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AN INVESTIGATION OF CO-RUMINATION ON STRESS LEVELS AND MOOD

A Thesis

Presented to

The Faculty of the Department of Psychology

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Anthony T. Holguin

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The Designated Thesis Committee Approves the Thesis Titled

AN INVESTIGATION OF CO-RUMINATION ON STRESS LEVELS AND MOOD

By

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August 2010

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ABSTRACT

AN INVESTIGATION OF CO-RUMINATION ON STRESS LEVELS AND MOOD

By Anthony T. Holguin

A recently defined type of social support known as co-rumination, the process of sharing negative thoughts, feelings, or ideas with a supporter that triggers the supporter to share similar thoughts and feelings of negativity, is believed to generate both a sense of bonding and an exacerbated stress response. The present study examined the impact of co-rumination on stress levels and mood states in men and women. Participants were assigned to one of three conditions (a control condition, a stress condition without a co-ruminator, or a stress condition with a co-ruminator), which depended on both the timeslot for which a participant signed up and the availability of researchers during the day. Stress was evaluated by examining salivary free cortisol levels derived from the difference between pre-stress baseline levels and post-stress peak levels.

Mood was measured using the Brunel Mood Scale containing subscales that measured anger, confusion, depression, fatigue, tension, and vigor. Results from this study were that participants in both the stress and co-rumination conditions produced elevated levels of cortisol in comparison to participants in the control condition. In addition, participants in both the stress and the co-rumination conditions differed from participants in the control condition on the fatigue dimension of the Brunel Mood Scale. The results of this study suggest that certain types of social support are not universally beneficial and are actually hazardous to the mental health of individuals.

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Introduction

Social support is a psychosocial coping mechanism in which people provide comfort to one another in the form of physical or mental help to buffer the negative influence of stress (Taylor, Welch, Kim, & Sherman, 2007). Stress is prevalent in all aspects of daily life, and it has become critical to understand the details around such mitigating factors as social support. Researchers generally examine two aspects of social support, structural support and functional support (Bellman, Forster, Still, & Cooper, 2003; Chan & Lee, 2006; Kim, Sherman, & Taylor, 2008). Structural support studies involve the number of support networks to which people are connected, while functional support studies examine the perceived level of support and quality of support that people believe that they have available to them (Hefner & Eisenberg, 2009). Even though studies have examined two different facets of the same construct, clinical studies generally report that the more support people have available to them, the better off they will be (Sluzki, 2010). However, recent research challenges this general assumption. The aim of the present study is to examine one exception to the notion that social support is universally beneficial.

Social Support

Roy, Steptoe and Kirschbaum (1998) defined social support as the perceived physical and emotional availability from members of one's own social network. Social support has been conceptualized in three forms: emotional, instrumental, and informational support (Malecki & Demaray, 2003). Emotional support comprises mutual feelings of trust, reliability, and bonding between two or more people; instrumental

support represents helping behaviors; and informational support includes instances where people pass along advice, insight or planning to help other people (Madjar, 2008; Malecki & Demaray, 2003). Investigators agree that social support in each form buffers the detrimental effects of stress by reducing the stress hormone, cortisol, thus generating beneficial effects, such as increased calmness, decreased anxiety, reduced heart rate, and an increased perception of friendship quality or closeness with members of one's own social support network (Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003; Kamarck, Manuck, & Jennings, 1990; Rosal, King, Ma, & Reed, 2004). Evidence from research on both subtypes indicates positive relationships between social support and the biological, psychological, and social health of individuals (Campbell, 1991; Cohen, 2001).

Contact with other people and participation in social groups have been linked to numerous mental and physical health benefits. According to Strazdins and Broom (2007), high amounts of social support are reportedly linked to improved immune function, reduced recovery times from injury or illness, and reduced mortality from serious diseases. In addition, high levels of social support have been associated with increased feelings of self-esteem, friendship quality, and belonging (Martyn-Nemeth, Penckofer, Gulanick, Velsor-Friedrich, & Bryant, 2009). The degree to which people benefit from this process fluctuates based on numerous variables including demographic factors, biological characteristics, situational factors, and behavioral factors (Jackson, Tucker, & Herman 2007).

Sources of social support traditionally come from primary relationships established between family members and friends, but more recent data suggest that social

support networks can be expansive and include other sources that are linked to people who are met while filling in multiple social roles (Lundberg, McIntire, & Creasman, 2008). For example, individuals can provide support to others through their student, family member, and employee roles. This enables individuals to seek and receive support from multiple domains and presumably allows them to greatly benefit from such distributed social support systems. As implied from the previous description of social support, this form of coping is a complex and variously defined concept. The problem has been sorting through all the complexities to determine when, under what conditions, and to what extent social support is beneficial.

Early research attempted to quantify the impact of social support on physical and mental health by using standardized, survey-based measures. As widely reported, survey studies face obvious limitations; perhaps most notably is the difficulty in determining the causal relationship between social support and wellness (Thorsteinsson & James, 1999). Another inherent problem involves the accuracy of using self-report data. Survey based studies typically ask participants to either examine how an individual would react in a hypothetical situation or to recall specific situations involving supportive mechanisms. Social support is a dynamic process and the degree of experimental control used in standardized surveys limits the observations that researchers make and the amount of information that they can generalize to others in real world settings. However, more recent research has manipulated social support by employing the use of friends and confederates that simulate supportive processes and events taking place in natural environments.

Heinrichs et al. (2003) established an experimental model that set the foundation for investigating the impact of social support on stress, as measured by levels of cortisol production. In their experiment, researchers administered the Trier Social Stress Test (TSST) (i.e., a public speaking and arithmetic task) to participants after receiving social support in the form of instrumental support and emotional support from a friend in one condition, or in the absence of social support in the control condition. Participants in the social support condition produced significantly lower cortisol levels than participants in the no social support condition. It is noteworthy that participants in the social support condition also reported to experience significantly lower levels of anxiety than participants in the no social support condition. Similar studies examining both survey based and physical/simulated forms of social support have also reported significant reductions in stress-induced cortisol levels for men, improved health perceptions for women, reductions in physical symptoms among men, and reductions in blood pressure and heart rate for both men and women (Grewen, Anderson, Girdler, & Light, 2003; Hale, Hannum, & Espelage, 2005; Kirschbaum, Klauer, Flipp, & Hellhammer, 1995).

Other studies have examined the impact of social support quality on cortisol production by manipulating social support type. Kirschbaum et al. (1995) used both friends and confederates when they examined the effect of short term social support on cortisol production in participants following in the Trier Social Stress Test. Participants either received no support, support from an opposite sex stranger (i.e., confederate), or support from their opposite sex boyfriend/girlfriend before engaging in the Trier Social Stress Test. In comparison to the control condition, experimenters found that when

support was provided by opposite sex strangers, cortisol levels decreased in males, but cortisol levels were reduced even further when support was provided by their female partner. However, for females, neither support from an opposite sex stranger or from a male partner produced as great of a benefit as for males. In other words, cortisol was not significantly reduced among females even though women rated the support that they received as being significantly more helpful than what was reported by males. Furthermore, females who used oral contraceptives showed low cortisol responses to the TSST regardless of the type of social support they recieved. Kirschbaum et al. (1995) state that in previous studies males who anticipated a stressor (public speaking) showed increased cortisol levels while females showed no response to the stressor. They suggest that non-responding and oral contraceptive use might explain smaller increases in cortisol responses to a stressor, which would make reductions from peak values to baseline values smaller as well.

Stress

Selye (1955) first defined stress as an adaptive reaction comprised of three stages (alarm reaction, stage of resistance, and stage of exhaustion) that followed a formulaic biological response which placed the body in a defensive state. Selye's work was seminal in the stress literature because it was first to identify a pathway for a stress response by linking a psychological phenomenon with a physiological response. Key in the stress response is the hypothalamic-pituitary-adrenal axis (HPA), the details of which are discussed below.

More recently, Krantz, Forsman, and Lundberg (2004) have defined stress as a physical, emotional or mental response to an external stimulus. Worldwide, researchers report that elevated stress levels contribute to numerous mental and physical symptoms such as heart disease, major depression, and memory deficits (Claar & Blumenthal, 2003; Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996; Mazure & Maciejewski, 2003; Russell, 2006). In keeping with Selye's early work, the primary mechanism by which stress is thought to produce its deleterious effects is by way of its activation of the HPA axis. This is a biological system that responds to mental or physical threats to stimulate the adrenal gland to release glucocorticoids in the form of cortisol into the bloodstream. The hormone cortisol completes a negative feedback loop initiated by the hypothalamus and the pituitary gland, signaling both structures to decrease the production of hormones activating the adrenal gland. Prolonged activation of the HPA axis sustains a "fight-or-flight" response, leading to a suppressed immune system and atrophied learning and memory centers of the brain (Miller, Chen, & Zhou, 2007). However, there exists great individual variability when it comes to cortisol responses to an acute stressor. The research on stress in humans places participants into one of two possible categories: Non-responders and responders.

Non-responders produce an increase in cortisol production that does not exceed 10% of their baseline value of cortisol production in response to a given stressor, while responders produce an increase in cortisol production that exceeds 10% of their baseline value of cortisol production (Kirschbaum et al., 1995). Concomitant with elevated cortisol levels, individuals who are "responders" tend to show an increase in the range of

heart rate variability, to report increased levels of subjective stress, and to show significantly greater impairments in mental health than individuals classified as "non-responders" (Kunz-Ebrecht, Mohamed-Ali, Feldman, Kirschbaum, & Steptoe, 2003). For this reason, experimenters often exclude participants who fall into the non-responder group from the final sample (Kirschbaum et al., 1996). Because stress poses a significant risk to the health of people in our modern day society, factors contributing to reactive stress responses have been the focus of much research. A recent line of research is starting to show that one of those factors, known as co-rumination, can produce exuberant stress responses.

Co-Rumination and Gender Differences

The general consensus among investigators involved in social support research is that high levels of social support are related to positive health outcomes, but this is not always the case (Heinrichs et al., 2003; Kamarck et al., 1990; Rosal et al., 2004). A recently defined form of social support, known as co-rumination, is the process of sharing negative thoughts, feelings, or ideas with a supporter that triggers the supporter to share similar thoughts and feelings of negativity (Rose, Carlson, & Waller, 2007). This process of venting to another person creates a stressful cycle that leads to no productive resolution or meaningful outcome for any of the issues that are discussed. Byrd-Craven, Geary, Rose, and Ponzi (2008) found that when experimenters asked pairs of participants to discuss a problem as they normally would about an emotionally troubling issue randomly assigned to them, some pairs tended to focus on the negative influence of the problem on either one person or both people involved in the issue. Pairs who co-

ruminated showed significant increases in cortisol production compared to pairs in the control condition. The results of this study were that participants co-ruminating about a shared problem produced significantly higher levels of cortisol than pairs of participants who had a casual conversation. The findings of this study suggest that in some instances, social support can have a detrimental impact instead of a positive impact on groups of people. Two additional studies investigating co-rumination revealed that participants who reported a high frequency of co-rumination also reported significantly higher levels of stress and anxiety than participants who reported low levels of co-rumination (Rose et al., 2007). In addition, adolescents reported co-ruminating significantly more often than children and that females reported co-ruminating significantly more often than males (Rose, 2002). These results imply that co-rumination increases with age and that it occurs at a higher rate among females.

It is assumed that women seek social support at a higher frequency than do males, so it makes sense that females have more opportunities to co-ruminate than do males (Day & Livingstone, 2003). An increase in social interaction among females enables women to remain open and to self-disclose information to other people in their social group. This allows members in the same social group to share emotionally sensitive information with each other which serves to build strong emotional and social bonds among members of a particular group (Belle, 1982). As members of a social group spend large blocks of time interacting with each other, they develop a sense of closeness and improve in friendship quality with one another (i.e., increased perceived social support),

but also, this may inadvertently increase their own stress level as their social support network grows over time (Calmes & Roberts, 2008; Rose, 2002).

Females tend to develop larger social networks than males, thereby increasing the number of opportunities that females have to share an emotionally troubling issue with another person which may make them more vulnerable to internalizing symptoms related to co-rumination than males. Males in contrast, display a distinctly different set of responses when faced with emotionally troubling thoughts or ideas. A plethora of research demonstrates that males seek lower amounts of social support as they age, that they are more likely to utilize drugs to cope with stress, and that they are more likely to develop mental and physical health problems when faced with excessive stress levels (Burda & Vaux, 1988; Takizawa, Kondo, Sakihara, Watanabe, Oyama, & Ariizumi, 2007; Zakowski, McAllister, Deal, & Baum, 1992). These results suggest that males tend to utilize support strategies that increase stress and that they participate in social processes that are perceived to be socially healthy coping mechanisms, such as co-rumination, to a lower degree than females.

Co-Rumination and Mood

Rose (2002) suggested that co-rumination plays a role in development of symptoms related to negative mood states such as depression and anxiety. In a follow up study conducted by Rose et al. (2007), they found that co-rumination activity positively correlated with both depressive symptoms and anxiety symptoms. Engagement in co-rumination is common among females, leading some researchers to theorize that females may be more susceptible to depression than males and that co-ruminating can increase

the likelihood of developing depressive symptoms among members of a social support network (Starr & Davila, 2009). This style of support utilizes maladaptive thought patterns that prevent members of a support network from using effective problem solving strategies, ultimately inducing depressive symptoms that in some cases can spread from one member to other members (Hoeksema, Parker, & Larson, 1994).

In a related study investigating the effects of rumination, low negative mood regulation, which is the ability to control mood by using various coping strategies, was reportedly associated with rumination or avoidant coping and with self-reported symptoms of depression (Drwal, 2008). Researchers hypothesized that participants suffering from depression are more likely to rethink stressful thoughts causing their state mood traits to shift in a more negative direction. An important note here is that participants who utilize this coping mechanism do not necessarily create new negative thoughts when they ruminate, but they amplify existing maladaptive cognitions (Ciesla & Roberts, 2007). According to Lavender and Watkins (2004), ruminative processes, whether they are experienced alone or with a cohort, influence the perception of future outcomes and can generate prolonged deleterious effects when people replay their thoughts with a negative outlook. Researchers report that people who are depressed and have pessimistic outlooks on future events are more vulnerable to the effects of rumination than others (Anderson, Spielman, & Bargh 1992). Rusting and Nolen-Hoeksema (1998) suggest that the ruminative coping process works in conjunction with associative network theory. Network theory proposes that information such as an emotion is structured in a way that links related ideas to each other (Rusting & Nolen-

Hoeksema, 1998). Rumination triggers activation of an emotion and brings with it thoughts, ideas, and experiences related to that emotion.

Associative network theory is based on the idea that the human brain is comprised of nodes that group memories together according to various emotional states such as happy or sad (Bower 1981). When a node such as happiness is activated, people are able to easily recall memories of people, places, or experiences that are related to this node but experience difficulty when attempting to recall situations related to an opposite node such as sadness. The co-rumination paradigm relates to associative network theory because it states that when a member of a group discusses an emotionally troubling issue with others, it primes the activation of a related node within each person's brain causing each member to recall or share similar thoughts or experiences, and creating an endless cycle of venting. Furthermore, Pravettoni, Cropley, Leotta, and Bagnara (2007) showed that constant rumination uses a variety of cognitive resources, making it difficult for people to dedicate these resources to other cognitive tasks. Rumination and co-rumination are strenuous processes that take a toll on people's cognitive capacity, making it challenging for many to recover from their negative effects, such as fatigue, stress or anxiety. It is important to note that adults are likely to form close relationships with friends, family, colleagues, or acquaintances, who are likely to serve as sources to practice co-rumination. To date, studies have been confined to friendships using self-report techniques.

Purpose

The purpose of this research was to examine the impact of directly manipulated social support in the form of co-rumination on stress levels in people following their

participation in the TSST. In addition, this study sought to analyze the influence of co-rumination on mood states related to depression, such as anger, fatigue, and anxiety. None of the studies mentioned previously examined how co-rumination would influence stress levels measured by cortisol production plus mood states in participants following their participation in the TSST. Some studies have (Heinrichs et al., 2003; Kamarck et al., 1990; Rosal et al., 2004) shown that social support is associated with increased calmness, decreased cortisol production, and decreased heart rate/blood pressure, whereas other studies have shown that social support is associated with increased cortisol production, increased stress levels, and increased anxiety levels (Rose, 2002; Rose et al., 2007).

This study sought to examine the impact of co-rumination on stress levels, as measured by cortisol production in adults, and to make sense of the conflicting results of studies reporting the benefits and drawbacks of social support. Based on the results reported by previous investigations, we predict that stressed participants, with or without co-rumination, will produce significantly higher levels of cortisol than those in the non-stressed control group and that stressed participants who co-ruminate will produce significantly higher levels of cortisol than those who do not co-ruminate. Co-rumination was provided by a confederate prior to the administration of the stressor. Also, stressed participants, with or without co-rumination, will report significantly higher mood scores on negative state sub-scales than non-stressed control participants, and that stressed participants who co-ruminate will report significantly higher mood scores on negative state sub-scales than stressed participants who do not co-ruminate.

Methods

Participants

An ethnically diverse sample of 147 male (n = 44) and female (n = 39) introductory psychology students, who were at least 18 years old, participated in this experiment to fulfill a course requirement. The group participated in a between subjects design with three experimental conditions; no stress/no co-rumination (control), stress/no co-rumination (stress), and stress/co-rumination (co-rumination), where the experimenter manipulated the amount of stress that participants received. Experimenters conducted each experimental session between afternoon and early evening hours to control for circadian rhythm effects on cortisol (Kirschbaum et al., 1996). Researchers assigned participants into one of the three conditions which depended on both the timeslot a participant signed up for and the availability of researchers during the day. Twenty-four hours prior to their participation in this study, researchers instructed all participants to refrain from smoking, exercising, and eating or drinking any food except for water one hour prior to their participation, all of which are factors that could confound the results of this study (Kirschbaum et al., 1996).

Investigators excluded participants who failed to comply with any of these restrictions because they could artificially alter cortisol production levels. In addition, participants who were pregnant, those who had any chronic neuroendocrine or inflammatory disorders, and those classified as “non-responders” were excluded from the final sample. Within the context of this study, participants were classified as non-responders if their post stress cortisol levels did not increase at least 10% from their pre-

stress cortisol level (Kirschbaum, et al., 1996). Fifty-three participants were classified as non-responders, nine participants violated experimental restrictions, and two participants had missing data and were removed from the final sample. Therefore the final sample consisted of 83 participants (44 male and 39 female) with an average age of 20.57 (*SD* = 5.26), with 36 participants (17 males and 19 females) in the control condition, 26 participants in the stress condition (17 males and 9 females), and 21 participants in the co-rumination condition (10 males and 11 females). The ethnic breakdown of the final group is as follows: 9.6% African American, 50.6% Asian, 20.5% Caucasian, 9.6% Latino, and 9.6% other/mixed. Furthermore, researchers received informed consent and assigned a three digit code to each participant to keep all the responses and the samples that each participant submitted anonymous.

Material and Devices

Trier Social Stress Test (TSST). The Trier Social Stress Test is an exercise used to induce a stress response in participants (Kirschbaum et al., 1993). The stress test is comprised of two separate exercises; a five-minute speech and a five-minute number counting task. During the stress task the experimenter instructed the participant to deliver a five minute impromptu speech to a panel of two judges while the panel evaluated and recorded the participant's performance using a video camera. The number counting task is an exercise that asked participants to count backwards from 2083 by 13 step intervals for five minutes. Each time they made a mistake, one of the two judges instructed the participant to start over from 2083.

Cortisol Collection. Saliva samples were collected from participants using Salivette test tubes (Sarstedt, Inc., Newton, NC). Each tube contained a cotton cylinder that participants chewed on for at least one minute for the salivette to absorb a sufficient level of saliva for an analysis at a later time. Each participant provided the experimenter with a total of three saliva samples. Experimenters stored all samples in a freezer at -80° Celsius. Experimenters analyzed cortisol levels produced in each sample using an enzyme-linked immunosorbent assay (Salimetrics, LLC, State College, PA), which is a technique that detects and measures salivary cortisol in nanomols per liter.

Brunel Mood Scale. Mood traits were evaluated using the Brunel Mood Scale which is a 24-item self-report questionnaire. It asked participants to indicate their current level on a series of mood traits such as boredom, anger, or annoyance on a likert scale that ranged from 1 (not at all) to 5 (extremely). The scores on the 24 items are combined to create six subscales that measure a participant's current mood level on the following traits: Anger, confusion, depression, fatigue, tension, and vigor.

Procedure

Participants in the control condition and participants in the stress condition were tested individually, while participants in the co-rumination condition were tested along with a confederate. All participants completed the experiment in one two-hour experimental session. Upon arrival to the lab, experimenters asked the participant or the participant and the confederate to sign a consent form and to fill out a screening questionnaire. The questionnaire contained six yes or no questions asking the participant if they smoked, exercised, or ate any food or drank any liquid other than water one hour

before arriving to the lab. In addition, it asked the participant to indicate if they were pregnant or if they had any chronic inflammatory or neuroendocrine disorders. Participants who answered yes to questions on the screening questionnaire were removed from the study.

Participants in the control condition and participants in the stress condition were instructed to sit alone in the lab while participants in the co-rumination condition were given the same instructions, but they sat in the waiting room with a confederate and began participating in the warm up phase of the co-rumination process. Co-rumination protocol was divided into two phases: A warm up phase and a problem talk phase (Byrd-Craven et al., 2008). During the warm up phase, the confederate initiated a conversation with the participant in order to bond with him or her and to build rapport. It followed a semi-structured discussion format where both the confederate and the participant discussed a series of pre-made topics such as school, work, and hobbies. The problem talk portion of the co-rumination process followed a similar semi-structured style, but focused on topics related to the speaking portion of the TSST, for example, inexperience with job interviews, stressful oral academic presentations, and fear of public speaking.

The problem talk phase did not immediately follow the warm up phase and took place later in the experiment (see Table 1). A short time later, the experimenter returned and announced that the confederate in the social support condition had been randomly selected to participate in an exercise in another room while the participant participated in an exercise in the waiting room. As part of another study, researchers exposed participants to a word list that assessed memory. Following the completion of the

memory exercise, experimenters collected a saliva sample (Table 1 - C1) and returned the confederate to the waiting room to sit with participants participating in the co-rumination condition. Next, experimenters introduced participants in both the stress and the co-rumination condition to the problem talk portion of the Trier Social Stress Test and instructed participants in the control condition to sit alone in a waiting room for a short period of time.

Table 1

Timeline for the Control, Stress, and Co-rumination Conditions in Ten Minute Intervals

Condition	Distractor			Experimental Manipulation	Brunel Mood Scale	Debrief
Control	Wait	C1	Wait	Video	C2	C3
Stress	Wait	C1	Wait	TSST	C2	C3
Co-rumination	Warm Up	C1	Co-rum	TSST	C2	C3
	0 10	20	30	40 50	60 70	80 90

Note. C = Cortisol sample, TSST = Trier Social Stress Test.

After participating in either the waiting period (control/stress) or the problem talk portion of the experiment (co-rumination), experimenters instructed participants in the control condition to watch a short travel video clip and informed participants in the stress condition and the co-rumination condition to prepare notes for the speaking portion of the TSST. Two judges administered the TSST to participants in another room and evaluated their performance following the preparation period. After which experimenters instructed participants to fill out the Brunel Mood Scale along with a demographic questionnaire and then collected another saliva sample (Table 1 – C2). If a participant finished filling out a measure early, the experimenter instructed the participant to read magazines until further notice. At the end of the study the experimenter collected the final sample (Table 1 – C3), the experimenter debriefed the participants about the study and the experimenter answered any questions that the participant asked.

Results

In accordance with Kirschbaum et al. (1996) procedures regarding cortisol analysis, researchers analyzed three samples collected from each participant; one pre-stress (Sample 1) at the start of the experiment to serve as a baseline value, one post stress (Sample 2) ten minutes after the cessation of the stressor to serve as a peak value, and a second post stress (Sample 3) thirty minutes after the cessation of the stressor to serve as a return to baseline value.

Table 2 shows the average amount of cortisol produced for each condition. There were no differences in baseline (Sample 1) cortisol levels among the control, stress, and co-rumination groups, F (2, 80) = 0.61, p = .544. This means that all groups started with similar baseline cortisol values when the experiment started. Cortisol levels differed among the three groups at Sample 2, F (2, 80) = 7.54, p = .001. Tukey post-hoc comparisons demonstrated that both the stress group (*MD* = -6.33, *SE* = 2.35, d = 1.35, 95% CI [-11.95, -.71] $p < .05$) and the co-rumination group (*MD* = -9.11, *SE* = 2.51, 95%, d = 0.76, CI [-15.11, -3.12] $p < .05$) had significantly higher cortisol levels than the control group at Sample 2. In addition, post-hoc comparisons between the stress group and the co-rumination group at Sample 2 were not statistically significant (*MD* = -2.78, *SE* = 2.68, d = 0.22, CI [-9.18, 3.62] $p > .05$). The differences between groups disappear at Sample 3, F (2, 80) = 2.69, p = .073. The stress group and co-rumination group demonstrated a similar response pattern by reaching peak cortisol levels at Sample 2 and decline over time to return to baseline levels at Sample 3. These results support the effectiveness of the Trier Social Stress Test in inducing stress in participants.

Table 2

Mean Cortisol Levels for the Control, Stress, and Co-Rumination Conditions in Nanomoles Per Liter

	Sample 1	*SD*	Sample 2	*SD*	Sample 3	*SD*
Condition						
Control	5.55	4.82	2.93	1.94	2.81	2.15
Stress	4.29	3.74	9.27*	6.33	4.67	2.93
Co-Rumination	7.09	15.47	12.05*	16.66	9.28	19.93

* Indicates significant differences between groups at $p = .05$

For the remaining statistical analyses, a single difference score was obtained for each participant. What is referred to as a "delta score" represents the difference between the baseline and peak cortisol levels. Delta 1 is the average change in concentration between Sample 1 and Sample 2. Delta 2 is the average change in concentration between Sample 1 and Sample 3. Table 3 displays the delta scores for each condition. The mean Delta 1 scores were $M = -2.62$ for the 36 participants in the control condition, $M = 4.97$ for the 26 participants in the stress condition, and $M = 4.95$ for the 21 participants in the co-rumination condition. ANOVAs' were performed on delta scores and yielded statistically significant F values at the .05 level for Delta 1, $F(2, 80) = 29.56$, $p < .001$ and Delta 2, $F(2, 80) = 7.81$, $p = .001$. Statistical significance among conditions prompted an in depth analysis between conditions.

Table 3

Delta Cortisol Values for the Control, Stress, and Co-Rumination Conditions in Nanomoles per Liter

	Delta 1	*SD*	Delta 2	*SD*
Condition				
Control	-2.62	4.01	-2.74	4.96
Stress	4.97*	4.34	0.38*	2.82
Co-Rumination	4.95*	5.26	2.19*	6.10

* Indicates significant differences between groups at $p = .05$

Tukey post-hoc tests confirmed statistical significance between Delta 1 scores, between control/stress (*MD* = -7.60, *SE* = 1.14, 95%, *d* = 1.81, CI [-10.34, -4.86] $p < .05$), and control/co-rumination (*MD* = -7.58, *SE* = 1.22, 95%, *d* = 1.61, CI [-10.50, 4.65] $p < .05$), but not for stress/co-rumination (*MD* = .02, *SE* = 1.30, 95%, *d* = 0.004, CI [-3.10, 3.14] $p > .05$). In addition, Tukey post-hoc tests confirmed statistical significance between Delta 2 scores between control/stress (*MD* = -3.12, *SE* = 1.22, 95%, *d* = 0.77, CI [-6.05, -.20] $p < .05$) and control/co-rumination (*MD* = -4.93, *SE* = 1.30, 95%, *d* = 0.88, CI [-8.05, -1.82] $p < .05$), but not for stress/co-rumination (*MD* = -1.81, *SE* = 1.39, 95%, *d* = 0.38, CI [-5.14, 1.51] $p > .05$). These results confirm that Delta 1 and Delta 2 scores for both the stress condition and the co-rumination condition were significantly greater than the Delta 1 and the Delta 2 scores for the control condition. These results indicate that stress levels remain significantly elevated for both the stress and the co-rumination condition, but show that there are no differences between the two experimental conditions. Furthermore, elevations in cortisol for the stress condition and the co-rumination plus stress condition followed a similar trend such that a sharp increase was observed at 10-min post stress and slowly approximated baseline levels by 30 minutes post stress. As predicted, post stress cortisol production for both the stress condition and the co-rumination condition goes up, while cortisol production for the control condition goes down. However, when the stress component was combined with the additional co-rumination variable it did not significantly elevate cortisol beyond the stress variable alone.

Based on results analyzing the differences in cortisol levels collected between the control, stress, and co-rumination groups, it was expected to find differences in mood characteristics between groups as well. Table 4 displays the mean mood scores for each condition on all six of the sub-scales analyzed with the Brunel Mood Scale. ANOVA tests revealed no significant differences among the conditions for anger F (2, 80) = 0.48, p = .620, confusion F (2, 80) = 1.71, p = .186, depression F (2, 80) = .79, p = .458, tension F (2, 80) = .01, p = .982, or vigor F (2, 80) = .28, p = .755, but it did find a significant difference among conditions on the fatigue subscale, F (2, 80) = 6.01, p < .004. Tukey post-hoc tests confirm that fatigue scores for the control condition are significantly higher than the fatigue scores of both the stress condition, (*MD* = 2.91, *SE* = 1.16, 95%, d = 0.64, CI [.13, 5.69] p < .05), and the co-rumination condition, (*MD* = 3.97, *SE* = 1.24, 95%, d = 0.86, CI [1.01, 6.95] p < .05). No differences emerged between the stress condition and the co-rumination condition on the fatigue sub-scale, (*MD* = 1.06, *SE* = 1.32, 95%, d = 0.24, CI [-2.11, 4.24] p > .05).

Table 4

Mean Mood Scores for the Control, Stress, and Co-Rumination Conditions

	Control	*SD*	Stress	*SD*	Co-Rum	*SD*
Sub-Scale						
Anger	5.72	2.42	6.35	3.44	5.71	2.02
Confusion	7.86	3.34	9.31	3.06	8.05	2.94
Depression	6.14	3.10	6.46	2.94	5.43	2.18
Fatigue	12.83	4.69	9.92*	4.36	8.86*	4.44
Tension	8.28	3.65	8.42	3.13	8.43	3.60
Vigor	9.67	3.86	9.73	3.67	10.43	4.19

* Indicates significant differences between groups at $p = .05$

Previous research regarding perceived social support conducted by this lab showed that gender played a role in the amount of cortisol produced following a participant's involvement in the Trier Social Stress Test. Table 5 shows that males typically produced an average amount of cortisol that was higher than females for both the stress condition and the co-rumination condition, but males also had larger standard deviation values than females for both conditions. Independent samples tests conducted between males and females for the control condition did not show significance for Sample 1 $t(34) = .35$, $p = .728$, $d = -0.11$, Sample 2 $t(34) = 1.00$, $p = .324$, $d = -0.33$, Sample 3 $t(34) = -.36$, $p = .716$, $d = 0.12$, Delta 1 $t(34) = .57$, $p = .955$, $d = -0.01$, and Delta 2 $t(34) = -.50$, $p = .620$, $d = 0.16$. T-tests analyzing differences between males and females for the stress condition followed a similar trend and did not show significance for Sample 1 $t(24) = -.77$, $p = .446$, $d = 0.30$, Sample 2 $t(24) = -1.72$, $p = .097$, $d = 0.65$, Sample 3 $t(24) = -.84$, $p = .406$, $d = 0.30$, Delta 1 $t(24) = -1.82$, $p = .080$, $d = 0.77$, and Delta 2 $t(24) = .14$, $p = .883$, $d = -0.07$. The final group of independent samples t-tests analyzed the differences between males and females for the co-rumination condition, but failed to find any significant differences for Sample 1 $t(19) = -.85$, $p = .403$, $d = 0.36$, Sample 2 $t(19) = -1.19$, $p = .249$, $d = 0.50$, Sample 3 $t(19) = -.94$, $p = .356$, $d = 0.40$, Delta 1 $t(19) = -1.20$, $p = .242$, $d = 0.52$, and Delta 2 $t(19) = -.90$, $p = .375$, $d = 0.39$.

Table 5

Mean Cortisol Values for Males and Females Between Conditions at Samples 1, 2, and 3

	Control	*SD*	Stress	*SD*	Co-Rum	*SD*
Sample 1						
Female	5.82	5.27	3.50	4.38	4.32	6.33
Male	5.25	4.41	4.71	3.43	10.14	21.62
Sample 2						
Female	3.24	2.22	6.43	7.92	7.97	8.17
Male	2.59	1.57	10.77	4.93	16.54	22.36
Sample 3						
Female	2.68	1.54	4.00	4.58	5.35	4.24
Male	2.95	2.72	5.00	1.60	13.61	28.68

Discussion

The purpose of this study was to determine the ability of a direct form of social support, co-rumination, to influence the production of cortisol following a stressful situation and to determine the influence that co-rumination has on six dimensions of mood; anger, confusion, depression, fatigue, tension, and vigor. The results of this experiment did not support my hypothesis which predicted an outcome similar to Rose et al. (2007) and Rose's (2002) data which show that when factors related to co-rumination come into play, this type of social support will act against support seekers and increase stress levels rather than decrease them. Although mean cortisol levels were higher in the co-rumination condition than the mean cortisol levels for the stress condition, co-rumination did not significantly increase cortisol above stress alone.

Variability among participants likely prevented the values in the co-rumination group (e.g., Cortisol Sample 3 = 9.28 +/-19.93) from reaching significance relative to the stress alone group (e.g., Cortisol Sample 3, *M* = 4.67 +/-2.93). This may have been due partly to the variability associated with demographic factors such as, ethnicity and gender. Present results are based on 50.6% Asian participant responses. Previous research has shown that Asian and Asian-American populations may exhibit unique responses to social support and we questioned whether our predominantly Asian sample may have contributed to the variance seen in the co-rumination group (Kim et al., 2008; Taylor et al., 2007). We conducted a small follow up investigation to explore this possibility.

Additional analyses examining differences between Asian and Non-Asian participants found a couple of interesting results. One, Non-Asian participants in the

stress condition produced higher Delta 1 cortisol values than Asian participants $t(25) = 5.846$, $p < .05$, while Asian participants in the co-rumination condition produced higher Delta 1 cortisol values than Non-Asian participants $t(20) = 4.314$, $p < .05$. This result indicates that Asian participants show a higher peak stress response following a stressor if they practiced co-rumination than Asian participants normally would display if they faced the same stressor on their own. In addition, Asian participants in the co-rumination condition displayed a faster recovery from stress than Non-Asian participants. Last, Asian participants displayed high variability when recovering from stress ($M = -3.91 \pm 10.98$) compared to Non-Asian participants ($M = -1.75 \pm 1.92$). This analysis indicates that ethnicity may have played a role in the amount of variability produced in the cortisol scores between conditions and it is consistent with previous research. Asians are reportedly less willing to seek social support when they are distressed, and they benefit less from it than do non-Asian groups (Kim, Sherman, Ko, & Taylor, 2006).

Oral contraception is another factor that may have played a role in the amount of variability produced in the cortisol scores between conditions. A large proportion of female participants in this study regularly used hormonally based birth control methods, which are known to artificially alter cortisol levels. In the present study, female participants used a variety of birth control methods that used varying degrees of hormones which may have produced different types of effects. An analysis examining the differences between participants using oral contraceptives and participants who do not use oral contraceptives found one significant difference between groups in the co-rumination condition. An independent samples t-test showed that participants in the co-

rumination condition that use oral contraceptives produce higher Delta 1 cortisol scores than participants that do not use oral contraceptives, $t(9) = 2.71$, $p < .05$. This result suggests that the combination of stress, co-rumination, and oral contraceptive use work together to keep cortisol levels elevated over time and prevent cortisol from returning to baseline levels.

Mood scores showed no differences between conditions on all sub-scales with the exception of the Fatigue sub-scale. Fatigue scores for both the stress condition and the co-rumination condition were significantly lower than the fatigue scores for the control condition. Based on the working mechanisms surrounding the sympathetic nervous system, this result makes sense. Stress activates a fight-or-flight response by using the sympathetic nervous system which increases stress levels while releasing hormones such as adrenaline and norepinephrine to deal with external stimuli that may be detrimental to the health and well being of an individual. When the sympathetic nervous system is activated, it prepares the body for action, thereby increasing energy levels in participants in both the stress and the co-rumination condition and causing them to report lower levels of fatigue.

The Trier Social Stress Test was used in this study to induce psychosocial stress in participants because it is widely reported to be an effective exercise that reliably increases cortisol levels (Kirschbaum et al, 1996). Furthermore, co-rumination is shown to evoke a similar stress response by forcing pairs to focus on stressful memories for a prolonged period of time. This study was designed to control for many variables that

may be confounding in order to strengthen the results of this study and to help clear up inconsistencies reported in the literature.

Control between variables was begun with volunteers for this study. First, volunteers were asked to refrain from eating, drinking, smoking, or exercising one hour prior to their participation in this study (Kirschbaum et al, 1996). Those who did not follow these guidelines were excluded because violations associated with any of these requests have been known to artificially alter cortisol levels. We sent out numerous phone calls, emails, and text messages to remind volunteers about the sensitive nature of this study, and as a result a few volunteers were prevented from participating. Second, volunteers who reported current pregnancies or any neuroendocrine or inflammatory diseases, such as arthritis, Cushing's disease, or asthma, were excluded from this study. Pregnancies are known to artificially inflate hormone levels, and both neuroendocrine and inflammatory diseases are reported to alter hormone production (Kirschbaum, Pirk, & Hellhammer, 1995; Rohleder, Wolf, Piel, & Kirschbaum, 2003). In addition, volunteers were notified that they were able to participate in this project between the hours of 12:00 p.m. and 6:00 p.m. Kirschbaum et al. (1996) reported that cortisol levels work in conjunction with the sleep-wake cycle and fluctuate dramatically early in the morning when people arise and late at night when preparing for sleep. Cortisol levels are the most consistent during the late afternoon and early evening hours. Lastly, those in the stress and co-rumination conditions who did not show at least a 10% increase in cortisol production from their baseline level following participation in the TSST were excluded from the final statistical analysis. The rules regarding participation in this study enabled

researchers to work with a specific population to increase the potential differences among experimental groups. To control for variability researchers kept data collection consistent among participants.

A set of strengths associated with this study is the consistent performance among experimenters. Prior to data collection, experimenters familiarized themselves with an informative script for each condition that went over details related to the study such as informed consent, instructions for each exercise and common questions that participants often asked. Researchers followed the script as closely as possible and were instructed to recite their lines concisely with little to no emotion. To control for the time of data collection, investigators mapped out a detailed timeline for all three conditions that synchronized exercise administration and saliva collection. Each exercise was administered at approximately the same time and each sample collection occurred about twenty minutes after the start of the experiment (baseline), ten minutes after the cessation of stress (peak), and thirty minutes post-stress (return to baseline). Next, to decrease variability within the experimenter and the confederate position, the primary investigator filled this position with a select group of individuals who served as either an experimenter or confederate on a regular basis. Each position required an orientation to the experiment, a couple days of training, two to three practice sessions, and memorization of experimental protocols related to each position in order to familiarize volunteers with the experiment and to develop consistency as well as timing.

The focus of this investigation is for the confederate of this study to develop a secure bond with the participants and to provide ruminative support, while the

investigator remains neutral and authoritative. A couple of studies show that females tend to evoke stronger feelings of support and greater amounts of friendship quality from both males and females than males are able to from either gender (Rose, 2002; Rose et al., 2007). To increase the support that participants received from our confederate and to decrease the perceived support that participants sought out from experimenters, the confederate position was filled by only females and the experimenter's role was controlled only by males. Although this study showed an increase in cortisol production for participants in both the stress condition and the co-rumination condition, which were significantly elevated compared to the control condition, there were no differences in cortisol levels between these two conditions and no differences between males and females for each condition.

In addition, this study examined the impact of co-rumination on several self-reported mood characteristics, but found that there were no differences between conditions on any of the Brunel Mood Scale's sub-scales with the exception of the fatigue subscale. Participants in the control condition reported significantly higher fatigue levels than participants in the stress and co-rumination conditions. There were no differences in self-reported fatigue values between participants in the stress condition and participants in the co-rumination conditions. Last, when this lab examined the impact that co-rumination had on the production of cortisol in Asian and Non-Asian participants, this lab did find significant differences between groups.

The mean cortisol values between conditions listed on Table 2 appear to be different, but a large amount of variability appears alongside each result. According to a

self-report study concerning recent health issues and coping behaviors, Kim et al. (2006) found that Asians seek lower levels of social support and that they perceive the help that they receive from friends and family to be less beneficial than other ethnic groups. Asians make up a large proportion of the population under investigation in this study and the variability present in the cortisol values may be attributed to ethnic differences. Due to the overrepresentation of Asians in this investigation and the underrepresentation of other cultural groups this lab was unable to compare the Asian population to other groups such as Caucasians, Latinos, or Africans. All other ethnicities were grouped together into one group and classified as "Non-Asians". When Asians were compared to Non-Asians, this lab found that Non-Asians are more stressed when they face a stressor alone and that Asians are more stressed when facing a stressor after co-rumination. Furthermore, Asians seem to recover from co-rumination at a higher rate than Non-Asians. There are a few possible procedural limitations that can serve as potential explanations for these results.

First, the co-rumination periods might not have been long enough. Each co-rumination session lasted ten minutes and required the confederate to sustain a structured conversation with a stranger that focused on bonding in the first session and stressful experiences related to public speaking in the second session. Most co-rumination studies ask participants to either self-report instances where they co-ruminated with a close friend or they instruct participants to co-ruminate with a loved one (Bryd-Craven et al., 2008; Calmes & Roberts, 2008; Rose et al., 2007). The emphasis of each study was to examine the relationship between two people who have previously established a bond

with one another. This study attempted to replicate the stress response that friends or loved ones generated between two strangers. Brief co-rumination sessions might have been too short and may have induced a weaker stress response than pairs who have known each other for longer periods of time. Longer friendships would potentially produce stronger stress responses creating noticeable differences between the stress condition and the co-rumination condition.

Second, confederates utilized a semi-structured discussion format to co-ruminate with participants. Flexible discussion periods and variable response patterns from participants in the co-rumination condition introduced variability from both participants and confederates into the study. Confederates attempted to adhere to their scripts as closely as possible, but needed to adjust their conversational style to fit the personality of the participant whom they spoke with. A lack of consistency in conversational style paired with no manipulation check on the quality of the confederate's performance possibly contributed to larger standard deviation values in the co-rumination group than in either the stress group or the control group. Last, medications such as birth control have a strong influence on the stress response that females experience (Kirschbaum et al., 1995; Rohleder et al., 2003). According to Rohleder et al. (2003), women who use hormonal birth control methods, such as the pill, show a blunted cortisol response to psychosocial stressors in comparison to women who do not use hormonal birth control methods. Hormonal birth control increases the release of corticosteroid binding globulins that connect to corticosteroids that come in the form of cortisol in the blood stream (Kirschbaum, Platte, Pirke, & Hellhammer, 1996). This prevents free stress molecules

from being released into the saliva causing birth control users to show a blunted stress response or a non-response to psychosocial stress (Kumsta, Entringer, Hellhammer, & Wüst, 2009). Even though this experiment has its limitations, a couple changes can improve the design of this experiment as well as lead to new experimental paths for investigations involving co-rumination.

One element of this study that experimenters should change in the future is to restrict the participant pool to only males who follow the same restrictions that were used in this investigation. Males respond to stress by producing greater levels of epinephrine, norepinephrine, and cortisol than females (Krantz et al., 2004). This implies that males are sensitive to stress and more challenged by stress inducing exercises than females. An all male population would enable researchers to detect subtle changes in cortisol production between conditions showing the influence that co-rumination has on the post-stress levels. Next, future investigations should implement manipulation checks that give both the participant and the confederate the opportunity to self-report the impact that co-rumination had on the participant from their perspective. Calmes and Roberts (2007) state that co-rumination increases cortisol levels while simultaneously activating depressive and anxious symptomology in pairs that co-ruminate even though they often report increases in friendship quality following a co-rumination session. Furthermore, the effects of social support are influenced by the perception of the amount of support that participants feel that they are receiving from other people (Gracia, & Herrero, 2004). A check on confederate's performance, friendship quality, and perceived support would allow future studies to learn more about that impact that social support co-variables have

on cortisol production following a stressor. Last, future experiments should examine the impact that co-rumination has on cortisol production and mood as a function of variables such as social support type, group size, or type of supporter (stranger, family member or significant other). This can lead to an increased applicability of the co-rumination model to a variety of experimental and real world conditions.

In conclusion, this study examined the impact of co-rumination on the production of cortisol and state mood traits following participation in a psychosocial stressor. Mean cortisol scores for the stress condition and the co-rumination condition were elevated compared to the control condition, but there were no discernable difference between the co-rumination condition and the stress condition. In addition, there were no differences between any conditions on five of six sub-scales that make up the Brunel Mood Scale. The only difference appeared on the fatigue sub-scale between the control/stress condition and the control/co-rumination condition. These results may be due to factors such as, length of co-rumination, strength of bonding between pairs, flexibility of the semi-structured conversational style, type of birth control, or medications used. In addition, investigations in the future should examine variables related to the co-rumination construct such as social support type, group size, or type of supporter. Social support involves using a certain type of strategy to cope with stressors in an attempt to buffer the deleterious effects of stress on the mental health and the physical health of individuals. Identifying the pros and cons associated with support type could enable social support providers and receivers to select a support method that addresses their social needs as well as maximize the benefits linked to the support type they are using.

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