

Autonomic Reactivity and Romantic Relational Aggression among Female Emerging Adults:
Moderating Roles of Social and Cognitive Risk

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Abstract

This study investigates the association between autonomic arousal in response to a relational stressor and the perpetration of relational aggression against romantic partners. In addition, the moderating role of social risk (relational victimization by a romantic partner) and cognitive risk (hostile attribution biases) was explored. Skin conductance, heart rate, and respiratory sinus arrhythmia during an experience of exclusion were assessed in a sample of female emerging adults ($N = 131$). Participants provided self-reports of romantic relational aggression, romantic relational victimization, and hostile attribution biases. Results indicated that both heightened and blunted reactivity served as risk factors for the perpetration of romantic relational aggression depending on women's social and contextual risk. Implications for understanding the development of intimate aggression are discussed.

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Romantic relationships become an increasingly important context for development during the transition to adulthood (Roisman, Masten, Coatsworth, & Tellegen, 2004). However, a substantial percentage of romantic relationships during this developmental period involve aggressive conduct; in fact, physical aggression is present in approximately one third of young couples (Jose & O'Leary, 2009) and research has documented even higher levels of psychological aggression (i.e., 75%-80% of couples; Stets, 1990). These prevalence rates are concerning given research suggesting that both perpetrators and victims suffer from a number of adjustment difficulties, including psychological, behavioral, and relationship problems (e.g., Callahan, Tolman, & Saunders, 2003; Goldstein, Chesir-Terin, & McFaul, 2008; Jouriles, Garrido, Rosenfield, & McDonald, 2009; Holt & Espelage, 2005; Stuart et al., 2006). Despite a number of advances in this area, the vast majority of studies have focused on male perpetration of physical forms of aggression, neglecting female perpetrators and relational forms of aggression. In addition, few studies have examined the association between physiological stress responses and perpetration of such conduct. Finally, researchers have neglected the potential moderating roles of social and cognitive risk in these associations. The goal of the present study was to address these limitations by examining the association between autonomic reactivity and perpetration of relational aggression against romantic partners in a sample of female emerging adults. In addition, the moderating roles of both social (i.e., relational victimization by romantic partners) and cognitive (i.e., hostile attribution biases) risk were assessed.

In the research literature, a number of terms have been used to describe aggressive conduct against romantic partners. Terms such as *violence*, *battery*, and *abuse* reflect relatively

severe levels of harmful acts whereas *aggression* includes less harmful behaviors (see Finkel et al., 2009). In addition, whereas violence and aggression reflect specific behaviors or acts, abuse is characterized by especially high levels of violence (Straus & Gelles, 1996) and battery is a broader term reflecting a syndrome of control and power over one's romantic partner, often including severe violence (Houry et al., 2008). However, despite these theoretical distinctions, many empirical studies do not clearly differentiate between levels of harm defined as aggression, violence, abuse, and battery (see Finkel et al., 2009; Straus & Gelles, 1996). In the present study, the focus is on the use of relational aggression against romantic partners, and, consistent with previous research in this area (e.g., Linder et al., 2002), the term *romantic relational aggression* is used to describe these behaviors. However, study hypotheses are drawn from research focusing on a variety of types of harmful behaviors against romantic partners.

Despite the common view that males are perpetrators and females are victims of aggression against romantic partners, emerging research has highlighted the important role of female aggressors (Capaldi, Kim, & Shortt, 2004). In fact, a recent meta-analysis demonstrated that females are as or more likely than males to engage in aggression against romantic partners during young adulthood (Archer, 2000; Stets, 1990; Stets & Straus, 1990). Nonetheless, a number of studies have demonstrated distinct processes involved in male- versus female-perpetrated aggression. For example, female victims are more likely to experience aggression in the context of battery (Houry et al., 2008) and severe violence (Archer, 2000), to be injured, and to require involvement of law enforcement (Archer, 2000; Phelan et al., 2005). Some research also indicates that females are more likely to perpetrate aggression in response to abuse by partners (Kernsmith, 2005). Finally, during young adulthood, females are less likely to engage in calm discussions and more likely to argue heatedly when encountering a conflict with a romantic

partner (Bookwala, Sobin, & Zdaniuk, 2005). Taken together, these findings suggest that distinct processes may be involved in female-perpetrated aggression against romantic partners and highlight the importance of research examining the development of these behaviors among women.

In addition, it is important to examine the development of non-physical forms of aggression against romantic partners. To date, the majority of research has focused on physical forms of aggression (i.e., using physical means to harm a partner; Ellis, Crooks, & Wolfe, 2009; Jackson, 1999; Linder, Crick, & Collins, 2002) despite emerging research highlighting the importance of examining emotional/psychological (e.g., insults, ridicule), and sexual (e.g., rape) aggression (Houry et al., 2008; Jouriles et al., 2009; Straus et al., 1996). This focus on physical aggression is surprising given research suggesting that other forms of aggression, such as psychological aggression, are more common (Jose & O’Leary, 2009) and sometimes more strongly associated with psychological problems (Jouriles et al., 2009; O’Leary, 1999) than physical forms of such conduct.

Recently, Linder and colleagues (2002) examined relational aggression in the context of romantic relationships in young adulthood (termed *romantic relational aggression*). Relational aggression is defined as behaviors intended to hurt or harm others through the manipulation of interpersonal relationships (Crick et al., 1999); romantic relational aggression includes interpersonally manipulative behaviors such as giving a partner the “silent treatment” or intentionally excluding a partner from activities with friends (Linder et al., 2002). Although some romantic relational aggression behaviors also fit the definition of psychological aggression (e.g., threatening to break up with a romantic partner to hurt him or her), psychological aggression is much broader and includes additional behaviors such as verbal insults (Jouriles et

al., 2009; Linder et al., 2002). Romantic relational aggression differs from other forms of aggression against romantic partners (e.g., physical, psychological) because it specifically focuses on damage to interpersonal relationships (Linder et al., 2002).

An emerging body of research has demonstrated the harmful nature of romantic relational aggression. Perpetrators and victims of these behaviors exhibit a number of adjustment problems, including both internalizing and externalizing problems (e.g., Bagner, Storch, & Preston, 2007; Coyne, Nelson, Graham-Kevan, Keister, & Grant, 2010; Murray-Close Ostrov, Nelson, Crick, & Coccaro, 2010; Schlad et al., 2008) and low-quality romantic relationships (Linder et al., 2002). In addition, research suggests that females exhibit similar (e.g., Bagner et al., 2007; Linder et al., 2002; Schlad et al., 2008) or higher (e.g., Coyne et al., 2010; Ellis et al., 2009; Murray-Close et al., 2010; although see Storch, Bagner, Geffken, & Baumeister, 2004) levels of romantic relational aggression compared to males.

One potential risk factor for the development of aggression against romantic partners is autonomic arousal (Langhinrichsen-Rohling, 2005). The autonomic nervous system (ANS) includes both the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). Activation of the SNS involves the “fight or flight” response and results in increases in physiological arousal (e.g., increases in heart rate and blood pressure). In contrast, the PNS is involved in the body’s restorative functions, and activation of the PNS results in reductions of physiological arousal (e.g., decreases in heart rate and blood pressure). Studies have examined a number of indices of ANS activity, including heart rate reactivity (HRR; a measure influenced by both SNS and PSN activity), skin conductance reactivity (SCR; a measure of perspiration influenced by SNS activity), and respiratory sinus arrhythmia reactivity (RSAR; a measure of the

ebbing and flowing of heart rate during respiration reflecting parasympathetic arousal) (van Goozen, Fairchild, Snoek, & Harold, 2007).

Several researchers have proposed that exaggerated ANS reactivity to stress, reflecting elevated SNS activation and/or elevated PNS withdrawal, may be associated with aggressive conduct. Exaggerated ANS reactivity reflects a pronounced “fight or flight” response to stress and may be an indicator of high levels of emotional lability which in turn results in aggressive responding (Scarpa & Raine, 1997). Consistent with this perspective, a recent meta-analysis demonstrated that exaggerated SNS reactivity was associated with elevated levels of aggression in adults (Lorber, 2004). In addition, some work suggests that that heightened parasympathetic withdrawal is associated with aggression (Beauchaine, 2001). Emerging research also suggests that exaggerated ANS reactivity is associated with relational forms of aggression in girls (Murray-Close & Crick, 2007), highlighting the possibility that these processes may be involved in the development of relational as well as physical forms of aggression.

However, other researchers have argued that blunted reactivity, reflecting a compromised “fight or flight” response to stress, predicts involvement in aggression. Blunted reactivity, indexed by blunted SNS activation and/or blunted RSA withdrawal, may be indicative of fearlessness (Ortiz & Raine, 2004), which may in turn serve as a risk factor for aggressive conduct (Scarpa & Raine, 1997). Consistent with this perspective, there is some evidence that blunted HRR (Ortiz & Raine, 2004) and blunted SCR (Posthumus, Böcker, Raaijmakers, Van Engeland, & Matthys, 2009) are associated with aggression and antisocial behavior. In addition, preliminary research suggests that poor RSA withdrawal (or even RSA augmentation) is associated with aggression (Calkins, Graziano, & Keane, 2007; Katz, 2007; Obradović, Bush, Stamperdahl, Adler, & Boyce, 2010; Porges, Doussard-Roosevelt, Portales, & Greenspan, 1996).

Poor PNS reactivity in response to stress, indexed by blunted PNS withdrawal or PNS activation, may reflect problems such as impaired emotion regulation capabilities and hypervigilance to threat (Calkins et al., 2007; Katz, 2007).

To date, little research has examined the association between ANS reactivity and aggression against romantic partners. However, preliminary research with male batterers suggests that relatively low levels of aggression may be associated with exaggerated ANS reactivity whereas more severe aggression may be associated with blunted ANS reactivity (Babcock, Green, Webb, & Yerington, 2005; Gottman et al., 1995). Given that romantic relational aggression involves relatively low levels of aggression and given research suggesting that young women are less likely to engage in calm discussions and more likely to engage in heated discussions when dealing with conflicts in their romantic relationships (Bookwala et al., 2005), a heightened “fight or flight” response to stress may be an important predictor of romantic relational aggression among female perpetrators. In fact, one recent study demonstrated that heightened RSA withdrawal in response to a romantic conflict discussion was associated with romantic relational aggression, particularly in the context of low-quality dating relationships (although effects were observed for males and females; Murray-Close, Holland, & Roisman, under review).

In addition to examining whether ANS arousal predicts involvement in romantic relational aggression, it is important to consider potential moderators on this association. For example, autonomic risk may only translate into romantic relational aggression in the context of high-risk relationships. This perspective is consistent with the developmental systems model of intimate aggression proposed by Capaldi and colleagues (Capaldi, Kim, & Shortt, 2004). This model emphasizes the interactive nature between previous predispositions towards aggression

and current contextual influences such as partner behavior. One prediction of this model is that partner aggression may elicit or exacerbate aggressive behaviors. Moreover, the moderating role of relationship context may be particularly important in predicting romantic relational aggression among women given findings from one study suggesting that at-risk women only exhibited elevated levels of aggression when their partners were violent whereas at-risk men were aggressive regardless of their partners' levels of aggression (Herrera, Wiersma, & Cleveland, 2008). In the present study, it was expected that ANS risk would be most strongly associated with romantic relational aggression among women who were frequently the targets of their partners' relational aggression.

A second potential moderator of the association between ANS activity and romantic relational aggression is hostile attribution biases. A number of studies have demonstrated that, when faced with ambiguous provocation situations (e.g., a peer knocks them over), aggressive individuals are more likely than their peers to assume hostile intent (e.g., that the peer was trying to hurt them; Crick & Dodge, 1994). Theoretically, hostile attribution biases may result in aggressive responding when individuals interpret others' behavior as mean or intentional, even in situations where such conclusions are not warranted (e.g., accidental slights; Dodge 1980). Importantly, research has demonstrated that physical aggression is associated with hostile attribution biases for instrumental provocations (e.g., a peer spills a drink on the individual's back) whereas relational aggression is associated with hostile attribution biases for relational provocations (e.g., not being invited to a party) (Bailey & Ostrov, 2008; Crick, Grotpeter, & Bigbee, 2002; Yeung & Leadbeater, 2007; although see Crain, Finch, & Foster, 2005; Nelson, Mitchell, & Yang, 2008). Moreover, findings from a recent study suggest that hostile attribution biases for relational provocations are also associated with romantic relational aggression among

adults (Murray-Close et al., 2010). These findings suggest that women who are both physiologically and cognitively at-risk may exhibit particularly high levels of romantic relational aggression.

Study Hypotheses

The goal of the present study was to examine the association between ANS reactivity and romantic relational aggression in a sample of female emerging adults. ANS reactivity was assessed in response to a relational provocation given research suggesting that hostile attribution biases in response to relational provocations are predictive of romantic relational aggression (Murray-Close et al., 2010). It was hypothesized that SNS activation and PNS withdrawal, indicating a “fight or flight” response to relational stress, would predict heightened involvement in romantic relational aggression. Social and contextual risk were hypothesized to increase the strength of the association between ANS reactivity and romantic relational aggression, such that women who were frequently relationally victimized by their romantic partners and who exhibited hostile attribution biases for romantic relational provocations would exhibit the strongest association between ANS reactivity and such conduct.

Method

Participants

Participants were drawn from a larger study examining the association between ANS activity and psychological functioning. Given the focus on romantic relationships in the present study, only females who self-identified as currently being in a romantic relationship or having been in a romantic relationship in the past year were included. Participants were not asked to identify their sexual orientation. The final sample for this study included 131 female emerging adults aged 18-22 years (M age = 19.13, SD = 1.11). Participants were predominantly Caucasian

(93% Caucasian, 3% Asian, 2% Latino, 2% African American, and 1% other) college students recruited from introductory psychology courses at a small Northeastern public university.

Participants were provided with course credit for their participation. Forty-five percent of participants were in monogamous relationships, 33% were in dating relationships, and 22% were currently single but had been in a romantic relationship within the last year.

Procedure

Participants were invited to the laboratory to complete a 1 ½ hour individual interview. Upon arrival to the laboratory, participants provided written consent and were given a tour of the laboratory and physiological equipment. During the first portion of the interview, physiological sensors were attached to the participant to assess autonomic arousal and participants completed a variety of stressor tasks as well as measures of baseline arousal. In the second portion of the interview, participants completed self-report measures of their relational aggression and relational victimization within the context of their current (or most recent) romantic relationship as well as a measure of their hostile attribution biases for romantic provocations. Participants also completed additional tasks and questionnaires not used in the present study.

Measures

Autonomic Arousal.

Autonomic arousal was assessed using a custom-made physiological acquisition system from James Long Company (Caroga Lake, NY). This system, including a Pentium computer, Snapmaster software, and James Long Company bioamplifier, allowed continuous physiological recordings of during baseline and stress responses. To assess SCL, Ag/AgCl electrodes, were attached to the palmar surface of the middle phalanges of the second and fourth fingers of the nondominant hand. A layer of isotonic citrate salt electrode gel was placed on the electrodes to

increase conduction, and the gel was limited to a 1 cm diameter circle on the participant's fingers through the use of double-sided adhesive collars. Skin conductance was measured in microsiemens. Participants washed and dried their hands prior to skin conductance measurement.

Heart rate and RSA were assessed using an electrocardiogram (ECG). Each participant placed disposable electrode stickers in a bipolar configuration on opposite sides of her chest and a ground lead was placed on the sternum. To assess respiration, pneumatic bellows attached to a pressure transducer were placed around the participant's chest and fixed with a metal bead chain. The ECG channel high-pass filter was set to 0.1 Hz and the low-pass filter was set to 1000 Hz. Cardiac inter-beat intervals (IBI) were measured as time in milliseconds between successive R waves of the electrocardiogram. Heart rate, reflecting beats per minute, was calculated using the following standard formula: $HR = (1/IBI) \times 60,000 \text{ ms}$. The James Long Company IBI Analysis System Program software algorithm was used to extract R-waves. Misspecified R-waves were visually inspected and manually edited. RSA was calculated using the 'peak-to-valley' method (Grossman & Svebak, 1987). This procedure calculates RSA based on the minimum IBI during inspiration and the maximum IBI during expiration. RSA was calculated using both ECG and respiration measurements to control for respiration (Grossman, Karemaker, & Wieling, 1991). RSA was measured in seconds.

Cyberball.

Participants were provided with a 5-minute accommodation period in which the psychophysiological equipment was attached to familiarize the participant with the physiological measurement procedures. To assess participants' physiological reactivity to relational provocation, participants played a 4-minute ball-throwing game called Cyberball (Williams, Cheung, & Choi, 2000). Cyberball was designed to mimic experiences of social exclusion that

are common in everyday life. Participants were told that they were going to play an online ball throwing game. In the game, each player is represented by a drawing and a name. In the version of Cyberball used in the present study, the names of the other three players were of same-sex individuals. Throughout the game, the ball is thrown between players. When the participant receives the ball, she chooses a player to throw the ball to and clicks on that player's name. In reality, there are no other players and the computer game is programmed to exclude the participant after she receives the ball twice. For the rest of the game, the other three players only throw the ball to each other. Previous research using Cyberball has demonstrated that short periods of playing the game are associated with feeling bad or sad (Williams et al., 2000) and fMRI research has demonstrated that playing Cyberball is related to increased activity in the anterior cingulate cortex, an area of the brain associated with distress (Eisenberger, Lieberman, & Williams, 2003).

Physiological arousal (i.e., heart rate, RSA, and skin conductance) was collected during baseline and during the Cyberball game. Baseline physiological activity was assessed during a 4-minute period of rest prior to the Cyberball game in which participants were told to clear their mind and relax. In addition, physiological arousal was continuously recorded throughout the game. Physiological reactivity was computed by subtracting mean levels of arousal during the baseline from mean levels of arousal during the Cyberball game. Thus, positive values indicate increases in arousal and negative values indicate decreased reactivity in response to the Cyberball game.

Experimenter error and equipment malfunction resulted in missing physiological data for 8 participants (1 missing only ECG and 7 missing both ECG and skin conductance). Analyses include all participants with relevant data.

Romantic Relational Aggression and Victimization.

The Self Report of Aggression and Social Behavior Measure (SRASBM) was used to assess participants' romantic relational aggression as well as relational victimization at the hands of their romantic partner (Linder et al., 2002). Participants were provided with items describing relational aggression against a romantic partner (5 items; e.g., "I give my romantic partner the silent treatment when s/he hurts my feelings in some way) and relational victimization at the hands of a romantic partner (5 items; e.g., "When my romantic partner is mad at me, s/he won't invite me to do things with our friends"). Participants rated each item on a scale from 1 ("not at all true") to 7 ("very true"). Scores were summed to yield overall measures of romantic relational aggression and romantic relational victimization, respectively. Participants reported on their current romantic relationship, or, if currently single, on their most recent romantic relationship within the last year. In the present study, self-reports of romantic relational aggression ($\alpha = .75$) and romantic relational victimization ($\alpha = .80$) were reliable.

Hostile Intent Attributions for Romantic Relational Provocations.

Hostile intent attributions regarding relational provocations were assessed by providing participants with three scenarios describing relationally-toned provocations perpetrated by a romantic partner (e.g., finding a romantic partner talking and laughing with an ex-partner at a party). These scenarios were adapted from previous research assessing peer-based hostile attribution biases in children (Crick, 1995) and adults (Bailey & Ostrov, 2008) and were developed by Dr. Nicki Crick and Dr. Julie Morales. Participants were instructed to imagine that each scenario described in the vignettes was actually happening to her. In each scenario, the intent of the romantic partner was ambiguous. Following each scenario, participants were asked to answer two questions. In the first question, participants were asked to choose one of four

possible reasons for their partner's behavior. Two of these options depicted benign intent (e.g., the partner was just having fun) and two depicted hostile intent (e.g., the partner was trying to make her mad). In the second question, participants were asked to identify whether their partner was deliberately trying to be mean or not. Following previous research in this area (e.g., Bailey & Ostrov, 2008), scores were calculated by adding the number of hostile responses within each scenario and then across scenarios. Internal consistency of this measure was adequate ($\alpha = .69$) and consistent with previous research assessing peer-based hostile intent attributions regarding relational provocations (Crick, 1995; Bailey & Ostrov, 2008). Data was missing for one participant on this measure.

Results

Descriptives

Consistent with previous research in this area (e.g., Bailey & Ostrov, 2008; Godleski, Ostrov, Houston, & Schlien, 2010), in the present sample measures skew and kurtosis for relational aggression, victimization, and hostile attribution biases were below the thresholds suggesting problematic skew and kurtosis (Kline, 1998). Resting and reactivity scores for heart rate and skin conductance were also within acceptable thresholds of normality; additionally, although many researchers recommend log transforming RSA data prior to analyses to normalize the distribution, this transformation resulted in increased skew and kurtosis in the current dataset. In addition, since RSA measurements at rest and during Cyberball were also below thresholds suggesting unacceptable deviations from normality (Kline, 1998), RSA measurements were not transformed prior to analysis. Means, standard deviations, and correlations among study variables are presented in Table 1. Romantic relational aggression was moderately correlated with romantic relational victimization. In addition, hostile attribution biases for romantic

relational provocations were positively correlated with both romantic relational aggression and romantic relational victimization. Romantic relational aggression was also positively correlated with skin conductance reactivity to Cyberball.

Autonomic Reactivity to Cyberball

A series of paired sample t-tests were conducted to examine whether participants exhibited autonomic reactivity (i.e., SCR, HRR, and RSAR, respectively) to the Cyberball task. Results indicated that participants exhibited increases in skin conductance from baseline ($M = 5.41$, $SD = 2.49$) to Cyberball ($M = 6.46$, $SD = 2.83$), $t(123) = 15.61$, $p < .001$. In addition, participants exhibited RSA withdrawal from baseline ($M = .10$, $SD = .07$) to Cyberball task ($M = .08$, $SD = .05$), $t(122) = -4.93$, $p < .001$. Finally, the increases in heart rate from baseline ($M = 78.14$, $SD = 14.76$) to Cyberball ($M = 78.75$, $SD = 14.97$), $t(122) = 1.87$, $p = .06$) approached conventional levels of statistical significance. These results suggest that, on average, the Cyberball game elicited sympathetic activation and parasympathetic withdrawal among participants.

Autonomic Reactivity and Relational Aggression

A series of regression analyses run separately by reactivity measure (i.e., SCR, HRR, and RSAR, respectively) were conducted to examine whether autonomic reactivity was associated with romantic relational aggression, and whether romantic relational victimization and hostile attribution biases for romantic relational provocations served as moderators of this association. Step 1 included physiological reactivity, romantic relational victimization, and hostile attribution biases for romantic relational provocations, Step 2 included the 2-way interactions among these variables, and Step 3 included the 3-way interaction in the prediction of romantic relational aggression. As recommended by Dawson and Richter (2006), predictors were standardized prior

to analyses. The template by Dawson and Richter (2006), available at <http://www.jeremydawson.co.uk/slopes.htm>, was used to graph significant interactions. In addition, follow-up simple slope analyses using procedures outlined by Aiken and West (1991) were used to further probe interactions at 1 SD above and 1 SD below the mean of the moderator variable. Given the overlap in regression analyses, significant findings emerging across different models are only reported once.

The results for SCR, presented in Table 2 (Model 1), indicated that SCR was positively associated with romantic relational aggression. However, this effect was qualified by a significant interaction between SCR, relational victimization, and hostile attributions (see Figure 1). Follow-up simple slope analyses indicated that high SCR was associated with romantic relational aggression among women who were highly relationally victimized and exhibited high levels of hostile attributions, $t(121) = 3.32, p < .01$. SCR was not associated with romantic relational aggression among women low in relational victimization and low in hostile attributions ($t(121) = 1.28, p = .21$), women low in relational victimization but high in hostile attributions ($t(121) = -.80, p = .43$), or women high in relational victimization but low in hostile attributions ($t(121) = -.40, p = .69$).

The results for RSAR are presented in Table 2 (Model 2). Results indicated a significant interaction between RSAR and relational victimization; however, follow-up simple slope analyses were not significant. RSAR also interacted with hostile attributions in the prediction of romantic relational aggression (see Figure 2). Follow-up simple slope analyses indicated RSA withdrawal was associated with romantic relational aggression at high levels of hostile attributions, $t(121) = -2.34, p < .05$. In contrast, RSA augmentation was marginally associated with higher romantic relational aggression at low levels of hostile attributions, $t(121) = 1.92, p =$

.06. Finally, the interaction between relational victimization and hostile attribution biases was significant. Follow-up simple slope analyses indicated that hostile attribution biases were associated with romantic relational aggression at low levels of relational victimization, $t(128) = 3.09, p < .01$, but not at high levels of relational victimization, $t(128) = .10, p = .92$. As depicted in Figure 3, women who were highly relationally victimized exhibited high levels of relational aggression regardless of their hostile attribution biases. In contrast, among women experiencing low levels of relational victimization, hostile attributions predicted heightened romantic relational aggression.

The results for heart rate reactivity (HRR), presented in Table 2 (Model 3), indicated that HRR interacted with hostile attributions in predicting romantic relational aggression. Follow-up simple slope analyses indicated that blunted HRR was associated with romantic relational aggression at low levels of hostile attributions, $t(121) = -2.36, p < .05$. In contrast, HRR was not associated with romantic relational aggression at high levels of hostile attributions, $t(121) = 1.31, p = .19$. As depicted in Figure 4, women with high levels of hostile attributions were relationally aggressive regardless of HRR. In contrast, women low in hostile attributions only exhibited high levels of relational aggression when they also demonstrated blunted HRR to the Cyberball task. Finally, the interaction between HRR, relational victimization, and hostile attributions approached conventional levels of statistical significance, $p = .09$. Follow-up simple slope analyses indicated that blunted HRR was associated with romantic relational aggression among women who were highly relationally victimized but exhibited low levels of hostile attributions, $t(120) = -2.31, p < .05$. In addition, heightened HRR was marginally associated with romantic relational aggression among women with high levels of relational victimization and high levels of hostile attributions, $t(120) = 1.95, p = .05$. In contrast, HRR was not associated with romantic

relational aggression among women with low levels of relational victimization and low levels of hostile attributions, $t(120) = -.53, p = .60$, or among women with low levels of relational victimization and high levels of hostile attributions, $t(120) = .44, p = .66$ (see Figure 5).

Follow-up analyses for all three measures of reactivity were also conducted controlling for baseline arousal given the suggestion that associations between autonomic reactivity and aggression against romantic partners may be a statistical artifact due to differences in baseline arousal (Babcock, Green, Webb, & Graham, 2004). All significant results remained with this additional control with one exception (the main effect of SCR was only marginally significant, $p = .09$ in this follow-up analysis).

Discussion

The goal of the present study was to examine the association between ANS reactivity and romantic relational aggression in a sample of female emerging adults and to examine whether social and cognitive risk moderated this association. Results indicated that ANS arousal was associated with romantic relational aggression; however, these effects were qualified by women's levels of relational victimization at the hands of their romantic partners and their hostile attribution biases. Overall, these findings suggest that distinct physiological reactivity profiles place women at risk for perpetration of relational aggression against romantic partners based on their levels of social and cognitive risk.

It was hypothesized that heightened "fight or flight" responses to a relational stressor would predict women's involvement in romantic relational aggression and that hostile attributions and relational victimization would moderate these associations. Consistent with hypotheses, exaggerated SNS reactivity to relational stress was associated with heightened romantic relational aggression, but only among women with high levels of hostile attribution

biases and who were frequently relationally victimized by their romantic partners. In addition, RSA withdrawal was associated with romantic relational aggression among women with high levels of hostile attribution biases. These findings are consistent with the hypothesis that hyper-reactivity to stress may be most strongly associated with impulsive, emotion-laden forms of aggressive conduct (Scarpa & Raine, 1997; van Goozen et al., 2007). In other words, “fight or flight” may be most likely to translate into aggressive responding among women who frequently perceive threats and hostility from their romantic partners.

However, there was also some evidence for an association between blunted “fight or flight” responses to stress and romantic relational aggression. Specifically, RSA augmentation, rather than RSA withdrawal, predicted romantic relational aggression among women with low levels of hostile attribution biases (although this effect only approached conventional levels of statistical significance). Additionally, blunted HRR was associated with romantic relational aggression among women with low levels of hostile attribution biases, and this effect was marginally strongest among women who were highly relationally victimized by their romantic partners. These findings suggest that fearlessness may be most predictive of romantic relational aggression among women who do not perceive high levels of hostility or threat from their partners; in addition, these findings are consistent with the hypothesis that blunted ANS arousal is most strongly associated with instrumental functions of aggression (van Goozen et al., 2007). In other words, women who do not perceive high levels of threat from their partners may engage in relatively unemotional forms of relational aggression to harm or control their partners. Furthermore, the findings for HRR suggest that some women may respond to victimization by partners with controlled and unemotional aggressive responding, particularly when they do not exhibit high levels of cognitive risk.

Interestingly, hostile attribution biases were only associated with romantic relational aggression among women who were infrequently relationally victimized. Women who were highly victimized exhibited elevated levels of romantic relational aggression, regardless of their cognitive risk. These findings are consistent with a developmental systems model of intimate aggression, in which partner aggression can elicit or exacerbate an individual's own level of aggression (Capaldi et al., 2004). These results also mirror previous research suggesting that hostile attributions only predict aggressive behavior when the provocation cues are ambiguous (Dodge, 1980) and when the individual does not have a previous history of conflict with the provocateur (see Crick & Dodge, 1994). Among highly victimized women, the history of relational aggression in the relationship may make the scenarios relatively unambiguous. Specifically, given the relationship history, it may be quite reasonable to infer that the behavior was intentional. As such, individual differences in this tendency may not distinguish between aggressive and nonaggressive individuals. In contrast, among women who are infrequently victimized by their romantic partners, the tendency to infer hostile intent is less warranted and thus may be a more meaningful contributor to aggressive conduct.

Limitations and Future Directions

Despite the interesting findings from the present study, it is important to acknowledge the limitations of the present work. First, the findings suggest that both over- and under-reactivity may be important predictors of romantic relational aggression, and previous aggression research has highlighted the potential role of hyper-arousal in emotional or reactive aggression and hypo-arousal in instrumental or proactive aggression (Scarpa & Raine, 1997; van Goozen et al., 2007). However, proactive and reactive functions of romantic relational aggression were not assessed in the present study, and future work would benefit from an explicit test of whether these

physiological processes confer unique risk for proactive and reactive romantic relational aggression. In addition, the relational stressor used in the present study focused on peer-based exclusion. Future research would benefit from examining physiological reactivity to a standardized exclusion experience perpetrated by a romantic partner, as it is possible that reactivity to these types of experiences would be more strongly associated with romantic relational aggression. In addition, the present study focused on female college students in dating relationships. Future research would benefit from examining the association between ANS arousal and romantic relational aggression perpetrated by males, particularly since preliminary evidence suggests that there may be distinct associations for males and females (Murray-Close et al., under review). In addition, future research may benefit from considering these associations in marital relationships and among older adults. Finally, due to the cross-sectional data in the present study, it is not possible to determine whether autonomic risk is associated with the development of aggression over time or vice versa. It is possible, for example, that aggression may, over time, alter women's physiological responses to stress (e.g., highly aggressive women may exhibit increases in autonomic reactivity over time). Future longitudinal work is necessary to address this possibility.

Despite these limitations, the findings suggest that ANS reactivity may be an important factor involved in the development of romantic relational aggression. Moreover, both social and cognitive risk appear to moderate of this association; in fact, the mixed findings from previous research regarding whether aggression is associated with hypo- or hyper-reactivity may reflect a failure to consider moderating variables. The findings also have important implications for clinicians working with women who relationally aggress against their romantic partners. For example, relationally aggressive women who exhibit heightened ANS reactivity to relational

stress may benefit from anger management training. In contrast, relationally aggressive women who exhibit blunted ANS reactivity may be most likely to benefit from empathy training or other methods that highlight the damaging effects of aggression on others. Finally, the findings highlight the importance of considering how functioning at various levels of analysis (psychophysiological, cognitive, and contextual) may jointly contribute to maladaptive functioning such as aggressive conduct.

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Table 1. Means, Standard Deviations, and Correlations among Study Variables.

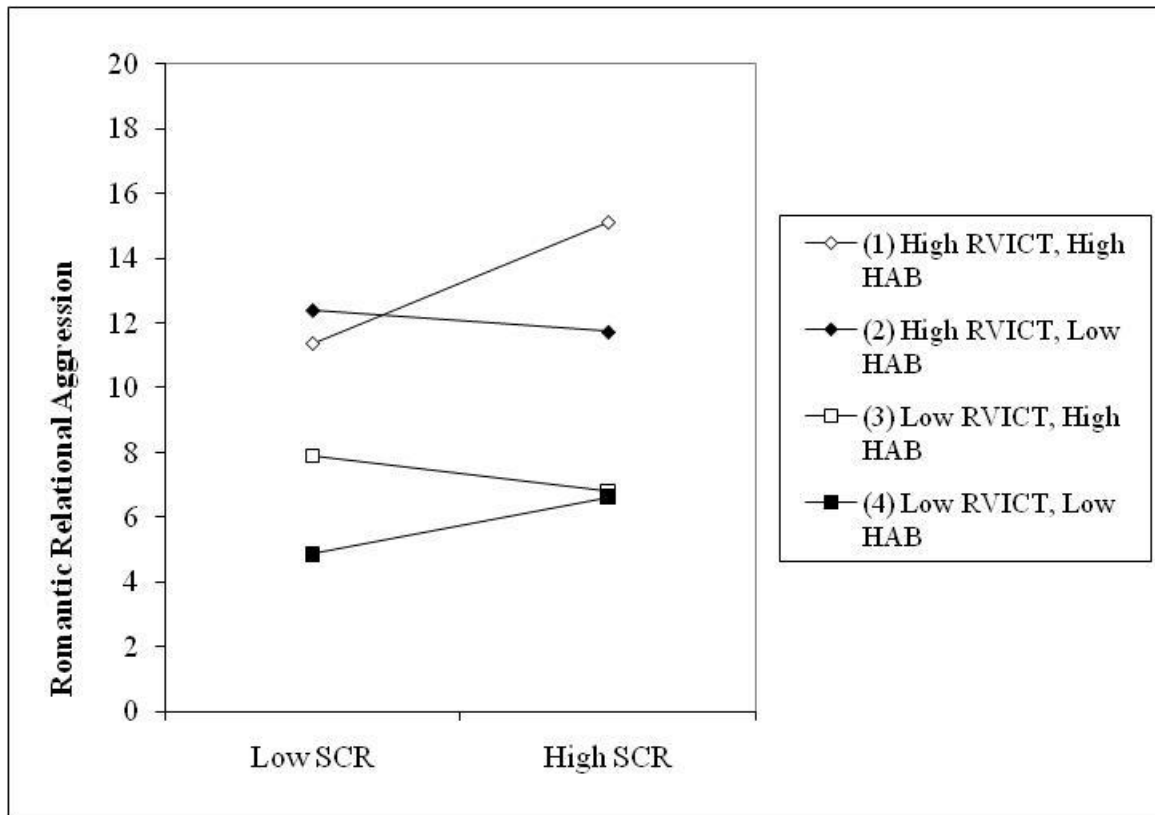
	1.	2.	3.	4.	5.	<i>Mean</i>	<i>SD</i>
1. Romantic Relational Aggression						9.49	4.61
2. Romantic Relational Victimization	.58***					9.45	4.97
3. Hostile Attribution Biases	.27**	.26**				.37	.89
4. Skin Conductance Reactivity	.20*	.10	-.01			1.05	.75
5. Heart Rate Reactivity	-.03	-.07	-.11	.15†		.61	3.59
6. RSA Reactivity	.03	-.04	.10	-.11	-.25**	-.02	.04

Table 2. Autonomic Reactivity and Romantic Relational Aggression

Model	Arousal Variable	Ste	Predictor	<i>B</i>	<i>t</i> -Value	<i>R</i> ² , ΔR^2	<i>F</i> , ΔF			
1	SCL Reactivity	1	SCL Reactivity (SCLR)	.16*	2.16	.37	23.14***			
			Rel Vict (RV)	.53***	6.91					
			HAB	.13†	1.74					
		2	SCLR X RV	.14†	1.76	.05	3.46*			
			SCLR X HAB	.05	.63					
			RV X HAB	-.13	-1.50					
		3	SCLR X RV X HAB	.26**	2.66	.03	7.08**			
			2	RSA Reactivity	1	RSA Reactivity (RSAR)	.03	.34	.35	21.40***
						Rel Vict	.52***	6.60		
HAB	.16*	2.06								
2	RSAR X RV	.22*			2.42	.12	8.22***			
	RSAR X HAB	-.26**			-2.92					
	RV X HAB	-.38***			-4.41					
3	RSAR X RV X HAB	.02			.25	.00	.06			
	3	Heart Rate Reactivity			1	HR Reactivity (HRR)	.03	.34	.35	21.39***
						Rel Vict	.52***	6.60		
HAB			.17*	2.14						
2			HRR X RV	-.06	-.61	.10	7.29***			
			HRR X HAB	.22**	2.75					
			RV X HAB	-.25*	-2.60					
3			HRR X RV X HAB	.22†	1.73	.01	3.00†			

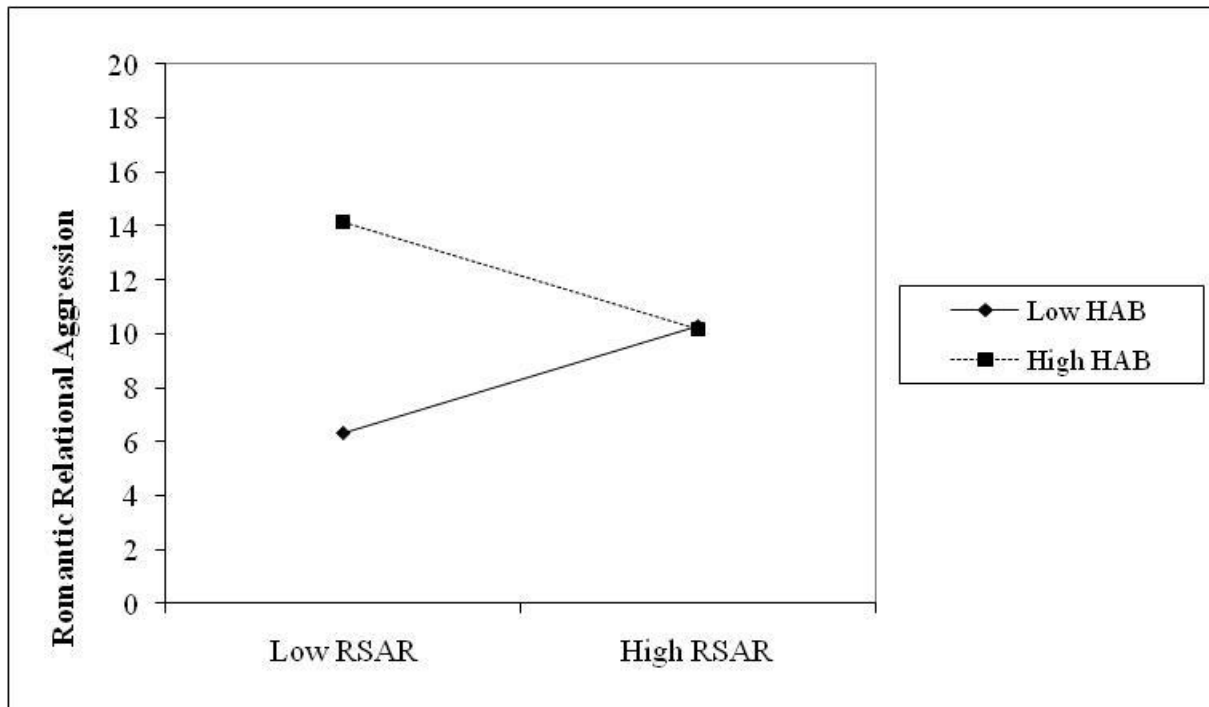
†*p* < .10**p* < .05***p* < .01****p* < .001

Figure 1. Interaction between skin conductance reactivity, romantic relational victimization, and hostile attributions on romantic relational aggression.



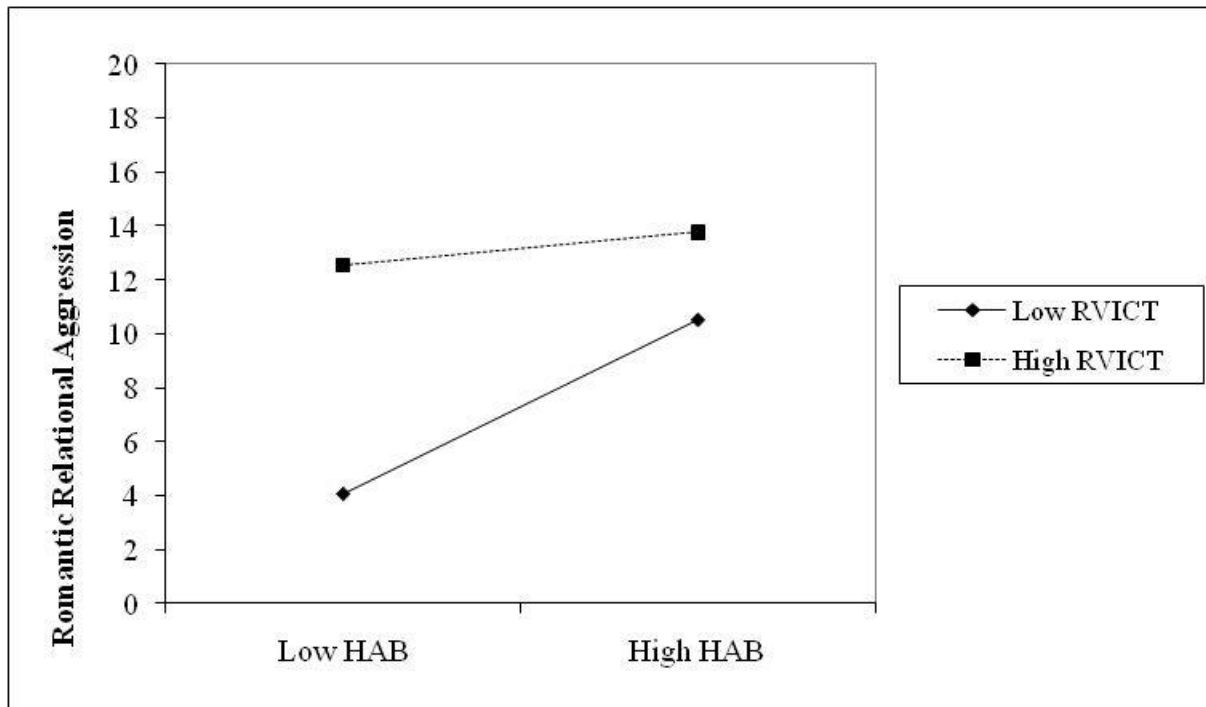
Note. RVICT = relational victimization. HAB = hostile attribution biases.

Figure 2. Interaction between RSA reactivity and hostile attributions on romantic relational aggression.



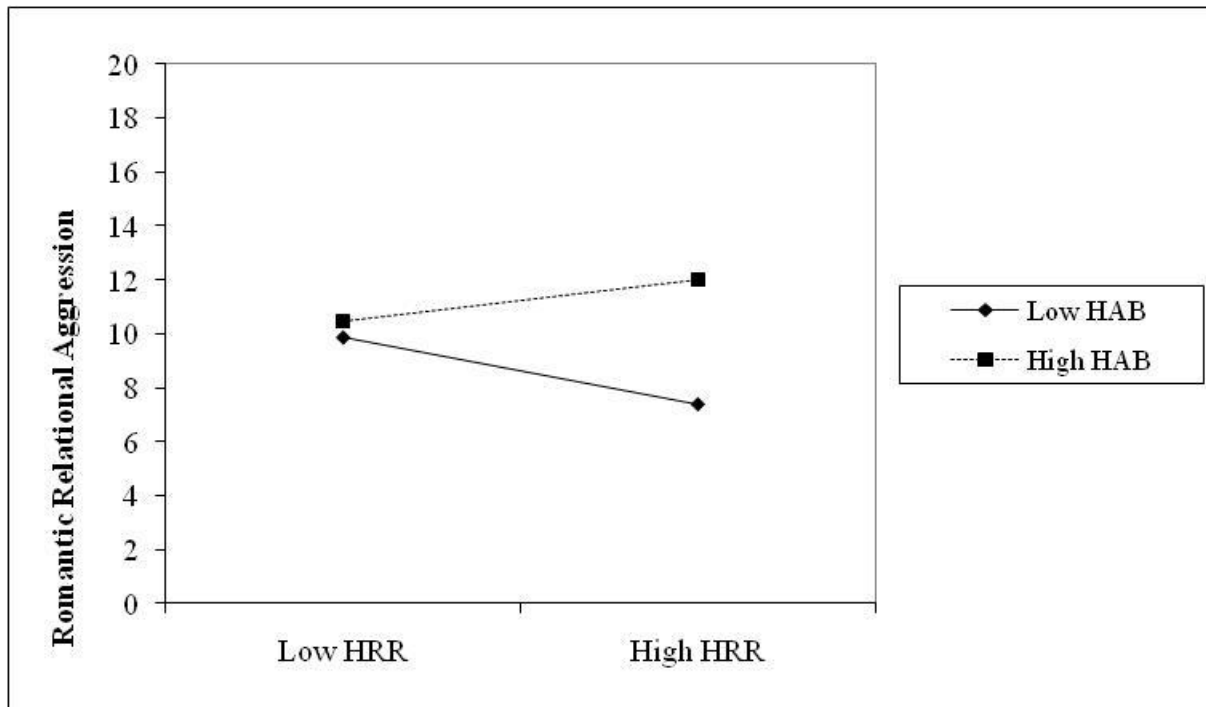
Note. HAB = hostile attribution biases.

Figure 3. Interaction between hostile attributions and relational victimization on romantic relational aggression.



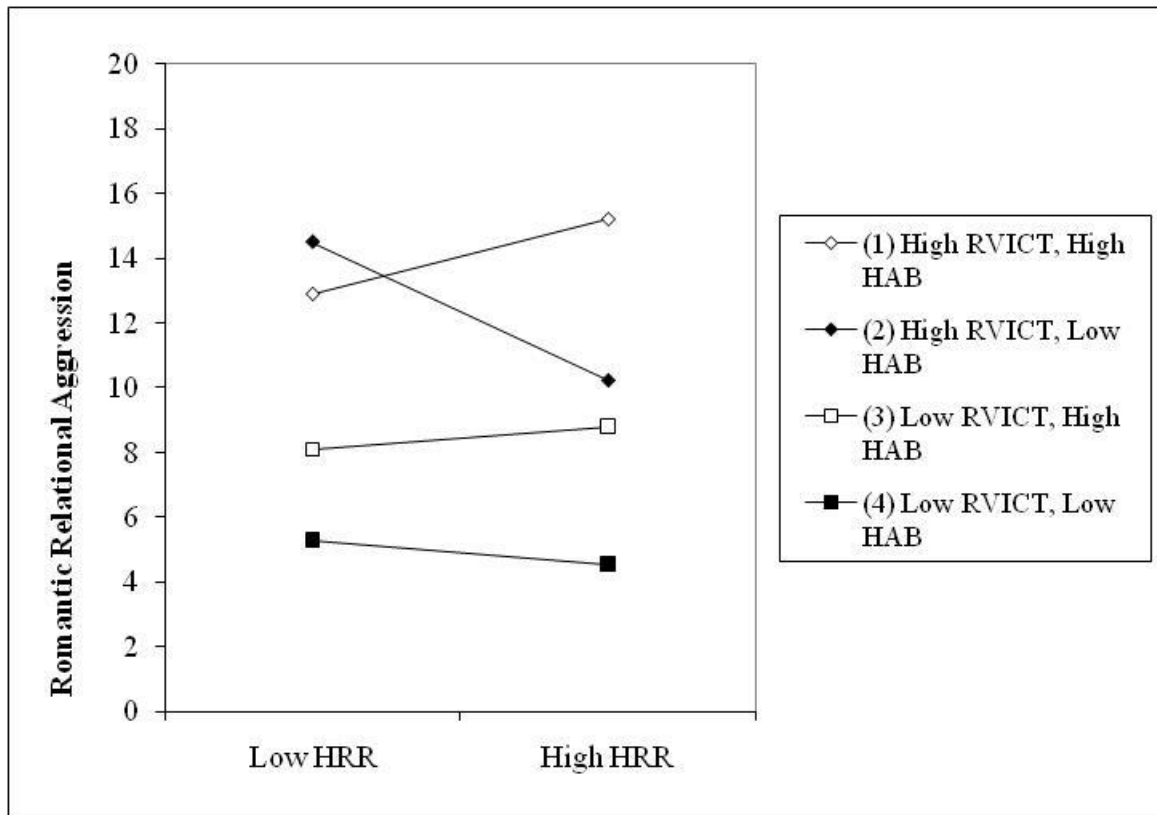
Note. RVICT = relational victimization. HAB = hostile attribution biases.

Figure 4. Interaction between heart rate reactivity and hostile attributions on romantic relational aggression.



Note. HAB = hostile attribution biases.

Figure 5. Interaction between heart rate reactivity, romantic relational victimization, and hostile attributions on romantic relational aggression.



Note. RVICT = relational victimization. HAB = hostile attribution biases.