given the diagnostic standard of looking for evidence of symptoms in at least two settings, and the fact that ADHD is most commonly diagnosed in school-aged children, it is important that research clarifies how race and SES are related parent and teacher reports of ADHD symptoms in school-aged children. This paper takes a first step toward clarifying these relationships by presenting two separate school-aged studies that examine SES and race as predictors of parent and teacher report of ADHD symptoms. We avoid the interpretive challenges associated with difference scores by employing multivariate regression. In Study 1, we examine the relationships between SES, race, and parent and teacher report of ADHD symptoms in a clinic-referred sample of children and adolescents being assessed for ADHD. We wanted

to determine whether SES and race are differentially associated with parent and teacher reports. In Study 2, we replicated these findings in a separate sample consisting primarily of school-referred children. We also included standardized observation measures of children's behavior, and examined the relations between SES, race and observation measures of inattention and hyperactivity/impulsivity.

Based on the findings of extant studies using preschool-aged children, (e.g., Harvey et al., 2013) we hypothesized that African American race, after controlling for SES, would be associated with higher levels of hyperactivity and inattention symptoms based on teacher report compared to parent report. Given the prior inconsistent evidence regarding SES and parent and teacher report of ADHD symptoms, we made no specific hypotheses about whether SES, after controlling for race, would be differentially associated with parent and teacher report of ADHD symptoms.

Study 1 Method

Participants

Study 1 employed data from clinic-referred Caucasian and African American children between the ages of 4 and 17 with parent and teacher ADHD symptom rating scales (N = 1056). This sample was drawn from a larger sample of children who were assessed for ADHD at an outpatient ADHD clinic at a large children's hospital in a northeastern urban area (N = 1709). The racial/ethnic distribution of the larger sample was 80.0 % Caucasian, 13.2% African American, 2.0% Hispanic/Latino, .9% Asian, .1% Native American, 2.3% Other, and 1.4% missing information about ethnicity. Due to the small sizes of samples for ethnicities other than Caucasian and African American race,

only Caucasian and African American children were used in current analyses. Additionally, only children with complete data on the home and school versions of the ADHD-IV rating scale (DuPaul, Power, Anastapoulos, & Reid, 1998) were included in the current sample.

Children in the study sample did not differ from excluded children in terms of sex (t (1707) = 1.46, p = .14, d = .07) or age (t (1707) = .34, p = .73, d = .02), but did have significantly lower SES than excluded children (t (1273) = 2.50, p = .01, d = .14).

Demographic data for our sample of 1056 children are summarized in Table 1. Based on the DICA-R (Reich, Leacock, and Shanfeld, 1995; see Measures section), 30.0% of the subsample met diagnostic criteria for ADHD Combined Type, 37.6% met criteria for ADHD Predominantly Inattentive Type, 7.8% met criteria for ADHD Predominantly Hyperactive-Impulsive Type, 24.3% did not meet diagnostic criteria for ADHD and .4% were missing diagnostic information.

Measures

SES. SES was calculated using the Four-Factor Index of Social Status (Hollingshead, 1975). Parental education was measured in seven categories: Less than 7th grade, Junior High School, Partial High School, High School graduate, Partial College/Specialized Training, Standard College/University Education, Graduate/Professional Degree. Parental occupation was measured in nine categories. In two-parent households, education and occupation scores for both parents were averaged; in single-parent households, education and occupation scores for the one parent were used. The SES score was calculated as a sum of the parental occupation score (multiplied

by 5) and the parental education score (multiplied by 3). Possible scores ranged from 8 to 66 (Hollingshead, 1975).

ADHD-IV Home and School rating scales. Parent and teacher reports of symptoms of inattention and hyperactivity/impulsivity were measured using the ADHD Rating Scale-IV (ADHDRS-IV) home version and school version, respectively (DuPaul et al., 1998). These scales assess the frequency and severity of ADHD symptoms as reported by parents and teachers. The ADHDRS-IV consists of 9 items that assess DSM-IV-defined symptoms of inattention and 9 items that assess DSM-IV-defined symptoms of hyperactivity/impulsivity. Each item is rated on a 4-point scale: 0 = not at all, rarely; 1 = sometimes; 2 = often; and 3 = very often. Possible scores on this measure range from 0 to 27 for inattentive symptoms and for hyperactive/impulsive symptoms.

Diagnostic Interview for Children and Adolescents-Revised. The Diagnostic Interview for Children and Adolescents-Revised (DICA-R; Reich, Leacock, and Shanfeld, 1995) is a semi-structured interview designed to evaluate symptoms of child psychopathology using DSM-IV criteria. In the current study, the DICA-R was administered to parents to evaluate diagnostic status for ADHD, as well as oppositional defiant disorder, conduct disorder, anxiety disorders, bipolar disorder, major depression, and dysthymia. The DICA-R was administered by doctoral-level psychologists and advanced doctoral students in psychology trained in measure administration.

Other demographic factors. Child age, race/ethnicity, and sex were measured by parent report. Race was coded for Caucasian (non-Hispanic/Latino) versus African American.

Statistical Approach

We first computed means and standard deviations of demographic variables and informant report scores for the full sample, as well as for the African American and Caucasian subsamples. Additionally, in order to report results comparable to previous studies that used difference scores, we computed Parent Minus Teacher Difference scores for inattention symptoms and hyperactivity/impulsivity symptoms. We used independent-samples t-tests to compare the Caucasian and African American subsamples on demographic variables, informant report scores, and difference scores.

The primary analysis used multivariate regression to simultaneously test relations between predictor variables and parent report and teacher report of inattention and hyperactivity/impulsivity symptoms. This enabled us to conduct tests of the coefficients across parent and teacher report using the Wald test of parameter constraints, in which paths to both informants' reports are constrained to be equal, and a significant test statistic indicates that the null hypothesis that they are equal can be rejected.

All analyses used raw scores for ADHDRS-IV home version and ADHDRS-IV school version. In all analyses, SES, race, age, and sex are entered in the model simultaneously. Therefore, reported coefficients for SES and race control for each other, as well as for age and sex.

The multivariate regression analyses used full information maximum likelihood (FIML) estimation, which allows the retention of subjects with missing data and has been found in simulation studies to outperform classical methods for missing data, such as available case methods and imputation (Enders & Bandalos, 2001; Peters & Enders,

2002). Three hundred and eight children (29.2%) were missing data for SES, and zero children were missing data for age, sex, or race. Results were qualitatively similar when listwise deletion was used to remove children who were missing SES. All multivariate regression analyses were implemented in Mplus Version 7 and all other analyses were implemented in Statistical Package for the Social Sciences (SPSS) Version 23.

Study 1 Results

Group comparisons

Results of the independent-sample t-tests comparing the Caucasian and African American subsamples are shown in Table 1. Caucasian participants had significantly higher SES scores (M = 46.33, SD = 11.69) than African American participants (M = 39.93, SD = 12.54); t (746) = 4.98, $p < .001$. The groups did not differ on age or sex.

For inattention symptoms, parents reported higher symptom levels for Caucasian children (M = 16.43, SD = 5.93) than for African American children (M = 15.28, SD = 6.72); t (1054) = 2.15, $p = .03$. However, teachers reported marginally higher inattention symptom levels for African American children (M = 18.24, SD = 7.49) than for Caucasian children (M = 17.18, SD = 6.65); t (1054) = -1.77, $p = .08$.

For hyperactivity/impulsivity symptoms, there was no difference for parent report, and teachers reported higher symptoms for African American children (M = 15.05, SD = 8.41) than for Caucasian children (M = 11.83, SD = 7.94); t (1054) = -4.54, $p < .001$.

Parent-Teacher differences scores for inattention symptoms, and hyperactivity/impulsivity symptoms differed significantly between Caucasian and

African American children.

Multivariate regressions

Age and sex were significantly related to informant report scores. Therefore, all analyses controlled for age and sex.

Inattention. As shown in Table 2 (Panel A), there was a significant negative association between SES and teacher report of inattention symptoms ($\beta = -.14$, $p < .001$), but SES was not significantly associated with parent report of inattention symptoms ($\beta = -.03$, $p = .46$). The path from SES to parent report differed significantly from the path from SES to teacher report (χ^2 (1) = 8.11, $p = .004$).

Race was not significantly associated with teacher-reported symptoms of inattention. However, parents reported significantly higher levels of inattention symptoms for Caucasian children than for African American children. The path from African American race to parent report differed significantly from the race – teacher report path (χ^2 (1) = 5.96, $p = .01$).

Hyperactivity/impulsivity. As shown in Table 2 (Panel B), there were significant negative associations between SES and teacher report of symptoms of hyperactivity/impulsivity ($\beta = -.12$, $p = .001$), as well as between parent report of symptoms of hyperactivity/impulsivity ($\beta = -.19$, $p < .001$). The paths from SES to parent report and from SES to teacher report did not differ significantly from each other (χ^2 (1) = 1.20, $p = .27$).

Teachers reported significantly higher levels of symptoms of hyperactivity/impulsivity for African American children than for Caucasian children.

Race was not significantly associated with parent-reported symptoms of hyperactivity/impulsivity. The paths from race to parent report and from race to teacher report differed significantly from each other (χ^2 (1) = 17.22, $p < .001$).

Study 2 Method

Participants

Study 2 employed data from school-referred Caucasian and African American children between the ages of 6 and 12 with parent and teacher ADHD symptoms rating scales ($N = 317$). This sample was drawn from a larger study conducted at three data collection centers ($N = 444$). The racial/ethnic distribution of the larger sample was 54.1% Caucasian, 34.0% African American, 5.6% Hispanic/Latino, .5% Asian, .7% Native American, and 5.0% other. Due to the small sizes of samples for ethnicities other than Caucasian and African American, the sample used for the present study was made up of only the Caucasian and African American children. We also excluded children who participated in the study as "controls" (were not being evaluated for ADHD) from the analytic sample. Additionally, only children with complete data on the home and school versions of the ADHD-IV rating scale (DuPaul, Power, Anastapoulos, & Reid, 1998) were included in the current sample.

Children in this sample did not differ from excluded children in terms of sex (t (442) = .57, $p = .57$, $d = .06$), age (t (429) = 1.74, $p = .08$, $d = .19$), or SES (t (399) = .17, $p = .86$, $d = .02$).

Demographic data for the sample are summarized in Table 4. Based on the NIMH Diagnostic Interview Schedule for Children 4 (DISC-4; Shaffer et al., 2000; see

Measures section), 40.1% of the subsample met diagnostic criteria for ADHD Combined Type, 21.5% met criteria for ADHD Predominantly Inattentive Type, 17.0% received a diagnosis other than ADHD, and 21.5% did not receive a diagnosis.

Measures

SES. SES was calculated using an adaptation of Hollingshead's (1975) nine-point scale (1 = lowest and 9 = highest) for occupation of the parent obtaining the higher score.

ADHD-IV Home and School rating scales. Parent and teacher reports of symptoms of inattention and hyperactivity/impulsivity were measured using the ADHDRS-IV Home version and School version, respectively.

NIMH DISC-4. The NIMH Diagnostic Interview Schedule for Children 4 (DISC-4; Shaffer et al., 2000) is a structured diagnostic interview designed to evaluate symptoms of child psychopathology using DSM-IV criteria. In the current study, the computer-assisted NIMH DISC-4 modules for ADHD, conduct disorder, oppositional defiant disorder, anxiety disorders, and mood disorders were administered to parents. See McConaughy, Ivanova, Antshel, & Eiraldi (2009) for additional detail about the DISC-4 administration procedures and test-retest reliability.

Test Observation Form. The Test Observation Form (TOF; McConaughy & Achenbach, 2004) is a standardized form for rating children's behavior during one-on-one psychoeducational test administration. The TOF was completed by a test examiner immediately after administration of the Wechsler Intelligence Scale for Children-IV (WISC-IV; Wechsler, 2003). The test examiner was unaware of the child's diagnostic status. The TOF consists of 125 items that describe children's behavior, affect, and test-

taking style. Immediately after the child completed the WISC-IV, examiners rated the child on each TOF problem item, using a 4-point scale: 0 = no occurrence; 1 = very slight or ambiguous occurrence; 2 = definite occurrence with mild to moderate intensity and less than 3 minutes duration; 3 = definite occurrence with severe intensity or 3 or more minutes duration. The current study employs raw scores from the TOF DSM-oriented Attention Deficit Hyperactivity Problems (ADHP) scale and its Inattention and Hyperactivity-Impulsivity subscales. These TOF subscales each contain 11 problem items that are consistent with ADHD symptoms of inattention and hyperactivity/impulsivity rated by parents and teachers on the ADHDRS-IV. Possible scores on each subscale range from 0 to 33. For more information about the TOF, see McConaughy, Ivanova, Antshel, & Eiraldi (2009).

Direct Observation Form. The Direct Observation Form (DOF; McConaughy & Achenbach, 2009) is a standardized rating form for rating children's behavior in group settings, such as in school classrooms. The DOF was completed by an observer after a 10-minute observation period. Immediately after each 10-minute observation, the observer rated the child on 89 problem items, using a 4-point scale similar to the scale for the TOF. The 0-1-2-3 item ratings were averaged across four 10-minute observation sessions conducted on two different days and then summed to obtain a total raw score for each DOF problem scale. The current study employed raw scores from the DSM-oriented Attention Deficit/Hyperactivity Problems (ADHP) and its Inattention and Hyperactivity-Impulsivity subscales. The DOF subscales contain problem items that are consistent with ADHD symptoms of inattention and hyperactivity/impulsivity rated by

parents and teachers on the ADHDRS-IV. The Inattention subscale has 10 items, resulting in scale scores ranging from 0 to 30; the Hyperactivity-Impulsivity subscale has 13 items, resulting in scale scores ranging from 0 to 39. For more information about the DOF, see McConaughy, Ivanova, Antshel, Eiraldi, & Dumenci (2009).

Other demographic factors. Race/ethnicity, child age, and child sex were measured by parent report. Race/ethnicity was coded for Caucasian (non-Hispanic/Latino) versus African American.

Statistical Approach

As in Study 1, we first computed means and standard deviations of all variables of interest for the full sample, as well as for the African American and Caucasian subsamples. Additionally, in order to report results comparable to previous studies that used difference scores, we computed Parent Minus Teacher Difference scores for inattention symptoms and hyperactivity/impulsivity symptoms. We used independent-samples t-tests to compare the Caucasian and African American subsamples on demographic variables, informant report scores, observer scores, and difference scores.

As in Study 1, the primary analysis used multivariate regression to simultaneously test relations between predictor variables (SES, race, age, and sex) and informants' reports of ADHD symptoms. We also employed TOF and DOF Inattention and Hyperactivity-Impulsivity raw scores as dependent variables. The Wald test of parameter constraints was used to compare coefficients between paths of interest (e.g., SES-parent report and SES-teacher report).

In all analyses, SES, race, age, and sex are considered in the model

simultaneously. Therefore, reported coefficients for SES and race control for each other, as well as for age and sex.

All multivariate regression analyses were implemented using FIML estimation to retain subjects with missing data. 29 children (9.1%) were missing data for SES, 4 children (1.3%) were missing data for the TOF scores, and 35 children (11.0%) were missing data for the DOF scores. Results were qualitatively similar when listwise deletion was used to remove children who were missing SES. All multivariate regression analyses were implemented in Mplus Version 7 and all other analyses were implemented in Statistical Package for the Social Sciences (SPSS) Version 23.

Study 2 Results

Group comparisons

Results of the independent-sample t-tests comparing the Caucasian and African American subsamples are shown in Table 3. Caucasian participants had significantly higher SES scores ($M = 6.20$, $SD = 1.71$) than African American participants ($M = 5.01$, $SD = 1.88$); $t\ (286) = 5.45$, $p < .001$. The groups did not differ on age or sex.

For inattention symptoms, teachers reported significantly higher symptom levels for African American children ($M = 17.33$, $SD = 6.77$) than for Caucasian children ($M = 14.52$, $SD = 6.82$); $t\ (315) = -3.59$, $p < 001$. Parent report of inattention symptoms did not differ between the two groups.

For hyperactivity/impulsivity symptoms, teachers reported significantly higher symptom levels for African American children ($M = 14.29$, $SD = 8.47$) than for Caucasian children ($M = 10.97$, $SD = 7.81$); $t\ (315) = -3.58$, $p < 001$. Parent report of

hyperactivity/impulsivity symptoms did not differ between the two groups.

Parent-Teacher differences scores for inattention symptoms and hyperactivity/impulsivity symptoms differed significantly between Caucasian and African American participants.

Scores on the DOF and TOF did not differ significantly between Caucasian and African American participants.

Multivariate regressions

Age and sex were significantly related to informant report scores. Therefore, all analyses controlled for age and sex.

Inattention. As shown in Table 4 (Panel A), there were significant negative associations between SES and teacher report of inattention symptoms ($\beta = -.16$, $p = .005$), but not parent report of inattention symptoms ($\beta = -.03$, $p = .59$). SES was not significantly associated with inattention scores on the TOF or the DOF. The path from SES to parent report and the path from SES to teacher report had a marginally-significant difference ($\chi^2 (1) = 2.85$, $p = .09$). The SES- DOF path differed significantly from the SES – teacher-report path ($\chi^2 (1) = 8.90$, $p < .01$).

Teachers reported significantly higher levels of inattention symptoms for African American children than for Caucasian children. African American race was not associated with parent report of inattention symptoms or with TOF inattention scores. There was a marginally-significant association between African American race and DOF inattention scores. The path from African American race to parent report differed significantly from the path from African American race to teacher report ($\chi^2 (1) = 8.32$, p

< .01).

Hyperactivity/impulsivity. As shown in Table 4 (Panel B), there were significant negative associations between SES and teacher report of symptoms of hyperactivity/impulsivity ($\beta = -.13$, $p = .03$), as well as SES and parent report of hyperactivity/impulsivity symptoms ($\beta = -.21$, $p < .001$). The SES – TOF path differed significantly from the SES – teacher-report path (χ^2 (1) = 6.42, $p < .05$). The SES- DOF path differed significantly from the SES – teacher -report path (χ^2 (1) = 16.54, $p < .001$), and from the SES – parent-report path (χ^2 (1) = 5.65, $p < .05$).

Teachers reported significantly higher levels of hyperactivity/impulsivity symptoms for African American children than for Caucasian children. African American race was not associated with parent report of hyperactivity/impulsivity symptoms or with DOF hyperactivity/impulsivity scores. There was a marginally-significant negative association between African American race and TOF inattention scores. The path from African American race to TOF differed significantly from the race – teacher-report path (χ^2 (1) = 13.13, $p < .01$).

Discussion

Across two separate samples of school-aged children being evaluated for ADHD, we observed systematic differences between parent- and teacher- reported ADHD symptoms based on child SES and race. In both samples, lower SES was associated with higher levels of inattention symptoms as reported by teachers, but not by parents. Lower SES also related to higher levels of hyperactivity/impulsivity symptoms as reported by both teachers and parents, with no significant contrast between parent and teacher report.

In both samples, African American race was associated with higher levels of teacher report, as compared to parent report, of both inattention, and hyperactivity/impulsivity symptoms.

The current results demonstrate the importance of considering SES, along with race/ethnicity, in examining different informants' reports of ADHD symptoms. These results are particularly noteworthy given that SES and race, which were correlated in the current samples, were examined controlling for each other. When considered in the Attribution Bias Context framework, these results suggest that there may be situational differences in behavior and/or differences in informants' attributions and perspectives that vary by SES and race. That is, lower SES and African American children may indeed show more hyperactivity/impulsivity symptoms at school, compared to at home, perhaps due to an increased likelihood of attending an under-resourced school. Alternatively, parents and teachers may differ in the attributions they make about children's behavior (e.g., whether or not it is normative) and in the frame of reference they use to make ratings. For instance, teachers have experience with many other same-age students, and may therefore use more consistent standards to rate children's behavior (Duckworth & Yeager, 2015).

These results extend prior work using preschool aged samples (e.g., Harvey et al., 2013; Phillips & Lonigan, 2010) in several ways. Our finding that African American race was associated with higher levels of teacher-reported inattention and hyperactivity/impulsivity symptoms, as compared to parent reports, is consistent with the results obtained by Harvey et al. (2013) and suggests that this pattern of informant report

differences continues into the school-aged years, a particularly relevant period to the diagnosis of ADHD in children. Regarding SES, our findings that lower SES was associated with higher levels of teacher reported inattention symptoms, as compared to parent report, is consistent with the findings reported by Phillips & Lonigan (2010) but differs from Harvey and colleague's (2013) results. Notably, this finding only reached full significance in our larger sample; similarly, limited sample size may have prevented Harvey et al. (2013) from observing discrepancies between informant's reports of inattention symptoms associated with SES. It is also important to note that our use of multivariate regression allowed us to observe that hyperactivity/impulsivity symptoms differed by SES according to both parent and teacher report.

Additionally, the observer report measures included in Study 2 provide valuable information about the levels of symptoms reported by observers, and their consistency or inconsistency with parent and teacher reports. Test examiners and classroom observers have access to different samples of behaviors in different contexts (e.g., classroom, one-on-one testing) and different from the contexts for parents and teachers. It is therefore not surprising that reports from test examiners and classroom observers showed different associations with SES and race compared to reports from parents and teachers. Reports by test examiners and classroom observers did not show a significant association between SES and their observations of inattention and hyperactivity/impulsivity problems. However, there was a significant association between race and test examiners' reports of hyperactivity/impulsivity. Specifically, test examiners reported lower levels of hyperactivity/impulsivity symptoms for African American than Caucasian children, in

contrast to higher hyperactivity/impulsivity symptoms for African American children reported by teachers and parents. A prior analysis of these data revealed that the testing and classroom observer report measures showed incremental validity over and above parent and teacher reports in predicting ADHD diagnoses (McConaughy et al., 2010). The current results suggest that observations of testing behavior and classroom behavior may provide unique information about symptom level across SES and racial groups as well. The findings suggest that future research on predictors of informant report discrepancies would benefit from including observer report measures, particularly those that provide unique perspectives on similar types of behavior across different contexts and situations.

The results of this study highlight the importance of a multi-informant, multi-setting assessment approach, especially for diverse populations. In particular, it is important for clinicians to consider SES, along with race, when interpreting discrepant parent and teacher reports of ADHD symptoms. The current results also raise the possibility that discrepancies between parent- and teacher- reported ADHD symptoms may contribute to different diagnostic patterns across socioeconomic and racial/ethnic groups. For example, because parents of lower SES children and parents of African American children may report lower levels of inattention symptoms than inattention reported by teachers, they might be less likely to seek an evaluation and treatment for their child and, if evaluated, their children might be less likely to receive an ADHD diagnosis than would higher SES, Caucasian children when the diagnostic interview relies on parental report. Without receiving an ADHD diagnosis, African American and

low income children may be less likely to receive needed intervention and more likely to be stigmatized for behavioral problems. As such, these results suggest that it is important for teachers, as well as parents, to identify children in need of assessment for ADHD. It is then important for clinicians to collect teacher ratings, along with parent ratings, during the assessment process and to consider conducting diagnostic interviews with teachers, particularly when parents and teachers do not agree on symptoms levels.

Several limitations should be considered in interpreting these results. First, it is likely that SES and race relate to informant report differences in ADHD symptoms because of proximal factors that may influence reporting patterns (e.g., parenting stress) or behavior (e.g., classroom structure in high income vs. low income areas). The current studies did not include measures of these more proximal factors, which could be valuable to test hypotheses about the causes of the observed informant report differences. Given that the current study provides evidence for consistent informant report differences by SES and race, it would be valuable for future research to collect measures of these proximal factors, along with more distal factors such as SES and race. In particular, it will be important to examine specific factors in children's home and school environments, as well as factors associated with parents (e.g., parenting stress, depression) and teachers (e.g., teacher race).

Second, it is important to consider that the current analyses compared overall levels of inattention and hyperactivity/impulsivity symptoms reported by parents and teachers. This approach was appropriate to test the question of whether the overall symptom levels varied by SES and race for teacher and parent reports, and whether these

associations differed from each other. However, this analytic approach does not consider *which* symptoms are reported. For example, a parent and a teacher could report the same overall level of inattention symptoms, but disagree entirely about which inattention symptoms the child shows at clinically significant levels. Therefore, to ask questions about how SES and race relate to parent-teacher disagreement, it will be important for future research to analyze symptom-level informant report data.

It is also important to note that the current samples were limited to Caucasian and African American children. As such, the current results do not provide information about informant report differences for children from other racial and ethnic groups, which is an important topic for future studies.

Finally, the current studies offer limited information about the meaning of variations in parent and teacher report by SES and race. Do parent or teacher report of ADHD symptoms relate more closely to functional impairment or other clinical outcomes? Does this vary by SES or race? It will be valuable for future studies to explore these questions by including impairment and clinical outcome measures.

Tables

Table 1

Sample 1 Characteristics

		Full Sample (N = 1056)		Caucasian Subsample (n = 908)		African American Subsample (n = 148)
Variable	N (%)	Mean (SD)	n (%)	Mean (SD)	n (%)	Mean (SD)
Age (in years)		9.52 years (2.55 years)		9.57 years (2.57 years)		9.22 years (2.44 years)
Male	814 (77.1)		700 (77.1)		114 (77.0)	
Hollingshead SES		45.50 (11.99) (N = 748)		46.33 (11.69) ** (n = 651)		39.93 (12.54) (n = 97)
Parent ADHDRS-IV Inattention Raw Score		16.27 (6.06)		16.43 * (5.93)		15.28 (6.72)
Teacher ADHDRS-IV Inattention Raw Score		17.32 (6.78)		17.18 (6.65)+		18.24 (7.49)
Parent ADHDRS-IV Hyp/Imp Raw Score		12.29 (6.74)		12.24 (6.71)		12.55 (6.98)
Teacher ADHDRS-IV Hyp/Imp Raw Score		12.28 (8.08)		11.83 (7.94)		15.05** (8.41)
Parent Minus Teacher Inattention Difference		-1.06 (8.02)		-.75** (7.99)		-2.97 (8.02)
Parent Minus Teacher Hyp/Imp Difference		-.002 (8.09)		.41** (8.06)		-2.50 (7.80)

Note. SES = socioeconomic status. ADHDRS-IV = ADHD Rating Scale-IV. Hyp/Imp = hyperactivity/impulsivity. Means and standard deviations are reported for the full sample, Caucasian subsample, and African American subsample. Independent sample t-tests were used to compare the Caucasian and African American subsamples on all variables displayed. ** $p < .01$ * $p < .05$ + $p < .1$

Table 2

Sample 1 Multivariate Regression Models

Panel A: Inattention Symptoms			
Predictor	Outcome/Contrast	Beta	Wald Value
SES	Teacher report	-.14**	
	Parent report	-.03	
	Teacher vs. Parent Contrast		8.11**
African American race	Teacher report	.03	
	Parent report	-.06*	
	Teacher vs. Parent Contrast		5.96*
Panel B: Hyperactivity/Impulsivity Symptoms			
SES	Teacher report	-.12**	
	Parent report	-.19**	
	Teacher vs. Parent Contrast		1.20
African American race	Teacher report	.11**	
	Parent report	-.02	
	Teacher vs. Parent Contrast		17.22**

Note. Multivariate regression models predicting teacher report and parent report of symptoms of inattention and hyperactivity/impulsivity from SES, African American race, age, and sex in Sample 1. SES = socioeconomic status. Wald Value indicates the result of the Wald test contrasting teacher report and parent report.

** $p < .01$ * $p < .05$ + $p < .1$

Table 3

Sample 2 Characteristics

	Full Sample (N = 317)		Caucasian Subsample (n = 192)		African American Subsample (n = 125)	
Variable	N (%)	Mean (SD)	n (%)	Mean (SD)	n (%)	Mean (SD)
Age (in years)		8.07 (1.61)		8.11 (1.58)		8.01 (1.65)
Male	221 (69.7)		129 (67.2)		92 (73.6)	
Hollingshead SES		5.77 (1.86) (N = 288)		6.20 (1.71)* (n = 184)		5.01 (1.88) (n = 104)
Parent ADHDRS-IV Inattention Raw Score		15.12 (6.89)		15.46 (6.99)		14.61 (6.72)
Teacher ADHDRS-IV Inattention Raw Score		15.63 (6.93)		14.52 (6.82)		17.33 (6.77)**
Parent ADHDRS-IV Hyp/Imp Raw Score		12.89 (7.53)		12.50 (7.49)		13.49 (7.58)
Teacher ADHDRS-IV Hyp/Imp Raw Score		12.28 (8.22)		10.97 (7.81)		14.29(8.47)**
Parent Minus Teacher Inattention Difference Score		-.50 (8.76)		.94 (8.60)		-2.72 (8.57)**
Parent Minus Teacher Hyp/Imp Difference Score		.61 (9.20)		1.53 (8.81)		-.80 (9.63)*
TOF Inattention		4.17 (4.85)		3.96 (4.39)		4.48 (5.49)
DOF Inattention		3.12 (2.46)		2.94 (2.31)		3.42 (2.69)
TOF Hyperactivity/Impulsivity		7.20 (5.78)		7.69 (6.01)+		6.46 (5.37)
DOF Hyperactivity/Impulsivity		5.28 (3.43)		5.14 (3.06)		5.49 (4.00)

Note. SES = socioeconomic status. ADHDRS-IV = ADHD Rating Scale-IV. Hyp/Imp = hyperactivity/impulsivity. TOF = Test Observation Form. DOF = Direct Observation Form. Means and standard deviations are reported for the full sample, Caucasian subsample, and African American subsample. Independent sample t-tests were used to compare the Caucasian and African American subsamples on all variables displayed.

**$p < .01$ * $p < .05$ + $p < .1$

Table 4

Sample 2 Multivariate Regression Models

Panel A: Inattention Symptoms			
Predictor	Outcome/Contrast	Beta	Wald Value
SES	Teacher report	-.16**	
	Parent report	-.03	
	DOF	.04	
	TOF - WISC	-.08	
	Teacher vs. Parent Contrast		2.85+
	Teacher vs. TOF Contrast		2.31
	Parent vs. TOF Contrast		.13
	Teacher vs. DOF Contrast		8.90**
	Parent vs. DOF Contrast		.46
African American	Teacher report	.14*	
	Parent report	-.08	
	DOF	.11+	
	TOF - WISC	.02	
	Teacher vs. Parent Contrast		8.32**
	Teacher vs. TOF Contrast		3.30+
	Parent vs. TOF Contrast		1.84
	Teacher vs. DOF Contrast		2.91+
	Parent vs. DOF Contrast		3.21+
Panel B: Hyperactivity/Impulsivity Symptoms			
SES	Teacher report	-.21**	
	Parent report	-.13*	
	DOF	.04	
	TOF - WISC	-.06	
	Teacher vs. Parent Contrast		.07
	Teacher vs. TOF Contrast		6.42*
	Parent vs. TOF Contrast		1.53
	Teacher vs. DOF Contrast		16.54**
	Parent vs. DOF Contrast		5.65*
African American	Teacher report	.12*	
	Parent report	.01	
	DOF	.06	
	TOF - WISC	-.14*	

Teacher vs. Parent Contrast	2.78+
Teacher vs. TOF Contrast	13.13**
Parent vs. TOF Contrast	3.28+
Teacher vs. DOF Contrast	3.21+
Parent vs. DOF Contrast	.07

Note. Multivariate regression models predicting informant report of symptoms, as well as TOF and DOF scores, from SES, African American race, age and sex in Sample 2. SES = socioeconomic status. DOF = Direct Observation Form. TOF = Test Observation Form. Wald Value indicates the result of the Wald test contrasting teacher report and parent report.

** $p < .01$ * $p < .05$ + $p < .1$

CHAPTER 3: OBJECTIVE AND SUBJECTIVE SES: DISTINCT RELATIONS WITH ACADEMIC ACHIEVEMENT

Abstract

Youth from wealthier households are healthier and perform better in school. Interestingly, adolescents with a higher *subjective* sense of their family's socioeconomic status (SES)—independent of their family's actual SES—also have better health, both physically and psychologically. Still, little is known about the relationship between subjective SES and academic achievement. In a large and diverse sample of high school seniors, we replicated prior research that objective SES predicts earning higher report card grades and scores on standardized achievement tests, and greater likelihood of college enrollment. However, subjective SES reliably predicted *lower* achievement on all indicators of academic success. Exploratory analyses offered a reason: Students with higher subjective SES were more globally satisfied with their lives, but were rated by teachers as working less hard on schoolwork. Whereas favorable impressions of one's own social status may be beneficial for psychological health, these same impressions may undercut effort toward achievement goals.

Socioeconomic status (SES) is associated with dramatic inequalities in children's life outcomes. Children and adolescents from wealthier and more educated households are healthier, both physically and psychologically, and they also perform better in school (e.g., Bradley & Corwyn, 2002). Yet, children's *subjective* impressions of their family's position on the socioeconomic hierarchy—independent of their actual standing in society—may also be associated with health and achievement (e.g., Demakakos, Nazroo, Breeze, & Marmot, 2008). Research suggests a positive association between subjective SES and health, but surprisingly little is known about its association with academic performance.

Objective SES is measured using a variety of verifiable indicators, including income, educational attainment, and occupational prestige. In contrast, measures of subjective SES rely on individuals' impressions of where they stand in the social hierarchy. One commonly used measure depicts American society as a ladder in which the people at the bottom are worst off and the people at the top are the best off—they have the most money, the best education, and the jobs that bring the most respect. Where people place themselves on the ladder serves as an indicator of their subjective socioeconomic status (Adler & Stewart, 2007).

Correlations between measures of objective and subjective SES are moderate in size (e.g., $r = .40$; Adler, Epel, Castellazzo, & Ickovics, 2000); two individuals with the same objective SES may have differing perceptions of their social status. One reason for the discrepancy may be that objective and subjective SES capture distinct aspects of experience. Objective SES represents access to material and social resources, including

higher quality educational opportunities and medical care (Adler & Snibbe, 2003). In contrast, subjective SES represents perceived social standing, and may relate more closely to what people feel capable of doing and controlling in their lives (e.g., Adler et al., 2000; McLaughlin, Costello, Leblanc, Sampson, & Kessler, 2012).

It makes sense then that higher subjective SES would be associated with better physical and mental health, even after controlling for objective indicators of SES (e.g., Adler et al., 2000; Demakakos et al., 2008; McLaughlin et al., 2012; Ostrove, Adler, Kuppermann, & Washington, 2000; Präg, Mills, & Wittek, 2016; Singh-Manoux, Marmot, & Adler, 2005). A recent meta-analysis of 45 studies found significant positive associations between subjective SES and adolescents' global rating of their overall physical health [Fisher's $Z = .178$], reports of general health symptoms (e.g., headaches, back pain, stomachaches) [Fisher's $Z = .162$], and mental health [Fisher's $Z = .189$]. These relationships were observed regardless of whether objective SES was controlled (Quon & McGrath, 2014). However, despite the growing literature on the salutary relationship between subjective SES and health, surprisingly little is known about how subjective SES relates to academic achievement.

Some have proposed that low perceived social status and low academic achievement go hand in hand. Why? Because low social status carries stigma; negative self-perceptions that, when triggered, may undermine effective studying, learning, and achievement. Such arguments have empirical justification: Students at a selective and socioeconomically diverse high school who rated their own social status as higher than their peers also earned higher grades, an association that was partially mediated through

emotional well-being and effective study habits (Destin, Richman, Varner, & Mandara, 2012).

On the other hand, it is possible that underestimating socioeconomic status may have its advantages. We propose that for two students at the same objective SES, unfavorable impressions of social standing may signal motivation to improve their lot in life, conferring a positive influence on achievement. If true, students who report relatively low subjective SES may experience tradeoffs in achievement versus health: a benefit to academic achievement may be a cost to health. Subjective SES, in other words, may be a double-edge sword. This would be consistent with emerging research suggesting that resilience is multi-faceted, with youth showing diverging outcomes in the achievement and health domains. In particular, adolescents who are on an upward socioeconomic trajectory demonstrate external success, such as enrollment in college. At the same time, these adolescents show increased levels of allostatic load, the wear and tear on the body resulting from chronic stress, as measured by stress hormone levels, blood pressure, and body mass index (Chen, Miller, Brody & Lei, 2014).

If *lower* subjective SES *is* associated with enhanced achievement, what can we say about students who are prone to making these judgments about their lower social standing? The model outlined above predicts that lower subjective SES, relative to objective SES, would be associated with decreased life satisfaction and increased motivation to change. This increased motivation may be reflected through higher self-control—the capacity to pursue long-term goals, despite conflicting impulses—particularly in domains relevant to improving their status (i.e., school work).

The current study tested this model by examining the associations among subjective SES, objective SES, and academic achievement, along with theoretically-relevant personal qualities. We used data from a large and socioeconomically diverse sample of high school seniors whose report card grades and standardized test scores, and college enrollment one year after high school, were collected. Consistent with prior research, we expected to observe a positive relationship between objective SES and academic achievement. However, we also tested the hypothesis that, controlling for objective SES, higher *subjective* SES would be associated with *worse* academic achievement. Finally, we explored self-reported and teacher-reported characteristics associated with subjective SES. The proposed model assumed that subjective SES would relate positively to life satisfaction and negatively to self-control.

Method

Participants

The sample included $N = 1819$ high school seniors (mean age = 17.95 years; SD = .52; range = 15.73 to 21.89; 50.7% female) drawn from three public high schools in the Northeast United States. These students were drawn from a larger study on college persistence. School 1 ($n = 167$) was a smaller selective-admissions public high school, and School 2 ($n = 470$) was a large comprehensive public high school. Two consecutive cohorts of seniors at School 3 (n = 669 and $n = 513$) participated in the study. The racial/ethnic distribution of the full sample was 34.5% White, 36.5% Black, 21.0% Asian, 5.6% Hispanic, and 1.4% Multi-racial.

Measures

Objective SES. We calculated an Objective SES composite score by averaging *z*-standardized scores on two available indicators: free or reduced-price lunch participation and median neighborhood income. In cases where data for one of the indicators was missing ($n = 87$), the available indicator was used.

Free or reduced price lunch participation. Students' participation in free or reduced-price lunch program (0 = no, 1 = yes) was obtained from school records.

Neighborhood income. We matched student addresses provided by school records to census block groups (500-2000 persons) data from 2009-2013 to obtain median neighborhood income (American Community Survey, Roblin, 2013). While using median neighborhood as a proxy for family income has limitations, this approach is strengthened by the fact that students in the sample lived in metropolitan areas, where associations between family and neighborhood income are stronger (Pardo-Crespo et al., 2013).

Subjective SES. Subjective SES was measured using the youth version of the MacArthur Scale of Subjective Social Status (Goodman et al., 2001). Students were asked to place their family in comparison with others in society on an image of a ladder, with higher rungs indicating higher status. This measure references traditional SES indicators, stating that the people at the top of the ladder "have the most money, the highest amount of schooling, and the jobs that bring the most respect." Thus, this measure can be conceptualized as the adolescents' perception of their family's socioeconomic status relative to society. See Figure 1.

Academic achievement. Senior year grade point averages, standardized test scores, and SAT scores were obtained from school records; college enrollment was obtained from the National Student Clearinghouse (NSC, www.studentclearinghouse.org) database.

Grade point average (GPA). Grades were first *z*-standardized within school to accommodate different grading scales, and then combined into one variable with $M = 0$ and $SD = 1$. Outlier values ($n = 8$), those more than 3.29 standard deviations below the mean, were set to –3.29 (Erceg-Hurn & Mirosevich, 2008).

Standardized achievement test scores. From school records, we recorded scaled scores on state-mandated, standardized achievement tests of math and reading taken during the students' junior year. Like GPA, scores were first *z*-standardized within each school before combining them into separate math and reading scores.

SAT score. From school records, we recorded the mean total SAT score (representing a sum of the critical reading, math, and writing SAT scores) obtained by each student. The mean SAT score of the sample was 1390 ($SD = 272$; range 610-2110).

First-year college persistence. Using the NSC data, we created a binary indicator (0 = no, 1 = yes) of whether or not each student had been continuously enrolled full-time at a 2- or 4- year institution as of the spring semester one year after high school graduation. 45.2% of students in the sample had been continuously enrolled in a 2- or 4-year college one year after high school graduation.

Self-report questionnaires.

Life satisfaction. Students answered the following question, "Overall, how satisfied or unsatisfied are you with your life?," from 1 = extremely unsatisfied to 7 = extremely satisfied.

Self-control. Students completed the Domain-Specific Impulsivity Scale for children (Tsukayama, Duckworth, & Kim, 2013), which assesses self-control in the domains of schoolwork (e.g., "I pay attention and resist distractions in class") and interpersonal relationships (e.g., "I can remain calm even when criticized or otherwise provoked") using four items for the schoolwork domain ($\alpha = .72$) and four items for the interpersonal relationships domain ($\alpha = .63$). Items were rated from 1 = not like me at all to 5 = very much like me.

Teacher-report questionnaires.

Self-control. For each student, classroom teachers completed a modified version of the Domain-Specific Impulsivity scale. To minimize burden, teachers provided one overall rating each self-control domain based on all of the scale items rather than providing separate ratings for each item. For example, teachers viewed all four schoolwork self-control items simultaneously and then provided an overall rating for each student from 1 = not at all like my student to 5 = very much like my student. Teachers only provided ratings for their current students. Two teachers provided ratings for each student in School 1, School 2, and School 3, Cohort 1. Three teachers provided ratings for each student in School 3, Cohort 2. Scores on teacher reports were correlated (all *r*'s between .17 and .40), so teacher ratings were averaged to obtain the teacher-report self-control measure.

Covariates.

Intelligence. Intelligence was measured using the matrix reasoning subtest of the Kaufmann Brief Intelligence Test (KBIT; Kaufman & Kaufman, 1990). In this subtest, students view a series of patterns in which one portion of the pattern is missing and must select the response that completes the pattern from a set of options. The number of correct answers before a ceiling of four consecutive incorrect responses constituted the raw score, which was converted to an age-normed scaled score. Cases with scaled scores of 40 (n = 60; lowest score possible), believed to be a sign of student disengagement or misunderstanding, were treated as missing data.

Demographic covariates. Multiple regression analyses also controlled for age, sex, school, and race/ethnicity. School was coded as a series of dummy variables; school 3 (cohort 1) was used as the reference group. Race/ethnicity was also coded as a series of dummy variables, with White used as the reference group. Due to the very small number of participants identified as multiracial (n = 26), multiracial students were also included in the reference group.

Statistical Approach

We first fit a series of multiple linear regression models predicting academic achievement from objective SES, subjective SES, and covariates (age, sex, IQ, school cohort, and race/ethnicity). We then fit additional models using self-reported life satisfaction, and self-reported and teacher-reported self-control as dependent variables.

We conducted several additional analyses to test the robustness of the results. To rule out the possibility of suppression effects, we tested models without objective SES

included as a covariate. Additionally, to examine the specificity of the effect with subjective SES, we tested models using life satisfaction as a predictor in place of subjective SES. We also tested objective SES, African American race, gender, grit, growth-mindset, and self-efficacy as moderators of the relationship between subjective SES and achievement.

The multivariate regression analyses used full information maximum likelihood estimation to retain subjects with missing data. 405 (22.3%) of students were missing data on one or more predictor variables and 831 (45.7%) were missing data on one or more dependent variables.

All multivariate regression analyses were implemented in Mplus Version 7 and all other analyses were implemented in Statistical Package for the Social Sciences (SPSS) Version 23.

Results

Participant characteristics

According to school records, 53.9% of the sample received free or reduced price lunch. The mean value for median neighborhood family income was $51,177 (*SD* = $22,383; range $9,471 - $194,583). The mean subjective SES value was 5.50 (*SD* = 1.70; range 1-10), on a scale with a possible range from 1 to 10.

Correlations

As shown in Table 1, the correlation between objective and subjective SES was statistically significant and positive, but small in magnitude (r = .24). Correlations between objective SES and academic achievement measures were positive and significant

(all *r*'s > .07). In contrast, correlations between subjective SES and academic achievement measures were negative and significant (*r*'s between -.08 and -.20; *p*'s between .02 and < .001).

Regression analyses

Academic achievement. In our target analyses, we examined the relationship between objective SES, subjective SES and academic achievement, controlling for age, sex, intelligence, school cohort, and race/ethnicity. Consistent with prior research, students from higher SES households earned higher GPAs and standardized tests scores (all β's > .06; all *p*'s < .05), and were more likely to persist through the first year of college (*OR* = 1.37; *p* < .001).

In contrast, students with higher ratings of subjective SES attained *lower* GPAs and standardized test scores (all β's < -.07; all *p*'s < .01) and were less likely to remain enrolled in college one year after high school graduation (*OR* = .87; *p* = .02). These results are shown in Table 2.

Self-reported characteristics. As shown in Table 3, students from higher objective SES households reported *lower* levels of self-control in the work domain (β = -.07; *p* = .008). In contrast, students with higher ratings of subjective SES reported higher levels of self-control in the work domain (β = .16; *p* < .001). Neither objective SES nor subjective SES related to self-reported self-control in the interpersonal domain. In line with the hypothesized model, students who reported higher subjective SES also reported higher levels of life satisfaction (β = .25; *p* < .001), but objective SES did not relate to life satisfaction.

Teacher-reported characteristics. As predicted, teachers reported *lower* levels of self-control in the work domain for students with higher ratings of subjective SES (β = -.07; p = .01). In contrast, objective SES was positively associated with teacher-reported self-control in the work (β = .05 p = .04) and interpersonal domains (β = .07; p = .006). These results are shown in Table 2.

Alternative models

In order to confirm that the negative relationship between subjective SES and academic achievement did not occur due to suppression effects, we also tested the main effect models without objective SES included as a covariate. The results of these analyses are shown in Table 3. In these models, subjective SES continued to show a negative relationship with all academic achievement measures and with teacher-reported work self-control, and showed a positive relationship with self-reported work self-control and life satisfaction.

In order to test the specificity of the subjective SES – achievement relationship, we also tested these models using life satisfaction, along with objective SES and covariates, as predictors of academic achievement measures. These results are shown in Table 4. Life satisfaction did not show the same relationship to academic achievement as subjective SES: it showed a positive relationship with GPA and college enrollment, a negative relationship with SAT scores and standardized reading, and significant relationship with standardized math. Furthermore, when subjective SES and life satisfaction were both included in the model, subjective SES had a significant negative relationship with the achievement measures and life satisfaction did not.

Moderation analyses

We ran exploratory models examining moderation of the subjective SES – achievement relationship by gender, and race (Black vs. other races) and objective SES. The subjective SES X Gender interaction term significantly predicted GPA ($\beta = .08$, $p = .01$), indicating a stronger negative relationship between subjective SES and GPA for male students compared to female students. The subjective SES X Race interaction term also predicted GPA ($\beta = -.08$, $p = .008$) and had a marginally-significant relationship with college enrollment, indicating a stronger negative relationship between subjective SES and these achievement outcomes for Black students compared to students of other races. Additionally, the subjective SES X objective SES interaction term had a marginally significant relationship with GPA ($\beta = .05$, $p = .055$), indicating a stronger negative relationship between subjective SES and GPA for students who were lower on objective SES. However, these interaction terms did not significantly relate to the other achievement measures. Additionally, we tested for moderation by grit, growth-mindset, and self-efficacy and did not observe moderation by these factors. Results of these analyses are shown in Table 5 and Figures 1 and 2.

Discussion

The present study provides evidence that objective SES and subjective SES show opposite relations to academic achievement. Consistent with a large body of research on socioeconomic disparities, our data showed that students with lower objective SES performed comparatively worse on multiple indices of academic achievement. However, adolescents with lower subjective SES, controlling for their objective SES, earned higher

grades in school, scored better on standardized exams, and were more likely to persist through the first year of college as a full-time student.

Who are these adolescents who report relatively low subjective SES, relative to their family's actual SES? Why might they show higher levels of academic achievement than their peers? As predicted, students with lower subjective SES tended to report lower life satisfaction. They also tended to self-report lower levels of self-control for schoolwork, yet their teachers reported that they showed higher levels of self-control in this domain. Teachers may have an advantage over students in judging self-control for schoolwork: they make this judgment from a non-egocentric perspective in comparison to a large number of other students (Duckworth & Yeager, 2015). These results are consistent with the proposed model that students who underestimate their SES may be more dissatisfied with their current standing in society which is manifest as more self-control as observable by others.

These findings are particularly interesting in light of work showing diverging outcomes in the domains of academic achievement and physical health. In particular, recent literature shows that youth from low-SES backgrounds who attain high levels of psychosocial competence and achievement show a physiological cost to this resilience (Brody et al., 2013; Chen, Miller, Brody & Lei, 2014). A separate literature finds that adolescents with lower subjective SES show worse health outcomes (Quon & McGrath, 2014). The current results raise the possibility that youth who underestimate their SES improve their academic achievement with at least short-term costs to their well-being. It

will be valuable for future studies to more directly test subjective SES as a predictor of this 'skin deep' resilience.

To the best of our knowledge, this investigation is the first to examine academic achievement and perceived SES relative to society at large. However, one prior study examined the relationship between adolescent's perceived SES compared to others in their school. Unlike the current results, this study found a positive relationship between perceived SES and grade point average (Destin et al., 2012). Several factors differ between ours and the study by Destin and colleagues that may explain the diverging results. Most notably, Destin and colleagues measured student's subjective SES in relation to others in their school, rather than relative to society, as done in the current study. As Destin and colleagues suggest, perceived status relative to peers in school may be particularly relevant in leading to emotional distress that has negative consequences for motivation and achievement. In contrast, adolescents' ratings of their family's SES compared to society may more closely reflect their beliefs about what constitutes relatively low or high SES and their motivation to change their own SES. This may lead low subjective SES to confer achievement advantages, as observed in the current study.

It is important to note that the negative relationship between subjective SES and achievement we observed was of a small effect size, with standardized coefficients between -.07 and -.15. Nevertheless, this relationship was observed consistent across multiple achievement measures and was robust to a number of controls. Further, subjective SES was measured with a simple, single-item measure; it is possible that

measurement unreliability attenuated associations with other constructs (Pruitt, Jeffe, Yan, & Schootman, 2012).

Our study has several limitations that offer useful directions for future research. First, the measures of objective SES were imperfect: neighborhood income is a broad proxy of family income and participation in free and reduced price lunch is a dichotomous measure of a continuous construct. The limitations of these individual measures are partially addressed by the use of a composite SES measure. Further, imperfect measurement of objective SES would be expected to attenuate the relationship between objective SES and achievement, but would not be expected to impact the subjective SES – achievement association.

Though our sample was racially and socioeconomically diverse, it was composed exclusively of high school seniors. Future research is therefore required to determine whether a similar pattern of associations between subjective SES and academic achievement would be observed across a wider age range.

Future research is required to examine mechanisms linking higher subjective SES to lower academic achievement. We proposed here that youth with relatively low subjective SES may be more motivated to improve their own socioeconomic position, resulting in improved academic achievement. This should be tested using more direct measures of dissatisfaction with social status, and motivation to change it. Another possibility is that high-achieving adolescents are more likely to have higher-SES peer groups, which leads them to underestimate their own perceived SES. Future studies may

be able to test this possibility by measuring information about peer social networks, along with subjective SES and achievement.

In sum, the current study supports the idea that objective SES and subjective SES shape development through distinct pathways. Indeed, they show opposite relations with academic achievement. This stands in contrast to the intuition that youth who perceive themselves as being relatively high SES would show favorable outcomes in the achievement domain, as they seem to in the health domain. Instead, these youth perform worse than their peers on a range of academic achievement measures, from GPA to college persistence. This new evidence suggests a need to revise the assumption that higher SES, whether measured by objective indicators or perceived status, confers only positive life outcomes.

Tables

Table 1

Indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Objective SES															
2. Subjective SES	.24**		-.06+	.01	-.18**	-.15**	-.22**	-.22**	-.20**	-.11**	.24**	.16**	-.03	-.08*	-.07+
3. Age	.02	-.06		-.05	-.02	.03	-.10**	-.06	.01	-.04	.004	.05	.02	.04	.04
4. Female gender	.03	.02	-.05		-.04	.16**	-.07+	.03	-.11**	.03	-.01	.11**	-.10**	.18**	.12**
5. IQ	.05	-.16**	-.02	-.04		.24**	.43**	.27**	.48**	.12**	.04	-.03	.06+	.14**	.15**
6. GPA	.04	-.13**	.03	.17**	.24**		.48**	.35**	.50**	.36**	.01	.17**	-.03	.56**	.40**
7. SAT score	.13**	-.18**	-.10**	-.06+	.43**	.48**		.70**	.72**	.41**	-.07+	-.09*	-.02	.20**	.21**
8. Standardized reading score	.13**	-.17**	-.05	.04	.28**	.35**	.70**		.51**	.31**	-.07*	-.09*	.01	.16**	.15**
9. Standardized math score	-.03	-.20**	.01	-.12**	.48**	.50**	.71**	.50**		.36**	-.002	-.06+	-.03	.23**	.21**
10. College enrollment	.10*	-.08*	-.04	.03	.12**	.36**	.42**	.32**	.36**		.02	.01	-.02	.14**	.14**
11. Life satisfaction	.06+	.24**	.01	-.01	.05	.01	-.06	-.06+	-.004	.03		.24**	.19**	.03	-.04
12. Self-reported work self-control	-.01	.15**	.05	.11**	-.03	.17**	-.09*	-.09*	-.06+	.01	.24**		.46**	.20**	.11**
13. Self-reported interpersonal self-control	.01	-.03	.02	-.10**	.06+	-.03	-.02	.01	-.03	-.02	.19**	.46**		.03	.07*
14. Teacher-reported work self-control	.04	-.06+	.04	.18**	.14**	.56**	.20**	.16**	.23**	.15**	.03	.20**	.03		.65**
15. Teacher-reported interpersonal self-control	.04	-.06	.05	.12**	.15**	.40**	.20**	.15**	.21**	.15**	-.03	.11**	.07*	.65**	

Correlations Controlling For School Cohort

Note. SES = Socioeconomic Status. GPA= grade point average. Correlations below the diagonal show partial correlations controlling for school only; correlations above the diagonal show partial correlations controlling for school and objective SES.

** $p < .01$ * $p < .05$ + $p < .1$

Table 2

Regression Models Using Subjective SES, Objective SES, and Control Variables to Predict Academic Achievement, Self-Reported Characteristics, and Teacher-Reported Characteristics

	Academic Achievement					Self-reported characteristics			Teacher-reported characteristics	
Variable	Senior year grade point average	Math standardized test	Reading standardized test	SAT total	College enrollment	Work Self-Control	Interpersonal Self-Control	Life satisfaction	Work Self-Control	Interpersonal Self-Control
	beta	beta	beta	beta	*OR*	beta	beta	beta	beta	beta
Age	-.06**	-.10**	-.13**	-.15**	.58**	.02	-.04	-.03	-.02	-.04
Female	.20**	-.04+	.09**	-.06*	1.62**	.09**	-.07**	-.05*	.21**	.13**
School										
School 1	-.09**	-.10**	-.07*	.22**	3.92**	-.03	.04	-.01	.06**	.06**
School 2	.01	.02	.05+	-.01	1.26+	.001	.03	-.02	-.08**	-.17**
School 3 (Cohort 2)	-.05+	-.04+	-.03	.07*	1.19	-.11**	-.05+	-.07**	.02	-.02
Ethnicity										
Black	-.17**	-.15**	-.13**	-.20**	.75*	.01	.08**	-.03	-.06*	-.11**
Hispanic	-.07*	-.05*	-.07**	-.08**	.57*	.02	.05+	.06	-.04	.00
Asian	.14**	.16**	-.004	.01	1.83**	.03	.05+	-.04	.13**	.16**
IQ	.25**	.45**	.31**	.35**	1.44**	-.02	.11**	.04	.12**	.11**
Objective SES	.06*	.07**	.13**	.14**	1.37**	-.07**	.03	-.03	.05*	.07**
Subjective SES	-.07**	-.11**	-.15**	-.15**	.87*	.16**	-.03	.25**	-.07*	-.04

Note. School 3 (Cohort 1) was used as the reference group for school. SES = Socioeconomic Status. GPA= grade point average. College enrollment indicates continuous full time enrollment in 2- or 4- year institution one year after high school graduation.

** $p < .01$ * $p < .05$ + $p < .1$

Table 3

Regression Models Using Subjective SES and Control Variables to Predict Academic Achievement, Self-Reported Characteristics, and Teacher-Reported Characteristics

	Academic Achievement					Self-reported characteristics			Teacher-reported characteristics	
Variable	Senior year GPA	Math standardized test	Reading standardized test	SAT total	College enrollment	Work Self-Control	Interpersonal Self-Control	Life satisfaction	Work Self-Control	Interpersonal Self-Control
	beta	beta	beta	beta	*OR*	beta	beta	beta	beta	beta
Subjective SES	-.06*	-.10**	-.12**	-.11**	.93	.14**	-.02	.24**	-.05*	-.02

Note. SES = Socioeconomic Status. GPA= grade point average. College enrollment indicates continuous full time enrollment in 2- or 4- year institution one year after high school graduation.

** $p < .01$ *$p < .05$ + $p < .1$

Table 4

Regression Models Using Life Satisfaction, Objective SES, and Control Variables to Predict Academic Achievement

	Academic Achievement				
Variable	Senior year GPA	Math standardized test	Reading standardized test	SAT total	College enrollment
	beta	beta	beta	beta	*OR*
Life satisfaction	.09**	-.01	-.07**	-.07*	1.12*

Note. SES = Socioeconomic Status. GPA= grade point average. College enrollment indicates continuous full time enrollment in 2- or 4- year institution one year after high school graduation.

** $p < .01$ *$p < .05$ + $p < .1$

Table 5

Regression Models Using Objective SES, Subjective SES, Interaction Terms, and Control Variables to Predict Academic Achievement, Self-Reported Characteristics, and Teacher-Reported Characteristics

	Academic Achievement					Self-reported characteristics			Teacher-reported characteristics	
Variable	Senior year GPA	Math standardized test	Reading standardized test	SAT total	College enrollment	Work Self-Control	Interpersonal Self-Control	Life satisfaction	Work Self-Control	Interpersonal Self-Control
	beta	beta	beta	beta	*OR*	beta	beta	beta	beta	beta
Objective SES X Subjective SES	.04+	.03	.01	-.02	1.02	.001	.02	.01	.04 +	.02
Female X Subjective SES	.08*	.04	-.02	-.02	.99	.04	.02	.02	.07*	.05
Black. X Subjective SES	-.08**	-.02	-.02	-.01	.82+	-.06+	-.10*	-.05	.00	.02

Note. SES = Socioeconomic Status. GPA= grade point average. College enrollment indicates continuous full time enrollment in 2- or 4- year institution one year after high school graduation.

** p < .01 *p < .05 + p < .1

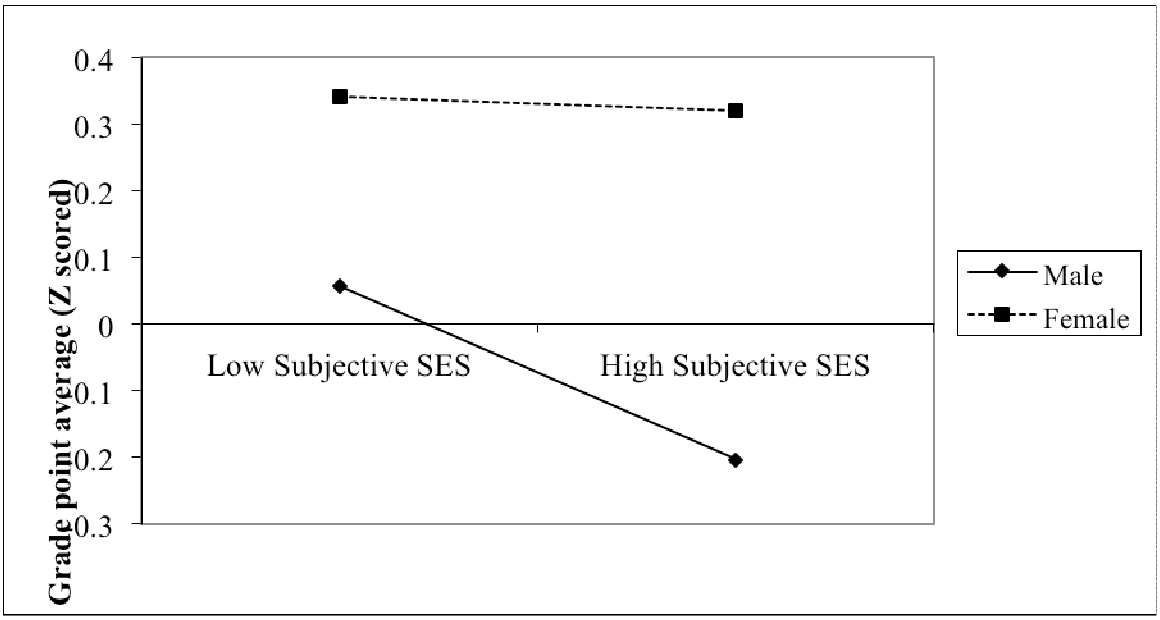


Figure 1. Subjective SES X Predicting GPA. Plot of Subjective SES x Gender interaction predicting standardized Grade Point Average. Plot of interaction effects represents White students at School 3, Cohort 1, at mean levels of all other control variables. Plotted using tool from Dawson (2014).

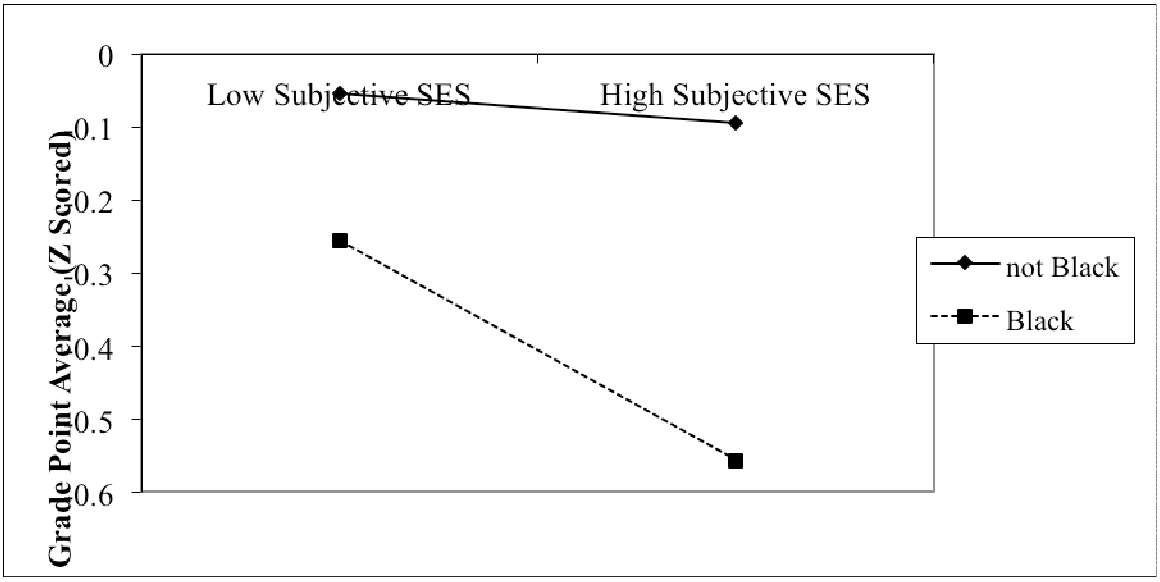


Figure 2. Subjective SES X Race Predicting GPA. Plot of Subjective SES x Race (Black or not Black) interaction predicting standardized Grade Point Average. Plot of interaction effects represents male students at School 3, Cohort 1, at mean levels of all other control variables. Plotted using tool from Dawson (2014).

GENERAL DISCUSSION

These three studies reveal novel evidence about how childhood socioeconomic status relates to specific behavioral outcomes, from ADHD symptoms to college persistence. Further, the impact of objective SES was distinct from the impact of related concepts, including subjective SES and childhood maltreatment. Chapter 1 observed a dissociation between the long-term neural correlates of childhood SES and childhood maltreatment: Whereas a history of maltreatment left its mark on hippocampal volume in young adulthood, low childhood SES did not. Chapter 2 found that the relationship between childhood SES, race and ADHD symptoms varied depending on whether parents or teachers were reporting symptoms. In particular, low SES and African American race were associated with higher levels of symptoms, as reported by teachers, but not by parents. Finally, Chapter 3 revealed that objective SES and subjective SES show opposite relationships to a diverse set of academic achievement measures.

These results add to a large body of literature examining the consequences of exposure to childhood adversity. It is common for such studies to combine multiple forms of adversity. For instance, a growing literature examines the psychological impact of 'cumulative risk exposure,' the number of sociodemographic, psychosocial and physical risk factors a child experiences (Evans, Li, & Whipple, 2013). The current studies take a different approach by examining the distinct impact of separate constructs (e.g., objective SES, subjective SES, race, exposure to child maltreatment). The results support recent arguments for the importance of distinguishing between different types of adverse experiences (e.g., Sheridan & McLaughlin, 2014).

The present results also highlight the importance of considering the perspective of multiple informants when examining an individuals' behavior. Chapter 2 found that parent and teacher report of ADHD symptoms differed in systematic ways by SES and race. In Chapter 3, the direction of the relationships between SES and self-control differed depending on whether self-control was measured by self or teacher report. These findings support arguments that informant discrepancies reflect meaningful information about behavior (e.g., De Los Reyes et al., 2015) and that reports from different informants have different strengths and limitations (Duckworth & Yeager, 2015).

These studies have a number of implications for policy and clinical practice. Taken together, they support the importance of considering socioeconomic context, as well as the impact of related forms of experience, in policy and practice decision-making. In particular, Chapter 2 suggests that SES and race should be considered when integrating multiple informants' reports about a child's behavior. Furthermore, the constructs examined here (objective SES, subjective SES, child maltreatment) are likely to be responsive to different policy interventions. These results suggest that such different interventions would have distinct impacts on child development. For example, policy changes that equalize access to resources might be expected to reduce socioeconomic gaps in achievement, but policies that equalize only perceived status might exacerbate them. Further work is needed to continue to identify specific targets for policy intervention and effective intervention approaches. Psychological research on the impact of different types of childhood experience may provide a framework to inform this work.

Additionally, these findings highlight some areas in need of further research. The present studies do not assume that SES is the direct cause of observed individual differences, but rather that it serves as a proxy for a number of experiences that tend to vary along SES gradients. Recent evidence finds support for early childhood home characteristics and parent-child interactions as mediators of SES disparities in cognitive outcomes (Hackman, Gallop, Evans, & Farah, 2015; Rhoades, Greenberg, Lanza, & Blair, 2011). It will be important for future research to continue to examine these more proximal causes of SES differences. The current studies suggest that objective SES and other related concepts (such as subjective SES) likely operate through different proximal pathways. As such, future studies examining these pathways should be designed to capture this possibility.

The three present studies were limited by their observational nature. It is, of course, not possible to rule out the possibility that any of the observed associations were due to unobserved third variables. In particular, it plausible that genetic factors may play a role in some of the associations observed in these studies (e.g., the relationship between childhood maltreatment and hippocampal volume). Future work using longitudinal and experimental methods is needed in order to provide evidence of causality. For example, studies capitalizing on "natural experiments," in which families are randomly given cash transfers or are assigned to poverty alleviation programs, find evidence that additional income is associated with small increases in cognitive ability (Duncan, Morris, & Rodrigues, 2011; Fernald, Gertler & Neufeld, 2008) and decreases in externalizing behavior (Costello, Compton, Keeler & Angold, 2003). Including measures of specific

cognitive systems and brain structures as outcomes in similar studies will be valuable in establishing causal evidence for relationships with SES (Raizada & Kishiyama, 2010). It may also be possible to manipulate subjective SES (e.g., see Brown-Iannuzzi, Lundberg, Kay, & Payne, 2015) to test the processes proposed in Chapter 3.

It is also important to note that these studies examine the outcomes associated with childhood adversity at multiple levels of analysis (e.g., brain structure, behavior). Further work is needed to clarify the relationships between these brain structures and behavior, as well as to clarify the ways in which these relationships may be moderated by SES or related constructs.

In sum, these results provide novel evidence that childhood SES and related constructs influence development in unique ways. Further research is needed to continue to clarify these relationships and to inform well-targeted interventions and policies to reduce the disparities associated inequalities in childhood experience.

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