2012-11-26

Cardiovascular Reactivity in Friendships: Length of Relationship and Frequency of Contact as Potential Moderators

Benjamin D. Clark
Brigham Young University - Provo

Cardiovascular Reactivity in Friendships: Length of Relationship and Frequency of Contact as Potential Moderators

Benjamin David Clark

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

Julianne Holt-Lunstad, Chair
Patrick R. Steffen
Chad D. Jensen

Department of Psychology

Brigham Young University

November 2012

ABSTRACT

Cardiovascular Reactivity in Friendships: Length of Relationship
and Frequency of Contact as Potential Moderators

Benjamin David Clark
Department of Psychology, BYU
Master of Science

Social support has been linked to positive health outcomes. Specifically, having available support from a friend may act as a buffer to the negative effects of stress on cardiovascular reactivity. Relationship quality is an important moderator of this effect. The purpose of this study was to examine how cardiovascular reactivity is affected by relationship quality within friendships and whether the length of relationship and frequency of contact may moderate the effect. 134 healthy male and female adults (and their same-sex friend) were recruited to participate. Results revealed no significant difference between subjects interacting with supportive friends compared to interacting with ambivalent friends on cardiovascular reactivity. Length of relationship was independently associated with higher cardiac output (CO) and lower total peripheral resistance (TPR), but there was no statistical interaction between length of relationship and relationship quality. Frequency of contact was not a significant predictor of cardiovascular reactivity and no statistical interaction was found between frequency of contact and relationship quality. This study provides some evidence that length of relationships may be important to consider in future studies examining stressful relationships.

Keywords: social support, friend, cardiovascular reactivity, relationship quality, length, contact

ACKNOWLEDGEMENTS

I gratefully acknowledge the contribution of Dr. Julianne Holt-Lunstad and thank her for reviewing this document multiple times and guiding me through this process. I also appreciate Dr. Patrick Steffen and Dr. Chad Jensen for their time and service on this thesis committee. My wife, Angie, and son, Ethan, deserve special thanks for their constant love, support, and sacrifice.

Table of Contents

Cardiovascular Reactivity in Friendships: Length of Relationship and Frequency of Contact as Potential Moderators

Social support has been classically defined as information or actions that lead individuals to feel cared for or believe support is available to them when needed (Major, Zubek, Cooper, Cozzarelli, & Richards, 1997). Additionally, the link between social support and health outcomes is well established (Berkman, 1995; Cohen & Wills, 1985; Holt-Lunstad, Smith, & Layton, 2010; House, Landis, & Umberson, 1988; Uchino, Cacioppo, & Kiecolt-Glaser, 1996) and has been demonstrated with individuals under stressful conditions (Birmingham, Uchino, Smith, Light, & Sanbonmatsu, 2009; Cacioppo, Malarkey, Kiecolt-Glaser, & Uchino, 1995). The *stress-buffering model* states that social support "buffers" or protects people from stressful events that could potentially put their health at risk (Cohen, 1988, 2004). Individuals tend to react less to stress when relationships provide informational, emotional, or tangible resources.

One pathway by which social support may specifically affect health outcomes is the buffering influence social relationships may have on reactivity to stress. A physiological indicator of stress is cardiovascular reactivity and research has linked this reactivity to various disease processes (Manuck, 1994; Treiber et al., 2003). Greater reactivity to stress and poor recovery from stress are associated longitudinally with poor cardiovascular status (Chida & Steptoe, 2010). Experimental evidence shows that having accessible social support can reduce cardiovascular reactivity during stress, thus reducing the risk of developing cardiovascular disease. (Birmingham et al., 2009; Christenfeld et al., 1997; Fontana, Diegnan, Villeneuve, & Lepore, 1999; Lepore, Allen, & Evans, 1993; O'Donovan & Hughes, 2008).

Importantly however, relationship quality may moderate the effect of support on cardiovascular reactivity during stress (Birmingham et al., 2009; Holt-Lunstad, Uchino, Smith, Olson-Cerny, & Nealey-Moore, 2003). Uchino et al. (2001) suggested that relationships may be characterized as supportive, aversive, ambivalent, or indifferent based on a high or low level of positivity, combined with either a high or low level of negativity. Ambivalent relationships are of particular interest due to their mix of high positive and negative aspects. Stress due to ambivalent relationships is associated with increased cardiovascular reactivity and ambulatory blood pressure (Holt-Lunstad et al., 2003) meaning individuals may not fully benefit from the support of an ambivalent friend during stress (Holt-Lunstad, Uchino, Smith, & Hicks, 2007). This may be important for those with higher numbers of ambivalent relationships within their social networks, as this is associated with higher depressive symptoms and greater cardiovascular reactivity during stress (Uchino et al., 2001).

In addition to relationship quality, how well one is acquainted with a source of social support may have an effect on cardiovascular response. There is conflicting evidence as to whether social support from a close friends or a stranger have comparable effects on cardiovascular response to stress. In one study, the presence of a supportive stranger showed reduced cardiovascular response when compared to participants being alone during the stressor (Lepore et al., 1993). A different study concluded that the presence of a either a friend or stranger reduced cardiovascular response and that the buffering effects of social support can be obtained without the person being familiar with the source of support (Fontana et al., 1999). Although the previously mentioned examples suggest that supportive strangers can be effective in reducing cardiovascular response to stress, Christenfeld et al. (1997) found that when participants delivered a speech to an observer, social support from a friend observer produced

lower cardiovascular reactivity than the support provided by a supportive confederate. This might suggest that the greatest reduction in cardiovascular response can be seen when there is an established relationship (Christenfeld et al., 1997).

Importantly, research suggests that there might be a transition period from being an acquaintance to being a close friend. Individuals come to know and understand personalities and behaviors better by observing them over time and in different situations (Biesanz, West, & Millevoi, 2007). Lydon, Jamieson and Holmes (1997) found that although acquaintances tend to act like friends, they often experience more discomfort about following communal scripts, such as reciprocating favors, than do people who report being in a close friendship. Individuals also report being more likely to offer tangible support (e.g., a ride to a train station) than to request the same type of support and this effect is more pronounced for casual than established friendships (Beck & Clark, 2009). Additionally, research on group performance has shown that close-friend groups perform significantly better than acquaintance groups on both decision-making and motor tasks, suggesting a greater degree of group commitment and cooperation (Jehn & Shah, 1997). These findings demonstrate a degree of vulnerability in new relationships, and suggest that as friendships develop over time, there is greater commitment, trust, and reciprocation.

Although the social support literature does not specifically address whether the length of relationships or frequency of contact with sources of social support have an effect on cardiovascular response, research has discussed how individuals habituate to stress. Habituation in the context of stress neurobiology has been defined as "a reduction in physiological responses elicited by an nth exposure to a repeated homotypic (same) stressor in comparison to the large responses elicited by acute exposure to that stressor" (Grissom & Bhatnagar, 2009). One study

showed that physiological response to stress elicited by multiple parachute jumps induced a strong adrenocortical responses but did not affect the cortisol responses of subsequent jumps (Deinzer, Kirschbaum, Gresele, & Hellhammer, 1997). A number of animal studies have looked at physiological habituation to stress, specifically through hypothalamic-pituitary-adrenal (HPA) activation (de Boer, Koopmans, Slangen, & Van der Gugten, 1990; Natelson, Ottenweller, Cook, & Pitman, 1988; Pitman, Ottenweller, & Natelson, 1988). Reduced physiological response to a repeated stressor might suggest that individuals are able to improve coping strategies when exposed to the same stressor over time (Deinzer et al., 1997).

Given the research on how well one is acquainted with a source of social support, vulnerability of new relationships, and how individuals may physiologically habituate to repeated stress, it seems reasonable to question whether exposure to the same ambivalent friend over time would eventually lead to a decrease in cardiovascular response. Thus, the first aim of this study was to compare individual's cardiovascular reactivity in the presence of either a supportive or ambivalent friend. Secondly, we examined how the length of relationship and frequency of contact with both supportive and ambivalent friendships moderated the cardiovascular response to stress. Consistent with the *stress-buffering model*, we hypothesized that interacting with supportive friends would be associated with lower cardiovascular response compared to interacting with ambivalent friends, regardless of length of relationship and frequency of contact with that individual. In ambivalent friendships however, we predicted that the length of friendships would moderate the cardiovascular response, such that shorter friendships would be associated with a higher response to the stressful condition. Additionally, we predicted that having frequent contact with ambivalent friends would moderate the

cardiovascular response, such that participants who had less frequent contact with their ambivalent friend would be associated with a higher response to the stressful condition.

If these hypotheses are confirmed, implications for this study might suggest that only early stages of ambivalent friendships may be detrimental. Furthermore, it might suggest that over time and with frequent contact, individuals are able to habituate to stressful friendships. Lastly, if individuals habituate to stressful relationships, having a large number of ambivalent friends may not necessarily be detrimental to cardiovascular health.

Methods

Design

This study analyzed and reported results from an existing data set which was collected by the primary investigator, Dr. Julianne Holt-Lunstad. Participants were randomly assigned to the conditions of relationship quality (i.e. supportive, ambivalent) and type of feedback given by the friend (i.e. positive, negative, ambivalent, and ambiguous). Gender of the friend was held constant, with all participants bringing in a same-sex friend.

Participants

This study was advertised as research being conducted on the relationship between public speaking and cardiovascular functioning. Fifty-five males and seventy-nine females along with their same-sex friend were recruited to participate in this study. The average age was 21.17 years (SD = 2.73). Most were recruited from introductory psychology courses at Brigham Young University and offered extra credit for their participation. The participant's friend received monetary compensation. Additional recruitment occurred through community advertisements to increase the ethnic diversity of the sample. Consistent with prior research (Cacioppo et al., 1995), participants were excluded from the study if they met any of the

following self-report criteria: existing hypertension, cardiovascular prescription medication use, past history of chronic disease with a cardiovascular component, recent history of psychological disorder, tobacco use, and consumption of more than 10 alcoholic beverages a week.

Procedure

Each participant was assigned a code, and all data can be identified by that code in order to ensure participant confidentiality. Participants were informed that they were free to withdraw from the study at anytime. Testing was divided into two sessions. For the first session, participants were asked to complete the Social Relationships Index (SRI, detailed below). Experimenters then randomly assigned each participant to either the supportive or ambivalent condition. Once random assignment was made, an initial screening of the listed persons on the participant's SRI took place. An individual was selected for the participant to bring to the second session based on their randomly assigned condition. Participants were unaware that a particular type of friend (ambivalent, supportive) was selected.

In the second session, participants were scheduled to come into the lab with their assigned friend. After consent was obtained, participants were escorted to a separate sound attenuated section of the lab where four mylar bands were placed in the tetrapolar configuration for impedance cardiograph recordings measured according to published guidelines (Sherwood et al., 1990). This entails placing two adhesive strips around the participant's neck and two around their thorax (rib cage area). An occluding blood pressure cuff of appropriate size was placed on the upper portion of their non-dominant arm. In order to allow time for contact resistance of the mylar bands to stabilize, individuals were seated in a comfortable chair and asked to complete a questionnaire packet (see below). Following this adaptation period of approximately 20 minutes, the participant were instructed to relax for the next 12 minutes while resting measures of

cardiovascular function were obtained. During the final 5 minutes of the resting assessment, cardiovascular assessments of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) were obtained once every 90 seconds, and impedance cardiograph readings were recorded continuously. The participant then completed a state anxiety scale at the end of the rest period.

The experimental portion of the study consisted of two tasks, a speech task and a discussion task. Although the primary analysis of this study focused on the discussion task, we also examined whether or not the type of feedback participants received from their friend (positive, negative, ambivalent, ambiguous) during the first task had an effect on cardiovascular reactivity in the second task.

During the first task, participants were gave a practice speech and then 3 two-minute speeches. Participants were asked to talk about their positions regarding various controversial topics. Topics were chosen that were sufficiently challenging and emotionally engaging according to past research. The practice topic was on whether to have rent control, and the 3 experimental speeches were (1) whether or not to require school uniforms in public schools, (2) whether to raise tuition on campus, and (3) whether or not to allow gays in the military. Participants were told that "part of giving formal speeches is being evaluated. Therefore we will allow your friend to pass you notes to let you know how you are doing." After each speech the participant was handed a note with a message on it. Unbeknownst to the participant, the experimenter actually had preset messages that the friends used. The feedback each participant received differed depending on random assignment to the valence of the message (positive, negative, ambivalent, and ambiguous). The friend copied the message on to a piece of paper in their own handwriting and was allowed to change the wording slightly to increase the

believability that they authored the message. The experimenter reviewed the message to ensure that it still met the standard before giving it to the participant. During each speech, cardiovascular assessments of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) were obtained once per minute, whereas impedance cardiograph readings was recorded continuously. At the end of the speeches, the participant completed an assessment to determine how they perceived their friend's feedback (positive, negative, ambivalent, ambiguous, or neutral).

Prior to the second task, participants were informed that one of the purposes of the study was to evaluate the effects of different types of feedback and that they were randomly assigned what kind of feedback they would receive following each speech (positive, negative, ambivalent, ambiguous). If participants were assigned to receive negative or ambivalent feedback, the experimenter also explained "we hope that this will not create any hard feelings and will not affect our next discussion task." Although participants were made aware of this deception, our analysis accounted for potential carry-over effect this may have on cardiovascular reactivity in the discussion task.

During the second task, participants and their friend engaged in a 6-minute discussion. Participants were given the "Life Experience Rating Sheet" and asked to list and rate up to 5 recent upsetting or stressful experiences on a scale of how important, positive, and negative the experiences were (1 = not at all, 5 = extremely). The experimenter then selected the event that was rated most highly across all three dimensions (important, positive, negative). The participant was informed of selected topic discussion with their friend. Both the participant and their friend were then asked to "please use the next 6 minutes to engage in a discussion as you would normally outside the laboratory." During the discussion task, cardiovascular assessments

of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and heart rate (HR) were obtained once per minute, and impedance cardiograph readings were recorded continuously.

Measures

Blood pressure. A Dinamap Model Pro 100 monitor (Critikon Corporation, Tampa, Florida) was used to measure systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and heart rate (HR). The Dinamap is a self-contained unit that uses the oscillometric method to estimate blood pressure. This automated method is used frequently in research and clinical practice and shows high reliability with interarterial blood pressure. Blood pressure assessments were obtained via a properly sized occluding cuff positioned on the upper left arm of the participant according to the manufacturer's specifications. Mean SBP, DBP, MAP and HR for each epoch were averaged across minutes to increase the reliability of these assessments.

Cardiac impedance. A Minnesota Impedance Cardiograph Model 304B was used to measure the electrocardiogram, basal thoracic impedance, and the first derivative of the impedance signal. Impedance and its derivatives were used to assess the underlying determinants of heart rate and blood pressure such as cardiac output (CO), total peripheral resistance (TPR), pre-ejection period (PEP), and respiratory sinus arrhythmia (RSA). For methodology see Sherwood et al. (1990).

Primary self-report measures. Participants were given a packet of questionnaires that assessed standard background information. The packet of questionnaires contained a background questionnaire to assess basic demographics; a series of Social Relationship measures to provide a network assessment; Mental Health measures to replicate other studies examining

social interactions; Individual difference measures to examine the moderating effects of personality; and a perceived stress measure to assess general levels of stress in addition to interpersonal stress. Below is a description and available psychometric properties of the questionnaire most relevant to the current study.

Social Relationships Index (SRI). The SRI is a reliable and valid measure used in health studies requiring a short assessment of relationships. It has demonstrated good psychometric properties, including test–retest reliability for the assessment of positivity and negativity, and of relationship classifications across social networks.

The SRI instructs individuals to list the initials of network members by relationship type. Specifically, individuals were instructed to rate their significant other, father, and mother, as well as up to five additional family members, friends, coworkers, and social acquaintances. These network members were rated in terms of how helpful and upsetting they are (1 = not at all, 6 = extremely) when the participant needs different types of assistance (i.e., emotional, tangible, and informational). Likewise, a criterion measure of subjective ambivalence was used to validate our measure of ambivalence. For more information on the SRI, refer to Campo et al. (2009).

Participants were instructed to rate the same people listed in the SRI on how mixed, conflicted, and indecisive they are, concerning the network member. In addition, network members were rated on length of time known, amount of contact per week, how important, how predictable, and how likely they are to go to this person for support (1 = not at all, 6 = extremely).

The SRI was also used to classify individual friends from the participant's social network as either supportive or ambivalent (depending on the condition that participant was assigned) for them to bring in to the laboratory. Importantly, positivity and negativity towards their friends

were rated in terms of three different contexts; (1) when they need support such as advise, understanding, or a favor; (2) when they are excited, happy, or proud of something; and (3) during routine daily interactions, conversations, or activities. Therefore, information was obtained on the participant's perception of their friend within negative, positive, and neutral contexts.

Experimenters selected the friend who most highly characterized the assigned condition (i.e., supportive or ambivalent) across all three contexts. The criterion used for the classification of "supportive" was a rating of a three or greater on measures of positivity and a rating of one (not at all) on negativity. For the classification of "ambivalent" a rating of a three or greater on the measures of positivity and a rating of greater than one on negativity were required. This is the same procedure done in prior studies by the primary investigator.

Statistical Analysis

Due to the non-independence of cardiovascular measures, separate linear regression analyses were used to examine our primary hypotheses regarding the association between relationship type, relationship length, frequency of contact, their statistical interactions, and each of the cardiovascular reactivity variables (SBP, DBP, MAP, HR, CO, TPR, PEP and RSA). Interaction terms were residual centered. Cardiovascular reactivity was reflected as a change in the average score recorded during the discussion task and the average score recorded during the baseline assessment. Relationship type was categorical (supportive, ambivalent), while length of relationship and frequency of contact were treated continuously in the analyses. We also examined the effects of age, sex, and body mass index (BMI) on each cardiovascular measure using linear regression. Those showing significant effects (age, sex, BMI) were included in the models as covariates.

Secondary analyses were conducted to examine whether there was any carry-over effect of the type of feedback participants received from their friend during the speech task prior to their discussion. Linear regression was used to examine whether type of feedback participants received is predictive of self-reported perceptions, and whether actual feedback and perception of feedback had independent effects on cardiovascular reactivity during the discussion task.

Results

Preliminary analyses were performed to examine factors that are known to independently influence the cardiovascular measures that may confound our primary results. These analyses revealed that age was statistically significant in predicting changes in SBP β = -.23, $t(131)$ = -2.38, p = .02, and MAP β = -.21, $t(131)$ = -2.20, p = .03. Sex was statistically significant in predicting changes in PEP, β = -.20, $t(114)$ = -2.03, p = .05. BMI was statistically significant in predicting changes in DBP, β = .20, $t(131)$ = 2.28, p = .02, and MAP, β = .19, $t(131)$ = 2.18, p = .03. Age, sex, and BMI were therefore included as covariates in the subsequent regression analyses for the appropriate dependent variables.

In our primary analysis, linear regression showed no significant effects of relationship quality on any of the cardiovascular measures, $p > .05$. We then tested the effects of length of relationship (measured in years), and frequency of contact (measured in hours per week). Length of relationship was significantly associated with CO (β = .28, $t(103)$ = 2.96, p = .004) and TPR (β = -.20, $t(103)$ = -2.06, p = .04) reactivity, such that longer relationships were associated with greater cardiac output and decreased TPR reactivity. Frequency of contact showed no significant effects for any of the cardiovascular measures, $p > .05$. Linear regression also revealed no statistical interaction between relationship quality and length of relationship for any of the

cardiovascular measures, $p > .05$. There was also no statistical interaction between relationship quality and frequency of contact on any of the cardiovascular measures, $p > .05$.

In our secondary analyses, we examined whether the feedback of the previous task had any carry-over effect on cardiovascular reactivity during the discussion task. As expected, the type of feedback given was predictive of how participants interpreted the feedback, $\beta = .36$, $t(127) = 4.31$, $p = .000$. However, neither the message nor the interpretation of the message yielded any significant effects on the cardiovascular measures, $p > .05$. Thus, we found no evidence of a carry-over effect.

Discussion

The purpose of this study was to examine how cardiovascular reactivity is affected by relationship quality within friendships and whether the length of relationship and frequency of contact may moderate the effect. We found no significant difference between subjects interacting with supportive friends compared to those interacting with ambivalent friends on cardiovascular reactivity. Length of relationship was independently associated with higher CO and lower TPR, but there was no statistical interaction between relationship length and relationship quality. Frequency of contact was not a significant predictor of cardiovascular reactivity and no interaction was found between frequency and relationship quality.

Inconsistent with prior research, we found no significant effect of relationship quality (supportive/ambivalent) on any measures of cardiovascular reactivity during the open-ended discussion task. Prior research has found that ambivalent friendships may be especially stressful and elicit a higher cardiovascular response, particularly when discussing negative or upsetting events (Birmingham et al., 2009; Holt-Lunstad et al., 2007; Holt-Lunstad et al., 2003). One potential explanation for this inconsistency was the type of message participant's friends

conveyed to them during the speech tasks that occurred prior to the open-ended discussion. However, analysis revealed that neither the message nor the interpretation of the message by the participant were factors in predicting changes in any of the cardiovascular measures during the discussion task, suggesting there was no significant carry-over effect of the previous task. Just prior to the discussion task (and after the speech task), participants were debriefed (told they were given experimentally predetermined feedback). Although it appears that the debriefing was effective in minimizing a carry-over effect, it is possible that participants disengaged from the remaining discussion task as an unintended consequence. It is also possible that because the discussion was open-ended that participants strategically chose safe topics to discuss with ambivalent friends. Given that previous studies have found relationship differences primarily within stressful contexts, it is possible the discussion was not sufficiently stressful.

We had also predicted that reactivity may differ according to the length of the relationship. We predicted that within ambivalent friendships, length of the relationship would moderate the cardiovascular response, such that shorter friendships would be associated with higher reactivity to the stressful condition. Although there was no moderation effect, length of the relationship was independently associated with higher CO and lower TPR reactivity. Increased CO would indicate a heightened myocardial response and decrease TPR a reduced vascular response.

Specifically with cardiac impedance, some have suggested that threatening tasks elicit increased CO and TPR whereas challenging tasks reflect increased CO and decreased or no change in TPR (Blascovich & Tomaka, 1996; Tomaka, Blascovich, Kibler, & Ernst, 1997). A person may perceive threat when they are unable to cope with the demands of a task or situation, whereas those who are able to cope perceive it as challenging (Blascovich & Tomaka, 1996). As

was seen in our sample, elevated CO and lower TPR may suggest that individuals view discussing a stressful event with a long-term friend as less threatening, and something they feel confident coping with (challenging).

Conversely, increases in CO and less change in TPR might suggest that discussing a stressful event with a short-term friend feels threatening to an individual. A perceived threat would imply that the person feels less able to cope with discussing a stressful event with their friend. A potential explanation for why someone may feel threatened by engaging in this type of discussion within a newly formed friendship is not having an established pattern of reciprocity and self-disclosure. People are more likely to self-disclose to their friends rather than acquaintances (Gaebelein, 1976). Furthermore, acquaintances typically engage in superficial, demographic, and shallow conversations (Planalp & Benson, 1992). Being asked to engage in a meaningful conversation within a short-term or newly formed friendship may violate the conversational norms of the relationship, thus making the participant feel vulnerable and threatened.

Another possible explanation for our finding that individuals in short-term friendships show more of a threat response might be an internal conflict between wanting to obtain support and wanting to avoid appearing negative or pessimistic. One study found a negative correlation between pessimistic individuals and length of friendships (Geers, Reilley, & Dember, 1998), suggesting that pessimistic people have shorter lasting friendships. We might infer that those conversing with short-term friends may not want to come across as overly pessimistic or negative in their conversations to avoid jeopardizing the newly formed friendship. Being asked to discuss a negative or upsetting situation with a new friend may go beyond a person's ability to cope, thus eliciting a threat response.

There was no support for our third hypotheses that having frequent contact with friends would moderate the cardiovascular response. Research has found that the mere perception of having available support when needed may have greater protective effects than actually receiving support (Uchino, 2006). Therefore, one explanation may be that participants similarly perceived the amount of available support in the moment they conversed with their friend, making the amount of past contact less relevant. As relationship quality (supportive/ambivalent) was not a factor in this study, past interactions may not be as important when only one source of support available. As mentioned before, another explanation for these findings is that participants may have disengaged from the conversation after being debriefed from the speech task. Designs aimed specifically at examining frequency of contact with sources of support and the quality of those specific interactions over time could better address this hypothesis.

There are a number of limitations worth mentioning. First, this study was not designed with the intent of examining length of relationships and frequency of contact as primary independent variables. These hypotheses could be better addressed by specifically recruiting and contrasting newly formed friendships with long, established friendships and/or manipulating frequency of contact. The generalizability is also limited because this study only included college-age, predominantly Caucasian, participants; thus, it is unclear to what extent these findings generalize to those at other stages in life or other ethnicities. In addition, all participants were required to bring in a same-sex friend. Individuals may react differently to members of the opposite sex or someone of a different relationship type (i.e. significant other, family member, or co-worker). The clinical relevance of the statistically significant changes in cardiovascular measures is also unclear, as health outcomes linked to social support typically develop over long periods of time.

Despite these limitations, this study is one of few to question the implications that length of relationship and frequency of contact have on cardiovascular reactivity. There is some evidence to suggest that length of relationships may be important and should be considered in future studies. Research may also benefit by further exploring how individuals psychologically cope with stressful friendships and whether or not this leads to physiological habituation.

References

Beck, L. A., & Clark, M. S. (2009). Offering more support than we seek. *Journal of Experimental Social Psychology, 45*(1), 267-270. doi: 10.1016/j.jesp.2008.08.004

Berkman, L. F. (1995). The role of social relations in health promotion. *Psychosomatic Medicine, 57*(3), 245-254.

Biesanz, J. C., West, S. G., & Millevoi, A. (2007). What do you learn about someone over time? The relationship between length of acquaintance and consensus and self-other agreement in judgments of personality. *Journal of Personality and Social Psychology, 92*(1), 119-135. doi: 10.1037/0022-3514.92.1.119

Birmingham, W., Uchino, B. N., Smith, T. W., Light, K. C., & Sanbonmatsu, D. M. (2009). Social ties and cardiovascular function: An examination of relationship positivity and negativity during stress. *International Journal of Psychophysiology, 74*(2), 114-119. doi: 10.1016/j.ijpsycho.2009.08.002

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. In M. P. Zanna (Ed.), *Advances in experimental social psychology, Vol. 28.* (pp. 1-51). San Diego, CA US: Academic Press.

Cacioppo, J. T., Malarkey, W. B., Kiecolt-Glaser, J. K., & Uchino, B. N. (1995). Heterogeneity in neuroendocrine and immune responses to brief psychological stressors as a function of autonomic cardiac activation. *Psychosomatic Medicine, 57*(2), 154-164.

Campo, R. A., Uchino, B. N., Holt-Lunstad, J., Vaughn, A., Reblin, M., & Smith, T. W. (2009). The assessment of positivity and negativity in social networks: The reliability and validity of the social relationships index. *Journal of Community Psychology, 37*(4), 471-486.

Chida, Y., & Steptoe, A. (2010). Greater cardiovascular responses to laboratory mental stress are associated with poor subsequent cardiovascular risk status: A meta-analysis of prospective evidence. *Hypertension, 55*(4), 1026-1032. doi: 10.1161/hypertensionaha.109.146621

Christenfeld, N., Gerin, W., Linden, W., Sanders, M., Mathur, J., Deich, J. D., & Pickering, T. G. (1997). Social support effects on cardiovascular reactivity: Is a stranger as effective as a friend? *Psychosomatic Medicine, 59*(4), 388-398.

Cohen, S. (1988). Psychosocial models of the role of social support in the etiology of physical disease. *Health Psychology, 7*(3), 269-297. doi: 10.1037/0278-6133.7.3.269

Cohen, S. (2004). Social relationships and health. *American Psychologist, 59*(8), 676-684. doi: 10.1037/0003-066x.59.8.676

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310-357. doi: 10.1037/0033-2909.98.2.310

de Boer, S. F., Koopmans, S. J., Slangen, J. L., & Van der Gugten, J. (1990). Plasma catecholamine, corticosterone and glucose responses to repeated stress in rats: Effect of interstressor interval length. *Physiology & Behavior, 47*(6), 1117-1124. doi: 10.1016/0031-9384(90)90361-7

Deinzer, R., Kirschbaum, C., Gresele, C., & Hellhammer, D. H. (1997). Adrenocortical responses to repeated parachute jumping and subsequent h-CRH challenge in inexperienced healthy subjects. *Physiology & Behavior, 61*(4), 507-511. doi: 10.1016/s0031-9384(96)00465-9

Fontana, A. M., Diegnan, T., Villeneuve, A., & Lepore, S. J. (1999). Nonevaluative social support reduces cardiovascular reactivity in young women during acutely stressful performance situations. *Journal of Behavioral Medicine, 22*(1), 75-91.

Gaebelein, J. W. (1976). Self-disclosure among friends, acquaintances, and strangers. *Psychological Reports, 38*(3, Pt 1), 967-970. doi: 10.2466/pr0.1976.38.3.967

Geers, A. L., Reilley, S. P., & Dember, W. N. (1998). Optimism, pessimism, and friendship. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues, 17*(1), 3-19. doi: 10.1007/s12144-998-1017-4

Grissom, N., & Bhatnagar, S. (2009). Habituation to repeated stress: Get used to it. *Neurobiology of Learning and Memory, 92*(2), 215-224. doi: 10.1016/j.nlm.2008.07.001

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine, 7*(7), 1-20. doi: 10.1371/journal.pmed.1000316

Holt-Lunstad, J., Uchino, B. N., Smith, T. W., & Hicks, A. (2007). On the importance of relationship quality: The impact of ambivalence in friendships on cardiovascular functioning. *Annals of Behavioral Medicine, 33*(3), 278-290. doi: 10.1080/08836610701359795

Holt-Lunstad, J., Uchino, B. N., Smith, T. W., Olson-Cerny, C., & Nealey-Moore, J. B. (2003). Social relationships and ambulatory blood pressure: Structural and qualitative predictors of cardiovascular function during everyday social interactions. *Health Psychology, 22*(4), 388-397. doi: 10.1037/0278-6133.22.4.388

House, J. S., Landis, K. R., & Umberson, D. (1988). Social relationships and health. *Science, 241*(4865), 540-545. doi: 10.1126/science.3399889

Jehn, K. A., & Shah, P. P. (1997). Interpersonal relationships and task performance: An examination of mediation processes in friendship and acquaintance groups. *Journal of Personality and Social Psychology, 72*(4), 775-790. doi: 10.1037/0022-3514.72.4.775

Lepore, S. J., Allen, K. A., & Evans, G. W. (1993). Social support lowers cardiovascular reactivity to an acute stressor. *Psychosomatic Medicine, 55*(6), 518-524.

Lydon, J. E., Jamieson, D. W., & Holmes, J. G. (1997). The meaning of social interactions in the transition from acquaintanceship to friendship. *Journal of Personality and Social Psychology, 73*(3), 536-548. doi: 10.1037/0022-3514.73.3.536

Major, B., Zubek, J. M., Cooper, M. L., Cozzarelli, C., & Richards, C. (1997). Mixed messages: Implications of social conflict and social support within close relationships for adjustment to a stressful life event. *Journal of Personality and Social Psychology, 72*(6), 1349-1363. doi: 10.1037/0022-3514.72.6.1349

Manuck, S. B. (1994). Cardiovascular reactivity in cardiovascular disease: 'Once more unto the breach'. *International Journal of Behavioral Medicine, 1*(1), 4.

Natelson, B. H., Ottenweller, J. E., Cook, J. A., & Pitman, D. L. (1988). Effect of stressor intensity on habituation of the adrenocortical stress response. *Physiology & Behavior, 43*(1), 41-46. doi: 10.1016/0031-9384(88)90096-0

O'Donovan, A., & Hughes, B. M. (2008). Access to social support in life and in the laboratory: Combined impact on cardiovascular reactivity to stress and state anxiety. *Journal of Health Psychology, 13*(8), 1147-1156.

Pitman, D. L., Ottenweller, J. E., & Natelson, B. H. (1988). Plasma corticosterone levels during repeated presentation of two intensities of restraint stress: Chronic stress and habituation. *Physiology & Behavior, 43*(1), 47-55. doi: 10.1016/0031-9384(88)90097-2

Planalp, S., & Benson, A. (1992). Friends' and acquaintances' conversations I: Perceived differences. *Journal of Social and Personal Relationships, 9*(4), 483-506. doi: 10.1177/0265407592094002

Sherwood, A., Allen, M. T., Fahrenberg, J., Kelsey, R. M., Lovallo, W. R., & van Doornen, L. J. (1990). Methodological guidelines for impedance cardiography. *Psychophysiology, 27*(1), 1-23.

Tomaka, J., Blascovich, J., Kibler, J., & Ernst, J. M. (1997). Cognitive and physiological antecedents of threat and challenge appraisal. *Journal of Personality and Social Psychology, 73*(1), 63-72. doi: 10.1037/0022-3514.73.1.63

Treiber, F. A., Kamarck, T., Schneiderman, N., Sheffield, D., Kapuku, G., & Taylor, T. (2003). Cardiovascular reactivity and development of preclinical and clinical disease states. *Psychosomatic Medicine, 65*(1), 46-62.

Uchino, B. N. (2006). Social support and health: A review of physiological processes potentially underlying links to disease outcomes. *Journal of Behavioral Medicine, 29*(4), 377-387. doi: 10.1007/s10865-006-9056-5

Uchino, B. N., Cacioppo, J. T., & Kiecolt-Glaser, J. K. (1996). The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. *Psychological Bulletin, 119*(3), 488-531. doi: 10.1037/0033-2909.119.3.488

Uchino, B. N., Holt-Lunstad, J., Uno, D., & Flinders, J. B. (2001). Heterogeneity in the social networks of young and older adults: Prediction of mental health and cardiovascular reactivity during acute stress. *Journal of Behavioral Medicine, 24*(4), 361-382.