Cognitive Appraisal Biases: An Approach to Understanding the Relation Between Socioeconomic Status and Cardiovascular Reactivity in Children

Edith Chen, Ph.D.
Washington University

Karen A. Matthews, Ph.D.
University of Pittsburgh

ABSTRACT

We tested the hypothesis that lower socioeconomic status (SES) children display heightened cardiovascular reactivity during stressful situations because they are more likely to appraise a wide variety of social situations, including ambiguous ones, as threatening. A sample of 201 children and adolescents, half White and half African American, were assessed initially. Ninety of these children were retested an average of 3 years later. At both time points, children were interviewed about appraisals of hostile intent and feelings of anger in response to scenarios with negative or ambiguous outcomes. Cardiovascular reactivity to 3 laboratory stress tasks was measured. Initially, lower SES was associated with greater hostile intent appraisal and anger during ambiguous scenarios across all participants. In addition, responses to ambiguous scenarios partially mediated the relation between SES and vascular reactivity. Longitudinally, low SES African American participants showed higher mean intensity of hostile intent appraisals during ambiguous scenarios, and these appraisals mediated the SES–reactivity relationship. These findings suggest that the way in which children appraise ambiguous social situations plays an important role in the relation between SES and cardiovascular reactivity.

(**Ann Behav Med** 2001, *23*(2):101–111)

INTRODUCTION

Low socioeconomic status (SES) has a profound influence on physical health across the life span. Adults from a low-SES background experience higher rates of morbidity and mortality than adults from higher social classes (see [1–3] for reviews). The effects of SES on physical health extend to childhood as well. As SES decreases, all-cause mortality rates during childhood increase linearly (4–6). An SES gradient in childhood has also been documented for a variety of cause-specific morbidity and mortality outcomes, including injury, asthma hospitalizations, and cancer (for a review, see [7–10]).

One health domain in which associations with SES have been extensively documented is cardiovascular disease, the leading cause of mortality across the life span. Low SES in adulthood is linked to higher incidence of and mortality rates from coronary heart disease, as well as poorer recovery from coronary artery disease (11–14) (see [15] for a review). Research has also shown that low SES in childhood increases risk for ischemic heart disease later in life (16). In seeking an understanding of the origins of these associations, researchers have begun to examine how SES is related to cardiovascular risk factors among children and adolescents. Within this population, one characteristic that may serve as a risk factor for later cardiovascular problems is heightened cardiovascular reactivity in response to stress (17,18).

How Does SES Relate to Cardiovascular Risk Factors in Childhood?

Low SES among children and adolescents is associated with heightened reactivity to laboratory stressors (19,20; cf .21). In addition, factors often associated with SES, such as crowded living conditions and chronic stress, have also been associated with greater cardiovascular reactivity (22–24). Elevated reactivity to stressors may then have negative implications for cardiovascular health outcomes. Adults with low childhood SES who display heightened cardiovascular reactivity have greater atherosclerotic progression (25). Greater blood pressure reactivity predicts rises in resting blood pressure over time in children (18,26), as well as extent of carotid atherosclerosis in adults (27). In addition, a meta-analysis concluded that both adults with borderline and those with essential hypertension have greater blood pressure responses to laboratory stressors (28).

These previous studies suggest that heightened cardiovascular reactivity may operate as a pathway linking childhood SES with cardiovascular disease endpoints during adulthood. An important limitation of this literature, however, is that it has yet to offer a comprehensive model of how low SES children come to exhibit heightened cardiovascular reactivity. This is the goal of our study.

We suggest that children from low SES backgrounds show heightened cardiovascular reactivity because they grow up in more stressful and unpredictable environments and hence develop a bias toward appraising, or interpreting, the world as a threatening place. This bias leads them to respond to a wide

This research was supported by National Institute of Health Grants HL25767 and MH18269, the John D. and Catherine T. MacArthur Foundation Research Network on SES and Health, and the Pittsburgh Mind–Body Center (HL65111 and HL65112).

We thank Linda Gallo and Gregory Miller for helpful comments on earlier versions of this article.

Reprint Address: E. Chen, Ph.D., Washington University, Department of Psychology, Campus Box 1125, One Brookings Drive, St. Louis, MO 63130.

range of situations—including both negative and ambiguous ones—with exaggerated cardiovascular changes.[1] Over time, these frequent and exaggerated episodes of reactivity may place them at greater risk for morbidity–mortality due to cardiovascular disease. We refer to this type of bias as a *cognitive appraisal bias.*

How Does SES Relate to Cognitive Appraisal Bias?

Social situations can be either negative in outcome (e.g., someone hits you) or ambiguous in outcome (e.g., someone laughs at a comment you make. This is ambiguous because it is unclear whether the person is laughing with you because you made a joke or laughing at you because you said something stupid). Certain individuals demonstrate a tendency to consistently make negative appraisals across a variety of ambiguous social situations. Within the social-information-processing literature, this phenomenon is referred to as a *cognitive bias.* For example, anxious children and young adults are more likely to interpret ambiguous outcomes as threatening and preferentially attend to anxiety-relevant words relative to neutral words (29–31). Aggressive children make more hostile interpretations than nonaggressive children when the intent of a story character is ambiguous, but the outcome is negative (e.g., a peer bumps into you and spills milk all over you. Spilling milk is a negative outcome, but it is unclear whether the peer did this intentionally or accidentally. For further descriptions of aggressive children's biases, see [32,33]).

A similar cognitive bias may apply to low-SES children. These children are more likely to live in neighborhoods that are more dangerous and have higher incidences of violence (34). In addition, lower SES children report more frequent stressful life events (35,36). This increased exposure to events that are unpredictable and stressful may lead low-SES children to develop a schema about the world being a place that requires constant vigilance. This schema may predispose low-SES children to appraise a wide range of situations, including ambiguous ones, as potentially threatening. Unlike aggressive children who demonstrate bias during negative outcome situations, low-SES children may show this bias in situations involving ambiguous outcomes (e.g., a peer laughing at a comment you make in class) because of a tendency to overgeneralize perceptions of threatening situations.

Cognitive Appraisal Theory

Our hypotheses about low-SES children's biases in interpreting social situations also tie in to a large literature on cognitive appraisal. According to Lazarus and Folkman, emotional and behavioral responses to situations are determined by an individual's cognitive appraisal of that situation (37). *Primary appraisal* is the initial interpretation of the meaning of a situation, including the degree to which a situation is personally relevant (goal relevance), and the degree to which a situation is appraised as threatening (goal congruence). *Secondary appraisal* relates to a person's resources and options for coping, including who is to blame (accountability), how one can change the situation for the better (coping potential), and the likelihood of changes occurring in the situation (future expectancy) (see [38,39] for a more elaborate discussion of these concepts). This study's scenarios included similar dimensions: That is, we created scenarios that would be personally relevant with the potential for threatening interpretations. Also included are the possibility of other-accountability (a character directly involved in the potentially harmful act) and postscenario probing of future expectancies. We hypothesize that low-SES children will make negative appraisals during ambiguous social situations because of a tendency to interpret situations as relevant to them, potentially harmful, the fault of others, and likely to remain harmful in the future.

As described earlier, SES relates to reactivity in children and adolescents. In addition, variables such as trait hostility mediate this relation among African American children (19). That is, lower SES African American children are more likely to have higher trait hostility scores, which in turn are associated with greater cardiovascular reactivity. In addition, previous research has demonstrated that among adults, those in lower status occupations who also have a tendency to make negative appraisals have higher blood pressure elevations at work (40). However, the role of processing styles that vary by situation, such as the cognitive appraisal bias we described earlier, has not been investigated in children.

This Study

This article represents a preliminary test of the model we described earlier. We test three specific hypotheses that are central to this model: that lower SES children experience greater cardiovascular reactivity during laboratory stressors, that lower SES children make more hostile intent appraisals and report more anger during only ambiguous social situations, and that this cognitive appraisal bias accounts for the associations between SES and reactivity. This is the first study we know of that tests cognitive appraisal bias as a mediator of the SES and cardiovascular reactivity relation. It is also unique in testing these relations among children and adolescents, which will hopefully provide researchers with information about psychological risk factors that develop at an early age.

In addition, we test these hypotheses in the context of a prospective study in which children participated in two laboratory sessions spaced approximately 3 years apart. This allows us a novel opportunity to examine whether associations differ for immediate versus longitudinal data; that is, do patterns in cognitive appraisal bias over time account for changes in reactivity over time? Although clinical cardiovascular and coronary outcomes such as essential hypertension and myocardial infarction do not typically manifest until adulthood, their un-

[1]We also note that, in addition to heightened reactivity, low SES is associated with higher resting levels of blood pressure among children and adolescents (58–60). However, because we hypothesize cognitive appraisal bias to be related to situation-specific reactivity, we do not propose a direct role of cognitive bias in influencing resting blood pressure levels.

derlying causes and risk factors can develop and progress in childhood and early adulthood. For example, atherosclerosis begins in youth, and atherosclerotic lesions increase rapidly during the teenage and young adult years (41,42). Similarly, longitudinal increases in risk factors such as cardiovascular reactivity may be particularly informative in predicting clinical outcomes. In this study, we hypothesize that lower SES will be associated with greater increases in cardiovascular reactivity over the 3-year period. Second, we hypothesize that across time, lower SES children will show higher mean hostile intent and anger responses to ambiguous scenarios. Third, we hypothesize that these longitudinal measures of cognitive appraisal bias will mediate the relation between SES and change in reactivity over time.

Our study is also unique in its attempt to define the contribution of various SES measures within the context of race. One challenge that arises in any study exploring associations of SES is the possible confound of race. More so than any other demographic variable, race has been linked to SES. African American families, on average, have lower income than White families. Thus, associations of SES with reactivity may be due primarily to race rather than SES per se. In addition, there may be synergistic effects, such that being of low SES is most detrimental to those who are also minorities (43). In this study, we explore the combined effects of race and SES. By recruiting a sample that was half African American and half White, we were able to test for SES by race interactions and, when present, to conduct SES analyses separately by race. We hypothesized that, as children aged, differences in cognitive bias would emerge by race. Low-SES African American children may gain more life experiences with stressful and unpredictable situations with age. Furthermore, experiences with racism present an additional burden that White children do not face. The net result of these two factors may be that as African American children grow older, relationships strengthen between low SES and biases in appraising ambiguous situations. In contrast, this type of strengthening would not be expected to occur among White children.

A second challenge that arises in this area is how to measure childhood SES. Some researchers have relied on family SES, whereas others have used only paternal SES scores. Both family and paternal SES have been associated with a variety of child health outcomes in the epidemiological literature (10,44), and, in fact, paternal SES scores have been relied on to demonstrate the effect of childhood SES on health in major studies among both adults and children (44–46). Despite the societal progress made in recent decades in women's employment opportunities, research still supports the predictive value of male head of household's SES. In fact, among adults, husbands' SES has been found to be a better determinant of wives' health status than wives' own SES (3,47). Similarly, paternal SES may be a better determinant of children's health than maternal or family SES. To address this issue in our study, we included measures of both family and paternal SES and test each separately to determine whether our model applies better to one type of SES measure.

METHOD

Participants

A total of 204 children and adolescents were initially recruited from school districts in the metropolitan Pittsburgh, Pennsylvania area. Three children were excluded from analyses: 1 participant had a high fever, 1 mother withdrew consent for use of her son's psychosocial measures after completion of the protocol, and 1 participant's data were deleted due to technical problems. At Time 2, 149 children and adolescents returned to be retested. Older participants who had not completed an echocardiogram at Time 1 were not invited to be retested at Time 2 (11%, $n = 23$). The remaining reasons for not returning for Time 2 testing were that 7% ($n = 14$) could not be located, and 7% ($n = 14$) refused participation. One participant was deceased. Of the 149 who participated in Time 2 testing, 59 were not administered one part of the protocol (the Social Scenarios Interview [SSI]—see following) because of a late decision to add in a revised version. Hence, their data are excluded from Time 2 analyses.

At Time 1, participants were recruited to provide equal numbers by sex and race (African American and White), in the age ranges of 8 to 10 and 15 to 17. Participants were also recruited to represent a wide range of SES backgrounds, with the exception that the upper level of occupational class (children whose parents had professional degrees) was excluded. For additional descriptive information about these participants, refer to an earlier article (48). At Time 2, returning participants ranged in age from 9 to 21 (average age = 13.6 years; average length between visits = 3.0 years). Demographic breakdown revealed 41 girls and 49 boys, and 41 African Americans and 49 Whites. Percentages of girls and boys by race and SES were similar across groups.

Initial eligibility requirements were no history of cardiovascular disease or any condition that would require medication that might affect the cardiovascular system (e.g., high blood pressure, asthma, oral contraception); no drug or alcohol abuse, history of mental illness, or any professional psychiatric counseling within the past year; less than 80% above ideal weight according to Metropolitan height and weight tables; and no smoking within 12 hr prior to the session.

A previous article (49) based on this sample tested the relations between SES and left ventricular mass (from echocardiograms), with trait hostility and cardiovascular reactivity as potential mediators. That article reported data from only two of the three laboratory stress tasks described following because reactivity to alpha-adrenergic tasks (the two used in that article) is associated with left ventricular mass (49). That article differs from this article in that it focused on associations between SES and cardiovascular outcomes at one point in time (no longitudinal data), and it examined trait hostility as a mediator as opposed to a situationally based measure of cognitive bias (19). In addition, in that article an anatomical measure (left ventricular mass) was the primary outcome of interest, whereas in this article measures of cardiac and vascular functioning are the primary outcomes of interest.

Measures

Social Scenarios Interview

To measure cognitive bias, four hypothetical social situations were generated. At Time 1, each situation differed with respect to the nature of the threat (physical vs. psychological) and the outcome (ambiguous vs. negative). The physical threat stories were modeled after those developed by Dodge et al. (32,33,50). Because psychological stories produced more anger and higher perceptions of hostile intent, Time 2 SSI was revised to contain all psychological stories (two of which were ambiguous and two negative). Given this revised version, all longitudinal analyses testing cognitive bias as a mediator of cardiovascular reactivity included Time 1 reactivity as a control variable. Story examples include: "You raise your hand in class and are called on. Immediately after making a comment, you hear a classmate of yours begin to laugh" (ambiguous story because it is unclear whether the person is laughing with you because you made a joke or laughing at you because you said something stupid) and "A popular girl walks up to you and asks why you didn't attend her party last night. You hadn't known there was a party. This girl tells you that she told another classmate of yours to tell you about the party" (negative story because you were not invited to the party). All story characters were described as a "classmate" for children and adolescents to avoid responses being influenced by associations with known individuals. Gender references used for story characters were matched to participants' gender and, thus, differed depending on the sex of the participants.

After reading each scenario aloud, experimenters asked participants about the intentions of the character in the story (e.g., "How do you think it happened that this person …?"). Additional nonleading questions were asked to clarify unclear responses. This was the "intent" appraisal question. It was coded as –1 if the participant described the story character's intent as benevolent or accidental and as +1 if the intent was described as hostile (i.e., the situation involved potential threat stemming from another person's actions). Participants were then asked how likely they thought it was that the story character would behave similarly in the future ("likelihood"). Responses to this future likelihood question were coded as 1 (*unlikely*), 2 (*somewhat likely*), and 3 (*very likely*). Participants' score on the intent question was then multiplied by their score on the likelihood question. This procedure yielded a score reflecting stable "hostile intent," which ranged from –3 (*not hostile and very likely to be nonhostile in the future*) to +3 (*hostile and very likely to be hostile in the future*) at Time 1 and served to normalize the distribution of responses.

Participants were also asked how they would feel in the situation. If participants reported that they would feel angry, a further probe clarified the degree of anger. This question was coded as 1 (*no anger*), 2 (*mildly angry*), and 3 (*very angry*).

All interviews were conducted and coded by trained research assistants and were tape-recorded so that they could be double coded for scoring reliability. Twenty-five percent of the child and adolescent interviews were randomly chosen to be coded by two raters; in case of discrepancies, final codes were assigned by consensus. Excellent agreement was obtained between coders for all questions: κs = 0.93 (hostile intent), 0.97 (anger), and 0.99 (likelihood).

SES

Hollingshead's Four Factor Index of Social Status (1975) was used to compute each participant's family SES. Both family and paternal social status were calculated. For family SES, average SES score for two parents was used whenever possible. If children came from a single-parent family, only the single parent's score was used. For paternal SES, values were coded as missing if no male head of household existed. SES was derived from the occupation and level of education for the head(s) of a family. Using Hollingshead's criteria, a family's occupation is given a score on a 1 to 9 scale. Education is categorized on a 1 to 7 scale. The score for occupation is multiplied by 5 and the score for education is multiplied by 3. The two scores are then summed to create a single SES score, with higher scores indicating higher SES. This information was collected at Time 1 and Time 2.

Physiological Recording Apparatus

A Minnesota Impedance Cardiograph Model 304B (Instrumentation for Medicine, Old Greenwich, CT) was used for the generation of the impedance wave form using a tetrapolar band electrode configuration (51). An EKG signal was transduced using two active Cleartrace LT disposable silver/silver chloride electrodes (Conmed Andover Medical, Haverhill, MA) placed on each side of the abdomen below the impedance electrode bands and a ground electrode beside the navel. The EKG signal was filtered and amplified by a Coulbourn S75–11 amplifier/coupler (Coulbourn Instruments, Allentown, PA). Processing of the impedance signals and ECG was accomplished using the Cardiac Output Program (COP), an online computerized videographics system for impedance cardiography analysis (Microtronics Corp., Chapel Hill, NC). Basal impedance, the first derivative of the pulsatile impedance signal (dZ/dt) and the EKG were sampled at 500 Hz per channel by a Dell 80386-based microcomputer hosting a Computer Boards CIO–AD08 analog-to-digital converter board (Dell Computer Corp., Round Rock, TX). The output of the COP program included heart rate (HR) and cardiac output (CO; calculated as the product of mean stroke volume and HR for a given period). The COP program calculates stroke volume using the Kubicek equation (52) and ensemble-averaged waveforms over the designated time periods.

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were monitored using an IBS Model SD–700A automated blood pressure monitor (IBS Corp., Waltham, MA) with a standard occluding cuff placed on the participant's nondominant arm. Total peripheral resistance (TPR) was calculated using the formula TPR = ({[(SBP–DBP)/3] + DBP}/CO)*80. Vascular reactivity is indicated by increases in DBP and TPR. Cardiac reactivity is indicated by increases in myocardial contractility (the SBP and HR product), as well as CO.

Experimental Tasks

All tasks were presented while the participant sat upright in a comfortable lounge chair that had a detachable desk surface. Reactivity was averaged across all tasks because of our hypothesis that biases in cognitive appraisal would result in a consistent pattern of heightened reactivity across multiple stressors and because averaging produces greater reliability in reactivity measures across time (53).

Reaction Time

A computerized task required the participant to respond by pressing a joystick button as quickly as possible to a 1000 Hz tone presented via headphones but to refrain from responding to a 2000 Hz tone. Tones were presented at irregular intervals by an AT&T 6300 microcomputer during the 3-min task. Participants earned 75 points for each time they beat the average reaction time of previous trials and 20 points for correctly withholding a response to the incorrect tone. Thirty points were subtracted for responding to the incorrect tone. Two cents were given to the participant for each point earned.

Mirror Tracing

Participants were required to trace around a copper star with a metal stylus while being allowed to see only the mirror image of the star. The tracing apparatus (Stoelting Co., Chicago, IL) was interfaced to an AT&T 6300 microcomputer, and customized software kept track of whether the stylus was on the star. Going off the star produced a loud beep through the headphones. Task time was 3 min.

Cold Forehead

A 2-quart bag of two parts crushed ice and one part water was placed on the participant's head for 1 min. The participants were informed of the time remaining during the minute to encourage completion of the minute, although the instructions for the task clearly indicated that the ice bag would be removed if the pain became too intense.

Procedure

Recruitment of participants was accomplished through a number of school districts in the suburban Pittsburgh area. Letters describing the study were sent to parents, and those who were interested in additional information were given phone numbers to call for an initial screening interview. The protocol was explained to the parents in detail during the initial recruitment contact. All adolescents and parents were required to sign a consent form prior to participation in the protocol; the younger children signed an assent form. All consent and assent forms were approved by the Psychosocial Institutional Review Board of the University of Pittsburgh Medical Center.

Participants arrived at the laboratory at about 8:30 a.m. Electrodes for impedance cardiography and the EKG were applied. The blood pressure cuff was placed on the upper aspect of the nondominant arm with the microphone placed above an area where the brachial artery could be palpated. Children were then given instructions for an initial (baseline) 10-min rest period. The reaction time, mirror tracing, and cold forehead tasks were given in counterbalanced order with 8-min intertask rest periods after each task. A fourth task (the Social Competence Interview) was conducted only at the first assessment so results are not reported here. This task was administered after the completion of the three other reactivity tasks and was followed by a final 10-min rest period. Sensors were removed, and participants completed the SSI. Participants were paid $75 for completing the protocol in addition to money earned in the reaction time task.

An average of 3 years later, participants were invited back for a follow-up study. Parents gave current information about their occupation and education for SES calculations. Children participated in the same three laboratory reactivity tasks and completed a revised SSI (protocol same as described earlier). Participants were paid $65 for completing this protocol in addition to money earned in the reaction time task.

Data Reduction

Data for HR and CO were collected on a minute-by-minute basis during the last 3 min of the initial (baseline) rest period, and during all 3 min of reaction time and mirror tracing. Of each minute, 55 sec were used for ensemble averaging. These minute-by-minute values were averaged to form means for each period. Data were collected in 10-sec blocks during the 1 min of the cold forehead task (7 sec of each 10-sec block were ensemble averaged). The six 10-sec blocks during the cold stimulus were averaged to form a mean for that task.

Blood pressures were recorded at the 5-, 7-, and 9-min mark of the baseline rest period, and the last two readings were averaged to form SBP and DBP means, coincident with impedance cardiography sampling. Three readings were taken during the reaction time and mirror tracing task, and these readings were averaged to form task means. One blood pressure reading, initiated 15 sec into the icebag application, was taken during the cold forehead task.

Reactivity scores were derived in two ways. For HR, SBP, and DBP, change scores were computed by subtracting baseline (initial) resting mean level of a variable from the task mean. Change scores were then summed across the three tasks. In addition, baseline levels were used as a covariate for all reactivity change score analyses. For impedance-derived variables involving volume-based measures (CO, TPR), the accuracy of absolute levels of these variables is questionable, and we therefore derived percent change scores for baseline to task mean for these variables. Percent change scores were summed across the three tasks.

Data Analyses

To disentangle the effects of race and SES on our variables of interest, we first conducted multiple regression analyses in which cognitive bias was regressed onto race, SES (centered), and the interaction of race and centered SES, as suggested by Aiken and West (54). Similar analyses were performed for cardiovascular reactivity. Significant interaction effects were probed further by examining the associations of SES with cognitive appraisal bias and reactivity for each race separately. For nonsignificant interactions, analyses with the whole sample were conducted.

To assess whether cognitive appraisal bias operated as a pathway through which SES is associated with cardiovascular reactivity, we followed Stone's recommendations for testing statistical mediation (55). Three criteria must be met for data to be consistent with a mediational model: (a) the predictor variable must be associated with the outcome variable, (b) the predictor variable must be associated with the proposed mediator, and (c) the magnitude of the association between the predictor variable and the outcome variable must be substantially reduced when the proposed mediator is statistically controlled.

Thus, to test the first criterion, we regressed reactivity change scores onto baseline physiological levels in the first step, and SES in the second step (or regressed percent change scores directly onto SES). To test the second criterion, we conducted correlations of SES with cognitive bias. To test the third criterion, we regressed reactivity change scores onto baseline physiological levels and cognitive bias in the first step, and SES in the second step. We then examined the difference in percentage variance accounted for by SES in the equation for Criterion 3 versus Criterion 1, with substantial decreases in variance indicating at least partial mediation. These analyses were conducted for both family and paternal SES scores at Time 1 (single-session analyses).

Longitudinally, we explored whether patterns in cognitive bias served as a mediator between Time 1 SES and Time 2 reactivity. Mean intensity of cognitive bias over time was calculated by averaging the hostile appraisal or anger scores across Times 1 and 2. Mediational analyses were conducted as described earlier, except that Time 1 reactivity was added in the first step of Criteria 1 and 3 as a control variable.

RESULTS

Differences Between Study Completers and Noncompleters

We first tested whether those participants who completed all Time 2 measures differed from those who did not on any Time 1 SES, cognitive appraisal bias, or physiological measures. Completers did not differ from noncompleters in family or paternal SES (all ts < 1.0, all ps > .5). The two groups also did not differ on any measures related to ambiguous scenarios (all ts < 1.0, all ps > .3). However, study completers reported greater anger during negative stories than study noncompleters, $t(193) = 2.45$, $p < .025$. The two groups did not differ in HR, SBP, or DBP reactivity at Time 1 (all ts < 1.0, all ps > .3). However, study completers showed less CO reactivity, $t(194) = 2.35$, $p < .05$, and greater TPR reactivity, $t(192) = 2.46$, $p < .025$, at Time 1. These reactivity differences are due to the fact that older participants who did not complete the echocardiogram at Time 1 were not invited back. When age is controlled, study completers and noncompleters did not differ in CO or TPR reactivity (ps > .05).

SES of Sample

Family SES at Time 1 averaged 30.92 (SD = 9.76) across the whole sample (possible range = 8–66). This translates into parents having, on average, approximately a high school education (M = 13.28 for fathers; M = 12.78 for mothers). Fathers, on average, fell into the category of skilled manual workers, and mothers, on average, fell into the category of semiskilled manual workers.

At Time 2, family SES averaged 32.06 (SD = 10.30) across the whole sample. Family SES did not differ across the two time points, $t(87) = 1.73$, $p > .05$. In addition, paternal SES did not differ from Time 1 to Time 2, $t(69) < 1.0$, $p > .5$. However, African American children in our sample had lower average family and paternal SES scores, both at Time 1 and Time 2, compared to White children (ts = 3.22–7.03, all ps < .01). In addition, those children who did not have a paternal head of household had lower family SES scores than those who did (ts = 2.18–6.18, ps < .05). This was because children who lived in single-parent families were disproportionately African American and came from lower SES households. Because of this differential elimination of participants for paternal SES analyses, all paternal SES analyses described next were repeated substituting maternal SES scores for missing values when no paternal figure existed. Patterns remained the same, and thus results are reported next for paternal-only scores.

Single-Session Associations of SES, Cognitive Appraisal Bias, and Reactivity

No significant Race × SES interactions emerged for any of the cognitive appraisal bias measures at Time 1. No significant Race × SES interactions emerged for any of the cardiovascular reactivity measures at Time 1. Therefore, all Time 1 analyses were conducted with the entire sample.

Our first hypothesis states that lower SES is associated with greater cardiovascular reactivity during laboratory stressors. Across the whole sample, lower family SES was associated with greater TPR reactivity at Time 1, $\beta = -.17$, $t(191) = 2.41$, $p < .025$. In contrast, higher family SES was associated with greater CO reactivity at Time 1, $\beta = .23$, $t(193) = 3.25$, $p < .01$ (this is expected because TPR and CO are inversely related mathematically). No associations between paternal SES and reactivity were found. This pattern of results suggests that lower family SES is associated with greater vascular reactivity and less cardiac reactivity across the whole sample. All mediational tests for Time 1 were therefore conducted with TPR reactivity as the dependent measure.

Our second hypothesis states that lower SES is associated with greater perceptions of hostile intent and anger during ambiguous scenarios. Correlations revealed that lower family SES was associated with greater hostile intent appraisals, $r(195) = -.24$, $p < .01$, and greater anger, $r(193) = -.20$, $p < .01$, during ambiguous stories at Time 1. Lower paternal SES was associated with greater hostile intent appraisals during ambiguous stories, $r(146) = -.24$, $p < .01$, and greater anger, $r(145) = -.21$, $p < .025$, during ambiguous stories at Time 1. Neither family nor paternal SES was associated with responses to negative stories (see Table 1).

Mediational Tests

Given that lower SES is associated with greater TPR reactivity and greater cognitive appraisal bias at Time 1, we

TABLE 1
Single-Session Associations at Time 1 Among SES, Social Scenarios Interview Responses, and Cardiovascular Reactivity

Social Scenarios Interview	*Family SES*	*n*	*Paternal SES*	*n*
Ambiguous scenarios				
Hostile intent appraisals	–.24**	195	–.24**	146
Anger	–.20*	193	–.21*	145
Negative scenarios				
Hostile intent appraisals	–.07	193	.00	144
Anger	.05	192	.08	144
	β		ΔR^2	
SES–TPR relation	–.17*		.030	
SES–TPR with hostile intent controlled	–.14		.020	
SES–TPR with anger controlled	–.15*		.022	

Note. SES = socioeconomic status; TPR = total peripheral resistance.
*$p < .05$. **$p < .01$.

tested cognitive bias as a mediator. The amount of variance in TPR reactivity that family SES accounts for is 3.0% ($R^2 = .03$, $\beta = -.17$), $t(191) = 2.41$, $p < .025$. When hostile intent perceptions during ambiguous scenarios are partialled out, the percentage of variance in TPR reactivity that SES accounts for decreases by 33% (R^2 changes from .030 to .020). Additionally, SES is a weaker predictor of TPR reactivity when hostile intent is controlled, $\beta = -.14$, $t(188) = 1.93$, $p > .05$. When anger during ambiguous scenarios is partialled out, the percentage of variance in TPR that SES accounts for decreases by 27% (R^2 changes from .030 to .022). However, SES remains a significant predictor of TPR reactivity when anger is controlled, $\beta = -.15$, $t(186) = 2.03$, $p < .05$ (see Table 1). We did not test for mediation with paternal SES because the TPR relation was not significant. Overall, the analyses are consistent with the hypothesis that hostile intent and anger during ambiguous situations partially mediate the relation between family SES and vascular reactivity. It should be noted that hostile intent and anger during ambiguous scenarios are significantly correlated, $r(196) = .65$, $p < .001$.

Longitudinal Associations of SES, Cognitive Appraisal Bias, and Reactivity

Longitudinally, a Race × SES interaction effect emerged for mean intensity of hostile intent appraisals during ambiguous scenarios using paternal SES, $\Delta R^2 = .05$, $F(1, 70) = 4.13$, $p < .05$. A Race × SES interaction effect also emerged for mean intensity of anger during ambiguous scenarios using paternal SES, $\Delta R^2 = .07$, $F(1, 69) = 4.97$, $p < .05$. Given the significant Race × SES effects for these cognitive bias measures, longitudinal analyses were conducted separately by race. In addition, note that cognitive appraisal bias scores from Time 1 to Time 2 were correlated more highly in African American ($r = .24$ and .41, $p = .12$ and .01, for hostile intent and anger, respectively) than White participants ($r = -.01$ and .25, $p = .94$ and .08, for hostile intent and anger, respectively).

Mean Intensity of Cognitive Appraisal Bias Across Time

African Americans

Our first set of hypotheses states that, with respect to longitudinal measures, lower SES at Time 1 is associated with greater cardiovascular reactivity to laboratory stressors at Time 2, controlling for Time 1 reactivity. Among African Americans, lower paternal SES at Time 1 was associated with greater SBP reactivity at Time 2, controlling for both resting SBP at Time 2 and SBP reactivity at Time 1, $\beta = -.39$, $t(29) = 3.26$, $p < .05$. This analysis indicates that the relation between Time 1 SES and Time 2 reactivity is independent of any association of SES and reactivity at Time 1. Family SES was not associated with longitudinal reactivity. All longitudinal mediational analyses were therefore conducted on only SBP reactivity.

Our second set of hypotheses also states that lower SES at Time 1 is associated with higher mean intensity of hostile intent appraisals and anger across the two time points in response to ambiguous scenarios. Among African Americans, lower paternal SES at Time 1 was associated with higher mean intensity of hostile intent across Times 1 and 2 during ambiguous scenarios, $r(30) = -.55$, $p < .05$. Lower paternal SES at Time 1 also was associated with higher mean intensity of anger during ambiguous scenarios across Times 1 and 2, $r(29) = -.37$, $p < .05$, and during negative scenarios, $r(29) = -.45$, $p < .05$ (see Table 2). Family SES was not associated with cognitive bias.

Mediational tests. Given that lower paternal SES at Time 1 is associated with both greater SBP reactivity at Time 2 and higher mean intensity of cognitive appraisal bias among African Americans, we tested mean intensity of cognitive bias as a mediator. The amount of variance in Time 2 SBP reactivity that Time 1 SES accounts for is 11.9%, $\Delta R^2 = .119$, $\beta = -.39$, $t(29) = 2.16$, $p < .05$. When mean intensity of hostile intent during ambiguous scenarios is partialled out, the percentage of variance in SBP re-

TABLE 2
Longitudinal Associations Among SES, Social Scenarios Interview Responses, and Cardiovascular Reactivity

Social Scenarios Interview	*White*	*n*	*African American*	*n*
Ambiguous scenarios				
Mean hostile intent appraisals	–.06	44	–.55**	30
Mean anger	.16	44	–.37*	29
Negative scenarios				
Mean hostile intent appraisals	–.03	44	–.07	30
Mean anger	.33*	44	–.45*	29
	β		ΔR^2	
SES–SBP relationship	–.39*		.119	
SES–SBP with hostile intent controlled	–.38		.086	
SES–SBP with anger controlled	–.53*		.196	

Note. SES is measured by paternal Hollingshead's Four Factor Index of Social Status (61). SES–SBP coefficients are for African American participants only. SES = socioeconomic status; SBP = systolic blood pressure.
*$p < .05$. **$p < .01$.

activity that SES accounts for decreases by 28% (R^2 changes from .119 to .086). Additionally, SES is no longer a significant predictor of SBP reactivity when hostile intent is controlled, β = –.38, $t(29) = 1.80$, $p > .05$ (see Table 2).

When mean intensity of anger during ambiguous scenarios is partialled out, the percentage of variance in SBP reactivity that SES accounts for does not decrease, indicating that high mean intensity of anger is not a mediator of the relation between Time 1 SES and Time 2 reactivity. Similarly, when mean intensity of anger during negative scenarios is partialled out, the percent of variance in SBP reactivity that SES accounts for does not decrease. These analyses suggest that only high mean intensity of hostile intent appraisals during ambiguous situations mediate the relation between SES and 3-year increases in SBP reactivity among African Americans.

Whites

Lower paternal SES at Time 1 was associated with greater HR reactivity at Time 2, controlling for both resting HR at Time 2 and HR reactivity at Time 1, β = –.29, $t(42) = 2.08$, $p < .05$. Again, this relation between Time 1 SES and Time 2 reactivity is independent of any association of SES and reactivity at Time 1. Family SES was not associated with reactivity.

Higher paternal SES at Time 1 was associated with higher mean intensity of anger only during negative scenarios, $r(44) = .33$, $p < .05$ (see Table 2). Family SES was not associated with cognitive bias. Given the lack of association of SES and responses to ambiguous scenarios, no mediational tests were conducted.

DISCUSSION

Our results support the hypothesis that biases in cognitive appraisal partially mediate the relation between low SES and heightened cardiovascular reactivity among children and adolescents. We demonstrated that lower SES children are more inclined to appraise ambiguous situations as containing hostile intent and, in some cases, to respond with greater anger during these situations. At Time 1, lower SES was associated with greater hostile interpretations and anger during ambiguous situations. In contrast, during negative situations, SES was not associated with hostile perceptions or anger. Longitudinally, lower SES African American children were more likely to have higher mean intensity of hostile intent and anger during ambiguous scenarios. Overall, these findings support the notion of low SES as a factor that predisposes individuals toward cognitive appraisal biases—that is, toward interpreting situations negatively, based on perceptions of relevance, potential for harm, being the fault of others, and likely to happen again (the components of appraisal as described by Lazarus [38]).

Second, the tendency to perceive hostile intent and to experience anger during ambiguous situations accounted for a substantial portion of the variability primarily in the longitudinal SES and reactivity relation among African American children. Mean intensity of hostile intent appraisals mediated the relation between Time 1 SES and Time 2 reactivity among African American children, reducing the percentage of variance in reactivity that SES accounted for by 28%. In contrast, at Time 1, although SES was associated with cognitive bias, associations between SES and cardiovascular reactivity were weak. Controlling for cognitive appraisal bias substantially reduced the percentage of variance in reactivity that SES accounted for; however, this percentage was quite small (3% at Time 1 compared to 12% longitudinally). Thus it may be that the effects of both SES and cognitive appraisal biases are cumulative, such that their impact on reactivity become more pronounced over time, particularly for African American children.

In exploring the SES and reactivity relation, it becomes apparent that children's responses during ambiguous, rather than negative, situations play a key role. This represents a critical distinction in social information processing styles between low-SES children and aggressive children. Low-SES children, because of a tendency to overgeneralize perceptions of threat, show biased responses when encountering ambiguous outcome situations (in which the intent of the story character is also am-

biguous). In contrast, aggressive children, because of a tendency to utilize aggressive schemata in interpreting social interactions, show biased responses when encountering negative outcome situations (with ambiguous intent) (56). Thus, although both groups of children demonstrate biases in information processing, these biases emerge in different types of social situations with different implications. Aggressive children, in part because of these processing biases, display behavioral reactions that are extreme in proportion to the situation (e.g., beating up another child because that child accidentally bumped him in line). These responses often lead the aggressive child to become socially rejected by peers (56). Low-SES children, in contrast, appear to develop a constantly vigilant nature that revolves around protecting themselves from external threats. This monitoring may take a physiological toll on the self rather than harming relationships with others. Over time this physiological burden may lead to health problems such as hypertension and coronary heart disease, both of which have been associated with low SES in adulthood (13,15).

Furthermore, it appears that hostile intent perceptions are a more potent mediator of the SES and reactivity relation than is anger during ambiguous scenarios. For example, even though both mean intensity of hostile intent appraisals and anger were associated with SES among African Americans, only mean intensity of hostile intent perceptions reduced the magnitude of the SES and reactivity relation. This suggests that heightened physiological reactivity exhibited during stressful situations results from negative cognitive interpretations rather than directly from negative emotions experienced during the interaction. That is, it suggests that negative emotions alone are not sufficient to produce elevated reactivity and may, in fact, have to be accompanied by specific negative cognitions about the individual with whom one is interacting. It is also possible that the scenarios may have produced negative emotions other than anger (e.g., anxiety) and that these other emotions would have been more relevant to the SES and reactivity relation.

Race Effects

Results supported our hypothesis that SES differences in cognitive appraisal biases would grow stronger over time in African American children. At Time 1, these biases were apparent in both low-SES African American and White children. However, over time, it was only low-SES African American children's biases that persisted. As described earlier, we believe that these relations may strengthen over time in African American children due to their experiences with racism and life stressors. Our longitudinal results suggest that experiencing low SES early in life may set African American children on a trajectory of increasingly hostile appraisals to ambiguous situations over time.

Measurement of SES

We also found that over time, paternal SES measures were more strongly linked to cognitive appraisal biases and reactivity than family SES measures. This research is consistent with SES and health research among adults, which has demonstrated that male head of household's SES is most predictive of health outcomes (3,57). However, the predictive value of family SES may increase in the years to come as women's employment opportunities and salaries become more commensurate with men's. It should be noted that the findings with paternal SES are intertwined with race, such that longitudinal relations held for paternal SES of African American children. It is unclear whether family SES measures would be predictive among White children for other health outcomes.

Limitations to this study include the measure of only one potential mediator of the SES and reactivity relation. Other possible noncognitive mediators such as health behaviors may also play an important role in this relation. Low SES in childhood has been associated with lower levels of physical activity and poor diet, and these factors may impact reactivity to stressors (7). Future studies could test the respective contributions of several classes of mediators in the SES and reactivity relation. A second important step for future studies would be to examine reactivity during the social scenarios rather than during separate laboratory stressors. The fact that relations were found despite this limitation suggests that the links between SES, cognitive appraisal bias, and cardiovascular reactivity in children may be more robust than indicated in our analyses. If so, there could be important intervention implications. If balanced with a recognition that such cognitions are adaptive in threatening environments, interventions that help low-SES children to minimize such biases in nonthreatening situations may reduce the physiological toll of such cognitions, which may lead to reductions in risk for cardiovascular disease later in life.

In sum, this is the first study known to date to test children's appraisals of and responses to social situations as a mediator of the relation between SES and cardiovascular reactivity. Our findings support the model of cognitive appraisal biases as a mediator for specific groups of children under certain conditions. That is, cognitive appraisal bias (hostile intent) was found to be a mediator of the longitudinal relation between SES and reactivity among African American children. To the extent that low-SES African American children show higher average levels of hostile intent across time, this accounts for increases that they display in reactivity to stressors over time. Finally, we found that paternal measures of SES had the most potent influence on African American children's health.

REFERENCES

(1) Adler NE, Boyce WT, Chesney MA, Folkman S, Syme SL: Socioeconomic inequalities in health: No easy solution. *Journal of the American Medical Association.* 1993, *269:*3140–3145.

(2) Haan MN, Kaplan GA, Syme SL: Socioeconomic status and health: Old observations and new thoughts. In Bunker JP, Gomby DS, Kehrer BH (eds), *Pathways to Health.* Menlo Park, CA: The Henry J. Kaiser Family Foundation, 1989, 76–135.

(3) Marmot MG, Kogevinas M, Elston MA: Social/economic status and disease. *Annual Review of Public Health.* 1987, *8:*111–135.

(4) Mare RD: Socioeconomic effects on child mortality in the United States. *American Journal of Public Health.* 1982, *72:*539–547.

(5) Nersesian WS, Petit MR, Shaper R, Lemieux D, Naor E: Childhood death and poverty: A study of all childhood deaths in Maine, 1976 to 1980. *Pediatrics.* 1985, *75:*41–50.
(6) Singh GK, Yu SM: US childhood mortality, 1950 through 1993: Trends and socioeconomic differentials. *American Journal of Public Health.* 1996, *86:*505–512.
(7) Chen E, Matthews KA, Boyce WT: *Socioeconomic differences in health: What are the implications for children?* Manuscript submitted for publication.
(8) Nelson MD: Socioeconomic status and childhood mortality in North Carolina. *American Journal of Public Health.* 1992, *82:*1131–1133.
(9) Pamuk E, Makuc D, Heck K, Reuben C, Lochner K: *Socioeconomic status and health chartbook. Health, United States, 1998.* Hyattsville, MD: National Center for Health Statistics, 1998.
(10) Pharoah POD, Alberman ED: Annual statistical review. *Archives of Disease in Childhood.* 1990, *65:*147–151.
(11) Hinkle Jr. LE, Whitney LH, Lehman EW, et al.: Occupation, education, and coronary heart disease: Risk is influenced more by education and background than by occupational experiences, in the Bell System. *Science.* 1968, *161:*238–246.
(12) Keil JE, Sutherland SE, Knapp RG, Tyroler HA: Does equal socioeconomic status in black and white men mean equal risk of mortality? *American Journal of Public Health.* 1992, *82:*1133–1136.
(13) Marmot MG, Shipley MJ, Rose G: Inequalities in death—specific explanations of a general pattern? *Lancet.* 1984, *i:*1003–1006.
(14) Williams RB, Barefoot JC, Califf RM, et al.: Prognostic importance of social and economic resources among medically treated patients with angiographically documented coronary artery disease. *Journal of the American Medical Association.* 1992, *267:*520–524.
(15) Kaplan GA, Keil JE: Socioeconomic factors and cardiovascular disease: A review of the literature. *Circulation.* 1993, *88:*1973–1998.
(16) Kaplan GA, Salonen JT: Socioeconomic conditions in childhood and ischaemic heart disease during middle age. *British Medical Journal.* 1990, *301:*1121–1123.
(17) Manuck SB: Cardiovascular reactivity in cardiovascular disease: "Once more unto the breach." *International Journal of Behavioral Medicine.* 1994, *1:*4–31.
(18) Matthews KA, Woodall KL, Allen MT: Cardiovascular reactivity to stress predicts future blood pressure status. *Hypertension.* 1993, *22:*479–485.
(19) Gump BB, Matthews KA, Raikkonen K: Modeling relationships among socioeconomic status, hostility, cardiovascular reactivity, and left ventricular mass in African-American and White Children. *Health Psychology.* 1999, *18:*140–150.
(20) Treiber F, Harshfield G, Davis H, Kapuku G, Moore D: Stress responsivity and body fatness: Links between socioeconomic status (SES) and cardiovascular (CV) risk factors in youth. Meeting of the New York Academy of Sciences. Bethesda, MD: 1999.
(21) Jackson RW, Treiber FA, Turner JR, Davis H, Strong WB: Effects of race, sex, and socioeconomic status upon cardiovascular stress responsivity and recovery in youth. *International Journal of Psychophysiology.* 1999, *31:*111–119.
(22) Boyce WT, Chesterman E: Life events, social support, and cardiovascular reactivity in adolescence. *Developmental and Behavioral Pediatrics.* 1990, *11:*105–111.
(23) Fleming I, Baum A, Davidson LM, Rectanus E, McArdle S: Chronic stress as a factor in physiologic reactivity to challenge. *Health Psychology.* 1987, *6:*221–237.
(24) Lepore SJ, Miles HJ, Levy JS: Relation of chronic and episodic stressors to psychological distress, reactivity, and health problems. *International Journal of Behavioral Medicine.* 1997, *4:*39–59.
(25) Lynch JW, Everson SA, Kaplan GA, Salonen R, Salonen JT: Does low socioeconomic status potentiate the effects of heightened cardiovascular responses to stress on the progression of carotid atherosclerosis? *American Journal of Public Health.* 1998, *88:*389–394.
(26) Woodall KL, Matthews KA: Changes in and stability of hostile characteristics: Results from a 4-year longitudinal study of children. *Journal of Personality and Social Psychology.* 1993, *64:*491–499.
(27) Kamarck TW, Everson SA, Kaplan GA, et al.: Exaggerated blood pressure responses during mental stress are associated with enhanced carotid atherosclerosis in middle-aged Finnish men. *Circulation.* 1997, *96:*3842–3848.
(28) Fredrikson M, Matthews KA: Cardiovascular responses to behavioral stress and hypertension: A meta-analytic review. *Annals of Behavioral Medicine.* 1990, *12:*30–39.
(29) Barrett PM, Rapee RM, Dadds MM, Ryan SM: Family enhancement of cognitive style in anxious and aggressive children. *Journal of Abnormal Child Psychology.* 1996, *24:*187–203.
(30) Chen E, Lewin MR, Craske MG: Effects of state anxiety on selective processing of threatening information. *Cognition and Emotion.* 1996, *10:*225–240.
(31) Vasey MW, Daleiden EL, Williams LL, Brown LM: Biased attention in childhood anxiety disorders: A preliminary study. *Journal of Abnormal Child Psychology.* 1995, *23:*267–279.
(32) Crick NR, Dodge KA: Social information-processing mechanisms in reactive and proactive aggression. *Child Development.* 1996, *67:*993–1002.
(33) Dodge KA: Social cognition and children's aggressive behavior. *Child Development.* 1980, *51:*162–170.
(34) McLoyd VC: Socioeconomic disadvantage and child development. *American Psychologist.* 1998, *53:*185–204.
(35) Attar B, Guerra N, Tolan P: Neighborhood disadvantage, stressful life events, and adjustment in urban elementary-school children. *Journal of Clinical Child Psychology.* 1994, *23:*391–400.
(36) Garbarino J, Kostelny K, Dubrow N: What children can tell us about living in danger. *American Psychologist.* 1991, *46:*376–383.
(37) Lazarus RS, Folkman S: *Stress, Appraisal, and Coping.* New York: Springer, 1984.
(38) Lazarus RS: Progress on a cognitive-motivational-relational theory of emotion. *American Psychologist.* 1991, *46:*819–834.
(39) Smith CA, Lazarus RS: Appraisal components, core relational themes, and the emotions. *Cognition and Emotion.* 1993, *7:*233–269.
(40) Flory JD, Matthews KA, Owens JF: A social information processing approach to dispositional hostility: Relationships with negative mood and blood pressure elevations at work. *Journal of Social and Clinical Psychology.* 1998, *17:*491–504.
(41) Berenson GS, Wattigney WA, Tracy RE, et al.: Atherosclerosis of the aorta and coronary arteries and cardiovascular risk factors in persons aged 6 to 30 years and studied at necropsy (the Bogalusa Heart Study). *American Journal of Cardiology.* 1992, *70:*851–858.

(42) Strong JP, Malcom GT, McMahan CA, et al.: Prevalence and extent of atherosclerosis in adolescents and young adults: Implications for prevention from the Pathobiological Determinants of Atherosclerosis in Youth Study. *Journal of the American Medical Association.* 1999, *281:*727–735.

(43) Williams DR: SES and ethnicity: The added effects of racism and discrimination. Meeting of the New York Academy of Sciences. Bethesda, MD: 1999.

(44) Colley JRT, Reid DD: Urban and social origins of childhood bronchitis in England and Wales. *British Medical Journal.* 1970, *2:*213–217.

(45) Mitchell EA, Stewart AW, Pattemore PK, et al.: Socioeconomic status in childhood asthma. *International Journal of Epidemiology.* 1989, *18:*888–890.

(46) Ostberg V, Vagero D: Socio-economic differences in mortality among children. Do they persist into adulthood? *Social Science and Medicine.* 1991, *32:*403–410.

(47) Goldthorpe JH: Women and class analysis: In defence of the conventional view. *Sociology.* 1983, *17:*465–488.

(48) Allen MT, Matthews KA: Hemodynamic responses to laboratory stressors in children and adolescents: The influences of age, race, and gender. *Psychophysiology.* 1997, *34:*329–339.

(49) Daniels SD, Meyer RA, Loggie JMH: Determinants of cardiac involvement in children and adolescents with essential hypertension. *Circulation.* 1990, *82:*1243–1248.

(50) Dodge KA, Frame CL: Social cognitive biases and deficits in aggressive boys. *Child Development.* 1982, *53:*620–635.

(51) Kubicek WG, Patterson RP, Witsoe DA: Impedance cardiography as a noninvasive method of monitoring cardiac function and other parameters of the cardiovascular system. *Annals of the New York Academy of Sciences.* 1970, *170:*724–732.

(52) Kubicek WG, Karnegis JN, Patterson RP, Witsoe DA, Mattson RH: Development and evaluation of an impedance cardiograph system. *Aerospace Medicine.* 1966, *37:*1208–1212.

(53) Kamarck TW: Recent developments in the study of cardiovascular reactivity: Contributions from psychometric theory and social psychology. *Psychophysiology.* 1992, *29:*491–503.

(54) Aiken LS, West SG: *Multiple Regression: Testing and Interpreting Interactions.* London: Sage, 1991.

(55) Stone AA: Selected methodological concepts: Mediation and moderation, individual differences, aggregation strategies, and variability of replicates. In Schneiderman N, McCabe P, Baum A (eds), *Stress and Disease Processes: Perspectives in Behavioral Medicine.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc., 1992, 55–71.

(56) Crick NR, Dodge KA: A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin.* 1994, *115:*74–101.

(57) Arber S: Class, paid employment and family roles: Making sense of structural disadvantage, gender and health status. *Social Science and Medicine.* 1991, *32:*425–436.

(58) Walter HJ, Hofman A: Socioeconomic status, ethnic origin, and risk factors for coronary heart disease in children. *American Heart Journal.* 1987, *113:*812–818.

(59) Whincup P, Cook D, Papacosta O, Walker M, Perry I: Maternal factors and development of cardiovascular risk: Evidence from a study of blood pressure in children. *Journal of Human Hypertension.* 1994, *8:*337–343.

(60) Wright LB, Treiber F, Davis H, Bunch C, Strong WB: The role of maternal hostility and family environment upon cardiovascular functioning among youth two years later: Socioeconomic and ethnic differences. *Ethnicity and Disease.* 1998, *8:*367–376.

(61) Hollinghead AB: *Four Factor Index of Social Status.* New Haven, CT: Hollinghead, 1975.