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The Intrapersonal and Interpersonal Consequences of a New Experimental Manipulation of Co-Rumination

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Co-rumination is a form of interpersonal emotion regulation wherein dyads engage in extensive, cyclical conversations regarding the causes and consequences of problems and associated negative emotions. In the present investigation, we leveraged the biopsychosocial model of challenge and threat to elucidate the intrapersonal costs and interpersonal benefits of co-rumination. To do so, we developed the first direct experimental manipulation of co-rumination using a multimethod, dyadic approach to test the effects of co-rumination on both dyad members. Friend dyads (N = 172) engaged in conversation during which one dyad member (i.e., the discloser) divulged and discussed their most stressful, extradyadic problem with their friend (i.e., the responder). Dyads either engaged in co-rumination or talked about the problem as they would naturally. Validating the experimental paradigm, results revealed a pattern of intrapersonal costs (stressed/upset feelings and rumination) and interpersonal benefits (perceived partner responsiveness) of co-rumination that replicated and extended past research. Regarding challenge and threat, results indicated that female disclosers in the co-rumination (vs. natural) condition exhibited physiological responses corresponding to greater psychological threat (i.e., greater total peripheral resistance). This research contributes to a growing body of literature identifying co-rumination as a vulnerability factor that exacerbates stress, potentially leading to poor downstream health outcomes. Furthermore, these results highlight the importance of examining co-rumination from a dyadic perspective, as inter- and intrapersonal effects varied as a function of whether individuals were disclosing or responding during the problem talk discussion.

Keywords: co-rumination, interpersonal emotion regulation, challenge and threat, psychophysiology

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Close friendships serve as a primary context for emotion regulation (Gross et al., 2006). Self-disclosure within close relationships promotes intimacy (Berndt, 2002) and perceived social support following disclosure of negative events or emotions can buffer against the effects of stress (Marroquín, 2011; Uchino, 2006). However, research on co-rumination suggests that when self-disclosure becomes ruminative in nature, the benefits of social support on stress are attenuated (Guarneri-White et al., 2015). *Co-rumination* is characterized by extensive, cyclical conversations about causes and consequences of problems and associated negative emotions (Rose, 2002). Fundamentally, co-rumination is an interpersonal emotion regulation strategy wherein individuals leverage the support of others with the intent of gaining insight into their problems and assuaging negative affect (Dam et al., 2014; English & Eldesouky, 2020). However, these efforts are largely ineffective; Although those who co-ruminate tend to experience the interpersonal benefits of self-disclosure that reinforce the behavior, individuals also experience the intrapersonal costs of rumination.

To better understand the costs and benefits of co-rumination for both members of a friendship dyad, the current research integrates the literature on interpersonal emotion regulation with the biopsychosocial model of challenge and threat (Blascovich & Mendes, 2010) and examines stress appraisal processes stemming from experimentally manipulated co-rumination. To this end, we utilized a self-disclosure paradigm wherein close friends engaged in a conversation in the laboratory during which one dyad member (i.e., the discloser) divulged and discussed their most stressful, ongoing problem with their friend (i.e., the responder). Moreover, we developed a novel experimental manipulation in which we assigned dyads to either engage in co-rumination (co-rumination condition) or talk about the problem as they naturally would (natural condition). This novel experimental paradigm directly manipulated co-rumination to assess the effects of co-rumination above and beyond the effects of unprompted, problem-focused conversations.

Co-Rumination and Stress Appraisals

Co-rumination lies at the intersection of rumination and self-disclosure and is associated with the interpersonal benefits of self-disclosure and the intrapersonal costs of rumination (Rose, 2002). Although individuals aim to downregulate their negative emotions

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via co-rumination (Dam et al., 2014), the ruminative nature of co-rumination is associated with increases in depressed mood (White & Shih, 2012), greater emotional exhaustion and burnout (Boren, 2013, 2014), and onset and exacerbation of psychopathology (Rose et al., 2017; Stone et al., 2011). Furthermore, co-rumination leads to other maladaptive coping strategies downstream such as intrapersonal rumination (Aldrich et al., 2019) and precludes more adaptive strategies such as problem solving (Waller et al., 2014). At the same time, co-rumination fosters prorelationship qualities through self-disclosure that reinforce the behavior such as trust (Dam et al., 2014) and emotional intimacy (Rose, 2002; Rose et al., 2014) and leads to increases in friendship quality over time (Rose et al., 2007).

Both the ruminative and self-disclosure components of co-rumination have implications for stress appraisal processes, which are integral to downstream physiological stress responses. Ruminative qualities of co-rumination such as perseveration, speculation regarding causes and consequences of problems, and negative valence may result in greater perceived situational demands (e.g., perceptions of required effort, uncertainty, danger) and fewer coping resources (e.g., perceptions of skills/ability, knowledge, and familiarity). Additionally, those who engage in ruminative thought and conversation tend to view their problems as more upsetting and harder to solve (Lyubomirsky et al., 1999; Lyubomirsky & Nolen-Hoeksema, 1995), they report lower self-confidence (Davidson et al., 2014), and are more sensitive to rejection (Carlucci et al., 2018). Thus, co-rumination may lead individuals to believe that they are less capable of dealing with the problem they are facing. Regarding self-disclosure, although disclosure of thoughts and emotions is a key predictor of increases in relationship intimacy over time, self-disclosure also includes inherent risk of rejection from others due to revealing personal information that reflects core aspects of the self (Laurenceau et al., 1998). Taken together, the ruminative and self-disclosure processes underlying co-rumination may lead disclosers to appraise greater demands and fewer resources going into a conversation where co-rumination occurs.

Although co-rumination should result in greater demands and fewer resources for disclosers, it is less clear how co-rumination may affect responders. Emotion regulation primarily occurs in social contexts, yet researchers have only recently begun to recommend dyadic approaches to studying the inter- and intrapersonal outcomes associated with specific emotion regulation strategies (English & Eldesouky, 2020). Research on expressive suppression, for example, has shown that attempts by one dyad member to regulate their own emotions can impact the physiological, affective, and behavioral outcomes of responders (e.g., Peters & Jamieson, 2016; Peters et al., 2019; Peters et al., 2014).

Like expressive suppression, co-rumination is an inherently dyadic emotion regulation strategy wherein attempts by disclosers to co-ruminate directly influence responders. For example, responders of those who engage in greater co-rumination tend to experience empathic concern, leading to distress as if the problem were their own (Smith & Rose, 2011), which could account for the transmission of internalizing symptoms observed within friendship dyads (Schwartz-Mette & Rose, 2012). In terms of stress appraisals, responders may take on the emotional and cognitive burden of disclosers' problems leading to increases in situational demands such as upset feelings, pressure to provide effective social support, or cognitive load due to problem-solving attempts. Yet, when compared to disclosers, these demands are likely to be less salient for responders because ultimately, they are not experiencing the problem firsthand, and they do not necessarily have the additional demands associated with self-disclosure and the accompanying risk of rejection.

Co-Rumination and the Biopsychosocial Model of Challenge and Threat

The biopsychosocial model of challenge and threat provides a theoretical framework for assessing stress appraisal processes during peak physiological reactivity of a stressful conversation. This theory posits that during acute stress, appraisals of situational demands and coping resources determine downstream activation of the sympathetic–adrenal–medullary (SAM) and hypothalamic–pituitary–adrenal (HPA) axes, which interact to mobilize metabolic resources to cope with the stressor (Blascovich & Mendes, 2000, 2010; Seery, 2011; Tomaka et al., 1997). Consequently, cardiovascular measures can be used to distinguish between adaptive (challenge) and maladaptive (threat) responses to acute stress. Challenge responses occur when perceived coping resources meet or exceed situational demands, whereas threat responses occur when perceived situational demands outweigh coping resources. Challenge and threat are anchors on a continuum of stress responses with appraisals of demands and resources moving individuals along the continuum toward either challenge or threat.

Both challenge and threat responses are characterized by SAM activation, which results in increased heart rate and ventricular contractility (VC). Demonstrating SAM activation via increases in VC is a prerequisite for assessing challenge and threat. In challenge responses, the accompanying release of catecholamines such as epinephrine causes vasodilation in skeletal muscles, decreasing vascular resistance—indexed by total peripheral resistance (TPR)—and increasing cardiac output (CO)—the volume of blood ejected from the heart in a given period of time. In threat responses, the HPA axis modulates SAM activation by inhibiting the release of epinephrine and its effects, resulting in relatively higher TPR and little (or no change in) CO (Blascovich & Tomaka, 1996; Brownley et al., 2000; Seery, 2011).

In the current research, we utilize the biopsychosocial model of challenge and threat to elucidate how stress processes elicited during the first minute of co-rumination occur within dyads and whether these processes differ between disclosers and responders. For individuals engaging in greater co-rumination, the combination of greater demands (e.g., perceiving problems as more upsetting and difficult to solve) and fewer resources (e.g., lower self-confidence and less effective problem solving) should be associated with greater threat (less challenge) responses. Additionally, this association between greater co-rumination and greater signs of threat should be particularly evident for disclosers (relative to responders) who have the added demands of disclosing their most stressful, ongoing problem. Only one study to date has examined physiological measures of stress associated with co-rumination (Byrd-Craven et al., 2008, 2011). Researchers found that in a problem-focused conversation between friends greater observed co-rumination was associated with higher salivary cortisol (the product of the HPA axis). This relationship was not found in a nonproblem talk comparison group. These results provide preliminary correlational evidence that co-rumination may lead to greater physiological indicators of

threat, as physiological indicators of HPA axis activation and cardiovascular indices of threat have aligned in other dyadic emotion regulation paradigms (Peters & Jamieson, 2016).

Sex Differences in Co-Rumination

The potential effect of sex is relevant to this investigation, as extant literature has emphasized sex differences in behavior and outcomes of co-rumination. Several influential studies have documented a pattern of costs and benefits for females (Calmes & Roberts, 2008; Rose, 2002; Smith & Rose, 2011), which has spurred a body of literature examining co-rumination using exclusively female samples (e.g., Byrd-Craven et al., 2008, 2011; Byrd-Craven & Massey, 2013; Starr & Davila, 2009). Although a meta-analysis showed that females do engage in co-rumination more frequently, which accounts for greater costs and benefits of co-rumination (Spendelow et al., 2017), findings for males were mixed. Some researchers suggest that these mixed findings may be due to constraining the operational definition of co-rumination to only same-sex friendship dyads (Calmes & Roberts, 2008; Rose, 2002; Smith & Rose, 2011). However, the context in which co-rumination is measured is important, as preferred confidants vary according to sex, with males confiding more frequently in different-sex friends (Barstead et al., 2013). When co-rumination is not constrained to same-sex friendships, the sex differences in the tendency to co-ruminate do not emerge (Barstead et al., 2013). Given these mixed findings and measurement confounds, research that utilizes samples of same- and different-sex dyads and that distinguishes between effects for males and for females is needed to understand more thoroughly who is at risk of negative outcomes of co-rumination. As detailed in the data analytic plan, we explore the effect of sex on outcomes of co-rumination, focusing specifically on females given the sex distribution of the sample.

Current Research

In this study, we conceptualized co-rumination as an interpersonal emotion regulation strategy, integrating the biopsychosocial model of challenge and threat to better understand the interpersonal and intrapersonal consequences of experimentally induced co-rumination for both members of a friendship dyad. Close friends engaged in a conversation during which one dyad member (the discloser) disclosed and discussed their most stressful, ongoing problem with their friend (the responder). Dyads either engaged in co-rumination (co-rumination condition) or talked about the problem as they naturally would (natural condition). The primary aims of this study were to (a) validate the experimental paradigm used to manipulate co-rumination and (b) assess the effect of co-rumination on cardiovascular stress responses.

To validate the experimental paradigm, we first examined the extent to which individuals engaged in co-rumination in each condition. We hypothesized (Hypothesis 1a) that both self- and observer-reports would indicate greater co-rumination in the co-rumination (vs. natural) condition. Additionally, we expected a successful manipulation of co-rumination to result in a pattern of intrapersonal costs and interpersonal benefits like extant findings in the literature. Thus, we examined intra- and interpersonal outcomes as a function of condition (co-rumination vs. natural) and role (discloser vs. responder). Specifically, we hypothesized that (Hypothesis 1b) co-rumination would result in greater negative affect (stressed and upset feelings), greater use of generally maladaptive intrapersonal coping strategies (rumination), and greater interpersonal benefits (perceived partner responsiveness) in the co-rumination (vs. natural) condition (i.e., a condition effect). Although extant research has yet to distinguish the effects of role in co-ruminative conversations, we expected that (Hypothesis 1c) across conditions, disclosers would report greater stressed and upset feelings, rumination, and perceived partner responsiveness than responders (i.e., a role effect) due to experiencing the problem firsthand and eliciting prorelationship behavior from responders through disclosure.

To test the effect of our co-rumination manipulation on stress appraisal processes, we utilized cardiovascular indices of challenge and threat that peak during the first minute of the conversation. We hypothesized that during this time, individuals in the co-rumination (vs. the natural condition) would exhibit a cardiovascular profile indicative of greater threat and less challenge (increases in TPR and little or no change in CO). However, due to greater and more salient demands associated with disclosing a problem as opposed to responding to it, we expected that (Hypothesis 2) the positive association between co-rumination and threat would be exacerbated for disclosers (i.e., a condition $\times$ role interaction). Finally, given the mixed findings in the co-rumination literature regarding sex differences, the heavy emphasis extant co-rumination research has placed on effects of co-rumination for females, and limitations in the sex distribution of the sample (see Data Analytic Plan section for more details) we explore Hypotheses 1 and 2 above specifically with regard to females.

Method

Power Analysis

A series of Monte Carlo simulations were conducted with equality constraints for the paths modeling effects of each dyad (Lane & Hennes, 2018; Mehl & Connor, 2012) using past dyadic data sets with similar physiological measures to approximate effects (Peters et al., 2014, 2018, 2019; Peters & Jamieson, 2016). Focusing on hypothesized interaction effects with an estimated small-to-medium effect size ($r \approx .20$), 120 dyads were needed to achieve sufficient power (>.80). After obtaining the target sample size, we continued collecting data through the end of the academic semester to account for cases that might be removed due to unforeseen validity concerns.

Participants

Friendship dyads were recruited from a population of undergraduates at a Midwestern university. Dyads were eligible to participate if both participants were 18 to 30 years of age, did not have a cardiac pacemaker, considered themselves to be close or best friends, and were not in a romantic relationship with each other. Questionnaires contained two attention check items (e.g., "Select *2* for this item")—one before and one after the conversation. For those who failed an attention check ($N = 5$), questionnaire data for that portion of the study were removed. The final sample consisted of 344 individuals (266 females, 72 males; $M_{age} = 18.86$, $SD = 1.30$, range = 18–30 years) in 172 dyads (see Tables 1 and 2 for descriptive statistics). Demographic information for six individuals was missing due to computer error. Individuals were compensated with their choice of course credit or $16 US.

Table 1
Age and Friendship Length for Full Sample and Split by Condition

Variable	Full sample		Natural condition		Co-rumination condition	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	18.86	1.30	18.81	1.32	18.91	1.29
Friendship length (months)	28.44	41.84	26.48	37.84	30.18	45.13

Note. $N = 344$. Data missing for 6 cases (1.7%).

Procedure

Data from this investigation have not been published elsewhere. All study procedures were conducted after review and approval from the Ohio University Institutional Review Board. Upon entering the laboratory, research assistants escorted participants to private testing rooms. After confirming eligibility for the study and completing the informed consent process, participants completed the problem-generation questionnaire (see the Measures section). Trained research assistants then affixed physiological sensors to each participant and instructed them to relax for a 5-min resting autonomic baseline period. After baseline, participants received instructions for the problem-focused conversation wherein one member of the dyad (the discloser) was randomly assigned to discuss one of the extradyadic problems they disclosed in the problem-generation questionnaire. The other member of the dyad (the responder) was assigned to respond to their friend. Severity items (see the Measures section) were summed for each problem and the discloser's most severe problem was assigned by the experimenter for discussion.

Additionally, dyads were assigned to one of two conditions. In the co-rumination condition ($N = 90$ dyads), participants were instructed to do the following: stay on topic, go over the problem multiple times, speculate about the causes and consequences of the problem, and uncover and dig into negative emotions. In the natural condition ($N = 82$ dyads), participants were instructed to talk about the problem as they naturally would (see the online supplemental material for full manipulation instructions). In both conditions, participants received cards to remind them of the instructions. Next, experimenters told participants to "gather their thoughts" for 3 min in their private testing rooms before instructing them to complete a short questionnaire regarding their appraisals of demands and coping resources for the upcoming conversation. After both participants finished the questionnaire, a foldable, sound-insulated wall separating the two private participant rooms was collapsed, and dyads engaged in an eight-minute, video-recorded conversation. After the conversation, the wall was closed and participants answered a series of questionnaires regarding co-rumination, stressed and upset feelings, rumination, and perceived partner responsiveness during the conversation (see the Measures section). Participants completed additional tasks and questionnaires not germane to the current investigation (see the online supplemental materials for full procedure). At the conclusion of the study, research assistants removed the physiological sensors and participants completed a demographic questionnaire.

Measures

Problem-Generation Questionnaire

The problem-generation questionnaire (Rose et al., 2005) prompted participants to write about two extradyadic problems they were experiencing at that time. Extradyadic problems were defined as personal problems that did not include the friend that they brought with them to the study. Participants then responded to seven items that assessed the severity of the problem on a scale

Table 2
Demographic Information for Full Sample and Split by Condition

Variable	Full sample		Natural condition		Co-rumination condition	
	N	%	*N*	%	*N*	%
Self-reported sex at birth						
Male	72	20.93	36	21.95	36	20.00
Female	266	77.33	126	76.83	140	77.78
Dyad sex composition						
Both female	119	69.19	58	70.73	61	67.78
Both male	23	13.37	13	15.85	10	11.11
Male and female	26	15.12	10	12.20	16	17.78
Race						
White	270	78.49	129	78.66	141	78.33
Black, African American	33	9.59	24	14.63	9	5.00
Asian	13	3.78	2	1.22	11	6.11
Mixed	15	4.36	6	3.66	9	5.00
Other	7	2.03	1	0.61	6	3.33
Hispanic origin						
No, Hispanic	326	94.77	157	95.73	169	93.89
Yes, Hispanic	12	3.49	5	3.05	7	3.89

Note. $N = 344$. Demographic information missing for 6 cases (1.7%).

from 1 (*not at all*) to 7 (*very much*). This method of generating conversation topics has been used in the co-rumination literature to generate an extradyadic problem discussion (e.g., Byrd-Craven et al., 2011; Rose et al., 2014).

Paradigm Validation

Self-Reported Co-Rumination. After the conversation, participants reported the extent to which they agreed with four statements pertaining to co-ruminative behavior they engaged in during the conversation on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Items included "I kept us on topic," "I encouraged us to go over the problem multiple times in order to understand the problem better," "I encouraged us to talk about the causes and consequences of the problem," and "I encouraged us to talk about negative emotions." Items were averaged to create a self-reported co-rumination score ($\alpha = .833$) for each dyad member.

Observer-Reported Co-Rumination. Trained research assistants who were blind to condition assignment and study hypotheses coded participants' co-rumination behavior using a coding scheme adapted from Rose (2002). For each individual in the interaction, coders scored quality (0 = *not at all*, 5 = *very high*) and quantity (0 = *not at all*, 5 = *nearly the whole time*) for each of the following dimensions of co-rumination in 1-min epochs: staying on topic (intraclass correlation coefficient [ICC] = .956; ICC = .948), going over the problem multiple times (ICC = .585; ICC = .682), speculating about causes and consequences of the problem (ICC = .743; ICC = .822), and discussing negative emotions (ICC = .703; ICC = .816). Scores were averaged across the conversation to create an observer-reported co-rumination score for each member of the dyad. See the online supplemental materials for more details regarding coding of quality and quantity of each dimension.

Stressed and Upset Feelings. Two face-valid items assessed the extent to which participants felt stressed and upset by the problem conversation, "To what extent did you find the conversation stressful?" and "To what extent were you upset during the conversation?" These items were measured on a scale from 1 (*not at all*) to 7 (*very much*) and averaged to create a composite score ($\alpha = .735$).

Rumination. Four items (i.e., "My thoughts and emotions were preventing me from focusing on finding possible solutions," "I kept going over and over the same thing," "I was getting stuck on the causes of problems rather than the solutions," and "I kept thinking about why this was a problem") adapted from prior research on rumination (Gratz & Roemer, 2004; Low et al., 2019; Nolen-Hoeksema, 1987, 1991) assessed the extent to which individuals ruminated during the conversation on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Items were averaged to create a rumination score for each dyad member ($\alpha = .725$).

Perceived Partner Responsiveness. After the conversation, perceived partner responsiveness was measured by the items "To what extent do you agree or disagree that you feel . . . (1) understood/validated by your friend? (2) cared for/loved by your friend?", adapted from Gable et al. (2012) and Reis et al. (2018), rated on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), ($\alpha = .821$).

Cardiovascular Reactivity

Cardiovascular signals were acquired during the autonomic baseline and conversation. Electrocardiography (ECG), impedance cardiography (ICG), and momentary blood pressure (BP) were collected to derive ventricular contractility (VC), cardiac output (CO), and total peripheral resistance (TPR). ECG electrodes were affixed in a lead II configuration and ICG hardware (NICO100C, Biopac Systems, Inc.) with band sensors was used to measure impedance magnitude (Z_0) and its derivative (dZ/dt). Signals were amplified using a Biopac MP160 system and recorded using Acqknowledge 5.0 software. BP readings were initiated and recorded from a separate control room using an ambulatory monitoring system (ColinT105, Colin Medical Instruments, San Antonio, TX) with a cuff placed on the participant's dominant arm. BP readings, including systolic, diastolic, and mean arterial pressure were collected every 2 min.

ECG and ICG signals were scored in one-minute epochs by trained personnel who were blind to condition assignment. Signals were visually examined for artifacts and ensemble averages were analyzed using MindWare software (IMP v3.2.4; MindWare Technologies, Gahanna, OH). B-points in the dZ/dt wave (opening of aortic valve) and Q-points in the ECG wave (start of left ventricle contraction) were calculated using the maximum slope change method. R-points in the ECG wave (left ventricle contraction) were detected by MindWare software. Researchers visually examined all B, Q, X, and R points and made manual corrections when necessary, before deriving VC, CO, and TPR. VC was derived by computing the interval between the Q and B points and multiplying by -1, such that greater values correspond to greater sympathetic nervous system arousal. CO was derived using the following equation: CO = stroke volume * heart rate. Stroke volume is the volume of blood ejected per heartbeat and is computed by Mindware analytic software using the Kubicek equation. Finally, TPR was derived using the equation: TPR = CO * mean arterial pressure / 80. Mean arterial pressure (MAP) values used to calculate TPR were measured directly, as opposed to calculated from systolic and diastolic blood pressure. Reactivity scores for VC, CO, and TPR were computed by subtracting scores obtained during the last minute of baseline from scores during the first minute of the conversation (Llabre et al., 1991). Extant research indicates that cardiovascular reactivity scores are highly reliable (Cronbach's αs $> .8$) (Kelsey et al., 2007). See Table 3 for descriptive statistics of dependent variables.

Data Analytic Plan

Following the guidelines by Kenny et al. (2006) for dyadic data analysis, we conducted a series of multilevel models in SPSS 26 using the MIXED procedure. These models use a heterogeneous compound symmetry covariance structure to account for the inherent dependency within distinguishable dyads (Kenny et al., 2006). To test our hypotheses, in Model 1 we regressed dependent variables on the fixed effects of condition, role, and condition $\times$ role. To test whether the pattern of results held for females specifically, in Model 2 we regressed dependent variables on condition, role, sex, condition $\times$ role, sex $\times$ condition, sex $\times$ role, and sex $\times$ condition $\times$ role. Members of each dyad were distinguished by role. Contrast codes indexed condition (-1 = natural, 1 = co-rumination) and role (-1 = responder, 1 = discloser) and a dummy code indexed sex (0 = female, 1 = male). We chose to dummy code sex rather than use a contrast code because of the sex imbalance in the sample, resulting in a lack of power to test interactions with sex. By dummy coding (as opposed to excluding male participants altogether), our analytic

Table 3
Descriptive Statistics for Variables of Interest for Full Sample and Split by Condition

Variable	Full sample (N = 344)		Natural condition (N = 164)		Co-rumination condition (N = 180)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Observed co-rumination	4.88	1.2	4.38	1.2	5.34	1.01
Self-reported co-rumination	2.56	0.54	2.40	0.56	2.70	0.49
Stressed/upset feelings	2.28	1.54	1.92	1.28	2.62	1.68
Rumination	3.29	1.26	3.12	1.29	3.44	1.23
Responsiveness	6.34	0.75	6.24	0.82	6.44	0.66
VC	6.67	9.75	6.82	11.45	6.53	7.90
CO	−0.02	0.48	0.00	0.51	−0.04	0.45
TPR	233.93	392.46	224.79	381.29	242.44	403.60

Note. VC = ventricular contractility; CO = cardiac output; TPR = total peripheral resistance.

approach for Model 2 conservatively limits our interpretations and conclusions to female partici-pants, while retaining data from different-sex dyads (N = 26) and including sex interaction terms. All zero-order correlations between the primary study variables for the full sample and split by sex are presented in Tables S1 and S2 in the online supplemental materials. For interested readers, in the online supplemental materials we also present models where systolic, diastolic, and mean arterial pressure are used as the dependent variables.

Results

Paradigm Validation

Hypothesis 1a: Co-Rumination Behavior

We hypothesized that according to both self- and observer-reports, disclosers and responders in the co-rumination (vs. natural) condition would engage in greater co-rumination. Supporting our hypothesis, results from Model 1 revealed that individuals in the co-rumination (vs. natural) condition reported engaging in significantly more co-rumination. Similarly, individuals in the co-rumination (vs. natural) condition were reported by observers to have engaged in significantly more co-rumination. In addition to the hypothesized condition effect, observers also reported that disclosers co-ruminated more than responders. Results from Model 2 revealed the same pattern of results as Model 1, for females. Full results for this section can be viewed in Table 4.

Hypothesis 1b and 1c: Costs and Benefits of Co-Rumination

We hypothesized that (H1b) co-rumination would result in greater stressed and upset feelings, rumination, and perceived partner responsiveness in the co-rumination (vs. natural) condition. Additionally, we expected that (H1c) across conditions, disclosers would report greater stressed and upset feelings, rumination, and perceived partner responsiveness than responders (i.e., a role effect). Full results for this section can be viewed in Table 4.

As expected, analyses from Model 1 revealed that individuals rated the conversation as more stressful and upsetting and reported engaging in greater ruminative thought when in the co-rumination (vs. natural) condition and when in the discloser (vs. responder) role. Individuals perceived their partner to be more responsive in the co-rumination (vs. natural) condition and in the discloser (vs. responder) role. These effects were qualified by a condition × role interaction (see Figure 1), such that disclosers perceived their partners (responders) to be engaging in high levels of responsiveness regardless of condition assignment (B = .03, 95% CI [−.09, .14], t = .45, p = .654, r = .03), whereas responders perceived their partners (disclosers) to be more responsive in the co-rumination (vs. natural) condition (B = .17, 95% CI [.06, .29], t = 3.07, p = .003, r = .23).

Analyses from Model 2 revealed the same pattern of results for females, with one exception. A significant condition × role interaction on self-reported rumination (see Figure S6 of the online supplemental materials) indicated that female disclosers reported engaging in high levels of rumination regardless of condition assignment (B = −.03, 95% CI [−.24, .19], t = −.27, p = .786, r = .02), whereas female responders reported engaging in greater rumination in the co-rumination (vs. natural) condition (B = .26, 95% CI [.06, .47], t = 2.51, p = .013, r = .19).

Overall, these findings provide evidence that we successfully manipulated co-rumination. Both self- and observer-reports indicate that on average, those in the co-rumination condition were engaging in more co-ruminative behavior than those in the natural condition. Additionally, the co-rumination (vs. natural) condition resulted in greater intrapersonal costs (i.e., greater stressed and upset feelings and intrapersonal rumination) for both dyad members and greater interpersonal benefit (i.e., greater perceived partner responsiveness) for responders. Results of Model 2 indicate that these findings hold for females, aside from self-reported rumination where the effect of condition varied based on role in the conversation.

Hypothesis 2: Cardiovascular Indicators of Challenge and Threat

Our second aim was to use cardiovascular indicators of challenge and threat to examine stress appraisal processes occurring as a result of experimentally manipulated co-rumination. Full results for this section can be viewed in Table 5. As a prerequisite for assessing challenge and threat, we tested whether individuals displayed an increase in ventricular contractility from baseline (Seery, 2011). Results from Model 1 revealed that, on average, participants exhibited a significant increase in VC (i.e., greater sympathetic arousal) from baseline, justifying the use of CO and TPR as indicators of psychological challenge and threat.

We hypothesized an effect of condition qualified by a condition × role interaction such that individuals in the co-rumination (vs. natural

Table 4
Effects of Condition, Role, and Sex on Self- and Observer-Reported Co-Rumination, Stressed and Upset Feelings, and Rumination

Variable	Model 1				Model 2			
	B	*SE*	*t*	*r*	*B*	*SE*	*t*	*r*
Self-reported co-rumination								
Condition	0.48	0.06	7.47**	0.50	0.50	0.07	6.81**	0.45
Role	−0.03	0.06	−0.51	0.04	−0.01	0.06	−0.17	0.01
Condition × Role	−0.04	0.06	−0.74	0.06	−0.04	0.15	−0.25	0.01
Sex					−0.10	0.06	−1.56	0.12
Condition × Sex					−0.13	0.15	−0.82	0.05
Role × Sex					−0.08	0.14	−0.53	0.03
Condition × Role × Sex					0.29	0.14	2.05*	0.13
Observer-reported co-rumination								
Condition	0.15	0.03	4.45**	0.33	0.15	0.04	4.12**	0.29
Role	0.16	0.02	8.96**	0.57	0.15	0.02	7.34**	0.49
Condition × Role	0.01	0.02	0.33	0.03	−0.10	0.07	−1.45	0.08
Sex					0.00	0.02	0.13	0.01
Condition × Sex					−0.03	0.07	−0.46	0.03
Role × Sex					0.06	0.05	1.20	0.09
Condition × Role × Sex					0.02	0.05	0.34	0.02
Stressed/upset feelings								
Condition	0.35	0.09	3.80**	0.28	0.35	0.10	3.44**	0.24
Role	0.38	0.06	5.97**	0.42	0.36	0.07	4.88**	0.35
Condition × Role	0.08	0.06	1.31	0.1	0.01	0.07	0.13	0.01
Sex					−0.09	0.20	−0.46	0.03
Condition × Sex					−0.04	0.20	−0.19	0.01
Role × Sex					0.14	0.17	0.87	0.06
Condition × Role × Sex					0.39	0.17	2.36*	0.16
Rumination								
Condition	0.16	0.07	2.16*	0.17	0.12	0.08	1.42	0.10
Role	0.30	0.06	5.15**	0.37	0.28	0.07	4.09**	0.30
Condition × Role	−0.11	0.06	−1.87	0.15	−0.15	0.07	−2.18*	0.16
Sex					0.02	0.17	0.10	0.01
Condition × Sex					0.17	0.17	0.98	0.06
Role × Sex					0.13	0.15	0.81	0.05
Condition × Role × Sex					0.14	0.15	0.93	0.06
Perceived partner responsiveness								
Condition	0.10	0.05	2.14*	0.16	0.07	0.05	1.47	0.11
Role	0.08	0.03	2.54*	0.19	0.10	0.04	2.68**	0.20
Condition × Role	−0.07	0.03	−2.22*	0.17	−0.10	0.04	−2.64**	0.20
Sex					−0.29	0.10	−2.86**	0.16
Condition × Sex					0.10	0.10	0.93	0.05
Role × Sex					−0.05	0.09	−0.54	0.04
Condition × Role × Sex					0.12	0.09	1.39	0.09

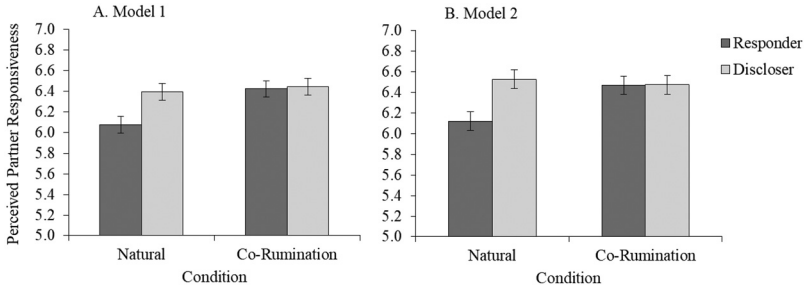
Note. Condition was contrast coded −1 = natural, 1 = co-rumination. Role was contrast coded −1 = responder, 1 = discloser. Sex was dummy coded 0 = female, 1 = male.
* $p < .05$. ** $p < .01$.

condition) would exhibit a cardiovascular profile consistent with greater threat and less challenge (i.e., increases in TPR, little or no change in CO) and that this relationship would be exacerbated for disclosers. Results from Model 1 supported our hypothesis; individuals in the discloser (vs. responder) role exhibited greater TPR reactivity, however, this was qualified by a condition × role interaction (see Figure 2). Tests of simple slopes indicated that within the co-rumination condition, disclosers (vs. responders) exhibited greater TPR reactivity (B = 114.69, 95% CI [58.53, 170.85], $t = 4.03$, $p < .001$, $r = .30$), whereas in the natural condition, TPR reactivity did not vary as a function of role (B = 19.03, 95% CI [−39.11, 77.17], $t = .65$, $p = .519$, $r = .05$). Additionally, there was an effect for role on CO; disclosers (vs. responders) exhibited greater decreases in CO ($B = -.06$, 95% CI [−.11, −.00], $t = -2.00$, $p = .048$, $r = .15$). Model 2 analyses revealed that the cardiovascular pattern observed in Model 1 remained in Model 2. Additionally, tests of simple slopes indicate that female disclosers in the co-rumination (vs. natural) condition exhibited greater TPR reactivity (B = 76.64, 95% CI [7.63, 145.65], $t = 2.20$, $p = .030$, $r = .18$).

Supplemental Analyses and Alternative Explanations

Although we attribute greater threat (less challenge) in the co-rumination vs. natural condition for disclosers to condition and role assignment, there are possible alternative explanations for these findings such as the complexity of the task instructions or prompting participants to behave in a way that is not natural to them. To test these alternative explanations, we reran Models

Figure 1
Perceived Partner Responsiveness by Condition and Role



Note. Model 1 (Panel A) represents the interaction between condition and role on perceived partner responsiveness for the full sample. Model 2 (Panel B) represents the same interaction for females only. Error bars represent ±1 standard error.

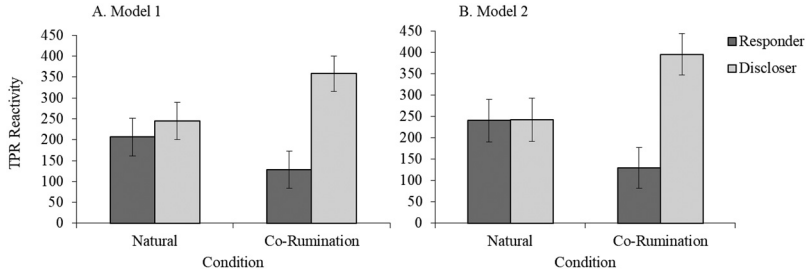
1 and 2 predicting TPR (the primary distinguishing variable between challenge and threat) controlling for self-reported instruction demands and trait co-rumination separately. After controlling for these potential confounding variables, our key result (i.e., the condition × role interaction) remained. Therefore, we retain our original interpretation of our findings as we believe our a priori explanations for the findings are the most parsimonious and grounded in the co-rumination and self-disclosure literatures. For a full discussion of these supplemental analyses, see the online supplemental materials. Additionally, at the request of a reviewer, we explored cardiovascular reactivity across minutes to assess challenge and threat across the conversation. Results presented in the online supplemental materials highlight the rapid habituation exhibited by those most threatened during the first minute of the conversation (i.e., female disclosers in the co-rumination condition).

Table 5
Effects of Condition, Role, and Sex on Cardiovascular Reactivity (VC, CO, and TPR)

	Model 1				Model 2			
Variable	*B*	*SE*	*t*	*r*	*B*	*SE*	*t*	*r*
VC								
Intercept	6.67	0.55	12.13**	0.69	6.12	0.61	9.99**	0.61
Condition	−0.14	0.55	−0.26	0.02	0.07	0.61	0.12	0.01
Role	−0.09	0.55	−0.17	0.01	−0.22	0.63	−0.35	0.03
Condition × Role	0.09	0.55	0.17	0.01	0.25	0.63	0.40	0.03
Sex					2.22	1.34	1.67	0.11
Condition × Sex					−1.25	1.34	−0.94	0.06
Role × Sex					−0.07	1.36	−0.05	0.00
Condition × Role × Sex					−1.10	1.36	−0.80	0.05
CO								
Intercept	−0.02	0.02	−0.76	0.06	−0.01	0.03	−0.36	0.03
Condition	−0.02	0.02	−0.97	0.08	−0.01	0.03	−0.39	0.03
Role	−0.06	0.03	−2.00*	0.15	−0.04	0.03	−1.30	0.10
Condition × Role	−0.01	0.03	−0.28	0.02	−0.01	0.03	−0.40	0.03
Sex					−0.05	0.06	−0.87	0.06
Condition × Sex					−0.08	0.06	−1.32	0.09
Role × Sex					−0.09	0.07	−1.38	0.08
Condition × Role × Sex					0.01	0.07	0.09	0.01
TPR								
Intercept	234.36	23.54	9.95**	0.61	252.42	26.11	9.67**	0.59
Condition	8.95	23.54	0.38	0.03	10.61	26.11	0.41	0.03
Role	66.86	20.46	3.27**	0.25	67.14	23.28	2.88**	0.22
Condition × Role	47.83	20.46	2.34*	0.18	66.03	23.28	2.84**	0.21
Sex					−85.94	56.15	−1.53	0.10
Condition × Sex					−4.06	56.15	−0.07	0.00
Role × Sex					6.58	52.62	0.13	0.01
Condition × Role × Sex					−83.28	52.62	−1.58	0.11

Note. Condition was contrast coded −1 = natural, 1 = co-rumination. Role was contrast coded −1 = responder, 1 = discloser. Sex was dummy coded 0 = female, 1 = male. VC = ventricular contractility; CO = cardiac output; TPR = total peripheral resistance.
* $p < .05$. ** $p < .01$.

Figure 2
TPR Reactivity by Condition and Role



Note. Model 1 (Panel A) represents the interaction between condition and role on TPR reactivity for the full sample. Model 2 (Panel B) represents the same interaction for females only. TPR = total peripheral resistance. Error bars represent ±1 standard error.

Discussion

In the present investigation we examined co-rumination as an interpersonal emotion regulation strategy using the biopsychosocial model of challenge and threat to examine the intrapersonal costs and interpersonal benefits of experimentally manipulated co-rumination. We developed a novel paradigm to experimentally test the effect of co-rumination on outcomes for both dyad members and used a combination of self-reports, physiological responses, and behavioral observations to test predictions. Primary aims for the study included validating the experimental manipulation of co-rumination and examining stress appraisals as a function of condition (co-rumination vs. natural) and role in the conversation (discloser vs. responder).

Results provide preliminary evidence for the validity of the experimental manipulation of co-rumination. Individuals in the co-rumination (vs. natural) condition engaged in greater co-rumination according to both self- and observer-reports. Additionally, results revealed a pattern of intrapersonal costs (stressed/upset feelings and rumination) and interpersonal benefits (perceived partner responsiveness) of co-rumination like that found in existing research. Notably, some of these findings were limited to responders, which provides insight into how co-rumination influences outcomes for both dyad members. This is the first investigation of co-rumination to distinguish between problem disclosers and responders in a dyadic experimental paradigm. Our research reveals that responders may experience costs due to co-rumination such as intrapersonal rumination and may be the key drivers of the interpersonal benefits resulting from co-rumination. Responders perceived disclosers as more responsive when instructed to co-ruminate, whereas disclosers perceived responders to be highly responsive regardless of condition assignment. This may be due to a ceiling effect, as disclosers were discussing their most stressful ongoing problem, which would naturally elicit responsive behavior from their close or best friend. However, it is also possible that this finding may be capturing a mechanism by which the cycle of co-rumination is perpetuated within dyads. Research indicates that disclosers who express emotion (which is integral to co-rumination) are perceived to be more responsive by responders and, in turn, responders are more likely to engage in reciprocal self-disclosure (Greene et al., 2006; Laurenceau et al., 1998). Therefore, individuals who respond to their friend's disclosure and co-rumination may be more likely to reciprocate by disclosing and co-ruminating about their own problem in the future, which would reinforce and maintain the relationship (Reis & Shaver, 1988; Rusbult et al., 2006). Because self-disclosure processes are reciprocal in nature, it is important to examine perceived partner responsiveness for both members of a relationship dyad to better understand how particular interpersonal emotion regulation strategies influence this prorelationship cycle. The present research may inform future longitudinal work examining how co-rumination cycles develop over time and how partner responses can influence outcomes for both individuals.

The development of a novel, experimental manipulation of co-rumination is significant because extant co-rumination research has relied heavily upon nonexperimental approaches. Of the few studies that have utilized experimental paradigms to study co-rumination (Byrd-Craven et al., 2008, 2011), none have directly manipulated co-rumination in a dyadic context, opting instead to manipulate the conversation context more broadly (e.g., providing an opportunity for problem talk vs. a nonproblem talk control condition). Pitting co-rumination against a natural problem talk condition provides a conservative test of our findings because individuals in the natural condition could have naturally engaged in co-rumination. Thus, the results presented here represent the effect of co-rumination above and beyond natural problem talk behavior.

The present study is the first to integrate co-rumination with the biopsychosocial model of challenge and threat. Results indicated that female disclosers in the co-rumination (vs. natural) condition exhibited increases in TPR during the first minute of the conversation, a response consistent with greater psychological threat. Female responders did not differ in TPR reactivity as a function of condition despite receiving the same manipulation instructions as disclosers, meaning that being presented with relatively more complicated and demanding instructions compared to the natural condition was not sufficient to elicit greater threat. These results suggest that co-rumination influences appraisals underlying physiological stress responses. For female disclosers, the physiological findings suggested that situational demands outweighed coping resources when starting a conversation after being instructed to co-ruminate. It is worth noting that supplemental analyses revealed that these cardiovascular responses were short-lived, which is consistent with existing studies using in-lab active coping tasks (Blascovich, 1992). These short-lived stress responses prevent conclusions being drawn regarding how co-rumination influences appraisal processes and physiological arousal as conversations unfold over time because decreases in physiological arousal may be due to habituation to the stressor or to the interpersonal processes occurring as a result of

co-rumination. Future research using physiological measures that are less subject to rapid habituation is needed.

These results are consistent with existing literature that provides preliminary, correlational evidence that co-rumination is a vulnerability factor that exacerbates stress (Starr & Davila, 2009) and leads individuals to view their problems as more upsetting and harder to solve (Lyubomirsky et al., 1999; Lyubomirsky & Nolen-Hoeksema, 1995). These results highlight the importance of examining relationships between co-rumination and downstream cognition, behavior, and health outcomes as co-rumination is linked to the development of somatic complaints in vulnerable populations (Byrd-Craven & Massey, 2013; Guarneri-White et al., 2015; Müller et al., 2019) and cardiovascular threat has been associated with physiological and cognitive dysfunction over time (Dienstbier, 1989; Jefferson et al., 2010; Kassam et al., 2009; Matthews et al., 1997; Wang et al., 2016). Longitudinal studies using biomarkers such as salivary cortisol should be conducted to examine the long-term effects of co-rumination on stress response systems.

Although we found support for our primary hypothesis that the effect of co-rumination on TPR reactivity would be more pronounced for disclosers (vs. responders), it is interesting that responders did not exhibit greater TPR reactivity in the co-rumination condition relative to the natural condition. While it is possible that co-rumination does not influence the acute physiological stress responses of responders, it may be that this result is due to experimental manipulation of co-rumination. For responders, having instructions for the conversation may have served as a resource, providing a framework for the conversation and guidance on how to respond to their friend, thereby reducing the burden of providing support and reducing uncertainty regarding how the conversation would unfold. It may also be the case that co-rumination affects stress responses of responders over time and that acute responses in the lab to one instance of co-rumination is not a context in which these effects can be observed.

Strengths, Limitations, and Caveats

The current research had several strengths that enhance our confidence in the results. We maximized experimental control by directly manipulating co-rumination and restricting problem disclosure to one member of the dyad. This allowed us to draw stronger conclusions regarding the potential causal effects of co-rumination on intra- and interpersonal outcomes. Additionally, despite being an inherently interpersonal emotion regulation strategy, co-rumination research has almost exclusively used data from only one individual, typically the discloser, or analyzed data at the dyad level, neglecting relevant within-dyad variability. The present study advances the literature by taking an interpersonal, dyadic approach, and specifically testing how co-rumination differentially impacts disclosers and responders. Moreover, we used multiple methods to draw these conclusions, pulling from self-report, behavioral, and physiological methods. Ultimately, the evidence provided by this research is a first step at integrating the biopsychosocial model of challenge and threat with the co-rumination literature.

Despite these strengths, we acknowledge the limitations of the present study. First, given the mixed findings regarding sex differences associated with co-rumination in the literature (Barstead et al., 2013), the lack of power to test sex interactions limits the generalizability of these findings, as interpretations and conclusions must be limited to females. As co-rumination has been shown to vary based on dyad composition (i.e., same- or different-sex dyads) and type of relationship (i.e., familial, platonic, romantic) for both sexes (Barstead et al., 2013; Calmes & Roberts, 2008), future studies should attempt to replicate these findings across different relationship types and contexts. Second, although we maximized experimental control by only having one person disclose their problem, this control comes at the cost of ecological validity as problem talk discussions typically involve reciprocal self-disclosure (Greene et al., 2006). Along these lines, although using reactivity scores to assess physiological responses to acute stress is useful for assessing challenge and threat, examining these short-lived responses does not inform how stress responses are influenced by co-rumination over time or how partner responses to disclosure can affect these physiological responses. Third, this study used a convenience sample of healthy college students, which may limit external validity. Little is known about co-rumination across the life span, as extant research has primarily been conducted using adolescent or young adult samples, thus it is unclear whether effects would replicate in an older sample for whom health concerns are particularly relevant. As clinical samples may differ in stress responses (Salomon et al., 2009), more research is needed to understand how co-rumination is related to physiological outcomes in these populations. Finally, although we attribute greater threat for disclosers to our manipulation of co-rumination and conversation role, we acknowledge that we cannot fully account for all potential confounding variables. Future work is needed using other control manipulations (e.g., sham instructions or problem solving) to fully understand how outcomes of experimentally manipulated co-rumination compare to other interpersonal emotion regulation strategies.

Conclusion

In this study, we examined the intrapersonal costs and interpersonal benefits of experimentally manipulated co-rumination using a combination of self-reports, physiological measures, and behavioral observations. We leveraged the biopsychosocial model of challenge and threat to better understand how experimentally manipulated co-rumination influences stress appraisal processes within dyads. We found that females who disclosed their most stressful, ongoing problem to their close friend and engaged in co-rumination (vs. natural problem talk), exhibited a physiological response consistent with greater psychological threat and less challenge. Finally, we provided evidence for the validation of a new manipulation of co-rumination between friends in the laboratory. These results contribute to a growing body of literature linking co-rumination to poor physical health outcomes and lays the foundation for future experimental studies to examine the long-term effects of co-rumination on health and relationship outcomes.

References

Aldrich, J. T., Lisitsa, E., Chun, S. K., & Mezulis, A. H. (2019). Examining the relationship between daily co-rumination and rumination in response to negative events among adolescents using ecological momentary assessment. *Journal of Social and Clinical Psychology*, *38*(8), 704–719. https://doi.org/10.1521/jscp.2019.38.7.704

Barstead, M. G., Bouchard, L. C., & Shih, J. H. (2013). Understanding gender differences in co-rumination and confidant choice in young

adults. *Journal of Social and Clinical Psychology*, *32*(7), 791–808. https://doi.org/10.1521/jscp.2013.32.7.791

Berndt, T. J. (2002). Friendship quality and social development. *Current Directions in Psychological Science*, *11*(1), 7–10. https://doi.org/10.1111/1467-8721.00157

Blascovich, J. (1992). A biopsychosocial approach to arousal regulation. *Journal of Social and Clinical Psychology*, *11*(3), 213–237. https://doi.org/10.1521/jscp.1992.11.3.213

Blascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: The role of affective cues. In J. P. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 59–82). Cambridge University Press.

Blascovich, J., & Mendes, W. B. (2010). Social psychophysiology and embodiment. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *The handbook of social psychology* (5th ed., pp. 194–227). Wiley. https://doi.org/10.1002/9780470561119.socpsy001006

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology*, *28*, 1–51. https://doi.org/10.1016/S0065-2601(08)60235-X

Boren, J. P. (2013). Co-rumination partially mediates the relationship between social support and emotional exhaustion among graduate students. *Communication Quarterly*, *61*(3), 253–267. https://doi.org/10.1080/01463373.2012.751436

Boren, J. P. (2014). The relationships between co-rumination, social support, stress, and burnout among working adults. *Management Communication Quarterly*, *28*(1), 3–25. https://doi.org/10.1177/0893318913509283

Brownley, K. A., Hurwitz, B. E., & Schneiderman, N. (2000). Cardiovascular psychophysiology. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of psychophysiology* (2nd ed., pp. 224–264). Cambridge University Press.

Byrd-Craven, J., Geary, D. C., Rose, A. J., & Ponzi, D. (2008). Co-ruminating increases stress hormone levels in women. *Hormones and Behavior*, *53*(3), 489–492. https://doi.org/10.1016/j.yhbeh.2007.12.002

Byrd-Craven, J., Granger, D. A., & Auer, B. J. (2011). Stress reactivity to co-rumination in young women's friendships: Cortisol, alpha-amylase, and negative affect focus. *Journal of Social and Personal Relationships*, *28*(4), 469–487. https://doi.org/10.1177/0265407510382319

Byrd-Craven, J., & Massey, A. R. (2013). Lean on me: Effects of social support on low socioeconomic-status pregnant women. *Nursing & Health Sciences*, *15*(3), 374–378. https://doi.org/10.1111/nhs.12043

Calmes, C. A., & Roberts, J. E. (2008). Rumination in interpersonal relationships: Does co-rumination explain gender differences in emotional distress and relationship satisfaction among college students? *Cognitive Therapy and Research*, *32*(4), 577–590. https://doi.org/10.1007/s10608-008-9200-3

Carlucci, L., D'Ambrosio, I., Innamorati, M., Saggino, A., & Balsamo, M. (2018). Co-rumination, anxiety, and maladaptive cognitive schemas: When friendship can hurt. *Psychology Research and Behavior Management*, *11*, 133–144. https://doi.org/10.2147/PRBM.S144907

Dam, A., Roelofs, J., & Muris, P. (2014). Correlates of co-rumination in non-clinical adolescents. *Journal of Child and Family Studies*, *23*(3), 521–526. https://doi.org/10.1007/s10826-012-9711-0

Davidson, C. L., Grant, D. M. M., Byrd-Craven, J., Mills, A. C., Judah, M. R., & Lechner, W. V. (2014). Psychometric properties of the co-rumination questionnaire. *Personality and Individual Differences*, *70*, 171–175. https://doi.org/10.1016/j.paid.2014.07.002

Dienstbier, R. A. (1989). Arousal and physiological toughness: Implications for mental and physical health. *Psychological Review*, *96*(1), 84–100. https://doi.org/10.1037/0033-295X.96.1.84

English, T., & Eldesouky, L. (2020). We're not alone: Understanding the social consequences of intrinsic emotion regulation. *Emotion*, *20*(1), 43–47. https://doi.org/10.1037/emo0000661

Gable, S. L., Gosnell, C. L., Maisel, N. C., & Strachman, A. (2012). Safely testing the alarm: Close others' responses to personal positive events. *Journal of Personality and Social Psychology*, *103*(6), 963–981. https://doi.org/10.1037/a0029488

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, *26*(1), 41–54. https://doi.org/10.1023/B:JOBA.0000007455.08539.94

Greene, K., Derlega, V. J., & Mathews, A. (2006). Self-disclosure in personal relationships. In D. Perlman & A. Vangelisti (Eds.), *The Cambridge handbook of personal relationships* (pp. 409–427). Cambridge University Press. https://doi.org/10.1017/CBO9780511606632.023

Gross, J. J., Richards, J. M., & John, O. P. (2006). Emotion regulation in everyday life. In D. K. Snyder, J. Simpson, & J. N. Hughes (Eds.), *Emotion regulation in couples and families: Pathways to dysfunction and health* (pp. 13–35). American Psychological Association. https://doi.org/10.1037/11468-001

Guarneri-White, M. E., Jensen-Campbell, L. A., & Knack, J. M. (2015). Is co-ruminating with friends related to health problems in victimized adolescents? *Journal of Adolescence*, *39*(1), 15–26. https://doi.org/10.1016/j.adolescence.2014.11.004

Jefferson, A. L., Himali, J. J., Beiser, A. S., Au, R., Massaro, J. M., Seshadri, S., Gona, P., Salton, C. J., DeCarli, C., O'Donnell, C. J., Benjamin, E. J., Wolf, P. A., & Manning, W. J. (2010). Cardiac index is associated with brain aging: The Framingham Heart Study. *Circulation*, *122*(7), 690–697. https://doi.org/10.1161/CIRCULATIONAHA.109.905091

Kassam, K. S., Koslov, K., & Mendes, W. B. (2009). Decisions under distress: Stress profiles influence anchoring and adjustment. *Psychological Science*, *20*(11), 1394–1399. https://doi.org/10.1111/j.1467-9280.2009.02455.x

Kelsey, R. M., Ornduff, S. R., & Alpert, B. S. (2007). Reliability of cardiovascular reactivity to stress: Internal consistency. *Psychophysiology*, *44*(2), 216–225. https://doi.org/10.1111/j.1469-8986.2007.00499.x

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis*. Guilford Press.

Lane, S. P., & Hennes, E. P. (2018). Power struggles: Estimating sample size for multilevel relationships research. *Journal of Social and Personal Relationships*, *35*(1), 7–31. https://doi.org/10.1177/0265407517710342

Laurenceau, J. P., Barrett, L. F., & Pietromonaco, P. R. (1998). Intimacy as an interpersonal process: The importance of self-disclosure, partner disclosure, and perceived partner responsiveness in interpersonal exchanges. *Journal of Personality and Social Psychology*, *74*(5), 1238–1251. https://doi.org/10.1037/0022-3514.74.5.1238

Llabre, M. M., Spitzer, S. B., Saab, P. G., Ironson, G. H., & Schneiderman, N. (1991). The reliability and specificity of delta versus residualized change as measures of cardiovascular reactivity to behavioral challenges. *Psychophysiology*, *28*(6), 701–711. https://doi.org/10.1111/j.1469-8986.1991.tb01017.x

Low, R. S. T., Overall, N. C., Cross, E. J., & Henderson, A. M. E. (2019). Emotion regulation, conflict resolution, and spillover on subsequent family functioning. *Emotion*, *19*(7), 1162–1182. https://doi.org/10.1037/emo0000519

Lyubomirsky, S., & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem solving. *Journal of Personality and Social Psychology*, *69*(1), 176–190. https://doi.org/10.1037/0022-3514.69.1.176

Lyubomirsky, S., Tucker, K. L., Caldwell, N. D., & Berg, K. (1999). Why ruminators are poor problem solvers: Clues from the phenomenology of dysphoric rumination. *Journal of Personality and Social Psychology*, *77*(5), 1041–1060. https://doi.org/10.1037/0022-3514.77.5.1041

Marroquín, B. (2011). Interpersonal emotion regulation as a mechanism of social support in depression. *Clinical Psychology Review*, *31*(8), 1276–1290. https://doi.org/10.1016/j.cpr.2011.09.005

Matthews, K. A., Gump, B. B., Block, D. R., & Allen, M. T. (1997). Does background stress heighten or dampen children's cardiovascular responses

to acute stress? *Psychosomatic Medicine*, *59*(5), 488–496. https://doi.org/10.1097/00006842-199709000-00005

Mehl, M. R., & Connor, T. S. (2012). *Handbook of research methods for studying daily life*. Guilford Press.

Müller, F., Hagedoorn, M., Soriano, E. C., Stephenson, E., Smink, A., Hoff, C., DeLongis, A., Laurenceau, J. P., & Tuinman, M. A. (2019). Couples' catastrophizing and co-rumination: Dyadic diary study of patient fatigue after cancer. *Health Psychology*, *38*(12), 1096–1106. https://doi.org/10.1037/hea0000803

Nolen-Hoeksema, S. (1987). Sex differences in unipolar depression: Evidence and theory. *Psychological Bulletin*, *101*(2), 259–282. https://doi.org/10.1037/0033-2909.101.2.259

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology*, *100*(4), 569–582. https://doi.org/10.1037/0021-843X.100.4.569

Peters, B. J., & Jamieson, J. P. (2016). The consequences of suppressing affective displays in romantic relationships: A challenge and threat perspective. *Emotion*, *16*(7), 1050–1066. https://doi.org/10.1037/emo0000202

Peters, B. J., Overall, N. C., Girme, Y. U., & Jamieson, J. P. (2019). Partners' attachment insecurity predicts greater physiological threat in anticipation of attachment-relevant interactions. *Journal of Social and Personal Relationships*, *36*(2), 469–489. https://doi.org/10.1177/0265407517734655

Peters, B. J., Overall, N. C., & Jamieson, J. P. (2014). Physiological and cognitive consequences of suppressing and expressing emotion in dyadic interactions. *International Journal of Psychophysiology*, *94*(1), 100–107. https://doi.org/10.1016/j.ijpsycho.2014.07.015

Peters, B. J., Reis, H. T., & Jamieson, J. P. (2018). Cardiovascular indexes of threat impair responsiveness in situations of conflicting interests. *International Journal of Psychophysiology*, *123*, 1–7. https://doi.org/10.1016/j.ijpsycho.2017.12.005

Reis, H. T., Crasta, D., Rogge, R. D., Maniaci, M. R., & Carmichael, C. L. (2018). Perceived partner responsiveness scale. In D. L. Worthington & G. D. Bodie (Eds.), *The sourcebook of listening research: methodology and measures* (pp. 516–521). Wiley.

Reis, H. T., & Shaver, P. (1988). Intimacy as an interpersonal process. In S. W. Duck (Ed.), *Handbook of personal relationships* (pp. 367–389). Wiley.

Rose, A. J. (2002). Co-rumination in the friendships of girls and boys. *Child Development*, *73*(6), 1830–1843. https://doi.org/10.1111/1467-8624.00509

Rose, A. J., Carlson, W., & Waller, E. M. (2007). Prospective associations of co-rumination with friendship and emotional adjustment: Considering the socioemotional trade-offs of co-rumination. *Developmental Psychology*, *43*(4), 1019–1031. https://doi.org/10.1037/0012-1649.43.4.1019

Rose, A. J., Glick, G. C., Smith, R. L., Schwartz-Mette, R. A., & Borowski, S. K. (2017). Co-rumination exacerbates stress generation among adolescents with depressive symptoms. *Journal of Abnormal Child Psychology*, *45*(5), 985–995. https://doi.org/10.1007/s10802-016-0205-1

Rose, A. J., Schwartz-Mette, R. A., & Carlson, W. (2005, April). An observational assessment of co-rumination in the friendships of girls and boys. In J. D. Coie & M. Putallaz (Chairs), *The costs and benefits of interpersonal processes underlying girls' friendships*. Symposium conducted at the Biennial Meeting of the Society for Research in Child Development, Atlanta, GA.

Rose, A. J., Schwartz-Mette, R. A., Glick, G. C., Smith, R. L., & Luebbe, A. M. (2014). An observational study of co-rumination in adolescent friendships. *Developmental Psychology*, *50*(9), 2199–2209. https://doi.org/10.1037/a0037465

Rusbult, C. E., Coolsen, M. K., Kirchner, J. L., & Clarke, J. (2006). Commitment. In A. Vangelisti & D. Perlman (Eds.), *Handbook of personal relationships* (pp. 615–635). Cambridge University Press. https://doi.org/10.1017/CBO9780511606632.034

Salomon, K., Clift, A., Karlsdóttir, M., & Rottenberg, J. (2009). Major depressive disorder is associated with attenuated cardiovascular reactivity and impaired recovery among those free of cardiovascular disease. *Health Psychology*, *28*(2), 157–165. https://doi.org/10.1037/a0013001

Schwartz-Mette, R. A., & Rose, A. J. (2012). Co-rumination mediates contagion of internalizing symptoms within youths' friendships. *Developmental Psychology*, *48*(5), 1355–1365. https://doi.org/10.1037/a0027484

Seery, M. D. (2011). Challenge or threat? Cardiovascular indexes of resilience and vulnerability to potential stress in humans. *Neuroscience and Biobehavioral Reviews*, *35*(7), 1603–1610. https://doi.org/10.1016/j.neubiorev.2011.03.003

Smith, R. L., & Rose, A. J. (2011). The "cost of caring" in youths' friendships: Considering associations among social perspective taking, co-rumination, and empathetic distress. *Developmental Psychology*, *47*(6), 1792–1803. https://doi.org/10.1037/a0025309

Spendelow, J. S., Simonds, L. M., & Avery, R. E. (2017). The relationship between co-rumination and internalizing problems: A systematic review and meta-analysis. *Clinical Psychology & Psychotherapy*, *24*(2), 512–527. https://doi.org/10.1002/cpp.2023

Starr, L. R., & Davila, J. (2009). Clarifying co-rumination: Associations with internalizing symptoms and romantic involvement among adolescent girls. *Journal of Adolescence*, *32*(1), 19–37. https://doi.org/10.1016/j.adolescence.2007.12.005

Stone, L. B., Hankin, B. L., Gibb, B. E., & Abela, J. R. Z. (2011). Co-rumination predicts the onset of depressive disorders during adolescence. *Journal of Abnormal Psychology*, *120*(3), 752–757. https://doi.org/10.1037/a0023384

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

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

Waller, J. M., Silk, J. S., Stone, L. B., & Dahl, R. E. (2014). Co-rumination and co-problem solving in the daily lives of adolescents with major depressive disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *53*(8), 869–878. https://doi.org/10.1016/j.jaac.2014.05.004

Wang, Y., Jackson, T., & Cai, L. (2016). Causal effects of threat and challenge appraisals on coping and pain perception. *European Journal of Pain*, *20*(7), 1111–1120. https://doi.org/10.1002/ejp.835

White, M. E., & Shih, J. H. (2012). A daily diary study of co-rumination, stressful life events, and depressed mood in late adolescents. *Journal of Clinical Child and Adolescent Psychology*, *41*(5), 598–610. https://doi.org/10.1080/15374416.2012.706518

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