

Socioeconomic Status and Health in Adolescents: The Role of Stress Interpretations

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The role of psychological interpretations in the relationship between low socioeconomic status (SES) and physiological responses was tested. One hundred high school students (ages 15–19) watched videos of ambiguous and negative life situations, and were interviewed about their interpretations. Lower SES was associated with greater threat interpretations during ambiguous (but not negative) situations and with greater diastolic blood pressure and heart rate reactivity. Threat interpretations partially mediated relationships between SES and reactivity. General life events (e.g., lack of positive life events), rather than specific life events (e.g., exposure to violence), partially explained the relationship between low SES and threat interpretations. Results suggest that the larger social environment helps explain how adolescents approach new social situations, which in turn has implications for adolescent physical health.

Low socioeconomic status (SES) has a profound influence on physical health throughout childhood (Chen, Matthews, & Boyce, 2002; Egbuonu & Starfield, 1982; Pamuk, Makuc, Heck, Reuben, & Lochner, 1998; Singh & Yu, 1996). Children lower in SES have higher rates of many diseases (Halfon & Newacheck, 1993; Newacheck, 1994; Pamuk et al., 1998). In addition, children lower in SES have higher levels of risk factors for disease, including higher blood pressure, lower rates of physical activity, and greater likelihood of smoking (Boulton, Cockington, Hamilton-Craig, Magarey, & Mazumdar, 1995; Conrad, Flay, & Hill, 1992; Escobedo, Anda, Smith, Remington, & Mast, 1990; Pamuk et al., 1998). Although these epidemiological relationships have been consistently demonstrated, explanations for why these relationships exist have not been as thoroughly tested.

The goal of the present study was to test the relationships among SES, one specific psychological characteristic, and physiological markers in adolescence. One psychological factor that has been related to both lower SES and poorer health is stress. Low-SES children are more frequently exposed to unpredictable and stressful negative life events (Attar, Guerra, & Tolan, 1994; Brady & Matthews, 2002; Garbarino, Kostelny, & Dubrow, 1991). Certain types of negative events tend to characterize the life experiences of low-SES individuals, including greater exposure to violence (Sampson, Raudenbush, & Earls, 1997; Selner-O'Hagan, Kindlon, Buka, Raudenbush, & Earls, 1998) and experiences with discrimination (Clark, Anderson, Clark, & Williams, 1999). Stressful life circumstances, in turn, have been linked to negative biological and health outcomes in children (Evans, Bullinger, & Hygge, 1998; Evans & English, 2002; Sandberg et al., 2000).

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Role of Appraisals

Many researchers have argued that a fuller understanding of stressful life experiences involves not only characterizing the events that occur but also the way in which individuals appraise these events. Appraisals refer to an individual's interpretation of the meaning and implications of an event for one's well-being (Lazarus, 1991; Lazarus & Folkman, 1984; Smith & Lazarus, 1993). In children, threat appraisals have been linked to psychological distress and adjustment problems, particularly among at-risk children (Krantz, Clark, Pruyn, & Usher, 1985; Lengua, Sandler, West, Wolchik, & Curran, 1999; Sheets,

Sandler, & West, 1996). In addition, children who have greater threat appraisals are more likely to experience negative effects of marital conflict, including behavioral problems, health problems, and heightened cardiovascular (CV) reactivity (El Sheikh & Harger, 2001).

A separate body of literature on children's social information processing has tested the notion that certain groups of children tend to draw negative interpretations, or appraisals, in certain situations. For example, aggressive children are more likely to draw negative interpretations when faced with a provocation by peers whose intent is ambiguous (Crick, 1995; Crick & Dodge, 1996; Crick, Grotpeter, & Bigbee, 2002; Dodge, 1980; Dodge & Coie, 1987; Dodge, Price, Bachorowski, & Newman, 1990; Quiggle, Garber, Panak, & Dodge, 1992). It is hypothesized that selective attention and deficits in detecting and encoding social cues are associated with these biases in aggressive children (Crick & Dodge, 1994).

SES and Threat Interpretations

In the present study, we extended models developed in previous research to address SES differences in biological responses to stress. Our model proposes that the more stressful and unpredictable environments that low-SES children grow up in lead them to be more likely to develop a pattern of thinking about the world as a threatening place that requires heightened vigilance. Previous researchers have reported that living in urban, undesirable environments increases one's sense of danger and uncertainty (Taylor & Shumaker, 1990; Wandersman & Nation, 1998). This vigilance then leads children to become more likely to make threat interpretations, particularly when presented with ambiguous social situations.

Social situations can vary in outcome, for example, being negative, positive, or ambiguous. We hypothesized that low-SES children would be more likely to draw threat interpretations specifically during ambiguous outcome situations because the uncertainty would lead low-SES children to overgeneralize perceptions of threat. For example, encountering an extremely attentive saleswoman while shopping is ambiguous because it could reflect a suspicious saleswoman or a saleswoman wanting to be helpful. We hypothesized that low-SES children would be more likely to believe that the saleswoman is suspicious of them, whereas high-SES children would be more likely to believe that the saleswoman is just trying to be helpful.

Thus, our model proposes that low-SES and aggressive children differ in the type of situation that evokes threat interpretations. The research on aggressive children has primarily used negative outcome situations with ambiguous intent, such as not being invited to a party. In contrast, our model about the social-cognitive processes of low-SES children stipulates that their living environments will make them more sensitive to perceiving threat when the outcome is ambiguous. In contrast, interpretations of negative outcome situations were not expected to differ by SES because both low- and high-SES children would accurately read these situations. We found support for this pattern in previous research using written hypothetical scenarios (Chen & Matthews, 2001).

The implications of this model suggest that children from varying SES backgrounds differ not only in terms of exposure to negative life events but also in how they interpret life situations. That is, the same life situation will evoke greater threat interpretations from low- versus high-SES children, creating an additional burden of perceived stress on low-SES children.

Stress Responses

We further hypothesized that this tendency toward interpreting ambiguous situations as threatening leads low-SES adolescents to become more physiologically reactive, which may represent one pathway toward poorer health over the long term.

According to our model, as well as more general theories of appraisal, a child's interpretations of ambiguous situations should in part determine the magnitude of his or her biological response. That is, we hypothesized that low-SES children would also exhibit heightened CV reactivity during ambiguous social situations because of differences in threat interpretations. Lower SES has been associated with heightened CV reactivity to laboratory stressors in several studies of children and adolescents (Gump, Matthews, & Raikkonen, 1999; Treiber, Harshfield, Davis, Kapuku, & Moore, 1999), and specifically among adolescents who live in low-SES neighborhoods (Wilson, Kliewer, Plybon, & Sica, 2000). In addition, factors related to low SES, such as chronic stress and exposure to violence, have been linked to blood pressure levels or reactivity (Evans & English, 2002; Fleming, Baum, Davidson, Reitan, & McArdle, 1987; Wilson et al., 1998). In the present study, we focused on CV reactivity variables (blood pressure and heart rate) because they show an immediate response to stress and because they are

important predictive indicators of future health problems.

The Present Study

Our goal was to explore SES differences in adolescents' psychological interpretations and physiological responses. In the present study, we focused on the question of whether SES was related to established interpretation styles in adolescents (rather than the development of interpretation styles). To separate clearly interpretations from the stressor itself (i.e., the event), it was important to keep the event constant across all individuals. In our previous study (Chen & Matthews, 2001), interpretations were assessed through written hypothetical scenarios. This approach is similar to that used in some childhood aggression studies (Crick, 1995). Limitations, however, include susceptibility to variations in reading skill (particularly in studies focused on SES) and the inability to measure CV reactivity during the situations. To overcome these limitations, we recently designed a set of videos (Cognitive Appraisal and Understanding of Social Events [CAUSE] videos) that presented adolescents with ambiguous or negative outcome social situations. The use of a video format allowed participants to experience more readily each situation and to measure threat interpretations and physiological reactivity during each situation (Chen & Matthews, 2003).

We used the CAUSE videos to test three hypotheses of our model in a sample of high school teenagers: (a) lower SES will be associated with greater threat interpretations during the ambiguous, but not negative, CAUSE videos; (b) lower SES will be associated with greater physiological reactivity to the CAUSE videos; and (c) one reason lower SES will be associated with physiological reactivity will be because of adolescents' interpretations of the situation (i.e., interpretations will mediate the relationship between SES and reactivity).

Contributors to threat interpretations. After testing the relationship between SES and threat interpretations, we then addressed possible reasons for this relationship. Our model proposes that the life experiences of children are critical to how they approach new life events. Thus, we tested three types of life experience variables as potential mediators of the SES–interpretations relationship: life events, exposure to violence, and discrimination experiences.

With respect to life events, the experience of repeated and unpredictable negative life events in low-SES children may lead them to develop patterns of thinking in which they come to expect the worst

even in ambiguous circumstances. Alternatively, the balance between negative and positive life events may be a critical factor in interpretation tendencies. Experiencing a greater number of negative life events relative to positive events is associated with increases in depressive symptoms (Holahan, Moos, Holahan, & Cronkite, 1999; Holahan, Moos, Holahan, & Cronkite, 2000). This type of balance may also be important in shaping how individuals interpret new ambiguous situations.

In addition, certain types of life events may be most relevant to interpretation styles. Specifically, we explored the role of danger-related events, such as exposure to violence, and life experiences with discrimination. Low-SES children are more likely to witness or be the victims of violence (Christoffel, Anzinger, & Merrill, 1989; Crouch, Hanson, Saunders, Kilpatrick, & Resnick, 2000; Garbarino et al., 1991; McLoyd, 1998; O'Keefe & Sela-Amit, 1997). Experiences with such danger-related events may lead children to develop heightened vigilance for threat cues and to have a lower threshold for interpreting a situation as threatening.

Finally, discrimination refers to perceptions of unfair treatment based on characteristics such as race, gender, or social class. Although typically linked to race (Williams & Neighbors, 2001), research has found that low-SES individuals report greater discrimination than high-SES individuals, especially when it comes to overt acts of discrimination (Clark et al., 1999; Hartman, Hoogstraten, & Spruijt-Metz, 1994; Kessler, Mickelson, & Williams, 1999). Over time, experiences with discrimination may lead low-SES individuals to assume that even in new situations, they are likely to be treated unfairly.

Role of race. One challenge that arises in any study exploring associations with SES is the possible confound of race. More so than any other demographic variable, race is linked to SES. African American families, on average, have income levels only .59 times that of Caucasian families (Economic Report of the President, 1998). In addition, the health of African American children and adults has consistently been found to be worse than that of their Caucasian counterparts (Gillum, 1993; National Center for Health Statistics, 1998; Williams, 1999; Williams & Collins, 1995). Thus, it is possible that associations found with SES primarily reflect effects of race. To clarify the role of race, we recruited an approximately equivalent number of African American and Caucasian adolescents to test whether associations with interpretations and reactivity were primarily due to SES, race, or a synergistic effect of SES and race.

Method

Participants

Participants were 101 students from a local high school in the St. Louis area. Kirkwood High School is a public high school consisting of approximately 25% African American students. There is a wide range of SES at this school, with 21% of students eligible for the federal free lunch program. Flyers, announcements, and classroom presentations were used to inform students about the study, and those interested in participating contacted our lab. One family declined to report any SES information and was excluded from analyses. The final sample consisted of 53 Caucasian and 47 African American students; 64 were female and 36 were male. Average age was 17.27. Exclusion criteria for study participation included: (a) under the age of 15, (b) history of CV health problems, (c) medication use that affected the CV system, (d) drug or alcohol abuse, and (e) chronic illness requiring regular medications.

Materials

SES. SES can be measured in a variety of ways, each indicating a different conceptualization of SES. Some researchers have argued that one critical dimension of SES is the material resources a family has, and thus that measures of assets (e.g., savings, wealth) are important to use. Others have focused on the nonmaterial aspects of SES, often referred to as prestige-based indicators of SES (e.g., family education, occupation; Krieger, Williams, & Moss, 1997; Winkleby, Jatulis, Frank, & Fortmann, 1992). In the present study, we tested associations with both types of SES measures.

Parents and guardians were asked about parents' occupation and number of years of education. Hollingshead's Four Factor Index of Social Status (Hollingshead, 1975) was used to compute a measure of prestige family SES. Average SES score for two parents was used unless a participant came from a single-parent family, in which case only the single parent's score was used. Higher scores indicate higher SES. To calculate an asset-based measure of family SES, parents and guardians were asked about family income and family savings. Early testing revealed that occasionally families did not wish to divulge their exact income or savings, or were unsure of the exact amount. We thus created categories of income and savings, which resulted in higher rates of response. All asset variables were standardized and averaged to create one composite asset score.

CAUSE videos. The development and validation of our two ambiguous and two negative social situations videos for adolescents were described in more detail in an earlier paper (Chen & Matthews, 2003). In that paper, we demonstrated convergent and divergent validity for our measure. Two of the CAUSE videos were used in this study: one ambiguous video (shopping: browsing in a department store with a very attentive saleswoman watching) and one negative video (class behavior: other students teasing you, you get mad and push a student's books off his desk, teacher yells at only you), given data demonstrating that the two ambiguous videos were fairly equivalent, as were the two negative videos (Chen & Matthews, 2003). Each video was approximately 3 min in length. Instructions stated that participants should imagine themselves as the main character and experience the video as if it were happening to them. After each video, participants were asked open-ended questions about their interpretations (e.g., "Why do you think the teacher has asked to speak with you?") and the reasons for their beliefs (attributions about the other character's behavior). Participants discussed their reactions to each video for at least 2 min with the interviewer. Participants' responses were coded by research assistants who were blind to the family's SES on a 5-point scale from -2 (*very benign*) to $+2$ (*very threatening*). Approximately 40% of the audiotapes were double-coded for reliability. Coders agreed within 1 point of each other 94% of the time. The correlation between the ratings of the two coders was .80. Further information on the validity and reliability of the CAUSE videos can be found in Chen and Matthews (2003).

Life events questionnaire-adolescents. Life events over the previous 6 months were measured using a self-report questionnaire (Masten, Neemann, & Andenas, 1994). In the original article, events were categorized by judges as being ambiguous, positive, or negative. Discriminant validity of these dimensions has been demonstrated through correlations with psychological adjustment (Garmezy & Tellegen, 1984). We used only negative (e.g., arguments among family members) and positive (e.g., winning an award) questions (12 items), given our hypotheses about the role of these types of events in the development of children's interpretation styles. The number of negative events, the number of positive events, and the ratio of negative to positive events experienced were calculated.

Exposure to violence. Exposure to violence was assessed using a structured interview designed to assess children and adolescents' experiences with witnessing or being the victim of acts of violence

(Thomson, Roberts, Curran, Ryan, & Wright, 2002). This measure has been validated in children as young as 8 (Thomson et al., 2002). Adolescents were asked whether they had: (a) witnessed or (b) experienced different types of violent acts during their lifetime (hearing gunshots, physical acts of aggression such as being punched, stabbings, shootings, and caretaker violence). For any violent acts they endorsed, follow-up questions were asked to ascertain the frequency of that act in the past year. A score was computed for the frequency of violence witnessed across all types of violence in the previous year. None of our sample reported experiencing violent acts (e.g., attacked with a knife) more than once in the previous year; thus, there is no frequency score for experienced violence. Finally, four yes–no questions probing concern about violence in one's neighborhood (e.g., afraid of being hurt by violence in neighborhood) were asked in this interview, and a score reflecting concern about neighborhood violence was created by summing these items, with higher scores indicating greater concern.

Discrimination questionnaire. This questionnaire consists of 10 items that ask about day-to-day experiences with discrimination (e.g., being treated with less respect than other people) and asks participants to indicate how often these events occur on a 4-point scale ranging from *never* to *often*. This scale is applicable to Caucasian and African American participants because it does not ask only about discrimination due to race. This scale has been demonstrated to have good internal consistency ($\alpha = .88$) in a large multistage area probability sample of adults (Williams, Yu, Jackson, & Anderson, 1997). Validity was demonstrated in this same study based on associations of discrimination experiences with greater psychological distress. Adolescents' scores were computed by summing the responses for each item, with higher scores indicating greater perceived discrimination.

Physiological measures. Heart rate was measured through EKG monitoring. An EKG signal was transduced using two active Meditrace SF450 disposable silver/silver chloride electrodes (Kendall-LTP, Chicopee, MA) placed on each side of the abdomen and a ground electrode beside the navel. The EKG signal was filtered and amplified by the Biopac MP100 system (Biopac Systems, Santa Barbara, CA). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were monitored using a Dinamap Pro 100 automated blood pressure monitor (Critikon, Tampa, FL) with a standard occluding cuff on the participant's right arm.

Procedures

All adolescents and parents were required to sign a consent form before participation in the study; this study was approved by the Institutional Review Board at Washington University. Testing took place after school hours, typically in the late afternoon. Parents were interviewed about family SES information. Adolescents were seated in an individual testing room, and the three EKG electrodes were applied. The blood pressure cuff was placed on the upper aspect of the participant's right arm with the microphone placed above an area where the brachial artery could be palpated. Adolescents were then given instructions for an initial (baseline) 10-min rest period. During all rest periods, participants watched a non-narrative video depicting nature scenes. Heart rate and blood pressure were monitored during the last 5 min of this period. Participants then watched the two videos in counterbalanced order. Following each video, participants were interviewed about their interpretations. Heart rate and blood pressure were monitored while participants watched and discussed the videos. All interviews were audiotaped. A 10-min rest period occurred between the two videos. Following the videos, the electrodes and blood pressure cuff were removed, and participants completed the life events, discrimination, and exposure to violence measures.

CV Data Reduction

Heart rate was monitored during the last 5 min of baseline, during the 3 min of each video, and during the first 2 min of discussion of each video. Blood pressure was taken every other minute during the last 5 min of baseline, once per minute while watching the videos, and once per minute for the first 2 min of discussion of each video. Heart rate and blood pressure readings were averaged across each task (baseline, video). Reactivity scores were calculated as readings during the video period partialling out baseline levels. No gender differences were found for interpretations during either the ambiguous or negative CAUSE videos, or for physiological reactivity measures (in 6 of 7 comparisons). Thus, gender was not included in analyses described in the Results section.

Results

Correlations Between SES Measures

We first tested the correlation between prestige-based and assets-based measures of SES in each

Table 1
Socioeconomic Status Variables by Race

	Caucasian		African American	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Education	15.52	2.56	13.70	1.67
Occupation	6.71	1.30	5.52	1.53
Income	3.90	1.42	2.29	1.06
Savings	4.66	2.15	2.29	1.54
No. of Cars	2.94	1.13	2.11	1.10
% own home	84.9%		70.2%	
Single-parent household	17%		61%	

Note. Education refers to average number of years of schooling for parents. Occupation is scored on a 9-point scale (mean for Caucasians falls into the technician/semiprofessional category; mean for African Americans falls into the clerical/sales worker category). Income is scored on a 6-point scale (mean for Caucasians falls into the \$50,000–\$74,999 category; mean for African Americans falls into the \$25,000–\$49,999 category). Savings is scored on a 7-point scale (mean for Caucasians falls into the \$10,000–\$19,000 category; mean for African Americans falls into the \$1,000–\$4,999 category). Caucasian participants came from households with higher parent education, $t(98) = 4.16, p < .001$; higher parent occupational status, $t(97) = 4.20, p < .001$; greater income, $t(95) = 6.28, p < .001$; greater savings, $t(80) = 5.73, p < .001$; greater number of cars, $t(97) = 3.70, p < .001$; and lower likelihood of being single-parent households, $\chi^2 = 20.29, p < .001$.

sample. Among Caucasian participants, prestige- and assets-based measures of SES were highly correlated, $r(50) = .54, p < .001$. In contrast, among African American participants, prestige- and assets-based measures of SES were not correlated, $r(42) = .08, p > .5$. Thus, we conducted analyses separately by type of SES measure rather than combining the two types of measures together, given the lack of correlation among African American adolescents.

African American and Caucasian participants differed in SES characteristics, as expected based on national trends (see Table 1). The range of SES scores was broad (occupation codes ranged from 1 to 9 on a 9-point scale; education ranged from 3 to 7 on a 7-point scale; income ranged from 1 to 6 on a 6-point scale; savings ranged from 1 to 7 on a 7-point scale; number of family cars ranged from 0 to 6). Families were well distributed across categories (e.g., for income, 13% fell into Category 1, 27% in Category 2, 22% in Category 3, 13% in Category 4, 19% in Category 5, and 6% in Category 6). The characteristics of our sample (presented in Table 1) are similar to the characteristics of the district of Kirkwood (where the high school is located), where median family income was in the \$50,000 to \$74,999 range, 50% of adults had a college degree or higher, and 80% of families owned homes (based on 2000 U.S. Census data).

SES, Race, and Interpretations

Our analytic approach involved conducting regression analyses to test simultaneously the effects of SES, race, and the interaction of SES and race in predicting interpretations. Given that simultaneous regressions control for the other variables included, this approach allowed us to determine whether there are SES effects (independent of race), race effects (independent of SES), or an interaction between SES and race. Regression analyses were conducted in which the continuous variable of SES was centered, and the categorical variable of race was coded using weighted effects (Aiken & West, 1991; Cohen, Cohen, West, & Aiken, 2003).

For the ambiguous video, there was a significant main effect of prestige SES, $\beta = -.43, t = 4.34, p < .01$, effect size [ES] (r) = .39, such that lower SES adolescents made greater interpretations of threat during the ambiguous video. No main effects of race or interaction effects were found for interpretations (see Table 2).

For the negative video, there was no significant interaction effect, nor were there main effects of race or SES (all $ps > .4$), suggesting that when a situation is negative, adolescents make similar interpretations of that situation, regardless of their SES or race.

Table 2
Effects of Prestige Socioeconomic Status (SES) on Threat Interpretations and Cardiovascular Reactivity

	β	<i>t</i>	<i>p</i>
Ambiguous video threat interpretations			
SES	-.43	4.34	< .01
Race	.13	1.32	<i>ns</i>
SES \times Race	.02	0.20	<i>ns</i>
Negative video threat interpretations			
SES	-.09	0.81	<i>ns</i>
Race	.04	0.34	<i>ns</i>
SES \times Race	-.03	0.28	<i>ns</i>
Systolic blood pressure			
SES	-.06	0.59	<i>ns</i>
Race	-.39	3.65	< .01
SES \times Race	.07	0.72	<i>ns</i>
Diastolic blood pressure			
SES	-.38	3.55	< .01
Race	-.34	3.24	< .01
SES \times Race	.06	0.66	<i>ns</i>
Heart rate			
SES	-.32	2.92	< .01
Race	-.38	3.52	< .01
SES \times Race	.01	0.09	<i>ns</i>

Note. Analyses involve simultaneous regression analyses of the dependent variable on SES (centered), race, and the interaction between SES and race.

Asset SES measures were not associated with interpretations.

SES, Race, and CV Reactivity

For reactivity analyses, the effects of baseline CV measures were first partialled out of task (video) scores to create a residualized reactivity score. Regression analyses were then conducted using the residualized scores, and testing the simultaneous effects of SES, race, and the interaction of SES and race in predicting CV reactivity. No interaction effects were significant.

There were main effects of prestige SES on the ambiguous video heart rate, $\beta = -.32$, $t = 2.92$, $p < .01$, $ES(r) = .28$, and DBP, $\beta = -.38$, $t = 3.55$, $p < .01$, $ES(r) = .34$, indicating that lower SES adolescents had higher heart rate and DBP reactivity while talking about the ambiguous video. There were also main effects of race on heart rate, $\beta = -.38$, $t = 3.52$, $p < .01$, $ES(r) = .34$; DBP, $\beta = -.34$, $t = 3.24$, $p < .01$, $ES(r) = .30$; and SBP, $\beta = -.39$, $t = 3.65$, $p < .01$, $ES(r) = .35$, indicating that Caucasian adolescents had greater reactivity to the videos than did African American adolescents (see Table 2).

During the negative video, there were main effects of race on DBP, $\beta = -.34$, $t = 3.26$, $p < .01$, $ES(r) = .31$, and heart rate, $\beta = -.33$, $t = 2.97$, $p < .01$, $ES(r) = .30$, indicating that Caucasian adolescents had greater reactivity to the videos than did African American adolescents. There was also a main effect of prestige SES on DBP, $\beta = -.37$, $t = 3.46$, $p < .01$, $ES(r) = .33$.

When analyses were done using assets SES, no interaction effects or main effects of SES were found. Main effects of race were found for heart rate during the ambiguous video, $\beta = -.34$, $t = 2.34$, $p < .05$, $ES(r) = .24$, and negative video, $\beta = -.38$, $t = 2.55$, $p < .05$, $ES(r) = .26$, and SBP during the ambiguous video, $\beta = -.34$, $t = 2.45$, $p < .05$, $ES(r) = .23$, indicating that Caucasian adolescents had greater physiological reactivity to the CAUSE videos, regardless of whether they were ambiguous or negative.

For comparison in terms of effect sizes, including other demographic and physical variables (gender, body mass index [BMI]) in the simultaneous regression equations for DBP and heart rate reactivity resulted in average effect sizes of .20 for SES, .15 for gender, .09 for race, and .06 for BMI.

Mediational Analyses

Mediational analyses involved testing psychological interpretations as a pathway between SES and CV reactivity (no mediational analyses were

conducted for race, given that race was not associated with interpretations). Given that there were no SES \times Race interaction effects noted earlier, we did not include the interaction term when testing mediation. However, there were significant race differences in SES. Thus, we kept race as a control variable in mediational analyses (so that tests would indicate effects of SES above and beyond race effects). We tested for statistical mediation following Stone's (1992) recommendations. Three criteria must be met for data to be consistent with a mediational model: (a) the predictor variable must be associated with the proposed mediator, (b) the predictor variable must be associated with the outcome variable, and (c) the magnitude of the association between the predictor and the outcome variable must be reduced when the mediator is statistically controlled. Criteria 1 (SES and interpretations) and 2 (SES and reactivity) were reported previously.

To test interpretations as a pathway using Criterion 3, we regressed residualized reactivity scores on race and interpretations in the first step, and SES in the second step. We compared the percentage of variance accounted for by SES in this equation with the equation without interpretations (residualized reactivity scores regressed onto race in the first step, and SES in the second step). Note that the effect sizes for the SES-reactivity relationship reported next are different because the Race \times SES interaction is not included in analyses testing mediation of SES effects. Given the cross-sectional nature of this study, the mediational analyses cannot conclude whether interpretations operate in a causal fashion; however, it does provide a preliminary indication of whether interpretations relate to SES and CV reactivity in a manner consistent with a mediational hypothesis, that is, of interpretations being a significant part of the causal path between SES and CV reactivity.

Given that lower prestige SES was associated with greater threat interpretations and with greater DBP and heart rate reactivity during the ambiguous video, we tested interpretations as a mediator of the SES-reactivity relationship during the ambiguous video. Initially, prestige SES accounted for 8.2% of the variance in heart rate reactivity, $ES(r) = .29$. When interpretations were partialled out, prestige SES accounted for 5.6% of the variance in heart rate reactivity, $ES(r) = .25$, representing a decrease of 32%.

As a second method of testing mediation, we conducted a statistical test of mediation according to MacKinnon's distribution of products test (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Given that we had specific directional hypotheses regarding mediational pathways, we used one-tailed

tests of significance. Ambiguous interpretations were found to be a significant mediator of the SES–heart rate relationship ($z = 2.98, p < .05$).

Initially, prestige SES accounted for 11.0% of the variance in DBP reactivity, $ES (r) = .33$. When interpretations were partialled out, prestige SES accounted for 8.6% of the variance in DBP reactivity, $ES (r) = .30$, representing a decrease of 22%. The MacKinnon test for statistical mediation found ambiguous interpretations to be a marginally significant mediator of the SES–DBP relationship ($z = 1.13, p < .10$).

Contributors to Threat Interpretations

In testing the role of life experiences in explaining the SES–interpretations relationship, we first conducted simultaneous regression analyses predicting life experiences from SES, race, and the interaction of SES and race. Main effects of SES included frequency of exposure to violence, $\beta = -.22, t = 1.99, p < .05$, $ES (r) = .19$, and positive life events, marginal: $\beta = 0.19, t = 1.72, p < .10$, $ES (r) = .17$. These effects suggest that low-SES adolescents were more frequently exposed to violence in their neighborhoods and exhibited a nonsignificant trend toward experiencing fewer positive life events.

Mediational analyses were conducted in an identical manner to the SES–reactivity analyses. Across all adolescents, SES accounted for 14.9% of the variance in interpretations, $ES (r) = .39$, effect size differs from that reported in the SES, Race, and Interpretations section because the Race \times SES effect is not included in mediation analyses of SES effects. When positive life events were partialled out, SES accounted for 11.9% of the variance in interpretations, $ES (r) = .34$, representing a decrease of 20%. The MacKinnon test found positive life events to be a significant mediator of the SES–interpretations relationship ($z = 3.71, p < .01$). In contrast, exposure to violence was not a significant mediator of the SES–interpretations relationship ($p > .20$).

In addition, the preceding simultaneous regression analyses also revealed significant SES \times Race interactions for negative life events, $\beta = 0.24, t = 2.41, p < .05$, $ES (r) = .24$; the ratio of negative to positive life events, marginal: $\beta = 0.18, t = 1.79, p < .10$, $ES (r) = .18$; and neighborhood concern about violence, $\beta = -0.26, t = 2.76, p < .01$, $ES (r) = .26$. To probe further this interaction, we tested associations of SES with life experiences separately by race. Among Caucasian adolescents, lower prestige SES was associated with greater negative life events, $r = -.29, t = 2.14, p < .05$, and a higher ratio of negative to

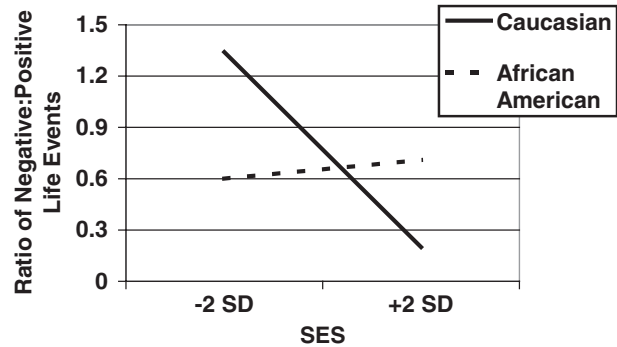


Figure 1. Relationship between socioeconomic status (SES) and the ratio of negative to positive life events among African American and Caucasian adolescents.

positive life events, $r = -.27, t = 2.00, p = .05$, but not with concern about neighborhood violence. Among African American adolescents, lower prestige SES was not associated with negative life events or the life events ratio, but was associated with greater concern about neighborhood violence, $r = -.36, t = 2.56, p < .05$ (see Figures 1 and 2).

Given that lower SES was associated with both ambiguous interpretations and life experiences, we tested the life experiences described earlier as mediators within the relevant racial group. Among Caucasian adolescents, SES accounted for 16.9% of the variance in interpretations, $ES (r) = .41$. Negative life events did not decrease the variance accounted for in interpretations. However, when the ratio of negative to positive life events was partialled out, SES accounted for only 13.3% of the variance in interpretations, $ES (r) = .36$, representing a decrease of 21%. Using the MacKinnon test for statistical mediation, the ratio of negative to positive life events was found to be a significant mediator of the SES–interpretations relationship ($z = 1.78, p < .05$).

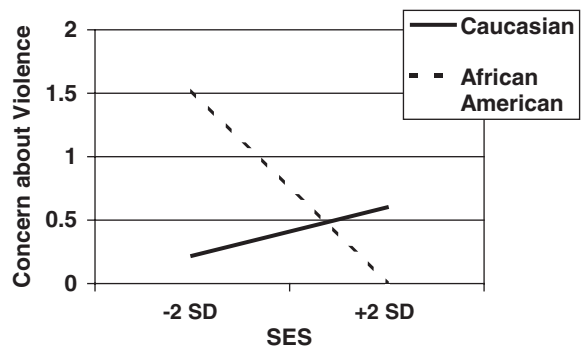


Figure 2. Relationship between socioeconomic status (SES) and concern about neighborhood violence among African American and Caucasian adolescents.

Among African American adolescents, SES accounted for 16.4% of the variance in interpretations, $ES (r) = .40$. When violence concern was partialled out, SES accounted for 13.5% of the variance in interpretations, $ES (r) = .37$, representing a decrease of 18%. However, the MacKinnon test did not find violence concern to be a significant mediator of the SES–interpretations relationship ($z = 0.55$).

Discussion

Among students from one high school in the St. Louis area, we found that lower SES adolescents were more likely to make threat interpretations during ambiguous social situations. In contrast, SES was not associated with interpretations during negative situations. The findings from this study are consistent with our previous study using written hypothetical scenarios (Chen & Matthews, 2001). Moreover, these findings suggest that the larger social environment, specifically socioeconomic background, contributes to adolescents' styles of interpreting new events, with low-SES adolescents being more likely to perceive threat when situations are ambiguous. After controlling for race, the effect size for the SES–interpretation relationship remained in the medium range by Cohen's (1988) standards ($r = .39$).

Second, lower SES was associated with heightened physiological responses to these social situations, similar to relationships between SES and biological markers demonstrated in previous research (Chen & Matthews, 2001; Evans & English, 2002; Gump et al., 1999; Wilson et al., 2000). After controlling for race, effect sizes for the SES–DBP/heart rate reactivity relationship were in the medium range ($r \sim .3$). These effects are similar in size to that of medically relevant family variables, such as family history of hypertension, predicting reactivity (Treiber et al., 1993). In the present study, SES was associated with DBP, but not SBP, reactivity. Previous researchers have argued that stressors can reflect either a threat or a challenge for individuals and that these two responses have different physiological underpinnings (Tomaka, Blascovich, Kelsey, & Leitten, 1993; Tomaka, Blascovich, Kibler, & Ernst, 1997). Stress as a threat is reflected by increases in vascular reactivity (linked to DBP). Stress as a challenge is reflected by increases in cardiac reactivity (linked to SBP). Thus, the fact that findings emerged for DBP, rather than for SBP, suggests that low-SES individuals may be displaying greater threat responses during ambiguous social situations.

Third, our findings were consistent with the notion that the way adolescents interpret ambiguous

social situations forms one pathway through which low SES leads to heightened heart rate and DBP reactivity in these situations. Multiple methods exist for assessing mediation. Ambiguous interpretations mediated the SES–heart rate relationship both statistically and based on percentage variance accounted for in the SES–heart rate reactivity relationship (32%). Ambiguous interpretations accounted for 22% of the variance in the SES–DBP reactivity relationship, but this effect was marginal according to the MacKinnon test. Previous research has demonstrated that other psychological factors such as hostility and Type A behavior pattern have a small effect size relationship with reactivity (Myrtek, 1995). Overall, our findings suggest that psychological pathways may be important in understanding why low SES is associated with heightened biological responses and, over time, why low SES leads to poorer health outcomes. Our findings may also help explain associations of low SES and heightened reactivity with poor CV outcomes later in life (Everson et al., 2001; Lynch, Everson, Kaplan, Salonen, & Salonen, 1998).

With respect to SES, our results suggest 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, report threat perceptions when encountering ambiguous outcome situations. In contrast, aggressive children, because of a tendency to use aggressive schemata in interpreting social interactions, report threat perceptions when encountering negative outcome situations (Crick & Dodge, 1994). We suggest that low-SES children develop a constantly vigilant nature that revolves around protecting oneself from external threats. This monitoring, though adaptive in many respects, may take a physiological toll on the self. 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 (Kaplan & Keil, 1993; Marmot, Shipley, & Rose, 1984).

We then conducted preliminary tests of life experience variables that might account for the SES–ambiguous interpretations relationship. We found that life events more generally, rather than specific types of life events, explained the SES–interpretations relationship, accounting for 20% of this relationship. Specifically, lower SES was associated with a lack of positive life events, and in turn positive life events partially mediated the SES–interpretations

relationship. This suggests that whereas both low- and high-SES adolescents experience negative life events, what distinguishes low-SES adolescents is a lack of positive life experiences. This lack of positive life experiences may lead low-SES adolescents to develop schemas about life situations being unlikely to have positive outcomes, and thus to be more likely to draw threat interpretations even during ambiguous situations. However, these analyses must be interpreted with caution, given the cross-sectional design of this study.

Our study also had the advantage of recruiting approximately equivalent numbers of Caucasian and African American adolescents, allowing us to test whether relationships were due to SES, race, or an interaction between the two. Race and SES effects were not confounded, as Caucasian adolescents responded with greater physiological reactivity to all laboratory tasks (both negative and ambiguous videos). However, the relationship between SES and life experiences did differ by race. For example, lower SES was related to greater concern about neighborhood violence only among African American adolescents, and neighborhood concern accounted for 18% of the variance in the SES–interpretations relationship. This is consistent with the previous literature demonstrating that African American children report greater experiences with violence than do Caucasian children (Crouch et al., 2000; O’Keefe & Sela-Amit, 1997) and thus may be more likely to develop concerns about violence. In contrast, among Caucasian adolescents, lower SES was related to a higher ratio of negative to positive life events, and this ratio accounted for 21% of the SES–interpretations relationship. This suggests that low-SES Caucasian adolescents are more likely to experience negative life events unbalanced by positive life experiences. These types of experiences may strengthen adolescents’ beliefs about the likelihood of future negative events, such that when a new ambiguous situation occurs, low-SES Caucasian adolescents interpret it as already being a threat.

In addition, we found that in African American adolescents, measures of family prestige were not significantly correlated with measures of family assets. This finding fits with previous research demonstrating that upward movement in educational or occupational attainment does not translate into income gains in African Americans as readily as it does in Caucasians (Williams, 2002). This lack of association may be due to discrimination that persists in our society. Previous researchers have noted similar trends, for example, that African American women with equivalent levels of education earn significantly

less income than do Caucasian women (Williams, 2002). The pattern of findings in the present study indicates that SES measures may have different meaning among different racial groups and suggests the importance of carefully considering one’s choice of SES measure when studying different racial and ethnic groups.

Overall, we found that in our sample of adolescents, prestige-based measures of SES, but not asset-based measures, were associated with interpretations and reactivity. This type of distinction among SES measures is common in the literature, with assets referring to material SES measures such as income and savings, and prestige referring to nonmaterial SES measures such as education and occupation. Note that these nonmaterial indicators may also confer benefits other than social status and prestige, such as social capital (e.g., social connections or access to resources that affect psychological processes). We speculate that one reason findings emerged only for prestige SES is that these nonmaterial aspects of SES confer a more stable worldview. Higher family prestige and social capital may engender the belief in children that they have the social resources to insure that ambiguous situations will turn out well. In contrast, income fluctuates much more dramatically than does parent education or occupation, and perhaps children from middle-income families sense that their SES could easily change, and thus they are not as likely to develop a stable worldview based on this dimension of their SES status.

In addition, it is possible that assets do not relate to psychological or physiological outcomes because of measurement issues rather than because of theoretical reasons. Assets and prestige SES were unrelated among African Americans; this may be because there is a more restricted range of assets for African Americans, thus limiting associations between assets SES and outcomes. Asset measures can also be difficult to interpret in light of complicated family structures (e.g., multigenerational families living together, divorced families).

Limitations to the current study include the generalizability of the conclusions. This study was undertaken with students from one high school in the St. Louis area; thus, it is likely that the sample that chose to participate was not representative of U.S. adolescents. It is possible that relationships would hold up if this study were replicated across multiple high schools in multiple states. However, it is also possible that relationships could differ in high schools with different compositions. For example, perhaps relationships would be stronger in schools with greater SES and ethnic diversity because stu-

dents would perceive greater relative SES discrepancies across students that might create more strongly differentiated beliefs among those from different SES groups. In addition, perhaps relationships with life experience variables would be stronger in more urban schools, where factors such as exposure to violence may be more common or more salient.

A second limitation involves not undertaking more extensive physiological measures. Future studies that use impedance cardiography methods could draw more definitive conclusions about cardiac versus vascular reactivity. In addition, future studies with larger sample sizes should use path analysis or structural equation modeling techniques to model relationships among various SES, life experience, interpretation, and physiological variables.

It should be noted that we found associations of SES with DBP reactivity to the negative videos, which was not part of our hypotheses. We speculate that perhaps this association is due to a sensitization effect, in which low-SES children experience multiple, ongoing negative life events, which results in a cumulative physiological arousal (i.e., allostatic load; McEwen, 1998) that makes it difficult to adapt to new stressful, negative life situations. Some previous studies have demonstrated that chronic stress heightens responses to acute stressors (Gump & Matthews, 1999; Matthews, Gump, Block, & Allen, 1997), although this finding has not been consistently demonstrated (Matthews, Gump, & Owens, 2001; Musante et al., 2000).

Now that SES-specific interpretation styles have been documented in adolescence, future studies are needed to test the age at which SES associations with threat interpretations emerge. Better understanding the development of children's interpretation styles will be important for timing future interventions aimed at changing physiologically detrimental interpretation styles before they become ingrained. In addition, future studies should assess lifetime histories of SES to determine whether SES at certain points in childhood serve as critical periods for the development of interpretation styles.

In sum, the present study demonstrates links among SES, psychological interpretations, and physiological reactivity in a sample of African American and Caucasian high school students. Lower prestige-based SES measures were associated with greater threat perceptions of ambiguous, but not negative, life situations. Threat perceptions partially mediated the relationship between low SES and greater heart rate and DBP reactivity to the videos. Finally, a lack of positive life events partially

explained why lower SES adolescents were more likely to draw interpretations of threat in new ambiguous situations. These findings suggest that the life events that adolescents experience may help shape the psychological interpretations they draw during ambiguous life situations; in turn, psychological interpretations may be one pathway through which low-SES children come to develop worse CV risk profiles. These findings raise the possibility that interventions targeted at selectively minimizing children's threat interpretations (while recognizing that such cognitions are adaptive in certain dangerous environments), may help reduce the physiological toll of these cognitions.

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