THE EFFECT OF RELATIONSHIP QUALITY ON MENTAL REPRESENTATIONS OF SOCIAL SUPPORT AND CARDIOVASCULAR REACTIVITY

Courtney C. Prather, B.A.

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APPROVED:

John R. Ruiz, Major Professor
Daniel J. Taylor, Committee Member
Adriel Boals, Committee Member
Vicky L. Campbell, Chair of the Department of Psychology
James D. Meernik, Acting Dean of the Toulouse Graduate School
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The aim of the current study was to examine how thinking about qualitatively different social network members may differentially affect cardiovascular reactivity to a subsequent stressor. Eighty-two undergraduates were asked to think and write about different types of relationships preceding a social stressor. No differences between conditions in CVR were found during social support induction phase or the stressor task. Women in the supportive condition were found to have slower SV recovery than those in the ambivalent condition. The results of this study are inconsistent with previous evidence for a relationship between mental representations of social ties and CVR. Future research should seek to rule out confounding variables and clarify this effect.
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INTRODUCTION

Cardiovascular diseases (CVD) claim more lives than diabetes mellitus, chronic lower respiratory disease, accidents and cancer combined (American Heart Association, 2009). Coronary heart disease (CHD) accounts for over 50% of CVD mortality, representing the leading cause of death in North America (American Heart Association, 2009; Lloyd-Jones, Adams, Carnethon, et al., 2009). Coronary Heart Disease has a long-term pathogenesis, with early correlates of atherosclerosis presenting in children (Worthley, Osende, Helft, et al., 2001), and over 80% of CHD related deaths occurring in individuals over age 65 (American Heart Association, 2009). Although many traditional risk factors for disease progression have been identified (e.g., family history, smoking, obesity, diabetes mellitus), hallmark studies in the 1970s drew attention to the salient effect of psychosocial factors on the health and wellbeing of individuals (Berkman & Syme, 1979; Cassell, 1976; Cobb, 1976). Subsequent research has aimed to identify mechanisms through which these psychosocial risk factors produce physiological changes that culminate in disease, including cardiovascular reactivity (CVR; Rozanski, Blumenthal & Kaplan, 1999).

The Reactivity Hypothesis

Cardiovascular reactivity (CVR) is hypothesized to be a pathway through which psychosocial risk factors contribute to CHD development (Treiber, Kamarck, Schneiderman, et al., 2003). Although the body is constantly responding to environmental and psychological demands, the specific physiological activity associated with stress may have important implications for disease (Kamarck & Lovallo, 2003). Cardiovascular reactivity refers to acute hemodynamic changes, including heart rate and blood pressure, mediated by the autonomic nervous system in response to psychological stress (Manuck, 1994). Individual variability in the
tendency to exhibit these changes to a greater or lesser degree is relatively stable when measured across multiple contexts, potentially compounding over time to affect health outcomes (Manuck, Kaplan, Adams, et al., 1989; Sherwood & Turner, 1995).

The pattern of more frequent, larger, and longer CVR in response to various life stressors and challenges is associated with the development of CHD (Treiber et al., 2003). Larger CVR in the lab is predictive of future development of risk factors and preclinical markers of disease including increased intima-media thickness (IMT; Heponiemi, Elovainio, Pulkki, et al., 2007; Jennings, Kamarch, Everson-Rose, et al., 2004), left ventricular mass (Murdison, Treiber, Mensah, et al., 1998), hypertension (Menkes, Matthews, Krantz, et al., 1989; Ming, Adler, Kessler, et al., 2004) and coronary artery calcification (Matthews, Zhu, Tucker & Whooley, 2006). This trend is also found when examining responses to environmental stressors, with ecological momentary assessment measures of CVR predicting development of IMT and atherosclerosis (Kamarck, Schwartz, Shiffman, et al., 2005; Manuck, Kaplan & Clarkson, 1983). Additionally, exaggerated CVR is associated with cardiac events such as myocardial ischemia (Kral, Becker, Blumenthal, et al., 1997); myocardial infarction (MI; Keys, Taylor, Blackburn, et al., 1971; Sundin, Ohman, Palm & Strom, 1995; Krantz, Santiago, Willem, et al., 1999), second MI (Manuck, Olsson, Hjerndahl & Rehnqvist, 1992), and cardiac death (Krantz et al., 1999). These findings have been demonstrated across patient and healthy samples, and independent of traditional risk factors. It should be noted that research has not been entirely consistent in providing support for the reactivity hypothesis (Ahern, Gorkin, Anderson, et al., 1990).

However, results have generally been stronger when considering the interaction of CVR and environments characterized by a high amount of psychosocial stress (Everson, Lynch, Chesney, et al., 1997; Lynch, Everson, Kaplan, et al., 1998; Treiber et al., 2003).
Social Support and CHD

The social environment represents an important moderator of CHD and stress-related CVR (Ruiz, Hamann, Coyne, & Compare, 2006; Ruiz, Hutchinson, & Terrill, 2008; Smith & Gerin, 1998). Social interactions constitute a major source of external stimuli in everyday life (Wheeler & Nezlek, 1977). Research demonstrates that positive interactions with social others attenuate (i.e., buffer) CVR and are associated with reduced cardiovascular risk (Ruiz et al., 2006). These interactions can be conceptualized with regard to general social integration to specific interpersonal interactions. At a more general level, greater embeddedness/social integration is associated with reduced CHD incidence (Eng, Rimm, Fitzmaurice & Kawachi, 2002; Rosengren, Willhelmsen & Orth-Gomer, 2004) and mortality (Orth-Gomer, Unden & Edwards, 1988). Effect sizes for social integration in healthy samples for future development of CHD are comparable to those representing more traditional risk factors such as smoking (Orth-Gomer, Rosengren & Wilhelmsen, 1993). Associated concepts including marital status, participation in social activities, and size of social network, are positively associated with mental and physical health benefits (Berkman, 1995; House, Landis & Umberson, 1988; Lett, Bumenthal, Babyak, et al., 2005). In an illustrative study, Eng and colleagues (2002) found that, in a sample of almost 30,000 healthy individuals, socially isolated men faced an 80% increased risk of future fatal CHD. Similar to healthy samples, social integration is as strong a predictor of mortality as traditional risk factors such as cholesterol level, tobacco use, and hypertension in the patient population (Mookadam & Arthur, 2004). Together these findings support the benefits of social integration and risks associated with social isolation.

Social relationships including friends, spouses, and family members are often collectively referred to as “supports” due to the expectation that they will provide assistance in times of
challenge. This assistance can be described in terms of the function of the support as informational, tangible, emotional or instrumental (Cohen & Willis, 1985). Alternatively, perceived social support can be conceptualized as the general communication that one is cared for, valued and belongs (Cobb, 1976). CHD patients with low perceived social support have decreased quality of life following myocardial infarction (Rankin & Fukuoka, 2003); and face an increased risk of future cardiac events (Horsten, Mittleman, Wamala, et al., 2000) and death (Brummett, Barefoot, Siegler, et al., 2001; Lett et al., 2007; Woloshin, Schwartz, Tosteson, et al., 1997). Welin, Lappas and Wilhelmsen (2000) found an almost three-fold increased chance of cardiac mortality in individuals low on perceived emotional support at 10-year follow up in a sample of MI patients. Although social support likely represents a health-protective factor through multiple mechanisms, it is hypothesized that social support may be particularly beneficial for individuals experiencing stress (Cohen, 1988).

**Social Support and CVR**

The stress-buffering hypothesis postulates that social support provides protective health effects by reducing the physiological impact of life stressors on the individual (Cohen & Wills, 1985; Lepore, 1992). The social network may intervene between the stressful stimuli and subsequent stress response through two mechanisms (Figure 1). Structural and functional aspects of support may increase perceived coping ability, potentially preventing threat appraisal (Jalowiec, Grady & White-Williams, 2007; Pakenham, Chiu, Burnsall, et al., 2007). Additionally, social support may intervene following appraisal to facilitate problem-solving and adaptive coping, reducing the impact of the stressor. According to this model, alterations in the psychological experience of stress attenuate CVR, producing less cardiovascular damage and

Appraisal of coping resources in response to stress includes the general perceived availability of functional support from the social network as a whole (Cohen & Willis, 1985). Laboratory studies indicate that social support measured at this global level is associated with attenuated CVR to stressors (O’Donovan & Hughes, 2008; Tardy, Thompson & Allen, 1989; Uchino, Holt-Lunstad, Uno & Flinders, 2001). For example, O’Donovan and Hughes (2008) found that individuals with higher perceived network support had lower HR reactivity to a psychosocial stress-task. Likewise, Nausheen, Girdon, Gregg and colleagues (2007) observed significantly larger increases in CVR associated with lower social support satisfaction and higher support need as measured by, an implicit association test. Similar results are observed in samples of CHD patients (Craig, Lynch and Quartner, 2000). This effect is not moderated by the immediate presence of support, indicating that an individual’s support network may act as a buffer against stress and subsequent responses in a general fashion by supplementing perceived coping abilities.

Higher levels of perceived support are also associated with reduced CVR and load throughout the day in response to stressors encountered in the environment. Ambulatory blood pressure (ABP) allows for continuous cardiovascular measures to be obtained outside of the laboratory, providing an ecologically valid measure of CVR. Satisfaction with social support is negatively associated with ABP at work, home and during sleep in both healthy and clinical samples (Carels, Blumenthal & Sherwood, 1998). Perceived support within specific and significant relationships is also associated with lower ABP independent of global support (Holt-Lunstad, Birmingham & Jones, 2008). These effects do appear to be mediated by an increase in
coping abilities (Carels, Blumenthal & Sherwood, 2000; Grewen, Girdler & Light, 2005). For example, Karlin, Brondolo & Schwartz (2003) observed lower workplace ABP in individuals reporting more perceived support from coworkers and supervisors, and these effects were more pronounced during the experience of acute stressors. Ambulatory blood pressure is strongly predictive of future cardiovascular outcomes (Staessen, Asmar, De Buyzere, et al., 2001), and the attenuation of CVR in response to everyday stressors represents an important mechanism through which social support may influence disease outcomes.

Laboratory Manipulations of Social Support and CVR

While appraisals of available support affect cardiovascular responses to stress, laboratory manipulations of actual support provision provide direct evidence for the stress-buffering mechanism of support (O’Donovan & Hughes, 2008). In an illustrative study, Glasser, Kiecolt-Glaser, Bonneau and colleagues (1992), assigned participants to discuss a controversial issue with two confederates, with a third confederate either expressing agreement or neutrality. Individuals in the supportive confederate condition exhibited significantly lower increases in diastolic blood pressure (DBP), systolic blood pressure (SBP) and heart rate (HR). Similarly, Lepore, Allen and Evans (1993) found that college students experienced reduced reactivity when giving a speech in the presence of a confederate who smiled and made encouraging remarks relative to a neutral, inattentive confederate. In a meta-analysis of studies using similar methodology, effects were largest when comparing supportive confederates to neutral confederates with effect size estimates for HR, SBP and DBP ranging from .60 to .82 (Thorsteinsson & James, 1999). These laboratory analogues of support provision during stress provide insight into how support may be operating as a health-protective factor in the environment.
Social support is primarily provided through relationships with friends and family (DuPertuis, Aldwin & Bosse, 2001), and laboratory studies using a stranger paradigm fail to appreciate the effect on appraisal and subsequent reactivity that existing sources of support may provide. Support from a friend is more strongly associated with attenuated CVR than support provided from a confederate or stranger (Edens, Larkin & Abel, 1992; Fontana, Diegnan, Villeneuve, et al., 1999). In a study using similar methodology as Lepore and colleagues (1993) described above, a friend-support group demonstrated smaller increases in DBP, SBP and HR relative to a confederate-support group. Additionally, the difference in CVR observed between these groups was of similar magnitude as that observed between the no-support and confederate-support, indicating a stepwise effect (Christenfeld, Gerin, Linden, et al., 1997). Supportive intentions may be more easily communicated and more meaningfully received in the context of an existing relationship. Even very discrete support-behavior from a friend has been observed to significantly attenuate stress responses (Bolger, Zuckerman & Kessler, 2000). Kamarck, Manuck and Jennings (1999) administered cognitive-stress tasks to participants while a friend periodically lightly touched the participant on the wrist and silently supported them. During the task, friends listened to white noise and filled out surveys and thus were not attentive to the participants’ performance. Despite this low level of involvement, participants in this condition exhibited attenuated SBP and HR responses. Reduced reactivity has also been observed when participants merely have a partner present during the task (Phillips, Carroll, Hunt & Der, 2006), receive a supportive note from a friend in a separate room (Uno, Uchino & Smith, 2002), or have 10-minutes of warm contact with a partner prior to a stress task (Grewen, Anderson, Girdler, et al., 2003). The very minimal supportive behavior from network ties necessary to attenuate stress responses highlights the profound influence of social support on stress appraisal and responses.
Ambulatory and laboratory studies including both confederates and network ties illustrate how social support reduces stress appraisal and consequent CVR. This effect represents a mechanism through which the social network, over time, beneficially affects health outcomes. Although supportive behavior from a stranger attenuates stress responses, support received in the context of existing relationships has a more profound and recurrent effect on stress responses. Very minimal supportive behavior from a friend or partner, including just being present, attenuates stress responses. In this case, expectations of support availability may function to increase coping appraisals and reduce stress reactions independent of actual support provision.

Mental Representations of Social Support

Perceptions of social support are likely guided by internal representations of the social network. Borrowing from attachment literature (Sarason, Peirce, Shearin, et al., 1991) and the social-cognitive model of relational schemas (Baldwin, 1992), individuals hold cognitive interpersonal scripts that guide behavior and expectations for specific relationships (Peirce, Sarason and Sarason, 1991). As such, cognitive appraisal of support is likely facilitated by activation of support behavior expectancies, and thus represents a probable mediator between perceived support and health outcomes.

The expectation of support from important social ties may enhance coping ability and reduce stress appraisal in the absence of actual support presence or provision (Pierce & Lydon, 1998). Smith, Ruiz and Uchino (2004) asked participants to think and write about either a supportive social tie or acquaintance before an evaluative speech task, finding individuals in the support-condition to exhibit significantly smaller increases in HR, SBP and DBP. Similar results were found in response to a task involving the disclosure of a past anger-evoking experience, where individuals who wrote about a supportive friend prior to the recall-task showed smaller
increases in HR, SBP and DBP compared to those who wrote about an acquaintance (Ratnasingam & Bishop, 2007). Evidence suggests that these relational schemas can be spontaneously activated in such a way to attenuate stress responses. A study by Grewen and colleagues (2003) observed enhanced cardiovascular recovery following a stress task when individuals were aware that they would be reunited with their partner following the task. The anticipation of supportive contact likely activated relevant schemas that enhanced coping. This ability to utilize the social support network through relational schemas may reflect a pathway through which social relationship affect CHD outcomes.

Social support is an important moderator of CVR, and mental representations of support act in much the same way as the actual presence of supportive ties. Accessing relational schemas may provide an additional pathway through which support is mobilized to enhance coping and attenuate CVR. Moreover, mental activation of social support may be more beneficial during stressors in which support provision could be perceived as threatening to an individual’s self-esteem (O’Donovan & Hughes, 2008). Thus, in addition to the functional aspects of social support mediating stress responses, general perception of availability of social support accessed through specific relational schemas likely contributes to the beneficial effects of the social network on CHD outcomes.

Variations in Relationship Quality

A comprehensive understanding of the social network-health link requires the consideration of the qualitative spectrum of the relational experience (Ruiz et al., 2008). Although relationships are often sources of support, they can also be associated with negative interactions including conflict, criticism and demands (Abbey, Abramis & Caplan, 1985). These social strains can function as stressors in themselves, and exert adverse effects on psychological
(Lepore, 1992; Vinokur & Van Ryn, 1993) and physical health (Walen & Lachman, 2000) independent of the supportive aspects of the relationship. The underlying valence of a given relationship can be characterized using a framework provided by Uchino and colleagues (2001) to map the relative amount of positive and negative feelings or interactions experienced in the context of a relationship (Figure 2). As represented in the figure, these positive and negative aspects of specific relationships are orthogonal (Finch, Okun, Barrera, et al., 1989; Lepore, 1992; Ruehlman & Karoly, 1991), and significant relationships can be characterized by a high degree of both positive and negative feelings (Major, Zubek, Cooper, et al., 1997).

Ambivalent relationships represent connections with network ties that are important sources of social contact and support, but also associated with frequent and significant negative interactions. Negative aspects of relationships tend to be more salient than positive aspects (Coyne & Bolger, 1990; Finch, Okun, Pool, et al., 1999), making ambivalent ties potentially greater sources of distress than support. The negativity associated with these relationships may be furthermore detrimental because of concurrent esteem and attachment to the tie (Uno et al., 2002). Consequently, ambivalent network ties may independently and additively contribute to distress through negative interpersonal interactions.

The negativity associated within ambivalent relationships may undermine the supportive and stress-buffering aspects of the relationship, and may actually serve to increase stress responses (Figure 1). Uno and colleagues (2002) observed more pronounced CVR in individuals receiving support during a speech task from an ambivalent social network member relative to those receiving no support at all. Similarly, Holt-Lunstad, Uchino and Smith (2007) found greater increases in SBP when disclosing a negative event to an ambivalent social tie. Evidence suggests that the effects of these ambivalent relationships on cardiovascular functioning may be
pervasive. Higher resting levels of cardiovascular functioning in the presence of ambivalent social ties have been observed (Holt-Lunstad et al., 2007), as well as increased CVR in response to a laboratory stressor in individuals reporting more ambivalent ties within the social network (Uchino et al., 2001). As such, ambivalent social ties may represent a toxic, rather than protective, element of the social network by increasing psychological distress and CVR.
CURRENT STUDY

Mental activation of ambivalent relational schemas may increase the opportunity for negative elements of these relationships to inhibit coping or increase stress. A study by Bloor, Uchino, Hicks and Smith (2004) failed to find differences in stress responses when participants discussed negative, positive, neutral or ambivalent relationships. However, differences among these groups may have been obscured by a floor effect of CVR during the task. Consistent with the stress-buffering hypothesis, relationship differences may be more salient when examined in relation to CVR to an unrelated stressor. The primary goal of this study was to examine the effect of mental representations of supportive, ambivalent, aversive and neutral social ties on CVR during a psychosocial laboratory speech task. The following hypotheses were explored:

1. Accessing schemas of qualitatively distinctive social relationships does not result in significant increases in CVR.

2. Activation of mental representations of supportive ties significantly attenuates CVR to a stressor compared with ambivalent, aversive or ties. Aversive ties are associated with the highest CVR during stress, followed by ambivalent ties.

3. Recovery from the stressor mirrors responses to stress, where the supportive condition will show increased recovery following the stressor compared with the other groups, and the aversive condition will demonstrate the slowest recovery.

4. As sex is a prominent determinant of cardiovascular functioning, sex was explored as a potential moderator of these effects.
METHOD

Participants

Participants were 82 undergraduates (60 females, 22 males) aged 18 to 39 (M = 20.95, SD = 3.57) recruited from psychology courses at the University of North Texas and received course credit for participation. The sample was primarily non-Hispanic White (49.1%), with 11.3% Black, 6.6% Asian, and 9.4% other or American Indian. Participants were randomly assigned to one of the four experimental conditions. The final distribution was 21 participants in the supportive condition, 19 in the ambivalent condition, 21 in the aversive condition, and 21 participants in the neutral condition.

Measures

Impact Message Inventory-Circumplex (IMI-C). The IMI-C (Kiesler, Schmidt & Wagner, 1997) is a 32-item self-report survey providing a measure of interpersonal dynamics based on the interpersonal circumplex. It is a transactional measure in that it provides information on the interactive style of a target individual based on the respondents’ subjective report of evoked actions and feelings. It consists of eight factors (i.e., dominant, hostile-dominant, hostile, hostile-submissive, submissive, friendly-submissive, friendly, and friendly-dominant) corresponding to the octants of the interpersonal circumplex (Kiesler, 1983). Reliability coefficients across 16 independent studies produced median Cronbach’s alphas ranging from .69 to .85. The IMI-C served as a manipulation check for the appraisal of relationship quality with the target social tie.

Quality of Relationships Index (QRI). The QRI (Pierce et al., 1991) consists of 25 self-report items measuring perceptions of a specific-relationship. The scale consists of three factors labeled support, depth and conflict, providing information on the ability to count on the target
individual for assistance, the relative importance of the relationship and the amount of negativity or ambivalence associated with the relationship, respectively. This three-factor structure has been validated for use with target relationships including friends, parents and romantic partners (Pierce et al., 1991; Verhofstadt, Buysse, Rosseel & Peene, 2006), with internal consistencies ranging from .79 to .91. The QRI served as an additional manipulation check to assess qualitative appraisal of target social ties.

Social relationships sampling. Participants identified three social ties consistent with assigned experimental condition via one of four surveys. Identified social ties were subsequently rated on their relative supportive and negative behavior. Based on these ratings, the tie most archetypal of the assigned relationship was used for the social support induction.

Physiological measures. The unidimensional conceptualization of CVR using HR and blood pressure as analogues for sympathetic activity fails to provide a comprehensive understanding of physiological stress responses (Uchino et al., 1996). The end-point measurements of blood pressure and HR result from several underlying factors controlled by both the sympathetic (SNS) and parasympathetic (PNS) branches of the autonomic nervous system. These branches function autonomously, and thus changes in physiological activity can be determined reciprocally (i.e., one branch activates while the other withdrawals), coactively (i.e., both branches are activated), or independently (i.e., change in activity of only one branch). Heart rate is a measure of cardiac chronotropy referring to the number of heart beats per minute. Heart rate is primarily controlled by the PNS through the vagus nerve, but is also indirectly influenced by SNS activity. An increase in HR, therefore, may reflect an increase in SNS activity, withdrawal of PNS activity, or a combination thereof. Additionally, HR varies with respiration, increasing during inspiration and decreasing during expiration. Respiratory sinus
The phenomenon of respiration sinus arrhythmia (RSA) accounts for this variability in HR and represents a pure measure of PNS innervation at the sinoatrial node. Similar to HR, blood pressure is a multidimensional measure, reflecting changes in both the vasculature and hemodynamics. Stroke volume (SV) is measured in milliliters (ml) and represents the amount of blood pumped from the heart in one beat, while cardiac output (CO) is an aggregate of SV providing a measurement of volume pumped in liters per minute (l/m). Total peripheral resistance (TPR) is a measure of the amount of resistance in the vasculature as a function of vasoconstriction/vasodilation. Increases in blood pressure may be a function of increased CO, increased TPR, or both, and including these measurements provides information on the determinants of observed changes. While the PNS is the dominant regulator of HR, the SNS controls contractility of the heart. Sympathetic nervous system activity is reflected in systolic measurements of preejection period (PEP). Preejection period refers to the time between the depolarization of the ventricle and opening of the left ventricular valve, with decreased PEP reflecting an increase in SNS activation. Acquiring these more direct measures of autonomic activity allows for delineation of the underlying physiological activity manifesting in more traditional measures of CVR (i.e., HR and blood pressure), and provides a more nuanced understanding of the reactivity patterns associated with the manipulations.

A Bionex Impedance Cardiograph (Mindwave Technologies, Ltd.) was used to assess the electrocardiogram (ECG), basal thoracic impedance ($Z_0$) and first derivative of the impedance signal ($dZ/dt$). ECG was collected through electrodes placed on the right collar bone (-), left lower rib (+) and right lower rib (ground). Additional electrodes were placed on the suprasternal notch, ziphosternal junction and corresponding locations on the back 1.5 inches above and below these, respectively. A 4mA AC current passes through these electrodes allowing for the collection of impedance and the derivation of $Z_0$ and $dZ/dt$. An ensemble average using the ECG
and impedance waveforms was created in 1-minute epochs to derive PEP. Stroke volume was derived through the Kubicek equation (Sherwood, Allen, Fahrenberg, et al., 1990). Cardiac output was estimated in l/m using the equation HR x (SV/1000). Total peripheral resistance was calculated in resistance units (dynes-s X cm⁻⁵) by applying the equation mean arterial pressure (MAP)/CO X 80. Respiratory sinus arrhythmia was derived through digitized interbeat intervals (IBI). Very large ultralow frequency trends were removed from the input signal via a high pass filter by fitting and subtracting a first order linear polynomial from the heart period time series (Litvack, Oberlander, Carney, et al., 1995). Following linear detrending, an interpolated finite impulse response filter band-pass filters the heart period time series from 0.12 to 0.40 (Neuvo, Cheng-Yu & Mitra, 1984). Fast Fourier transform was used to calculate the power spectrum of the heart period time series scaled to msec²/Hz. Respiratory sinus arrhythmia was averaged for each minute and calculated as the natural log of the area under the heart period power spectrum within the corner frequencies of the band-pass filter (Litvack et al., 1995). A GE Carescape V100 was used to collect an oscillometric measure of SBP, DBP and MAP through an occluding cuff on the participants’ upper nondominant arm at one-minute intervals throughout the procedure.

Procedure

Upon arrival to the laboratory, a research assistant escorted the participant to one of two experimental rooms, separated from physiological monitors and observed via audio and visual recording equipment. Participants read and signed an informed consent document. Following completion, electrodes and an occluding cuff were applied as described above and consistent with manufacturers’ recommendations.

Baseline. In order to establish baseline measures of cardiovascular activity, participants engaged in a ten-minute minimally demanding task. During this “vanilla” baseline period
(Jennings, Kamarck, Stewart, et al., 1992) participants viewed pairs of nature scenes for one-minute each and selected their preference. Self-reported affect was assessed at the end of the baseline period.

Embarrassing-speech preparation. Participants were informed via an audio recording that they were to discuss a personal, embarrassing moment in order to study the effects of stress. Following this introduction, participants were given an Embarrassing Moments Rating Form on which they identified three events and rated them based on a 7-point Likert-type scale. Based on these responses, participants were instructed to select one event rated as highly-embarrassing to talk in depth about.

Participants prepared for discussing various aspects of the experience by providing written answers on an event recall notes page in 1-minute intervals to the following questions:

1. Describe the issue and the events that led up to the experience.
2. Describe the feelings, thoughts, and emotions that you experienced at the time the event occurred.
3. Describe the ways in which you dealt with or coped with the event. What did you do afterwards?
4. Please describe how thinking and talking about this event makes you feel now.

Following this task, participants completed a post-preparation mood scale.

Social support manipulation. Participants were provided with the social relationships sampling form. The research assistant asked participants to complete the form, and emphasized the vignette provided at the top of the form to ensure understanding of the target relationship type. The completed social support sampling was used to identify a social network member prototypical of the assigned experimental condition. In a few cases, participants clearly
misunderstood the relationship type requested. In such instances participants were provided with a new sampling form, and the target relationship vignette was repeated. Following selection, pre-recorded audiotape prompts guided the participant through providing written responses in 1-minute intervals to four questions about the target tie (Smith et al., 2004):

1. Briefly describe what you value or appreciate most about this person.
2. Briefly describe what you value or appreciate least about this person.
3. Describe what this person does for you that is supportive or helpful.
4. Describe what this person does for you that is unhelpful or not supportive.

A subsequent set of prompts guided the participant to silently review their responses for 30 seconds each.

Embarrassing-speech task. Participants received their written responses to the speech preparation task on the event-recall notes page, and reviewed each response for 30-seconds according to recorded prompts. Following this review, the research assistant placed a tripod video camera approximately 1-foot from the participant. Although the video camera was not set to record, participants were led to believe their responses were recorded. Audio recording directed participants to verbally describe the four aspects of the event prepared earlier on the event-recall notes page. If participants ceased speaking prematurely, they were directed to restate or elaborate on their previous remarks.

Recovery period. Participants were instructed to remain seated for a final 10-minute recovery period.

Data analysis. Analyses of variance (ANOVA) was utilized to assess equality of randomized conditions on demographic variables and baseline cardiovascular measurements. Sex is an important moderator of cardiovascular functioning, with men displaying higher 24-
hour blood pressure levels than women (Khoury, Yarows, O’Brien, et al., 1992; Staessen, Fagard, Lijnen, et al., 1990), and therefore was included as a fixed factor in the model. It was hypothesized that a main effect would be observed for sex, and that no significant differences would exist between groups on any demographic or cardiovascular measures.

In order to evaluate the validity of the social support manipulation, experimental condition was entered as a predictor in separate analyses for scores on the QRI and IMI factors. Conditions were expected to differ on these measures in directions consistent with the relationship-construct (e.g., supportive target tie described as warm, close and positive; aversive tie as dominant, hostile and distant).

A repeated factor with five levels (i.e., baseline, social support induction, speech preparation period, speech task and recovery period) was included for the manipulation check of the stress task. Greenhouse and Geisser (1959) correction was used to adjust for colinearity of repeated observations. Change scores were calculated by subtracting baseline estimates of cardiovascular parameters from epochs or task averages (Llabre, Spitzer, Saab, et al., 1991). Tonic cardiovascular levels potentially affect cardiovascular reactivity (Benjamin, 1967) and thus baseline parameter estimates of the dependent variable were entered as covariates in each model.

The effect of social support condition (i.e., supportive, aversive, ambivalent, neutral) on cardiovascular reactivity during the stressor task was analyzed using separate repeated measures analysis of covariance (ANCOVA) for each cardiovascular parameter (i.e., SBP, DBP, HR, MAP, TPR, CO, SV, PEP, RSA). Continuous impedance measures were aggregated over 1-minute epochs, while discrete blood pressure and MAP assessments were taken in 60-second intervals. Change scores at these intervals were entered in the models as 4 and 3-level repeated
factors, respectively, and reflect phasic cardiovascular reactivity over the stress task. Pairwise comparisons using Tukey’s honestly significantly different procedure were performed for significant main effects.
RESULTS

Demographic Equivalence of Conditions and Sexes

Table 1 presents the means and standard deviations for age and BMI and the gender frequencies for each condition. A two-way (Condition X Sex) analysis of variance (ANOVA) was utilized to assess baseline differences between conditions. No significant differences were found for conditions, sex or interaction terms on age, body mass index (BMI), ethnicity, race, marital status or current year in school, all $F$s $\leq 1.02$, $p = \text{n.s.}$

Anthropomorphic Equivalence of Conditions

Two-way (Condition X Sex) ANOVAs assessed baseline equivalence of tonic cardiovascular activity. The means and standard deviations of baseline blood pressure (BP) and HR are presented by condition and sex in tables 2 and 3, respectively. The tables also provide the overall $F$-statistic, $p$-value, and effect size for each model.

A significant difference was found between conditions for SBP, but not DBP or MAP. Tukey’s HSD revealed marginally higher SBP in the supportive condition compared with those in the neutral condition. Men had significantly higher resting SBP than women, and no differences existed between sexes in DBP or MAP. Interaction effects between condition and sex were observed for SBP, $F(3, 74) = 2.92, p < .05$, $\eta^2_p = .11$, and DBP, $F(3, 74) = 2.94, p < .05$, $\eta^2_p = .11$. Follow-up analyses isolated by sex revealed no simple effects of condition for SBP. Among women, those in the ambivalent condition had higher resting DBP ($M = 68.64$, $SD = 6.86$) than the neutral group ($M = 59.60$, $SD = 4.93$). No significant main effects or interaction terms were found for baseline differences on MAP or TPR, $F \leq 2.58$, $p = \text{n.s.}$

A main effect of condition was found for HR. However, follow-up analyses failed to demonstrate any significant simple effects between conditions, $p > .05$. Women had higher...
resting HR than men. A significant interaction term was observed for HR, $F(3, 65) = 2.98, p < .05, \eta^2_p = .12$. Separate analyses by sex indicated that men in the supportive condition ($M = 62.41, SD = 7.37$) had significantly higher HR than those in the aversive condition ($M = 83.12, SD = 13.58$). No main effects of condition or sex or interaction was observed for RSA, $F \leq 1.71, p = \text{n.s.}$

Results revealed no main effect of condition for SV, CO, or PEP, $F \leq .73, p = \text{n.s.}$ Men had significantly higher SV, $F(1, 70) = 10.30, p < .01, \eta^2_p = .14$, and CO, $F(1, 70) = 5.11, p < .05, \eta^2_p = .08$, than women. Pre-ejection period did not differ between sexes, $F(1, 70) = 1.48, p = \text{n.s.}$ No significant interactions of sex and condition emerged for SV, CO, and PEP, $F \leq 1.25, p = \text{n.s.}$

In summary, men exhibited higher resting SBP and SV than women, and women had higher HR than men. Two simple differences between conditions were observed. Women in the ambivalent condition had higher resting DBP than those in the neutral group, and men in the supportive condition had higher HR than those in the aversive condition. No other significant differences were found. Although some baseline cardiovascular differences existed, autonomic activation is transient and baseline differences are not likely to reflect meaningful, stable differences (Bernston, Cacioppo & Quigley, 1993). Regardless, baseline measurements were entered as covariates in additional models to account for these differences.

Effectiveness of Social Support Induction on Perceptions of the Target

It was expected that conditions would differ on interpersonal measures related to the target tie in directions consistent with the social support manipulation. Figure 3 represents the relationship types using the interpersonal space of the circumplex model and 8 factor scores of the IMI-C. Differences between conditions were examined on the two primary factors,
dominance and affiliation. As hypothesized, a significant difference was observed for the factor of perceived dominance, $F(3, 80) = 11.71, p < .001, \eta^2_p = .31$, on the IMI-C. A priori analyses indicated that individuals in the aversive condition rated the imagined target to be significantly more dominant than supportive or neutral conditions. Ambivalent ties were significantly more dominant than supportive ties. The neutral condition did not significantly differ from the supportive or ambivalent conditions. Analysis of the perceived affiliation factor also yielded a significant difference, $F(3, 80) = 48.65, p < .001, \eta^2_p = .66$. The aversive condition rated target social ties as significantly lower on affiliation than the supportive, ambivalent, and neutral conditions. Additionally, the supportive condition was associated with significantly higher ratings of affiliation than ambivalent or neutral conditions. Affiliation ratings between the ambivalent and neutral conditions were not significantly different. In summary, those in the supportive condition described their ties as highly affiliative; the aversive ties were described as more dominant and hostile than other conditions; and the ambivalent and neutral ties were not significantly distinguished on measures of affiliation or dominance.

Conditions significantly differed on all factors of the QRI. The condition means and standard deviations for each factor of the QRI are available in Table 4. Figure 4 provides a visual representation of condition differences in target relationship support, conflict, and depth. An omnibus test of significance revealed a difference between conditions on the support factor. Contrasts indicated a significantly lower rating of support by the aversive condition than supportive or ambivalent conditions. The neutral condition was associated with significantly lower scores on the support factor than all three conditions. The ambivalent and supportive conditions did not differ significantly on ratings of support. ANOVA revealed a significant difference between conditions on the conflict factor, with the ambivalent condition being
associated with significantly more interpersonal conflict than the aversive, supportive or neutral conditions. Ratings of conflict were significantly lower for the neutral condition than other conditions. No difference was observed between supportive and aversive conditions on conflict ratings. Significant differences were also observed among condition ratings of depth of relationship with the target social tie. A priori contrast analyses revealed significantly more depth in relationships with supportive social ties than aversive, ambivalent or neutral ties. Additionally, the ambivalent condition was associated with significantly higher ratings of depth than the aversive or neutral conditions.

In summary, the supportive and aversive conditions were well differentiated by the IMI-C. Individuals in the supportive condition described their target tie as highly warm, and aversive ties described as hostile and dominant. However, neutral and ambivalent ties were not distinguished from one another on factors of dominance and affiliation, rating as relatively low on both. A different picture emerged for the QRI, where ambivalent ties were rated as helpful as supportive ties and more conflictual than aversive ties, consistent with the ambivalent construct. Additionally, ambivalent ties were significantly closer to participants than neutral or aversive ties. Aversive and supportive ties were described consist with expectations on the QRI. These results provide inconclusive evidence for the validity of conditions.

Effectiveness of the Stress Task

One-way repeated measures ANOVA revealed significant task period differences for SBP, $F(4, 81) = 102.19, p < .001, \eta^2_p = .056$, DBP, $F(4, 81) = 77.04, p < .001, \eta^2_p = .49$, MAP, $F(4, 81)= 98.07, p < .001, \eta^2_p = .55$, and HR, $F(4, 81) = 50.74, p < .001, \eta^2_p = .43$. Paired samples T-tests were employed to contrast cardiovascular reactivity between specific task periods. As shown in figure 5, systolic blood pressure for all task periods (social support
induction, speech preparation, and speech task) was elevated above baseline, $t(81) \leq -3.20, p < .01$, supporting the effectiveness of the manipulation to evoke a stress response. Similar patterns were observed for DBP and MAP, $t(81) \leq -4.91, p < .001$. Heart rate during the speech task was also significantly elevated above baseline, $t(81) = -6.27, p < .001$, although the pattern of results among other task periods deviated from the blood pressure findings.

Important differences also emerged between study tasks. Systolic blood pressure, DBP, MAP and HR all increased significantly from the social support induction phase to speech preparation, $t_s \leq -2.17, p < .05$, and the speech task, $t_s \leq -8.03, p < .001$. Systolic blood pressure significantly decreased from social support induction to the recovery period, $t(81) = 14.12, p < .001$; while DBP and MAP levels during the recovery period were significantly elevated from the social support induction, $t_s \leq -2.64, p < .01$. Heart rate did not significantly differ between social support induction and recovery from the speech task, $t(70) = -.37, p > .05$.

Systolic blood pressure, DBP, MAP and HR all increased significantly from speech preparation to the speech task, $t_s \leq -6.25, p < .001$. Systolic blood pressure and HR decreased from speech preparation to the recovery period, $t_s > 5.72, p < .001$, whereas no significant differences between these task periods were observed for SBP or DBP. The recovery period was associated with a significant decrease in SBP, DBP, MAP and HR from the speech task period, $t_s > 9.25, p < .001$.

In general, significant increases in blood pressure and HR were observed between baseline and the social support induction, speech preparation, and speech stressor tasks. Cardiovascular reactivity continued to increase from the imagined task, to the speech preparation task, from the preparation task to the highest levels of reactivity during the speech task, and returned to baseline levels during the recovery period. These findings support the effectiveness
of the manipulation to evoke a stress response and induce cardiovascular recovery following the tasks.

Summary of Equivalence, Manipulations and Task Effectiveness

Experimental conditions were demographically similar. Baseline cardiovascular activity followed expected sexual dimorphisms. Two simple baseline differences were found. Women had higher DBP in the ambivalent condition than the neutral condition, and men had higher HR in the supportive condition compared with the aversive condition. Baseline levels will be included in subsequent models to account for these differences. The supportive and aversive conditions were represented as expected on ratings of dominance and affiliation on the IMI-C. In contrast, the ambivalent and neutral groups were characterized by relatively low scores on both factors, and were not significantly distinguished from one another. Ratings of target tie interpersonal behavior were consistent with expectations based on the QRI. Notably, ambivalent ties were rated as similarly supportive as those in the supportive condition, and more conflictual than aversive ties. The ambivalent condition also described their target ties as closer than those in the neutral condition.

Cardiovascular activity, as evidenced by increases in BP and HR, was observed to significantly increase from baseline for all explored cardiovascular measures, and significantly decrease during the recovery period, indicating that participant did indeed experience the speech task as stressful. Based on these observations, the experimental manipulations employed in this study are considered to be valid for this sample.

Main Analyses

Condition and sex effects on CVR to social support induction. I hypothesized that relationship quality would not moderate CVR while passively accessing mental representations
of these relationships. Separate repeated measures ANCOVA models were utilized to analyze the effect of condition and sex on blood pressure, HR and their impedance-derived determinants during the social support induction task. No significant condition, sex, or interaction differences were found for SBP, DBP, or MAP during this period, all $F$s $\leq .75, p = n.s.$ Additionally, no differences were observed for the determinants of blood pressure (i.e., CO, SV, TPR), all $F$s $\leq 1.00, p = n.s$. Similarly, HR reactivity during the imagined task, and analysis of PEP and RSA yielded no significant results for condition, gender, or the interaction term, all $F$s $\leq .98, p = n.s.$ As expected, these results indicate that simply thinking about qualitatively different relationships is not salient enough to evoke differential cardiovascular responses.

Condition and sex effects on CVR to speech stressor. The primary hypothesis was that thinking about qualitatively different social relationships would moderate CVR to a subsequent stressor. Repeated measures ANCOVA was used to examine condition and sex effects on CVR during the speech task. The expected effects of experimental condition on SBP, DBP, and MAP were not confirmed, and no sex or interaction differences emerged, all $F$s $< 2.44, p = n.s.$ No main effects of condition or sex were observed for CO, SV, or TPR, all $F$s $< 1.97, p = n.s.$ Although no interaction effect was found for TPR, $F(3, 55) = 1.10, p = n.s.$, condition by sex interactions occurred for SV, $F(3, 59) = 3.16, p < .05, \eta^2_p = .14$ and CO, $F(3, 59) = 3.66, p < .05, \eta^2_p = .16$. When analyzed separately by sex, repeated measures ANCOVA revealed that these differences in SV and CO did not exist between conditions, $F$s $\leq 2.37, p = n.s.$, suggesting that simple differences occurred between sexes within a condition. Condition and sex did not have significant effects on HR during the speech task, $F$s $\leq .95, p = n.s.$, and no significant main or interaction effects emerged for PEP or RSA, all $F$s $\leq 1.89, p = n.s.$
Condition and sex effects on recovery. It was hypothesized that condition and sex would influence the rate of cardiovascular recovery following the speech task. Repeated measures ANCOVA’s revealed no significant differences by condition, sex, or their interactions on SBP, DBP, or MAP, all $F$s $\leq 1.31$, $p = \text{n.s.}$ In addition, no main effects of condition or sex were observed for, SV, CO, or TPR, all $F$s $\leq .32$, $p = \text{n.s.}$ No interaction effects occurred for CO or TPR, $F$s $\leq 2.61$, $p = \text{n.s.}$, but a significant condition by sex interaction emerged for SV, $F(3, 59) = 3.85$, $p < .05$, $\eta^2_p = .16$. To isolate this effect, separate repeated measures ANCOVA were conducted for each sex. No differences were observed for SV between conditions for men, $F(3, 13) = 1.60$, $p = \text{n.s.}$; however, an effect of condition was observed for women, $F(3, 45) = 3.16$, $p < .05$, $\eta^2_p = .17$. Post-hoc analyses indicated that women in the supportive and ambivalent groups significantly differed in SV during the recovery period, $F(1, 22) = 7.11$, $p < .05$, $\eta^2_p = .24$. Univariate analyses indicated that women in the supportive condition demonstrated significantly higher SV (i.e., pumping more blood per beat) during all minutes of the recovery period except minutes 4 and 6 (i.e., minutes 1 through 3, minute 5 and minutes 7 through 10), all $F$s(1,24) $\geq 4.13$, $p < .05$. Contrary to expectation, in each case women in the ambivalent group exhibited significantly larger decreases in SV compared to the supportive group suggesting they may have recovered more quickly from the stress task.

With respect to HR, condition, sex, and their interaction did not affect recovery, all $F$s $\leq 1.14$, $p = \text{n.s.}$, or associated autonomic determinants PEP and RSA, all $F$s $\leq 1.45$, $p = \text{n.s.}$ In general, results during the recovery period did not support the hypothesized main effect of condition. Unexpectedly, an effect of condition was observed for women, where those in the supportive condition maintained elevated blow flow longer than those in the ambivalent condition.
DISCUSSION

The social network includes ties that are sources of stress and negativity, as well as support. In the absence of actual network ties, individuals may activate and use mental representations of social relationships to cope with stress (Baldwin, 1992; Sarason et al., 1991; Pierce & Lydon, 1998; Smith et al., 2004). The current study examined the moderating effect of relationship quality with imagined social ties on cardiovascular reactivity and recovery to a standardized stressor.

The study relied on the validity of two manipulations to examine the research question. The speech stressor produced a significant and reliable increase in CVR from baseline, as evidenced by increases in BP and HR. The task was followed by a recovery period in which CVR significantly decreased. The social support manipulation relied on the identification of target ties consistent with one of the four relationship types. Scores on factors of the QRI supported the validity of all four experimental conditions. Importantly, target ties of the ambivalent condition were rated as equally nurturing and close as supportive ties, and associated with more conflict than aversive ties. Results of the IMI-C also supported the validity of the supportive, aversive, and neutral conditions. However, ratings of ties in the ambivalent condition were not differentiated from neutral ties in either dominance or affiliation, indicating that this relationship type may not have been accurately identified in the sample.

The inconsistency between validation measures may reflect differences in the instruments themselves, or difficulty capturing the construct ambivalence. Birmingham, Uchino, Smith and colleagues (2009) manipulated experimenter behavior to represent supportive, aversive and ambivalent support ties, but found poor construct validity for the ambivalent condition based on the IMI-C. The authors hypothesized that ambivalence in relationships may only be established
over a period of time. However, the target relationships in the current study were sampled from participants’ social network and therefore likely established over multiple interactions. In previous studies, relationships sampled using the SRI and categorized as ambivalent were rated as significantly more dominant than supportive and neutral ties; but, they remained less dominant than aversive ties and less affiliative than supportive ties (Bloor et al., 2004; Holt-Lunstad et al., 2007). It is possible that the inconsistency and conflicted feelings associated with ambivalent ties make general schemas of these relationships unclear and unreliable, reflected in inconsistent reporting of interpersonal behavior. As ambivalence is a pattern of behavior, these relationships are likely best identified through longitudinal tracking of social ties in order to measure fluctuations in relationship quality, and not generalizations of behavior.

Consistent with hypotheses, relationship quality did not affect cardiovascular reactivity while accessing mental representations of relationships. Bloor and colleagues (2004) found a larger increase in SBP for women who spoke about aversive relationships compared with supportive or neutral relationships, but no differences in CVR while thinking about these relationships. Simply accessing schemas about a social tie’s interpersonal behavior in a general way may be too passive to elicit significant differences in physiological activity. However, thinking of supportive social ties may still exert a psychological benefit. Smith and colleagues (2004) observed a significant decrease in state anger following the priming of a supportive tie in low-hostile participants, compared with a neutral tie induction. While passive activation of relational schemas may not elicit differences in CVR, quality relationships may impart beneficial psychological experiences that increase resilience and well-being. Relationship quality may be more likely to actually affect CVR during activation of specific and emotional memories involving the target tie. In the current study the purpose of this task was to access and prime
mental representations of relationships, and not to independently elicit a stress response; however, future research should consider examining this relationship.

The main goal of the current study was to examine the effect of relationship quality of mentally represented social ties on CVR to a subsequent stressor. No differences in blood pressure or impedance-derived measures of CVR were found between conditions during the stress period. The undetermined validity of the ambivalence condition may explain a portion of the null results. However, manipulation checks supported the validity of the supportive, aversive, and neutral conditions, and thus it is surprising that supportive and neutral conditions did not differ in CVR. The current study may have failed to replicate the previously observed main effect (Ratnasingam et al., 2007; Smith et al., 2004) for several reasons. Cardiovascular reactivity is not necessarily consistent across tasks or contexts (Abel & Larkin, 1991), and it is possible mental representations of social relationships may be more important in coping with some stressors relative to others. Although the stress tasks employed among these studies were relatively similar, future research should be sensitive to this possible factor. In addition, the previous studies used different writing prompts for each condition during the social support induction, whereas the current study standardized prompts across conditions. Differences in CVR observed by other groups may be a result of the diverse prompts used in the study, and not relationship quality. It is also possible that a third unknown variable may have invalidated the social support induction in the current study. Finally, the current study may have lacked sufficient power to detect small differences between groups, producing a Type II error.

As cardiovascular recovery is an independent element of the stress response and is also associated with CHD development (Hocking-Schuler & O’Brien, 1997), analysis included investigation of condition differences in recovery from the stressor. Contrary to expectations,
women who accessed mental representations of ambivalent ties were found to demonstrate faster blood flow recovery (i.e., decreases in SV) than those in the supportive condition, and maintained significantly lower SV throughout almost the entire period. Discrete patterns of CVR are observed in relation to challenge and threat stress appraisals (Blascovich & Tomaka, 1996), and a difference between groups on an isolated measure is not necessarily meaningful. However, it is important to note that the ambivalent condition tended to have lower BP and HR than the supportive condition throughout the speech and recovery period, although these differences failed to reach significance. It is possible that the findings of this study were limited by statistical power, and that women may actually benefit from mental representations of ambivalent relationships during acute stressors.

General Limitations

While the present study had many positive qualities, including an experimental design and assessment of blood pressure determinants, several limitations are noteworthy. The sample consisted of predominantly young, white, middle and upper SES undergraduate students from the Southwest region of the United States. Furthermore, the gender distribution was not balanced, and disproportionally female. The procedure also included a single standardized laboratory stressor, and findings here cannot be assumed to generalize to environmental stressors or other standardized stress tasks. Finally, the social support induction task may have been invalid for one or more conditions. Writing and reflecting on answers to questions is likely not equivalent to the rich representations accessed spontaneously in the environment, and the social support induction task may be unrelated to the activity of mental representations of relationships in vivo. Moreover, these representations cannot be directly observed, and it is possible that this manipulation was not a valid induction of relationship schemas in any capacity.
Future Directions

Apart from addressing the limitations as noted above, future research should seek to address other possible moderators of the effect of mental representations of the social environment on cardiovascular reactivity. Measures of the social network and perceived social support were not included in the current model. Level of global social support may function as an important moderator, as having support “reserves” may compensate for immediate lack of support or negative aspects of a single relationship (i.e., cross-domain buffering; Lepore, 1992). Furthermore, mental representations of social support have long been described in terms of working models of attachment developed in early relationships and modified through life experience (Ainsworth, Blehar, Waters & Wall, 1978; Bowlby, 1988; Hazan & Shaver, 1987). An individual’s attachment style may more heavily influence one’s ability to “use” schemas of social support than the interpersonal dynamic of a specific relationship. Most importantly, replication studies should address how inconsistencies in methodology between the current study and previous work may explain the disparate findings, as noted above, and clarify the relationship between mental representations of social support and stress responses.
Table 1

**Participant Demographics**

<table>
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<tr>
<th></th>
<th>Supportive</th>
<th>Ambivalent</th>
<th>Aversive</th>
<th>Neutral</th>
<th>( F )</th>
<th>( p )</th>
<th>eta(^2 )</th>
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<td><strong>Age</strong></td>
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<td>22.00 (4.61)</td>
<td>20.12 (1.73)</td>
<td>21.15 (4.75)</td>
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<td>.04</td>
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<td><strong>BMI</strong></td>
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<td>24.60 (6.48)</td>
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<td>.01</td>
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<td>Female</td>
<td>15 (68.2%)</td>
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<td>White</td>
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<td>16 (72.7%)</td>
<td>9 (42.9%)</td>
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<td>1 (4.5%)</td>
<td>7 (33.3%)</td>
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<td>1 (5%)</td>
<td>1 (4.5%)</td>
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### Table 2

**Baseline Cardiovascular Values by Condition**

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<tr>
<th>Condition</th>
<th>Supportive</th>
<th>Ambivalent</th>
<th>Aversive</th>
<th>Neutral</th>
<th>F</th>
<th>p</th>
<th>( \eta^2 )</th>
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</thead>
<tbody>
<tr>
<td>SBP</td>
<td>109.79 (11.33)</td>
<td>108.89 (10.28)</td>
<td>107.14 (10.09)</td>
<td>102.95 (6.25)</td>
<td>2.91</td>
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<td>.11</td>
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<tr>
<td>DBP</td>
<td>64.97 (7.24)</td>
<td>66.02 (7.45)</td>
<td>63.03 (5.18)</td>
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<tr>
<td>MAP</td>
<td>81.68 (8.14)</td>
<td>82.02 (7.94)</td>
<td>78.97 (5.83)</td>
<td>75.73 (5.40)</td>
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<td>.07</td>
<td>.09</td>
</tr>
<tr>
<td>HR</td>
<td>75.44 (14.31)</td>
<td>79.13 (6.42)</td>
<td>82.26 (10.37)</td>
<td>75.46 (9.80)</td>
<td>2.94</td>
<td>.04</td>
<td>.12</td>
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### Table 3

**Baseline Cardiovascular Values by Sex**

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<tr>
<th></th>
<th>Males</th>
<th>Females</th>
<th>F</th>
<th>p</th>
<th>( \eta^2 )</th>
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<tbody>
<tr>
<td>SBP</td>
<td>112.62 (10.52)</td>
<td>105.15 (8.87)</td>
<td>11.38</td>
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<td>DBP</td>
<td>61.97 (5.73)</td>
<td>64.11 (6.93)</td>
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<td>.03</td>
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<tr>
<td>MAP</td>
<td>80.83 (6.91)</td>
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<td>.02</td>
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<td>HR</td>
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<td>80.02 (10.35)</td>
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Table 4

Mean and Standard Deviations for QRI Factor Scores by Experimental Condition

<table>
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<tr>
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<th>Supportive</th>
<th>Ambivalent</th>
<th>Aversive</th>
<th>Neutral</th>
<th>F</th>
<th>p</th>
<th>eta²</th>
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</thead>
<tbody>
<tr>
<td>Support</td>
<td>17.81 (2.20)</td>
<td>18.63 (3.27)</td>
<td>13.76 (3.16)</td>
<td>10.43 (2.71)</td>
<td>35.22</td>
<td>.000</td>
<td>.58</td>
</tr>
<tr>
<td>Conflict</td>
<td>27.38 (3.17)</td>
<td>31.95 (4.59)</td>
<td>26.10 (5.62)</td>
<td>17.90 (4.45)</td>
<td>33.65</td>
<td>.000</td>
<td>.56</td>
</tr>
<tr>
<td>Depth</td>
<td>18.90 (2.19)</td>
<td>16.58 (3.13)</td>
<td>11.29 (3.12)</td>
<td>9.86 (3.50)</td>
<td>41.89</td>
<td>.000</td>
<td>.62</td>
</tr>
</tbody>
</table>
Figure 1. The stress-buffering hypothesis of social support modified to include potential stress-exacerbating effects of social relationship.
Figure 2. Positive and negative continuum of social relationships.

Figure 3. QRI factor scores by condition.
**Figure 4.** The interpersonal circumplex representation of relationship types.

**Figure 5.** Systolic blood pressure levels during study tasks.


