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Cardiovascular Reactivity During Social and Nonsocial Stressors: Do Children's Personal Goals and Expressive Skills Matter?

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The relationships between social competence and cardiovascular reactivity were evaluated in 180 children (ages 8–17; 52% female; 53% Caucasian). Participants performed a social task (Social Competence Interview [SCI]) and 2 nonsocial tasks while reactivity measures were obtained. Social competence was coded from SCI audiotapes. Among adolescents, higher scores on the Acceptance–Affiliation subscale were associated with increased heart rate (HR) and blood pressures and with decreased HR variability during the SCI. Among boys, greater Acceptance–Affiliation scores were associated with increased vascular reactivity during the SCI. During the nonsocial tasks, higher Self-Defensiveness and Expressiveness scores were associated with increased cardiac output and stroke volume among African American children. Personal strivings and expressive skills do matter for understanding cardiovascular responses in children.

Key words: cardiovascular reactivity, interpersonal stress, social strivings

Social interactions are linked with a number of physiological processes, including cardiovascular, neuroendocrine, and immune changes (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). For example, the presence of a supportive other during a laboratory stressor results in less blood pressure (BP) and heart rate (HR) reactivity than the presence of an unsupportive other or no support in some, though not all, investigations (K. M. Allen, Blascovich, Tomaka, & Kelsey, 1991; Kamarck, Peterman, & Raynor, 1998; Lepore, Allen, & Evans, 1993). Conversely, social conflicts have deleterious physiological consequences. Negative marital interactions produce significant increases in BP and changes in immune function in a laboratory setting (Dopp, Miller, Myers, & Fahey, 2000; Ewart, Taylor, Kraemer, & Agras, 1991; Kiecolt-Glaser et al., 1993).

The same social situation, however, does not produce equivalent levels of cardiovascular reactivity (CVR) in all people. Thus, it is important to understand the factors that influence how social interactions produce different effects in different individuals. Previous research has shown that adolescent girls who have a high need for social acceptance and social support show greater reactivity to an interpersonal laboratory stressor than girls who have a low need for social acceptance and support (Ewart, Jorgensen, & Kolodner, 1998). Similarly, attributes that characterize an individual's approach to a specific social situation may also influence reactivity.

One key set of attributes that is hypothesized to influence the frequency, intensity, and duration of a person's exaggerated cardiovascular responses to stress is labeled as *social competence*. This construct is defined broadly as the ability to select and pursue desired, attainable goals by achieving control over one's actions and emotions and by understanding, connecting with, and influencing other people (Ewart, 1994; Ewart, Jorgensen, Suchday, Chen, & Matthews, 2001). Social competence is viewed as a function of (a) one's goals or strivings in a problematic situation and (b) one's interpersonal skill and "impact" (Ewart, 1994; Ewart et al., 2001). An individual's responses to problems are shaped by his or her goals or strivings, defined as what one is trying to accomplish in a challenging situation (Diener, Suh, Lucas, & Smith, 1999). For example, an adolescent girl who earnestly wants to be accepted by a group of peers may have a very different perception of a group member's challenging remark than a girl whose main goal is to become the group's leader. Pursuing goals that are intrinsically valued, realistically attainable, facilitated by one's life context, and compatible with one's other strivings increases competence in coping with life's problems (Diener et al., 1999). Goal-oriented strivings shape emotional reactions to others by influencing the way a social encounter is appraised initially (Lazarus, 1991). Thus, specifying which goals a person perceives to be threatened, harmed, or challenged in a stressful situation is important for understanding his or her emotional and physiological responses.

Success in achieving one's goals also depends in part on the actions of other people and thus calls for skill in forming support-

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ive relationships. Interpersonal skills include motor, cognitive, and affective behaviors that elicit positive responses from others. Especially important for stress exposure are (a) expressive skills, including the ability to communicate thoughts and feelings; (b) speech stylistics, including the loudness and rate of speaking, which are related to expressiveness; and (c) relationship-enhancement skills, including empathic understanding and rapport.

The Social Competence Interview (SCI; Ewart & Kolodner, 1991) measures both strivings and personal skills that affect vulnerability to stress-related illnesses. It was also designed to serve as an ecologically valid social stressor for laboratory research. In the SCI, strivings are inferred from the outcomes a person expects in a stressful situation, and how, ideally, the person would like the problem to be resolved. Although such strivings may vary with the changing demands of the immediate situation, they are expected to exhibit some stability over time because people often approach similar situations in predictable ways (Ewart et al., 2001).

In the present study, we evaluated hypothesized relationships between personal strivings, interpersonal skill, and CVR to two types of laboratory stressors, social and nonsocial, in a sample of children and adolescents. We hypothesized that children and adolescents who strive to be accepted by others (acceptance–affiliation striving) would exhibit heightened CVR during the social interview task (describing a stressful interpersonal problem in one's life) because of the stressfulness of having a goal (being accepted by others) that was difficult to achieve in that particular situation (an interpersonal conflict). Previous research has demonstrated support for the idea that the greatest CVR occurs when a situation threatens one's goals. For example, women, who typically place a greater value on relationships (*communion*), show heightened CVR to a task involving disagreement with another person, whereas men, who typically focus more on the self (*agency*), show heightened CVR only to a task that taps personal achievement (Smith, Gallo, Goble, Ngu, & Stark, 1998; Smith, Limon, Gallo, & Ngu, 1996). In the present study, patterns for acceptance–affiliation may be similar to those found for communion, and thus we hypothesized that acceptance–affiliation strivings would be associated with CVR during the social stressors but not during nonsocial stressors.

We hypothesized a different pattern of associations between strivings and reactivity during nonsocial stressors (reaction time and mirror tracing tasks). Because performance demands constitute the stressful aspect of this task, we hypothesized that children and adolescents with competitive strivings would show the greatest CVR during these tasks. That is, we hypothesized that competitive strivings would be more relevant to, and therefore associated with, CVR during nonsocial achievement-oriented tasks, but would not be relevant to CVR during a social stressor, when performance demands are not an issue. The first goal of this study, then, was to examine how various social strivings and interpersonal skills were associated with reactivity during two types of stressors (social and nonsocial).

We also explored associations of strivings and interpersonal skills with the underlying determinants of cardiovascular responses. Changes in BP and HR can result from different mechanisms in different individuals. Increases in BP can be due either to increases in cardiac reactivity and/or to increases in vascular reactivity (for a discussion of these issues, see Light, Turner, Hinderliter, & Sherwood, 1993). Similarly, stress-related increases in HR can reflect increases in sympathetic and/or decreases in parasympathetic activity. Differences in these patterns are thought to potentially have different implications for cardiovascular health. In addition, differences in patterns of reactivity may reflect different psychological states. For example, reactivity patterns may relate to the types of appraisals an individual makes about the demands of a situation and their resources for coping (Blascovich & Tomaka, 1996; Monroe & McQuaid, 1994; Wheaton, 1994). With respect to HR reactivity, it is also possible that different psychological states are reflected in degree of sympathetic versus parasympathetic changes. A previous study using this same sample found that greater family conflict was associated with patterns of parasympathetic withdrawal (Salomon, Matthews, & Allen, 2000). In the present study, we evaluated how cardiac versus vascular responses and sympathetic versus parasympathetic responses during social and nonsocial tasks vary according to children's strivings. These analyses also included demographic factors (age, gender, race) as moderators, given that strivings were found to differ by demographic group (Ewart et. al., 2001).

Method

Participants

A total of 204 children and adolescents were initially recruited from school districts in the metropolitan Pittsburgh, Pennsylvania area. Three of these children were excluded from all analyses for the following reasons: One participant was found to be running a high fever, 1 participant's 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. In addition, data for the SCI were not obtained for 13 participants for the following reasons: Seven interviews were not recorded (because of tape recorder malfunctioning), five audiotapes were not coded by raters (because of poor tape quality), and 1 person declined to complete the interview. Participants were recruited to provide equal numbers by gender and race (African American and Caucasian), in the age ranges of 8–10 years (young) and 15–17 years (old). Participants were also recruited from a variety of socioeconomic (SES) backgrounds, with the exception that children of parents with professional degrees were excluded from participation. We excluded the latter to attain comparability in the educational attainment of African American and Caucasian parents. The sample used in these analyses was 52% female and 48% male. Fifty-three percent of participants were Caucasian, and 47% were African American. Children averaged 11.44 years in age (SD = 3.46). For additional descriptive information about these participants, refer to an earlier article (M. T. Allen & Matthews, 1997).

Initial eligibility requirements were (a) no history of cardiovascular disease or any condition that would require medication that might affect the cardiovascular system (e.g., high BP, asthma, use of oral contraception); (b) no drug or alcohol abuse, history of mental illness, or any professional psychiatric counseling within the past year; (c) no more than 80% above ideal weight; and (d) no smoking within 12 hr prior to the session.

Measures

A Minnesota Impedance Cardiograph Model 304B (Bio Impedance Technology, Inc., Old Greenwich, CT) was used for generation of the impedance wave form using a tetrapolar band electrode configuration (Kubicek, Patterson, & Witsoe, 1970). An electrocardiogram (EKG) signal was collected 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.

Processing of the impedance signals and EKG was accomplished using the Cardiac Output Program (COP), an on-line 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 an IBM-based computer hosting a Computer Boards CIO-AD08 (Dell, Rock Round, TX) analog-to-digital converter board. The output of the COP program included stroke volume (SV), HR, cardiac output (CO; calculated as the product of mean SV and HR for a given period), and pre-ejection period (PEP). Shortening of or decreases in PEP represents increased sympathetic activity (Lewis, Leighton, Forester, & Weissler, 1974). The COP program calculates SV using the Kubicek equation (Kubicek, Karnegis, Patterson, Witsoe, & Mattson, 1966) and ensemble-averaged waveforms over the designated time periods.

Systolic BP (SBP) and diastolic BP (DBP) were monitored using an IBS Model SD-700A automated BP 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 $TPR = (\{[(SBP - DBP)/3] + DBP\}/CO)80$.

Customized software allowed us to extract continuous interbeat interval (IBI) data from files created by the COP program for estimations of HR variability. These IBI files were screened and edited for artifactual values, and the mean successive difference (MSD) statistic was computed for each data series. MSD is the average of the differences between successive IBIs for a particular time period.

Experimental Tasks

Tasks were presented while the participant sat upright in a comfortable lounge chair that had a detachable desk surface.

SCI. The SCI is a semistructured interview in which adolescents discuss a stressful life situation for approximately 10 min (Ewart & Kolodner, 1991). Participants were shown three cards with lists of interpersonal stressful problems common during adolescence and were asked to select the most stressful problem for them. The cards included stress with friends (e.g., arguments with friends), stress with family (e.g., parents separating), and stress with others (e.g., problems with a teacher). Participants were then asked to discuss their most stressful problem by reexperiencing a specific occasion when the problem occurred, remembering precise details about location and other people's facial expressions and actions, as well as the participant's thoughts and emotions during the situation. The final portion of the interview involved assessment of problem-solving capabilities. Participants were asked how they would ideally like the problem to be resolved and what they could do to make that come true.

Goal-oriented strivings were assessed by rating participants' descriptions of their problem and its ideal outcome. Categories of strivings were derived initially from theories of motivation (e.g., Ford, 1987, 1992; McCleland, 1985); pilot testing and factor analytic studies in three different adolescent samples suggested that coping goals could be represented by six dimensions. In the present study, four of these categories were selected to represent the types of strivings that seemed most likely to increase or diminish the frequency of stressful daily experiences or to facilitate or impair emotional regulation.

Three of these categories represented potentially stressful interpersonal strivings, including Self-Defensiveness (e.g., trying to stop hostile criticism, rumors, abuse, or to get even with someone), Acceptance–Affiliation (e.g., trying to secure someone's sympathetic support, affection, or understanding), and Competitiveness (e.g., trying to convince others that you are better than they are in a sport or school subject, striving to win respect from a teacher or coach who doubts your capabilities). A fourth category represented striving to enhance valued skills, abilities, or personal qualities, and was labeled Self-Improvement (e.g., trying to make the honor roll or an athletic team, striving to acquire a valued skill). In analyses below, Competitiveness and Self-Improvement were log transformed because of skewed distributions.

Interpersonal skill and style were assessed by the SCI code; Expressiveness, which comprised items designed to measure an outgoing (i.e., socially dominant) expressive style. The Expressiveness scale included items to measure social charisma (e.g., "Unguarded"; "Gives detailed—not monosyllabic—responses"; "Voice easily expresses emotion") and speech stylistics (e.g., "Speaks loudly"; Speaks emphatically"; "Speaks rapidly"). Factor analyses in multiple samples disclosed that Emotional Expressiveness and Speaking Style repeatedly loaded on the same factor and that a socially dominant, expressive style was positively correlated with interviewer ratings of Social Attractiveness (Ewart et al., 2001).

Coding procedure and reliability. SCI audiotapes were coded by three clinical psychology graduate students and three undergraduate psychology majors who had been trained by Craig K. Ewart. Coders listened to each interview twice; Interpersonal Skills were coded after the first hearing, and Goal-Orientation and Social Impact ratings were coded after the second hearing. Coders were provided with a detailed manual and recorded samples from interviews illustrating graded differences in speech rate, volume, and inflection, as well as goal orientation. Before coding the interview data reported here, all coders separately rated 15 "training" interviews and received corrective feedback prior to rating an additional 10 "calibration" interviews on which interrater reliability was assessed. Coders were allowed to code the study tapes only if their ratings differed from the calibration standard by ≤ 1 scale unit (on a 5-point rating scale) on at least 80% of items rated. Interview tapes from the present sample were included in a larger pool of tapes from two other studies.

All interviews were coded at the same time by the same team. Interrater reliability among the coders was monitored regularly by computing interrater agreement with other randomly selected coders on a weekly basis. Whenever interrater agreement on one of the five SCI scales failed to meet the calibration standard, the project coordinator reviewed the interview tape, resolved the disagreement, and provided corrective training as needed. Nineteen percent of the interviews in the present study were coded by more than one rater. Interrater agreement levels for the entire sample were estimated by computing weighted kappas for each SCI scale. However, because kappas are influenced by base-rate occurrence of a behavior, and because some of the strivings occurred infrequently, we also report percentages of agreement within 1 point (on the 5-point scale). Kappas and percentages of agreement are presented in Table 1.

Internal consistencies of the five scales assessed by Cronbach's alpha in the present study are also presented in Table 1. We speculate that the lower internal consistencies for Self-Defensiveness and Competitiveness reflect some heterogeneity in the items (e.g., "Wanting someone to stop criticizing" vs. "Wanting someone to stop demanding things of you" both fall under Self-Defensiveness, but possibly have different meanings to the individual).

The stability of participant rankings on the five scale dimensions was assessed in a different sample of 103 adolescent girls who were interviewed on two occasions separated by a 3-month interval. These data are provided in another report (Ewart et al., 2001). Temporal stability assessed by test–retest correlations varied according to the type of SCI scale and whether the participant's primary problem had changed or had remained the same over time (e.g., an adolescent who, in the first interview, focused on trying to improve a bad grade but in the second interview, focused on a relationship problem with a friend, was classified as having changed the problem focus). Expressiveness ratings were little affected by a change in problem focus, as indicated by test–retest correlations of $r = .64$ and $r = .60$ (ps $< .0001$) in the same-focus subgroup ($n = 42$) and the different-focus subgroup ($n = 61$), respectively. The stability of Goal-Oriented strivings was more variable and was closely related to consistency of problem focus. Statistically significant test–retest correlations were found in the same-focus subgroup for Self-Defensiveness, ($r = .61$; $p < .0001$), Acceptance–Affiliation, ($r = .40$, $p < .01$), and Self-Improvement ($r = .79$, $p < .0001$) but not for Competitive Striving ($r = -.06$, *ns*). In the different-focus subgroup, none of the striving scales yielded a statistically significant coefficient of test–retest stability. These data imply that SCI

Table 1
Descriptive Statistics for Social Competence Interview Scales

Scale (no. of items)	Example	*M*	*SD*	κ (% agreement)	Cronbach's α
Acceptance–Affiliation (6)	Wanting someone to like him/her Wanting to know how someone really feels about him/her	5.20	4.84	.64 (86)	.82
Self-Defensiveness (5)	Striving to protect or defend oneself Wanting someone to stop making demands on him/her	6.10	3.92	.73 (84)	.61
Expressiveness (10)	Is open, easy to get to know Voice easily expresses emotion	20.25	6.94	.59 (87)	.90
Competitiveness (5)	Striving to demonstrate superiority over another person in some area Wanting to show someone that she/he is better than they think	0.67	1.53	.64 (97)	.62
Self-Improvement (5)	Wanting to achieve a self-standard that is important to him/her Striving for self-mastery or personal achievement	0.76	2.31	.31 (97)	.87

Note. Each item is scored on a 0–4 scale.

Expressiveness is reasonably stable over a 3-month interval regardless of problem focus but that changes in problem focus do affect the types of strivings that individuals express.

Reaction time. A computerized choice reaction-time task required the participant to respond by pressing a joystick button as quickly as possible to a 1000-Hz tone presented through 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.

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 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 BP 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 a baseline 10-min rest period.

The reaction-time and mirror-tracing tasks were administered as part of a set of three stress tasks (including the cold forehead task, described further in Allen & Matthews, 1997). We chose not to include the cold forehead task in these analyses because it involved passive as opposed to active coping, and thus we did not expect it to relate to strivings or interpersonal style. The three tasks were presented in counterbalanced order with 8-min intertask rest periods after each task. The SCI was then administered and audiotaped for later coding by the Craig K. Ewart lab. Following the SCI, participants rested for a final 10-min period. Participants were paid $75 for completing the protocol in addition to money earned in the reaction-time task.

Data Reduction and Analyses

Data for HR and impedance-derived variables were collected on a minute-by-minute basis during the last 3 min of the baseline rest, the 3 min of reaction time, the 3 min of mirror tracing, and the first 10 min of the SCI. For impedance cardiography calculations, 55 s of each minute were used for ensemble averaging. These minute-by-minute values were averaged to form means for each period.

BPs were recorded at the 5-, 7-, and 9-min mark of the initial baseline rest period, and the last two readings were averaged to form SBP and DBP means, coincident with impedance cardiography sampling. Readings were taken every minute during the reaction-time and mirror-tracing tasks, and every other minute during the SCI. Readings were averaged to form task means. CVR scores were calculated as change scores (task mean minus initial baseline mean) for non-volume-based measures (HR, SBP, DBP, PEP, MSD).[1] For impedance-derived variables involving volume-based measures, percentage of change scores were used (CO, SV, TPR). This was done because absolute levels of volume-based impedance measures may be influenced to an unknown degree by factors that are idiosyncratic to the impedance technique (for a discussion of these issues, see Sherwood et al., 1990). Nonsocial reactivity was calculated as the average reactivity across the reaction-time and mirror-tracing tasks. See Table 2.

To test the associations of strivings and interpersonal skill with CVR, we first regressed reactivity scores onto baseline levels to obtain a residualized reactivity score. For those reactivity variables associated with body mass index (BMI; SBP, DBP), we regressed reactivity scores onto both baseline

[1] The decision about the amount of time for intertask rests stemmed from previous research that has demonstrated that longer baseline periods (20 min) were not more stable than shorter periods (Jennings, Kamarck, Stewart, Eddy, & Johnson, 1992). In general, intertask baseline values tend to increase across a session, creating ceiling effects in which there is less room to detect reactivity effects. In addition, during intertask rests in the present study, cardiovascular measures were taken only during the last minute, and thus are less reliable than initial baseline rests. We thus used initial baseline rests for reactivity scores and counterbalanced the order of all nonsocial tasks.

Table 2
Descriptive Statistics for Cardiovascular (CV) Measures

	M			*SD*		
CV measure	Resting	SCI change score	Nonsocial change	Resting	SCI change score	Nonsocial change
Heart rate (bpm)	77.87	9.75	16.50	13.75	6.20	12.16
PEP (ms)	99.57	1.51	−10.66	11.28	5.02	9.68
MSD (ms)	61.20	−19.39	−28.24	34.18	27.16	44.32
SBP (mmHg)	110.03	7.79	16.33	9.32	8.37	13.89
DBP (mmHg)	62.62	8.42	16.20	8.73	9.81	15.51
TPR (dyne-s/cm^5)	1,342.69	9.30	7.20	427.25	16.47	29.59
CO (L/min)	5.11	2.32	15.50	1.65	10.72	23.36
SV (ml)	69.07	−9.46	−5.44	30.47	9.26	17.47

Note. Change scores for total peripheral resistance (TPR), cardiac output (CO), and stroke volume (SV) reflect percent change. SCI = Social Competence Interview; PEP = pre-ejection period; MSD = mean successive difference score (heart rate variability); SBP/DBP = systolic/diastolic blood pressure.

levels and BMI.[2] We then regressed residualized reactivity scores onto all demographic variables (age, race, gender) and the striving (centered variable) in the first block, followed by the interactions between demographics and striving in the second block, as recommended by Aiken and West (1991). When significant interactions emerged, we tested for simple main effects within each demographic group. Analyses were conducted separately for social and nonsocial stressors.

To address the possibility that rate of speech or choice of stressor topic may confound the results, we controlled for speech as rated by the SCI coders (“Speech is slow and halting,” rated on a 5-point scale) and topic choice (friends, family, other).

Results

Main Effects of Strivings and Demographic Variables

SCI. There were no main effects of Acceptance–Affiliation, Self-Defensiveness, Competitiveness, or Self-Improvement on any physiologic variables (all R^2s $\leq .01$). There was a significant main effect of Expressiveness on SBP ($\beta = .21$, $p < .05$, $R^2 = .02$) and TPR ($\beta = .21$, $p < .05$, $R^2 = .02$), indicating that greater expressiveness was associated with greater SBP and TPR reactivity during the SCI. There was also a main effect of age, indicating that adolescents had greater SBP ($\beta = .17$, $p < .05$), DBP ($\beta = .20$, $p < .025$), CO ($\beta = .30$, $p < .001$), and SV reactivity ($\beta = .20$, $p < .025$), but lower TPR reactivity ($\beta = -.20$, $p < .025$) than children. A main effect of gender indicated that girls had higher HR ($\beta = -.20$, $p < .025$), lower MSD (less HR variability; $\beta = .19$, $p < .025$), and lower PEP (greater sympathetic reactivity; $\beta = .23$, $p < .01$) than boys. Finally, there was a main effect of race, indicating that Caucasian participants had higher HR ($\beta = .23$, $p < .01$), SBP ($\beta = .28$, $p < .001$), DBP ($\beta = .27$, $p < .001$), and TPR reactivity ($\beta = .18$, $p < .025$), but lower SV reactivity ($\beta = -.17$, $p < .05$) compared with African American participants.

Nonsocial stressors. There was a main effect of Competitiveness ($\beta = .33$, $p < .05$, $R^2 = .02$), indicating that greater competitiveness was associated with greater HR reactivity during the nonsocial stressors. A significant main effect of Self-Defensiveness ($\beta = .18$, $p < .05$, $R^2 = .03$) indicated that greater self-defensiveness was associated with greater SBP reactivity. There were no main effects of Acceptance–Affiliation, Expressiveness, or Self-Improvement on any physiologic variables (all R^2s $\leq$ .01). For demographics, there was a significant main effect of age on CO ($\beta = .19$, $p < .025$), indicating that adolescents had greater CO reactivity than children. Finally, there was a main effect of age ($\beta = -.23$, $p < .01$) and gender ($\beta = .20$, $p < .025$) on TPR, indicating that younger children and males had greater TPR reactivity.

Interaction of Demographics With Strivings

SCI. Table 3 presents beta weights for the interaction findings reported below for reactivity during the SCI. A Gender × Acceptance–Affiliation interaction was found for DBP and TPR reactivity during the SCI. Among males only, greater Acceptance–Affiliation was associated with greater DBP reactivity ($R^2 = .05$, $\beta = .23$, $p < .05$) and TPR reactivity ($R^2 = .08$, $\beta = .27$, $p < .025$) during the SCI.

An Age × Acceptance–Affiliation interaction was found for HR, HR variability, SBP, and DBP reactivity. Among older children, greater Acceptance–Affiliation was associated with greater HR ($R^2 = .20$, $\beta = .44$, $p < .001$), less HR variability ($R^2 = .15$, $\beta = -.38$, $p < .01$), greater SBP ($R^2 = .11$, $\beta = .33$, $p < .01$), and greater DBP ($R^2 = .05$, $\beta = .23$, $p < .05$) reactivity during the SCI. Among younger children, there were no significant associations. No interactions were found with Acceptance–Affiliation for PEP or cardiac reactivity (SV or CO, $R^2 \leq .01$).

A Gender × Self-Improvement interaction was found for DBP and TPR reactivity. Among female participants, greater striving for Self-Improvement was associated with greater DBP reactivity ($R^2 = .07$, $\beta = .27$, $p < .01$), and greater TPR reactivity ($R^2 = .04$, $\beta = .19$, $p = .07$) during the SCI. Among male participants, there was no significant association. A Gender × Self-Improvement interaction was found for PEP reactivity, such that among girls only, greater striving for Self-Improvement was associated with greater decreases in sympathetic activity during the SCI ($R^2 = .03$, $\beta = .17$, $p < .09$). No interactions were found for Self-Improvement with HR, SBP, MSD, CO, or SV ($R^2 \leq .01$).

No interactions were found for any demographic variables with Self-Defensiveness, Expressiveness, or Competitiveness during the SCI ($R^2 \leq .01$).

[2] Findings with all other cardiovascular variables remained unchanged when controlling for BMI.

Table 3
Summary of Strivings by Demographic Interactions During the Social Competence Interview (SCI)

SCI interaction	β^a	R^2	Finding
Acceptance–Affiliation			
× Gender	.19*	.02	Males: ↑ AA ↑ DBP reactivity
× Gender	.21*	.02	Males: ↑ AA ↑ TPR
× Age	.26***	.04	Adolescents: ↑ AA ↑ SBP
× Age	.18*	.02	Adolescents: ↑ AA ↑ DBP
× Age	.31***	.06	Adolescents: ↑ AA ↑ HR
× Age	−.28***	.05	Adolescents: ↑ AA ↑ MSD
Self-Improvement			
× Gender	−.27**	.03	Females: ↑ SI ↑ DBP
× Gender	−.28**	.03	Females: ↑ SI ↑ TPR
× Gender	−.27**	.03	Females: ↑ SI ↑ PEP

Note. Self-Defensiveness, Expressiveness, and Competitiveness had no significant interactions. Up arrow (↑) = higher score; down arrow (↓) = lower score; AA = Acceptance–Affiliation; DBP = diastolic blood pressure; TPR = total peripheral resistance; SBP = systolic blood pressure; HR = heart rate; MSD = mean successive difference (lower scores indicate less heart rate variability); SI = Self-Improvement; PEP = pre-ejection period (higher scores indicate less sympathetic reactivity).
[a] β for interaction.
* $p < .05$. ** $p < .025$. *** $p < .01$.

Nonsocial stressors. Table 4 presents beta weights for the interactions reported below for the nonsocial stressors. A Race × Self-Defensiveness interaction was found for CO such that among African Americans only, greater self-defensive striving was associated with greater CO reactivity during nonsocial stressors ($R^2 = .05$, $\beta = .23$, $p < .05$). No interactions with Self-Defensiveness were found for any other physiological variable ($R^2 \leq .01$).

A Race × Expressiveness interaction was found for CO and SV. Among African American participants, greater Expressiveness was associated with greater CO ($R^2 = .08$, $\beta = .28$, $p < .025$) and SV ($R^2 = .07$, $\beta = .27$, $p < .025$) increases during nonsocial stressors. Among Caucasian participants, there were no significant associations.

A Gender × Expressiveness interaction was found for HR variability, indicating that among females only, greater Expressiveness was associated with lower HR variability ($R^2 = .06$, $\beta = -.24$, $p < .025$). No interactions with Expressiveness were found for HR, SBP, DBP, PEP, or TPR (R^2s $\leq .01$).

An Age × Competitiveness interaction was found for PEP reactivity, indicating that among younger children only, greater Competitiveness was associated with greater sympathetic activity during the nonsocial stressors ($R^2 = .03$, $\beta = -.17$, $p < .08$). Finally, an Age × Acceptance–Affiliation interaction was found for HR variability, indicating that among older children only, greater Acceptance–Affiliation was associated with less HR variability during the nonsocial stressors ($R^2 = .12$, $\beta = -.34$, $p < .01$). No other interactions were found with Competitiveness or Acceptance–Affiliation for the other physiological variables ($R^2 \leq .01$).

No interactions between demographic variables and Self-Improvement were found ($R^2 \leq .01$).

Discussion

The results of this study confirm the utility of individual strivings and interpersonal skill as an approach to explaining children and adolescents' physiological responses to stressful situations. As hypothesized, strivings and interpersonal skill produced different associations with CVR, depending on the type of stressor. In addition, demographic variables of age group, gender, and race

Table 4
Summary of Strivings by Demographic Interactions During the Nonsocial Stressors

SCI interaction	β^a	R^2	Finding
Acceptance–Affiliation × Age	−.29***	.05	Adolescents: ↑ AA ↓ MSD
Self-Defensiveness × Race	−.23*	.02	African Americans: ↑ SD ↑ CO
Expressiveness			
× Race	−.22*	.02	African Americans: ↑ Exp ↑ CO
× Race	−.22*	.02	African Americans: ↑ Exp ↑ SV
× Gender	.25**	.03	Females: ↑ Exp ↓ MSD
Competitiveness × Age	.19*	.02	Young children: ↑ Comp ↓ PEP

Note. Self-Improvement had no significant interaction. SCI = Social Competence Interview; up arrow (↑) = higher score; down arrow (↓) = lower score; AA = Acceptance–Affiliation; MSD = mean successive difference (lower scores indicate less heart rate variability); SD = Self-Defensiveness; CO = cardiac output; Exp = Expressiveness; SV = stroke volume; Comp = Competitiveness; PEP = pre-ejection period (lower scores indicate greater sympathetic reactivity).
[a] β for interaction.
* $p < .05$. ** $p < .025$. *** $p < .01$.

moderated these associations. During a social stressor (the SCI), higher scores on the Acceptance–Affiliation subscale were associated with greater HR and BP reactivity and decreases in HR variability among adolescents. In boys, higher scores on the Acceptance–Affiliation subscale were associated with greater vascular (DBP and TPR) reactivity. These findings suggest that striving to be accepted by others heightens the stressfulness of discussing an interpersonal problem situation, particularly in adolescents and boys.

Previous research has shown that situations that are stressful relative to an individual's goals can produce negative health consequences. For example, women, who have more relationship-oriented goals, show greater CVR to a disagreement task, whereas men, who have more achievement-oriented goals, show greater reactivity to a task that ostensibly taps their verbal abilities (Smith et al., 1998). Individuals who have more feminine personality traits exhibit greater increases in BP during a task in which they are instructed to persuade rather than empathize with others on a controversial topic. In contrast, individuals who have more masculine personality traits exhibit greater increases in BP when told to empathize with rather than persuade others about a controversial topic (Davis & Matthews, 1996). Finally, individuals who score highly on the trait of *John Henryism* (e.g., a strong disposition toward striving to excel) and who are in situations in which achievement is difficult (e.g., low SES) are more likely to develop hypertension (James, Strogatz, Wing, & Ramsey, 1987).

In the context of the current study, those adolescents or boys who seek acceptance from others but who are thrust into an interpersonal conflict situation may perceive this situation as quite stressful and thus display heightened HR and BP responses. The associations for adolescents indicate that perhaps the desire for acceptance from others becomes more salient as children grow older, resulting in interpersonal conflicts being perceived as more stressful for these older children. The finding among males is somewhat surprising given the literature demonstrating a greater focus on relationships with others among females (Helgeson, 1994). However, it may be that boys who strive for acceptance from others find interpersonal conflicts most stressful because they hold goals that are gender atypical and for which they may get little support from others. In addition, the fact that the interviewer in this study was always female may mean that boys' pattern of seeking acceptance from a woman differs from girls' pattern of seeking acceptance from a woman.

Girls who strive for greater self-improvement during an interpersonal conflict also showed greater vascular reactivity when discussing this situation. This finding suggests that self-improvement is an important striving for girls and that when girls strive for an achievement that is important to them personally but feel that others are hindering this striving (thus the interpersonal conflict), this creates a stressful situation that results in heightened vascular reactivity in girls. However, it should be noted that the percentage of variance in reactivity accounted for by self-improvement was relatively small.

During the nonsocial stressors, different sets of strivings were associated with reactivity. Greater competitiveness was associated with greater HR reactivity across the sample and with increased sympathetic activity in younger children. Greater self-defensiveness was associated with greater SBP reactivity across the sample and with CO increases in African American children. It may be that certain children who have strivings that have antagonistic qualities (i.e., those who seek to compete against or defend themselves against others) are likely to find nonsocial stressors most stressful or challenging and to react physiologically to these types of stressors. However, it should be noted that the percentage of variance in reactivity accounted for by these strivings was relatively small.

Among African American participants, expressiveness also was associated with reactivity during the nonsocial stressors. African American children who displayed greater expressiveness had greater CO and SV increases during the nonsocial stressors. In addition, girls who displayed greater expressiveness also had greater parasympathetic withdrawal during the nonsocial stressors. These findings suggest the possibility that certain groups of children who tend to be open and expressive may be getting most engaged in the nonsocial tasks and thus displaying greater increases in reactivity. Overall, this pattern of differential associations for social and nonsocial stressors is consistent with the notion that cardiovascular reactors to achievement stressors are often not the same reactors to interpersonal stressors (Lassner, Matthews, & Stoney, 1994).

Contrary to our hypotheses, competitive strivings were not robustly associated with CVR during the nonsocial stressors. One reason for this may have been the unexpectedly low levels of competitiveness coded in this sample. It is possible that children and adolescents do not verbalize much competitiveness at these ages. In addition, given that we excluded the highest SES children, it is possible that competitive strivings may be lower in low-SES compared with high-SES communities. The fact that no competitiveness was coded in many children limits the conclusions that can be drawn about this type of striving, but may also account for why reliability statistics are not that good for this subscale. A previous study also found low test–retest reliability for this scale (Ewart et al., 2001).

We also sought to understand the hemodynamic underpinnings of reactivity to social and nonsocial stressors in a sample of children and adolescents. As described earlier, stress-related increases in BP could be due either to increases in cardiac reactivity or increases in vascular reactivity (for a discussion of these issues see Light et al., 1993). Similarly, stress-related increases in HR could reflect increases in sympathetic or decreases in parasympathetic activity. We found that seeking acceptance was associated with increases in vascular reactivity (DBP/TPR) among boys, and seeking self-improvement was associated with increases in vascular reactivity among girls during the social task. In contrast, self-defensive strivings and expressiveness were associated primarily with increases in cardiac reactivity (CO, SV) among African American participants during the nonsocial stressors. There is some suggestion that vascular reactivity is linked with risk of essential hypertension and its complications (e.g., carotid atherosclerosis), whereas cardiac reactivity may be linked with risk of coronary atherosclerosis. This speculation is based on data demonstrating that vascular reactivity is associated with rises in BP over time, left ventricular mass, and carotid atherosclerosis (Everson et al., 1997; Matthews et al., 1998; Matthews, Woodall, & Allen, 1993; Murphy, Alpert, & Walker, 1992; Treiber et al., 1996). In contrast, HR reactivity is associated with atherosclerosis in the large coronary arteries of the cynamolgus monkey (Manuck, Kaplan, Adams, & Clarkson, 1989; Manuck, Kaplan, & Clarkson, 1983). These findings suggest that the associations of strivings with different reactivity patterns may have different implications for children's long-term cardiovascular health.

In terms of the determinants of HR reactivity, we found that acceptance–affiliation strivings were associated with decreased HR variability reactivity during both the social and nonsocial stressors among older participants. Thus it appears that older participants who strive for acceptance–affiliation are likely to show decreases in HR variability reactivity across a variety of stressors, both social and nonsocial. In addition, girls who are expressive show greater decreases in HR variability during the nonsocial stressors. That these strivings and interpersonal style are associated with decreased parasympathetic activity suggests that social competence characteristics may have implications for children's ability to regulate responses to a variety of environmental demands (Porges, Doussard-Roosevelt, Portales, & Greenspan, 1996). Decreased parasympathetic activity has been linked to increased risk of sudden cardiac death (van Ravenswaaij-Arts, Kollee, Hopman, Stoelinga, & van Geijn, 1993), and Porges has proposed that the parasympathetic system serves as a "brake" that regulates sympathetic responses to stressors. An unresponsive system (low HR variability) indicates an inability to quickly respond to environmental demands and may place an individual at greater risk for coronary events later in life (Porges, 1994; Porges et al., 1996).

Limitations to the strivings and style codings include the reliance on verbalizations of strivings and the coding of strivings during only the social task. Differences in how well children are able to verbalize their goals during interpersonal stressors may have influenced the coding of strivings. In addition, given that strivings and interpersonal style were coded only during the social task, it is possible that some associations among strivings style, and reactivity to nonsocial stressors were weakened by not developing a method for assessing strivings during nonsocial tasks. We recognize that the situation itself plays a large role in determining which strivings are most relevant and most likely to be used; however, it does appear that individuals who report certain strivings will also have specific patterns of reactivity to different types of situations (that is, a person by environment interaction may best describe these findings). A second limitation is that the social and nonsocial tasks differed in dimensions other than the interpersonal component of each task. For example, the social task revolved around a conflict stressor, whereas the nonsocial tasks emphasized performance stressors. It is possible that differences between these three tasks had more to do with the nature of each task than the social or nonsocial component of the task. Future studies should test associations of strivings and interpersonal style with different types of social and nonsocial stressors. Other limitations include questions of generalizability to samples that include parents with professional degrees, and the possibility of Type I error given the multiple physiological and strivings variables.

Although these findings provide some interesting patterns suggesting how strivings are associated with different types of stressors, it will still be important to test these associations as children experience stressors in their daily lives. It is possible that reactivity while describing an interpersonal stressor differs from reactivity while experiencing this interpersonal stressor. Ambulatory studies may be able to clarify some of this issue in future studies. In addition, it will be important to test associations of strivings with real-life nonsocial stressors.

In sum, social strivings and interpersonal style were associated with a variety of CVR indices in a sample of children and adolescents. Higher scores on Acceptance–Affiliation were associated with increased HR and BP as well as decreased parasympathetic activity during the SCI among adolescents and with increased vascular reactivity during the SCI among boys. During nonsocial tasks, Self-Defensiveness and Expressiveness scores predicted cardiac reactivity among African Americans only. This study represents an important first step in the study of how situational strivings and interpersonal skills influence stressor-related reactivity in children. It clearly shows that children's personal goals and expressive skills do matter.

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