

DOES CHOICE MODERATE THE EFFECTS
OF RECEIVED SOCIAL SUPPORT ON
CARDIOVASCULAR REACTIVITY?

by

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ABSTRACT

Social support is a reliable predictor of physical health. However, most studies examine this link with measures of perceived social support that are only modestly correlated with actual support received. Importantly, laboratory studies that manipulate received support often find that it results in greater distress and physiological reactivity. One theoretical model posited by Bolger and Amarel (2007) suggests that social support costs are dependent on whether or not the support is received prior to or after an individual decides support is wanted or needed. The current study examined the main and interaction effects of social support and choice for the support on reactivity to a lab speech stressor task using an induced compliance paradigm to increase perceived choice in receiving support during a speech task. One hundred eighteen participants were assigned to varying conditions of choice (induced choice, no induced choice, no reference to choice) and received support (received support during task, received no support during task). Participants completed measures of self-esteem, anxiety, threat, and control during the speech task. Cardiovascular functioning was measured via blood pressure and cardiac impedance. Results did not support choice as a moderator between support and reactivity. Received support predicted increased cardiovascular reactivity during the speech task ($p's < .08$). However, there were no differences in psychological reactivity. Implications are discussed.

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INTRODUCTION

Social support is a reliable predictor of physical health outcomes, including morbidity and mortality (Cassel, 1976; Cobb, 1976; Cohen, 1988; House, Landis, & Umberson, 1988; Uchino, 2004). In a review of large epidemiological studies, House et al. (1988) found evidence that more socially isolated individuals are at increased risk of earlier mortality, even after controlling for age and initial health status. More recent reviews find that individuals who perceive higher levels of available social support are at reduced risk of mortality (Holt-Lunstad, Smith, & Layton, 2010). These effects were consistent across gender, age, initial health status, and cause of death. In fact, the overall effect size found by Holt-Lunstad and colleagues in predicting mortality appeared comparable to standard risk factors like smoking, smoking cessation, and physical activity.

Consistent with these epidemiological links, social support has been associated with a multitude of health relevant physiological outcomes (Roy, Steptoe, & Kirschbaum, 1998; Uchino, 2006; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). In one study of immune functioning and social support, participants with higher levels of social isolation not only experienced greater levels of psychological stress, but also elevated levels of cortisol and poorer antibody response to an influenza vaccine (Pressman, Cohen, Miller, Barkin, Rabin, & Treanor, 2005). Studies of social support and aging have also found that older adults with access to supportive social networks experience better mental and

physical health (Krause, 2001). For example, low social support in caregivers of Alzheimer's disease patients was associated with age-related increases in heart rate reactivity, whereas those individuals with access to social support displayed age-related decreases in heart rate reactivity (Uchino, Kiecolt-Glaser, & Cacioppo, 1992). Finally, individuals with greater access to supportive individuals have lower neuroendocrine responses to stress (Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007), as well as attenuated cardiovascular reactivity (CVR) to laboratory stress tasks and lower ambulatory blood pressure in daily life (Christenfeld et al., 1997; Holt-Lunstad, Uchino, Smith, Cerny, & Nealey-Moore, 2003; O'Donovan & Hughes, 2008; Phillips, Gallagher, & Carroll, 2009; Piferi & Lawler, 2006).

Much of the research that documents a beneficial influence of social support on health has focused on perceived social support, or one's perception that he or she has access to a supportive social network if such assistance became necessary. Received support, in contrast, is the actual receipt of support from others (e.g., instrumental, emotional, informational) and has been found to be less consistently predictive of beneficial health outcomes (Barrera, 2000; Uchino, 2004, 2009). In addition, perceived support correlates weakly with actual support that is received, providing evidence that received social support and perceived social support are two separate dimensions drawn from the greater concept of social support and thus are not interchangeable (Kaul & Lakey, 2003; Lakey & Lutz, 1996; Sarason, Sarason, & Pierce, 1990a).

Importantly, in contrast to perceived support, several studies have shown a detrimental influence of receiving support on health outcomes (Barrera, 2000; Bolger, Zuckerman, & Kessler, 2000; Wills & Shinar, 2000). Epidemiological studies have found

links between the receipt of support and increased mortality (Uchino, 2004). For instance, Forster and Stoller (1992) found that receiving greater instrumental assistance was associated with lower survival rates in older women. This finding is similar to Kaplan, Cohen, Kauhanen, Wu, and Salonen's (1993) work that showed greater risk of death for older adults who received support during times of need. Moreover, in a study of social support and aging, received social support was associated with greater mortality when the support was instrumental in nature, but with lower mortality if it was emotional in nature (Penninx et al., 1997).

Of particular relevance for this research are studies linking received social support to CVR during laboratory stress (Glynn, Christenfeld, & Gerin, 1999; O'Donovan & Hughes, 2008; Uno, Uchino, & Smith, 2002). This work is based on the reactivity hypothesis which proposes repeated exposure to stressors over time acts as a strain upon the cardiovascular system due to increased, prolonged, or excessive CVR. Consequently, the cumulative impact of these acute stress responses contributes to the development of chronic cardiovascular disease. A recent meta-analysis found evidence for this view that stress-induced CVR indeed contributes to an increased risk of cardiovascular disease (Chida & Steptoe, 2010).

This work linking exaggerated reactivity to cardiovascular risk is important because according to the buffering hypothesis, social support functions as a significant moderator of the association between acute CVR and chronic cardiovascular disease (Cohen, 1988; Cohen & McKay, 1984; Cohen & Wills, 1985). Social support may benefit the recipient by inhibiting or buffering these physiological stress responses, thereby reducing the pathogenic processes that increase the risk of cardiovascular disease.

Consistent with this stress-buffering hypothesis, Thorsteinsson and James (1999) found that received social support reduced CVR during laboratory stress. However, they also found significant variability in these associations and identified significant moderators (e.g., evaluation). This is consistent with more recent research that has reported inconsistent influences of received support on lab-based reactivity (Uchino, Carlisle, Birmingham, & Vaughn, 2011). In contrast to the primarily internal construal of perceived social support, received social support functions in a situational capacity, introducing the potential for significant variation across antecedent circumstances and contextual factors that mediate health outcomes (Uchino, 2009).

Several psychological explanations have been put forth to further understand the inconsistent relationship between received social support and health. Proposed explanations have addressed provider-related factors, such as perceived emotional responsiveness of the provider, support-related factors such as matching the type of support needed within the current negative event, and recipient-related factors such as increased feelings of indebtedness or relational inequity (Barbee, Gulley, & Cunningham, 1990; Coyne, Wortman, & Lehman, 1988; Fekete, Stephens, Mickelson, & Druley, 2007; Gleason, Iida, Bolger, Shrout, 2003; Horowitz et al., 2001; Maisel & Gable 2009). Evaluative threat felt by the recipient in the presence of the support provider may also confound the benefits of received support (Kamarck, Annunziato, & Amateau, 1995; Taylor et al., 2010). Moreover, simulation studies have been conducted to test alternative explanations behind the distress observed as a result of received support (Seidman, Shrout, & Bolger, 2006). Insufficient evidence emerged for both the reverse causation model – where increased distress leads to increased received support – and the third-

variable adversity model – where an adverse third variable increases both distress and received support (Seidman et al., 2006). These simulation studies suggest that received support may have a direct negative influence on psychological and physical health outcomes.

Recently, Bolger and Amarel (2007) have proposed an integrative model aimed at understanding the disparate influences of received support. According to these researchers, the timing of when that support is received is important and they distinguish between anterogatory and postrogatory support processes. The anterogatory stage refers to support received prior to the decision to request assistance, whereas the postrogatory stage refers to support received after the recipient has experienced a demanding event, appraised it as stressful, and has made the decision to seek support. Thus, according to this model, postrogatory received support might be associated with less negative influences than anterogatory received support, because the recipient has already acknowledged a need for assistance and does not view the support as a threat to self. This model is consistent with work by Martire, Stephens, Druley, and Wojno (2002), who found that if independence was not a central concern, high levels of received support were related to less negative reactions.

Based on the model of Bolger and Amarel (2007), one crucial factor moderating the effects of received social support on CVR may be that of individual choice (Bolger & Amarel, 2007; Bolger et al., 2000). Individuals who receive unsolicited social support (anterogatory process) may perceive such support as an indication that the support provider does not view them as capable of handling the stressful event. This construal made by the recipient can lead to increased feelings of threat to self-efficacy, competency,

or independence (Bolger & Amarel, 2007; Bolger et al., 2000; Martire et al., 2002). Additionally, they may subsequently reappraise the stressful event as more threatening than originally appraised, as the unsolicited social support may be implied to mean that the provider perceives the stressor as great enough to elicit support. State self-esteem may be impacted by the threat to self-efficacy or independence, and changes in state anxiety might also be observed as greater threat appraisals are made. Such cognitive appraisals of threat may in turn affect physiological stress responses (Sherwood, Dolan, & Light, 1990; Tomaka, Blascovich, Kiebler, & Ernst, 1997). For instance, threat appraisals are associated with higher negative affect and increased CVR through vascular resistance (total peripheral resistance, TPR; Christian & Stoney, 2006; Tomaka et al., 1997). In contrast, once the choice to receive support has been made (postrogatory process), individuals may not construe such support as a threat to self-efficacy or independence. Instead, these individuals would have already judged an event as stressful or threatening and explicitly decided to seek support. More specifically, the receipt of solicited social support may promote reappraisal of the situation as less threatening or bolster the individual's perceived ability to cope.

In the current study, our primary aim was to test the predictions of Bolger and Amarel's (2007) model by examining recipient's choice in receiving support as a crucial contextual factor that may moderate the relationship between received social support and CVR. By empirically substantiating the role of recipient choice in received social support as a moderator, we may explain the inconsistent effects observed in prior work. We used an induced-compliance paradigm, to experimentally manipulate participants' perceptions of their choice in whether or not social support will be received (Linder, Cooper, & Jones,

1967). This paradigm has previously been utilized in the attitude change and cognitive dissonance literature; though in the context of the current study, it was not used to elicit attitude change, but rather to create the perception of choice, and thus to randomly assign participants to conditions of choice. In contrast to prior work on choice and social support, by randomly assigning participants on the recipient-related factor of choice of social support, we provided a stronger test of choice moderating CVR.

In order to examine its potential links to health, we assessed SBP, DBP, and HR reactivity as these measures have been linked to longer term disease outcomes (Chida & Steptoe, 2010). Cardiac output (CO) and total peripheral resistance (TPR) data were also collected from impedance cardiography in order to investigate the processes driving blood pressure changes. (Sherwood, Allen, et al., 1990; Tomaka et al., 1997). Support type was be controlled for across experimental groups. Instrumental support – offering practical and tangible help – was utilized for the study because it has been classified as a warm, but dominant type of support (Trost, 2000). As a result, this particular type of support is particularly relevant to the Bolger and Amarel (2007) model as it is typically seen as a more dominant and controlling form of support and hence might be appraised as a possible threat to self-efficacy or competency (Cohen, Gottlieb, & Underwood, 2000; Reinhardt, Boerner, & Horowitz, 2006; Wilson et al., 1999).

The second aim of this study was to examine the psychological processes associated with received social support and cardiovascular functioning. As noted earlier, one possible mechanism contributing to the exacerbation of reactivity is that of threat appraisal made by recipients in relation to their self-efficacy in the face of unsolicited social support (Bolger & Amarel, 2007). That is, unsolicited social support may threaten

the recipient's feelings of personal control (R. Smith, 1989). Such threats and decreased feelings of control have been associated with changes in state self-esteem (Burns & Seligman, 1989; Nadler & Fisher, 1986). To examine these processes, we examined participant reported state self-esteem, feelings of control, and threat appraisal during a speech task in which they were given a choice to receive support or were not.

According to Bolger and Amarel's (2007) model, choice - independent of subsequent support - is theorized to reduce the activation of costly psychological appraisals regarding self and stressor. Thus, we predicted a main effect of choice upon CVR, such that those participants who perceive having choice will exhibit lower CVR than those in no-choice conditions. Additionally, we predicted a main effect of support upon CVR. Previous literature has identified an effect of receiving social support in reducing CVR in the lab (Glynn et al., 1999; Lepore, Allen, & Evans, 1993).

Finally, we predicted a statistical interaction between choice and received support on CVR. More specifically, we hypothesized that participants who perceived that they chose to receive social support and did receive such support during a laboratory-based stress task – an impromptu speech task – would exhibit less CVR as compared to the other experimental groups. We also predicted that participants who were simply provided with support without a choice would exhibit the greatest CVR as compared to the other experimental groups. These effects are predicted to be particularly evident on total peripheral resistance, which has been linked to increased threat appraisals (Tomaka et al., 1997). We also predicted that these effects on CVR would be mediated by threat appraisals and other psychological processes such as state self-esteem and feelings of control.

METHOD

Participants

Participants were 118 individuals (70 female, 48 male) recruited from the university participant pool for course credit or from the local community and compensated \$20 for their time. Inclusion criteria included participants who were generally healthy and without medical conditions with a cardiac component (e.g., no hypertension or cardiovascular medications; see Cacioppo et al., 1995). For participant characteristics, see Table 1. Participants were randomly assigned to a 3 (Support Choice: Yes, no, none mentioned) X 2 (Support Received: Yes, no) between-participant design (See Table 2).

Procedure

Participation included one session at the lab of approximately 2 hours in length. All participants were treated according to APA Ethical Code. Upon arrival at the laboratory, informed consent was obtained and participants were asked to fill out preliminary questionnaires. Height and weight were recorded. During the consent process, participants were told that we were interested in the physiological responses observed during speech performance. Participants were then escorted into a sound attenuated room where a blood pressure cuff (Dinamap Pro100; Critikon Corp.) was attached to the upper nondominant arm of the participant to measure heart rate and blood

Table 1
 Characteristics of Study Participants

Variable	Mean \pm SE or Percent
Sex	60.34% Female
Age	22.98 \pm 4.18*
BMI	23.98 \pm 3.87**
Ethnicity	68.97% Caucasian 10.34% Hispanic/Latino 9.48% Asian-American 1.72% African-American 9.48% Other
Annual Income	46.87% <\$10,000 29.20% \$10,000-20,000 23.88 >\$20,000
Education	89.66% Some college / Working toward degree

* In years; **Body Mass Index = weight (kg)/height (m²)

Table 2
 Study Conditions and Sample Sizes

	Choice	No Choice	No Reference to Choice (Control)
Social Support	<i>n</i> =20	<i>n</i> =19	<i>n</i> =19
No Social Support	<i>n</i> =20	<i>n</i> =20	<i>n</i> =18

pressure responses to the protocol. Disposable spot electrodes were then placed according to published guidelines (Hoetink et al., 2002). Afterward, participants were instructed to relax quietly for 10 minutes while resting measures of cardiovascular function were obtained.

Following a resting baseline period of 10 minutes, participants were informed they were giving three 1-minute speeches on current events, preceded by a 1-minute practice speech to ensure that the participants understood task instructions (see T. Smith, Nealey, Kircher, & Limon, 1997) (see Figure 1). Participants were instructed to state their opinions on each topic (mandating diversity coursework; addition of comprehensive exam to graduation prerequisites; adoption of more stringent admissions standards for their university) and to speak for 1 minute supporting each opinion. Prior to each stressor task, participants completed the measures of pretask appraisal (e.g., challenge, threat, control), while measures of state self-esteem and state anxiety were collected after each stressor.

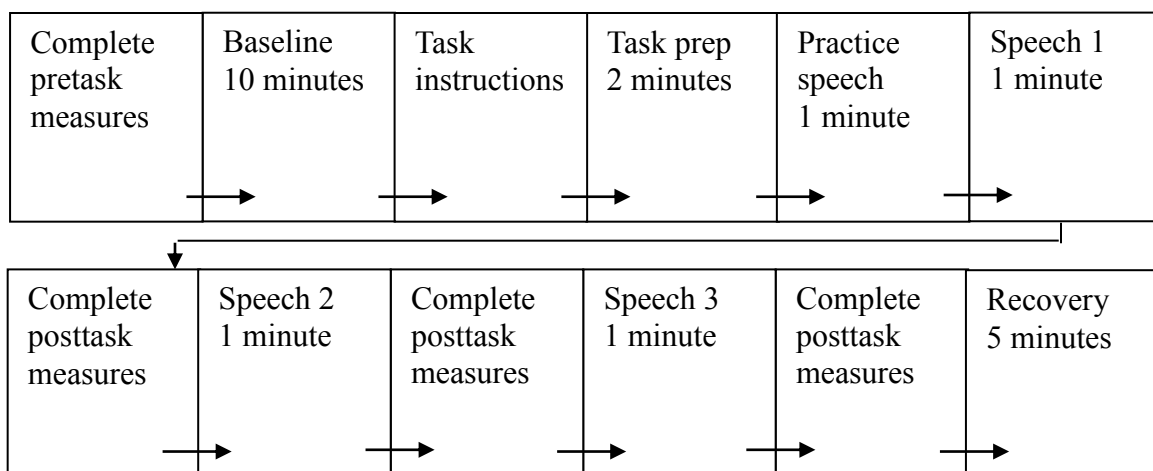


Figure 1. Study procedures flowchart.

Participants had 2 minutes to prepare their speech responses. At the end of the preparation period, participants were verbally prompted when to begin and end each speech. Physiological readings were recorded during each of the three speeches. At the end of the speech period, there was a 5-minute recovery period, while resting measures of cardiovascular functioning were recorded.

Participants were asked to perform these three impromptu speeches under varying conditions of choice and received support (see below). The manipulation of received support during these speeches is based on our prior work. Individuals assigned to receive support received instrumentally supportive notes from a confederate at the end of each short speech, beginning after the practice speech and ending with the second-to-last speech. The timing of the note delivery was such that participants experienced manipulation of support prior to speech tasks where data are collected (see Uno et al., 2002). The instrumentally supportive notes were written on a piece of paper and were identical for all participants within the supportive condition. Individuals in the no received support condition simply performed the speech tasks. We specifically focused on instrumental support in this study because it is viewed as a warm but dominant support behavior (Trobst, 2000). As a result, its interpretation can be more easily modulated by the manipulated context of choice.

Participants were randomly assigned to three possible support choice conditions (Support Choice: Yes, no, none mentioned). The basic paradigm was a conceptual replication of an induced compliance manipulation shown to be effective in prior work (Linder et al., 1967; Rhodewalt & Agustsdottir, 1986). More specifically, individuals in the choice condition were told the following:

“In this study we are having some people work on tasks alone and others working on the task while receiving support from another. If it is okay with you, we are going to ask you to receive help (not receive help) from another. You don’t mind doing this, do you? Thanks, it is really up to you, you don’t have to work with another (not work with another) if you don’t want to.”

Individuals in the no choice condition were told the following:

“In this study we are having some people work on tasks alone and others working on the task while receiving support from another. You have been assigned to receive help (not receive help) from another. I wish that we could give you a choice but the experiment requires that you be assigned to this condition.”

A control condition included no reference to choice and was a basic replication of received support influences to compare with the above manipulations. This condition was important to determine whether choice actually lowers reactivity or no choice heightens reactivity (or perhaps some combination of both).

Individuals in the no reference to choice condition were told the following:

“In this study we are having you work on the tasks alone (or while receiving support from another).”

Participants assigned to the received support condition were informed that a confederate whom they were introduced to upon arrival at the laboratory would listen to them give their speeches in an adjacent room and whenever possible would try to send them a note filled with suggestions and/or comments to help and support them through the task and that the feedback can vary quite a bit. This last instruction served to lead the participant to believe that while in fact the confederate is providing support due to the

study parameters, the confederate has a large degree of freedom in the quantity, quality, or type of support provided. Participants in the no received support conditions met the confederate but were told that the person would simply be listening to their speech as part of the study. After the preparation period and prior to each speech, the experimenter entered the chamber to give the participant handwritten notes believed to be written by the confederate for the participant and explain that: “Before beginning your next speech, the listener has made some comments and suggestions to help and support you with the task.” Participants in the support condition received a total of three notes, one prior to each 1-minute speech. In terms of an instrumentally supportive comment, an example was, “You’re doing well. The only thing I can think you could have also done is to give more examples in that last speech. For your next topic, I jotted down these ideas in support of the statement. Thought they might help you with your speech. For the diversity coursework topic, maybe you could say, ‘It would expose students to new ideas and experiences they might not pursue otherwise.’”

Following the stressor task, manipulation checks were completed. Manipulations checks included a “choice” assessment used in prior work (Linder et al., 1967; Rhodewalt & Agustsdottir, 1986). Additionally, other measures were assessed following the task (see Measures). We also measured pretask appraisals (e.g., challenge, threat, and control) prior to each speech in the stressor task, as well as state anxiety and state self-esteem following each speech in the stressor tasks. Upon completion of the protocol, the physiological equipment was removed, participants debriefed and thanked.

Measures

Cardiovascular Assessments

A Mindware 2000D Impedance Cardiograph was used to measure ECG, basal thoracic impedance (Z_0), and the first derivative of the impedance signal (dZ/dt). Disposable spot electrodes were placed according to published guidelines (Hoetink et al., 2002). The impedance data were ensemble averaged within 1-minute epochs and each waveform was verified or edited prior to analyses. Cardiac output and total peripheral resistance were scored following standard procedures (Sherwood, Allen, Fahrenberg, Kelsey, Lovallo, & van Doornen, 1990) and averaged across minutes to increase reliability (e.g., Kamarck et al., 1992). A Dinamap Model 100 monitor was used to measure SBP, DBP, and HR (Critikon Corporation, Tampa, Florida). The Dinamap uses the occillometric method to calculate blood pressure. Cardiovascular assessments were obtained via a properly sized occluding cuff positioned on the upper left arm. Mean SBP, DBP, and heart rate were calculated by averaging across each assessment period (i.e., baseline, speech stressor) to increase reliability (Kamarck et al., 1992).

Threat and Challenge Appraisals

Prior to each speech task, participants completed a measure of challenge and threat appraisals utilized by Tomaka et al. (1997). Participants were asked to rate on a 6-point Likert scale “how threatening do you expect the task to be” and “how able are you to cope with the task.”

Perceived Task Control

Perceptions of task control were assessed before each speech with items used in prior social psychophysiological studies (Gerin et al., 1995). Perceived control in performing well on the speech task was assessed on a 1 to 5 point Likert scale. This measure has been shown to be sensitive to experimental manipulations of control (Gerin et al., 1995).

State Anxiety Scale

The short-form of the Spielberger State-Trait Anxiety Scale was administered to participants following each of the three psychological stressors (Marteau & Bekker, 1992). Participants were asked to rate their current feelings on a 1 (not at all) to 4 (very much) point scale. The internal consistency of the scale in our prior work has been high (Chronbach's $\alpha > .78$).

Perceived Choice

Perceptions of choice for receiving support were assessed using a 1 to 5 point Likert scale after completing the speech task in its entirety. This measure has been shown to be sensitive to experimental manipulations of choice in our prior work (Linder et al., 1967).

State Self-Esteem

We used the state self-esteem scale (SSES) short form to assess potential group differences (Heatherton & Polivy, 1991). The SSES is sensitive to both naturally-occurring and laboratory-based threats, and has good psychometric properties

(Heatherton & Polivy, 1991). It was administered after each speech is performed.

Although examined the total scale score, of particular interest was the social evaluation subscale as this seems most sensitive to the relationship-based processes we examined (see Baldwin, 1994).

Social Relationships Index (SRI)

The SRI was developed as a self-report version of the social support interview (Pagal, Erdly, & Becker, 1987; Uchino et al., 1992). Participants rated the confederate in terms of how helpful and upsetting they were during the speech task (1 = not at all, 6 = extremely). The SRI has a two-factor structure (i.e., positivity and negativity) and good internal consistency and test-retest reliability (see Campo et al., 2009). The SRI was administered once following completion of the speech task in its entirety.

Impact Message Inventory (IMI)

The IMI is an inventory derived from the interpersonal circumplex model and assesses perceptions of another individual's interpersonal behavior along two dimensions: friendliness versus hostility and dominance versus submissiveness (Kiesler, Anchin, & Perkins, 1985; Kiesler, Schmidt, & Wagner, 1997). The IMI in this study consisted of 32-items with 4 items per octant. The IMI has been found to have adequate psychometric properties. In previous studies, it was sensitive to similar interpersonal manipulations (Kiesler et al., 1985). The IMI was administered once following completion of the speech task in its entirety.

Posttask Questionnaire

The posttask questionnaire consisted of four items on a Likert-style scale (1= not at all, 6 = extremely). These items used the wording of the SRI items, but were focused on how helpful or upsetting the support was, rather than the confederate. Additionally, the questionnaire asked for participants' perceptions of how well they performed and how evaluated they felt.

Brief COPE Inventory

The Brief COPE is an inventory intended to assess coping strategies through self-report of 16 items on a Likert-style scale (1= I usually don't this at all, 4= I usually do this a lot) (Carver, 1997). The brief version was developed for greater ease of administration while retaining sound psychometric properties.

Experience in Close Relationships-Short Form (ECR-S)

The ECR-S is a measure of attachment style as an individual difference using a Likert-style scale for each item (1= disagree strongly, 7= agree strongly). It is a shortened version of the original ECR designed to retain reliability, validity, and factor structure (Wei, Russell, Mallinckrodt, & Vogel, 2007). The ECR-S was administered as a preliminary questionnaire, prior to collection of any physiological data or engaging in the psychological stress task.

RESULTS

Preliminary Analyses

A series of 2 (Support: yes, no) X 3 (Choice: choice, no choice, no reference to choice) ANOVAs were performed on all main dependent measures using SAS PROC GLM. SAS PROC REG was also used for regression analyses examining manipulation checks and other internal analyses with continuous independent variables.

For the speech task, participants were asked to debate an issue. Sixty-one percent argued against increasing the stringency of University admissions standards, 88.50% argued for mandating diversity classes at the University, and 74.56% argued against requiring a comprehensive exam to graduate. With the exception of TPR, the speech task significantly altered physiological reactivity across multiple cardiovascular measures, suggesting that participants did indeed experience the speech task as stressful (all p 's < .05).

Manipulation Checks

Choice Manipulation

Participants significantly differed in their perceived choice as to whether or not they received social support as a function of the choice manipulation. Participants who received the induced compliance task instructions perceived greater choice than participants ($M = 3.35$, $SE = .22$) who received the no choice instructions ($M = 1.92$, $SE =$

.23) and the no reference to choice instructions ($M = 2.06$, $SE = .24$) ($F(2, 111) = 12.06$, $p < .0001$).

Social Support Manipulation

Participants who received social support during the speech task perceived the confederate as significantly more helpful and less upsetting (composite score of helpfulness and upsetting ($M = 1.47$, $SE = .09$) than participants who did not receive social support ($M = 1.75$, $SE = .10$) ($F(2, 109) = 4.65$, $p = .03$). Participants in the social support condition perceived the confederate as more affiliation-oriented ($M = 2.53$, $SE = .16$) than participants in the no support condition ($M = -.26$, $SE = .16$) ($F(1, 112) = 160.34$, $p < .0001$). However, there were no differences in participant perceptions of the confederate as dominant. This is consistent with prior research on instrumental support as a more dominant support function than emotional support (Cohen & Wills, 1985). However, participants who received social support did not perceive significantly lower social evaluative threat ($M = 3.67$, $SE = .15$) than participants who did not receive support ($M = 3.37$, $SE = .15$) ($F(1, 112) = 2.07$, $p = .15$). The wording of this item assessed the participants' perception of any evaluation, so we cannot conclude if this was perceived evaluation by the experimenter or confederate.

Finally, we also examined whether participant suspicions about the confederate differed across conditions, as the extent to which the confederates interacted with the participants differed depending on whether participants received support. Fourteen out of the 118 (11.8%) participants reported some suspicion regarding the study cover story and the confederate. Six out of 118 (5%) participants also reported some suspicion that the social support received may have been prepared or prewritten for the confederate, rather

than generated by the confederate. Two of these 6 participants also reported suspicion regarding the confederate cover story. However, there were no significant differences across conditions in participant suspicions (p 's<.32) and most participants reported feeling uncertain about their suspicions at debriefing.

Do Choice and Social Support Influence Psychological
Reactions During Stress?

We first examined whether social support influenced psychological appraisals of threat or bolstered appraisals of psychological resources during stress as a conceptual replication of earlier work (Bolger & Amarel, 2007) (see Tables 3, 4, and 5). Subsequent analyses include gender as a control variable in the models as well as examining potential interactions with gender. However, including this covariate did not change the patterns described below.

Table 3

Least Squares Means and Standard Errors for Psychological
Reactions as a Function of Social Support

	Support		No Support	
	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
Self-esteem	3.23	.09	3.31	.09
Anxiety	4.14	.20	3.87	.19
Task app	.89	.06	.84	.06
Control	3.70	.14	3.57	.14

Table 4

Least Squares Means and Standard Errors for Psychological Reactions as a Function of Choice

	Choice		No Choice		No Reference	
	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
Self-esteem	3.31	.11	3.23	.11	3.27	.12
Anxiety	3.89	.24	3.83	.24	4.28	.24
Task app	.80	.08	.88	.08	.93	.08
Control	3.65	.16	3.55	.17	3.69	.17

Table 5

Least Squares Means and Standard Errors for Psychological Reactions as a Function of Social Support and Choice

	Choice X Support		Choice X No Support		No Choice X Support		No Choice X No Support		No Reference X Support		No Reference X No Support	
	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
Self-esteem	3.19	.16	3.42	.16	3.13	.16	3.34	.16	3.38	.16	3.17	.17
Anxiety	4.38	.34	3.41	.33	3.78	.36	3.89	.33	4.25	.34	4.31	.35
Task-appraisal	.78	.11	.83	.11	.99	.11	.76	.11	.92	.11	.94	.12
Control	3.90	.23	3.40	.23	3.47	.24	3.63	.24	3.67	.25	3.72	.25

State Self-Esteem

Social support ($F(5, 109) = .32, p = .57$), choice ($F(5, 109) = .11, p = .90$), and the support X choice interaction ($F(5, 109) = .32, p = .32$) did not predict changes in state self-esteem during the speech stress task (see Tables 3, 4, and 5). In a follow-up model, we controlled for trait self-esteem which produced the same nonsignificant results.

State Anxiety

Social support ($F(5, 107) = .93, p = .34$), choice ($F(5, 107) = 1.01, p = .37$), and the support X choice interaction ($F(5, 107) = 1.64, p = .20$) did not predict changes in state anxiety during the speech stress task (see Tables 3, 4, and 5).

Task Appraisal

We examined whether task appraisals were significantly influenced by social support, choice, or the interaction between these two conditions. However, no significant associations emerged for the threat, challenge, or ratio score ($p > .26$) (see Tables 3–5).

Perceived Control

We also found that perceived control on the task was not significantly influenced by social support ($F(1, 108) = .46$, choice ($F(2, 108) = .46, p = .50$), or the interaction between these conditions ($F(2, 108) = 1.01, p = .37$) (see Tables 3, 4, and 5).

Do Choice and Social Support Influence Physiological

Responses During Stress?

We next examined whether social support influenced CVR during the stress task. We examined change scores of task from baseline for blood pressure and impedance-

derived measures (e.g., CO, TPR, PEP, and RSA). Additionally, baseline levels of cardiovascular activity were treated as a control variable in the GLM models, to account for differences in reactivity accounted for by individual differences at baseline (Wainer, 1991). Subsequent analyses also include gender as a control variable in the models as well as examining potential interactions with gender. However, including this covariate did not change any of the patterns described below. There were no significant differences in resting cardiovascular activity at baseline across study conditions.

Social support did not consistently predict CVR during the speech task, though social support predicted greater TPR during the task than did not receiving social support ($F(1, 108) = 7.08, p = .01$) (see Tables 6 and 7). Receiving social support was marginally related to greater SBP ($F(1, 108) = 3.19, p = .08$), such that participants who received social support had greater increases in SBP during the task. The main effect of choice was not significant for any cardiovascular measures (see Tables 8 and 9).

Table 6

The Main Effects of Social Support on Cardiovascular Reactivity

	<i>F</i>	DF	<i>p</i>
SBP	3.19	1, 108	.08*
DBP	.16	1, 108	.69
HR	1.18	1, 108	.28
CO	1.05	1, 79	.31
TPR	7.08	1, 78	.01***
RSA	.01	1, 97	.92
PEP	1.72	1, 102	.19

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 7

Least Squares Means and Standard Errors for Cardiovascular Reactivity as a Function of Social Support

	Support		No Support	
	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
SBP*	21.37	1.46	17.70	1.45
DBP*	13.25	.95	12.72	.94
HR**	18.03	1.23	16.14	1.22
CO	1.08	.45	1.69	.39
TPR**	135.09	43.13	-15.78	36.10
RSA (log)	-.29	.18	-.25	.19

*mmHg; **Beats per minute

Table 8

The Main Effects of Choice on Cardiovascular Reactivity

	<i>F</i>	<i>DF</i>	<i>p</i>
SBP	.54	2, 108	.55
DBP	.27	2, 108	.76
HR	1.12	2, 108	.33
CO	1.16	2, 79	.32
TPR	.04	2, 78	.96
RSA	.16	2, 97	.85
PEP	.06	2, 102	.94

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 9

Least Squares Means and Standard Errors for Cardiovascular Reactivity as a Function of Choice

	Choice		No Choice		No Reference	
	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
SBP*	17.99	1.77	20.59	1.77	20.02	1.81
DBP*	12.37	1.15	12.99	1.14	13.60	1.84
HR**	16.40	1.49	15.93	1.49	18.92	1.53
CO	.83	.48	1.37	.50	1.96	.56
TPR	68.05	46.35	61.80	46.62	49.11	52.11
RSA (log)	-.19	.22	-.35	.22	-.27	.25

Similarly, we examined the interaction between social support and choice in predicting cardiovascular reactivity. No significant associations emerged (see Tables 10 and 11). Our final hypothesis was to examine whether or not the association between social support and choice was mediated by threat appraisals, state self-esteem, or state-anxiety. Because there were no main effects or interaction on these psychological variables, we did not test for mediation (Rucker, Preacher, Tormala, & Petty, 2011).

Ancillary Analyses of Physiological and Psychological Changes

During the Stress Task

To follow-up the primary analyses of the study, we conducted secondary analysis. We collapsed data across study conditions to examine whether participants' perceived choice, confederate positivity and negativity, positivity or negativity of the received support, and evaluation threat significantly predicted cardiovascular or psychological outcomes. No associations emerged as significant (p 's > .15).

Table 10

Interaction Effects of Social Support and Choice on Cardiovascular Reactivity

	<i>F</i>	DF	<i>p</i>
SBP	1.85	2, 108	.16
DBP	1.06	2, 108	.35
HR	1.10	2, 108	.34
CO	.54	2, 79	.58
TPR	1.65	2, 78	.20
RSA	.63	2, 97	.53
PEP	1.02	2, 102	.36

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 11

Least Squares Means and Standard Errors for Cardiovascular Reactivity as a Function of Social Support and Choice

	Choice X Support		Choice X No Support		No Choice X Support		No Choice X No Support		No Reference X Support		No Reference X No Support	
	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>	<i>LSM</i>	<i>SE</i>
SBP*	17.44	2.57	18.54	2.47	22.27	2.54	18.91	2.46	24.41	2.54	15.64	2.60
DBP*	11.36	1.66	13.38	1.60	14.31	1.64	11.66	1.60	14.10	1.64	13.122	1.69
HR**	18.55	2.15	14.25	2.09	15.06	2.15	16.80	2.09	20.47	2.14	17.37	2.19
CO	.79	.75	.88	.62	1.25	.75	1.48	.65	1.20	.85	2.72	.73
TPR	73.63	72.71	62.48	58.00	173.39	70.27	-49.78	61.00	158.25	79.58	-60.02	67.85
RSA (log)	-.32	.30	-.06	.31	-.47	.31	-.23	.31	-.08	.34	-.47	.36

*mmHg; **Beats per minute

DISCUSSION

The primary aims of this study were to (a) examine the main and interaction effects of choice and social support on psychological reactions during a stressful task and (b) examine the main and interaction effects of choice and social support on CVR during a stressful task. We predicted that under conditions of high choice, social support would act as a stress-buffer and would be associated with reduced psychological and CVR. However, in the absence of choice, we predicted social support would be associated with increased psychological and CVR.

Overall, we found little evidence for the moderating role of choice on social support and reactivity. Additionally, psychological task reactions did not significantly differ as a function of either choice or support. However, our hypothesis that support would be associated with greater reactivity was partially supported as TPR and SBP reactivity were elevated when support was received. Choice and its interaction with social support did not differ significantly affect CVR.

TPR and SBP marginally increased for participants receiving support compared to those who did not receive support. This is consistent with prior work demonstrating the physiological costs of receiving support (Kaul & Lakey, 2003; Lakey & Lutz, 1996; Sarason, Sarason, & Pierce, 1990b). According to prior work, receiving support may not always be associated with benefits and may even be detrimental because receiving

support is more likely to activate support costs than high perceived support availability. Unlike perceived support, received support may be perceived as intrusive, poorly matched to the stressor, unsolicited, or ineffective (Barrera, 2000; Uchino, 2004, 2009).

While there was some evidence that receiving support was stressful, appropriate caution is necessary in making this inference. First, threat appraisals are theorized to serve as the psychological mechanisms linking stressful situations to TPR reactivity. However, no significant main effects were found for threat appraisals in relation to study conditions. Second, consistent trends were not observed across all indices of CVR. However, TPR is a composite index of reactivity calculated by combining cardiac output and mean arterial pressure.

The current study yielded no evidence that choice was an important factor in influencing either psychological or physiological responses during stress. One possible interpretation of the current data is that choice failed to operate as hypothesized by “pushing” the received social support from anterogatory to postrogatory support. In other words, choice was intended to increase participants’ perceptions that the support was solicited and wanted. Based on Bolger and Amarel’s (2007) model, postrogatory support is less likely to activate concerns over independence, self-efficacy, and competency. Thus, in the current study, induced compliance may have significantly increased perceived choice, but the manipulation may not have been strong enough to buffer against the harmful psychological appraisals associated with physiological reactivity observed in prior empirical work. Importantly, social support conditions also failed to reduce social evaluative threat during the task. This is also consistent with prior work demonstrating that social evaluative threat may interfere with the potential benefits of

social support on reduced reactivity (Grunewald, Kemeny, Aziz, & Fahey, 2004; T. Smith et al., 1997).

While Bolger and Amarel's (2007) original model made a delineation between these anterogatory and postrogatory processes, the existing empirical work in support of this model has often operationalized support in terms of its visibility and invisibility, ostensibly because invisible support would bypass the need for received support to be postrogatory to be beneficial (Bolger et al., 2000). However, a recent study examined support visibility during an experimental task as opposed to Bolger's daily diary work and found no significant differences in CVR as a function of visibility (Kirsch & Lehman, 2013). Instead, when manipulated social evaluative threat was low, instrumental support did indeed reduce CVR. Interestingly, one confederate served the explicit role of the social evaluation source and a second confederate was explicitly the support provider. This explicit disentangling of two social roles (support, evaluation) may have reduced participants' appraisals of the support provider as evaluative as opposed to the current study's procedure.

There are several conceptual and methodological issues to consider for the current study. This is the first study of which we aware to apply the induced compliance paradigm to social support research. The paradigm was used in order to manipulate participants' choice perception. This paradigm is borrowed from the literature on attitudes and attitude change. This methodological tool was typically used to increase perceived choice in participants' doing an undesired or attitude incongruent behavior in order to promote dissonance without sufficient external justification for the behavior. Thus, it is unknown whether the use of the induced compliance paradigm may have other

unintended effects on participants. For example, participants in the high choice condition may have been more engaged in the task as a result of their “choice” to accept support which would have negated any potential reduction of CVR resulting from choice. One limitation of the current study is that participants’ self-report of motivation to engage and objective ratings of participant effort and engagement on the task were not collected. Such psychological variables may have had downstream effects on CVR. Additionally, engagement or performance also have independent effects on physiological reactivity. Thus, we cannot conclude how behavior on the speech task may have affected the study outcome.

Similarly, it is unknown whether participants who perceived high choice may have experienced dissonance between their behavior (accept support) and their attitude toward the task (not stressful enough to need help from a peer whose expertise or qualifications are unknown). In the attitude change literature, such dissonance has been associated not only with psychological tension, but physiological arousal as well. This may have unintentionally affected the reactivity-buffering effects of choice.

In the current study, confederate participants were in a separate room from participants during the speech task. As such, social support came in the form of written notecards delivered by the experimenter in between speeches. As this was the first study of which we are aware to apply an induced compliance paradigm to social support protocols, we wished to control for possible interpersonal interaction confounds should the confederate be in the same room with the participant. However, this may have affected the study in several other ways. First, participants may have perceived greater psychological distance from the support provider than if the confederate had been in the

same room or had delivered the social support themselves. This may have reduced the strength of the support manipulation. Second, in participants' natural environments, support interactions usually come from established relationships with known individuals in more direct forms of communication. For example, an individual may elicit a particular support functions (e.g., emotional support) based on the context of the situation. However, in the current study, communication between confederate and participant was only one-way during the task. These threats to face and ecological validity may have contributed to the study's outcome.

The timing of measurement is an important methodological issue when collecting physiological measurements. Prior evidence suggests that participants habituate to the speech task across the three trials, with participants' typically showing greatest reactivity regardless of social anxiety in the first speech (Mauss, Wilhelm, & Gross, 2003). In order to measure psychological self-report, participants completed questionnaires in between each of the three speeches. Although brief, these questionnaires created breaks in the speech task which may have reduced participant stress or stretched out the speech task such that habituation effects were greater across each trial.

As this is the first study to manipulate choice perceptions during a stress task and social support context, the effect size is unknown. Thus, a study recruiting a larger sample size may have been able to detect a smaller effect size. We used instrumental support in the study as it is typically a more dominant form of support with more heterogeneous associations with reactivity. If the study used emotional support, differences in variance of reactivity – and thus statistical power – as a function of choice may have been reduced because received emotional support more consistently tied to

buffered reactivity and less aversive to recipients. Thus it is unknown if and how choice would impact stress reactivity and other support functions (e.g., belonging, emotional, etc.). Additionally, our sample consisted of college students who were also predominantly Caucasian. As a result, caution is required in generalizing these findings beyond a similar demographic. For example, preliminary evidence suggests that the benefits and costs of solicited and unsolicited support may be as a function of independent and interdependent-oriented cultures (Taylor, Welch, Kim, & Sherman, 2007; Uchida, Kitayama, Mesquita, Reyes, & Morling, 2008).

Despite the predominantly null results, there are several strengths of the current study. First, this is the first study to use the induced compliance paradigm to increase perceived choice for social support and manipulation checks were consistent with prior work. Additionally, it is one of the only studies to extend Bolger and Amarel's model to physiological processes as well as psychological processes. Future research might examine other approaches to manipulating support into a postrogatory or anterogatory process. Follow-up studies may also consider experimental research of the current study's objectives using a support provider known to the support recipient.

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