CARDIOVASCULAR ACTIVITY DURING ROUTINE INTERACTIONS IN ROMANTIC RELATIONSHIPS

by

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ABSTRACT

Although couples research tends to focus on interactions of high salience interactions, it is likely that couples spend the majority of their time engaged in interactions of low salience (i.e., completing chores, having everyday conversations, being in the same physical space). Theory suggests that physiological functioning should be more efficient when in the presence of a spouse during both low- and high-salience interactions. It is likely that this increased efficiency in physiological functioning may be observed in a decrease in high-frequency heart rate variability (HF-HRV). The purpose of this study was to determine how much time couples spend engaged in both low- and high-salience interactions, whether physiological functioning is more efficient in the presence of a spouse during a low-salience interaction than alone, and whether relationship satisfaction moderates this change in functioning. Participants completed two consecutive 5-minute resting baselines, one in the presence of their spouse and one alone. Consistent with predictions, participants reported spending significantly more time engaged in low-salience interactions than high-salience interactions. Further, results indicated a significant increase in HF-HRV for participants who completed their first baseline alone and had their spouse reintroduced for the second baseline. No significant effects were found for heart rate or moderation by relationship satisfaction. Taken together, results suggest that participants are experiencing physiological stress during baseline. Additionally, anticipation of conflict in the study may turn one’s spouse into a stressor during baseline. Limitations and future directions are discussed.

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INTRODUCTION

Biobehavioral research on married couples has largely focused on observable behaviors, particularly interactions of high-saliency, such as times in which partners are experiencing conflict or are actively engaged in supportive behaviors. However, it is highly likely that the majority of the time couples spend together is not spent involved in these high-saliency interactions. Much of the time that spouses spend together is likely spent engaging in low-saliency interactions, such as completing everyday chores or simply being in the same physical space without talking or interacting. A growing body of research suggests that simply being in the presence of a spouse may be associated with significantly different levels of physiological activation relative to being in the presence of a stranger or to being alone (Coan, Schaefer, & Davidson, 2006; Helm, Sbarra, & Ferrer, 2012). Behavioral theory (Cayoun, 2011) suggests that the nature of these changes in physiological activity may depend on relationship quality. If the relationship is well functioning, one's spouse may have a calming effect physiologically and vice versa. The primary aims of the current study are test these suppositions by (1) determining the relative amount of high- and low-saliency interactions during couples' time together, (2) testing whether physiological activity is different when alone versus when in the presence of a spouse during low-saliency interaction, and (3) testing relationship satisfaction as a moderator of changes in physiological activity.

A large body of empirical evidence demonstrates that a wide range of physiological responses, including cardiac activity like heart rate (HR) and respiratory sinus arrhythmia (RSA), are major pathways by which couple interaction is linked to overall relationship functioning, mental health, and physical well-being (see Kiecolt-Glaser & Newton, 2001 and Robles & Kiecolt-Glaser, 2003 for reviews). For example, faster HR during couple conflict is associated with lower levels of concurrent relationship satisfaction and greater longitudinal decline in relationship satisfaction (e.g., Levenson & Gottman, 1985), higher levels of negative communication behaviors (e.g., Newton & Sanford, 2003), and increased risk for hypertension and cardiovascular disease (e.g., Robles & Kiecolt-Glaser, 2003). Recent evidence also links higher levels of negative communication, depression, anxiety, and anger to lower levels of tonic high frequency-heart rate variability (HF-HRV), which is a measure of RSA (Diamond, Fagundes, & Butterworth, 2012; Smith et al., 2011). These effects are generally understood to occur as a result of the distress that partners experience during stressful couple interactions (e.g., Robles & Kiecolt-Glaser, 2003). More specifically, dysfunctional patterns of interaction are a salient social stressor that provoke physiological responses. Prolonged and repeated exposure to the stress of dysfunctional interactions results in longer term changes to physiological functioning, and these changes in physiological functioning increase risk for a range of negative outcomes.

The majority of what is known about how romantic relationships and physiological activity are related is based on brief, high-salience interactions, but these interactions are likely to account for a small percentage of the time that spouses and partners spend together. Though high-intensity conflict and moments of deep emotional connection are valuable means for researching the impact of relationship processes on spouse's physiological responding, it is likely that overall relationship quality affects spouse's physiological activity beyond these high-salience interaction contexts (Robles & Carroll, 2011) . For example, marital conflict has long-lasting effects even after a single bout of conflict is over (Malis & Roloff, 2006), and an episode of marital tension is associated with significantly higher levels of marital tension up to a day later (Margolin, Christensen, & John, 1996). These findings suggest that it is likely that spouses in distressed relationships may evidence chronic changes in physiological activity, such as increased HR and decreased RSA, when in one another's presence even when not arguing.

Additional support for this possibility comes from a growing body of research supporting the idea that spouses may respond to one another at a physiological level during low-salience interaction. Social Baseline theory posits that close interpersonal relationships have evolved to allow for decreased energy expenditure (Beckes & Coan, 2011). This lowered expenditure occurs because individuals would increase their chance of survival if a predator attacked the group and with more individuals there is increased vigilance resulting in increased safety. These benefits allow an individual to decrease his or her own vigilance and provide some regulatory benefit. This proposed regulatory benefit has been supported by studies showing that when individuals are threatened with a shock threat-reactive activity is lessened when holding a partner's hand relative to when holding a stranger's hand or being alone (Coan et al., 2006).

Research has also shown changes in cardiovascular functioning as the result of proximity to a loved one. For example, individuals who perceive their partner as being important have lower resting blood pressure (Uchino, Sanbonmatsu, & Birmingham, 2013). Porges (1998) suggests that a link between the vagus and cardiovascular system may impact how individuals experience love and intimacy and that this connection enables both sexual desire and the creation of lasting close relationships. Porges' (2007) Polyvagal Theory proposes that the vagus nerve acts as a brake that can be used to decrease parasympathetic activation during times of stress, instead of engaging the sympathetic nervous system. Variation in interbeat intervals, or high-frequency heart rate variability (HF-HRV), provides a measure of parasympathetic inhibition.

Polyvagal Theory suggests that there should be an increase in parasympathetic functioning when one feels comfortable or safe, and this change in parasympathetic functioning would be reflected in an increase in HF-HRV. Conversely, when one is in a stressful or dangerous situation, there should be a decrease in parasympathetic functioning that would lead to a decrease in HF-HRV. These predictions are supported by research showing an association between higher levels of marital quality and higher levels of HF-HRV, as well as by a link between greater activation in areas of the brain which process threat and safety and lower HF-HRV (Smith et al., 2011; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). This collection of findings suggests that physiological responses to the presence of one's partner are likely to be observable in HF-HRV.

Research on well-established patterns of interaction in relationships provides a conceptual framework for understanding how simply being in the presence of one's partner could impact physiological activity. It is well known that distressed couples discuss less novel conflict topics and respond to one another in increasingly rigid and stereotyped ways as their level of distress and relationship length increase (Eldridge, Sevier, Jones, Atkins, & Christensen, 2007). This increasing rigidity can be understood as a form of behavioral conditioning. Operant conditioning is a process by which the frequency of a behavior is influenced by its consequences. Behaviors that result in favorable outcomes are reinforced and more likely to occur again in the future. This reinforcement process may lead to the repetition of highly crystallized interaction behaviors between spouses.

The co-emergence model of reinforcement suggests that physiological activity is also likely to be conditioned as behavioral patterns are established (Cayoun, 2011). In this model, the body is thought to manifest physical reactions in response to the presentation of a stimulus and that the nature of the reaction is determined by the evaluation of the stimulus. Interoception of these physiological responses is thought to then drive subsequent behavioral responses even if individuals are not consciously aware that interoception has occurred.

Extending this model to couples suggests that if spouses are distressed, they may evaluate one another negatively, exhibit parasympathetic withdrawal in one another's presence, and have a higher likelihood of engaging in negative behaviors, such as criticizing, blaming, or withdrawing, as a result. Either approach- or avoidance-oriented behaviors are likely to result in restoration of parasympathetic homeostasis. If spouses engage in approach-oriented behaviors that lead to a conflict, they typically separate from one another either as a means to end the conflict or to cool down after the conflict. If spouses engage in avoidance-oriented behaviors, they separate from one another as a means to prevent an argument from occurring in the first place. In either case, parasympathetic recovery is likely to occur after physical separation from the spouse (e.g., Shahrestani, Stewart, Quintana, Hickie, & Guastella, 2015). A similar process may also result in parasympathetic upregulation for satisfied couples who evaluate one another positively and have frequent, positive interactions stemming from a physiological state of associated with safety and intimacy (e.g., Floyd et al., 2007).

Based on the theory and evidence presented above, it is hypothesized that spouses will report spending significantly larger amounts of time interacting than speaking to one another or arguing and significantly more amounts of time speaking to one another than arguing as a proportion of the total amount of time spent together (Hypothesis 1). Additionally, it is hypothesized that individuals will experience significantly lower HR and increased HF-HRV when with their spouses relative to when alone (Hypothesis 2). In addition to the separate versus together baseline condition, exploratory analyses will also be run to test for differences in physiological responses when spouses are reunited versus separated from one another (Hypothesis 2a). Finally, it is hypothesized that relationship satisfaction will moderate the influence of the presence of the spouse on change in HR and HF-HRV. More specifically, higher levels of relationship satisfaction will be associated with larger decreases in HR and larger increases in HF-HRV when in the presence of the spouse when compared to being alone (Hypothesis 3).

METHOD

Participants

Participants are 60 married couples (*N*=120) living in and around Salt Lake City, Utah recruited for participation in one of two studies with identical laboratory protocols. Mean age for participants was 29.62 (*SD* = 7.65). Seventy point two percent of participants identified as White, 14.2% identified as Asian, , 4.2% identified as Native Hawaiian or Pacific Islander, and 1.7% identified as Black or African American. Eight point three percent identified as Hispanic or Latino, and 9.2% chose not to answer questions on either race or ethnicity. Thirty-two point five percent of participants identified as a member of the Church of Jesus Christ of Latter-day Saints, 10% of participants identified as non-LDS Christian, 1 participant identified as Muslim (.01%), 17.5% identified as atheist, agnostic, or nonreligious, and 8 participants (.07) chose to skip the question. Twenty participants (16.7%) completed the study before this question was added and thus no data are available for them. Participants included 59 heterosexual couples and 1 female, same-sex couple. On average, couples had .83 children (*SD* =1.33) with a combined monthly income of $1,887 (*SD* =2979.27). Study 1 consisted solely of a 3-hour laboratory procedure, while Study 2 consisted of both the same 3-hour laboratory procedure as well as the continued collection of data for the subsequent 7 days following the laboratory assessment. Study 2 also included two additional physiological measures to facilitate out of laboratory data collection.

Inclusion and exclusion criteria were highly similar for both studies. For Study 1 and 2, all spouses had to be fluent in English and married for at least 1 year. Additionally, at 1 one spouse had to score at or below a score of 18 on the four-item version of the Couple's Satisfaction Index (CSI-4;Funk & Rogge, 2007) in order to prevent a positively skewed distribution of relationship satisfaction scores frequently observed in community samples, and the couple had to live within 20 miles of the University of Utah for Study 2. Likewise, for Study 1 and 2, participants could not have current or previous medical conditions (e.g., heart disease) or current use of medications (e.g., beta blockers) that affect cardiovascular responses and pregnancy. Additional exclusion criteria for Study 2 included moderate (or higher) levels of intimate partner violence, and children, parents, or anyone other than the couple living in the home. Finally, Study 1 obtained a stratified random sample, aiming for 20 mildly distressed, 20 moderately distressed, and 20 severely distressed couples, as determined by the Couples Satisfaction Inventory, 4-item version (CSI-4; Funk & Rogge, 2007).

Procedures

Couples were recruited through campus and community fliers, email listserves, on-line classified postings, and departmental research participant websites. Before participating, each partner was screened by phone or internet separately to ensure that all criteria were met. Eligible participants completed a 3- to 4-hour laboratory assessment that included four baseline measurements (two resting baselines, a paced breathing task, and a standardized reading assessment), a battery of self-report questionnaires, and four interactions tasks. Data for the current study were taken from the two resting baseline measurements and two self-report questionnaires.

The two resting baselines were used to assess physiological activity when in the presence of the spouse and when alone. Both resting baselines were obtained by asking participants to sit quietly for 5 minutes, once while in separate rooms and once while sitting together in the same room. The order of whether the together or separate baseline was collected first was randomized and counter-balanced. One of the two spouses moved from the main laboratory room to a nearby room for the separate baseline assessment. The determination of which spouse stayed in the main laboratory room and which spouse moved to the nearby room was also randomized and counter-balanced. To minimize movement artifact, only the spouse who stayed in the same room for both baselines were included in analyses for hypotheses 2 and 3.

Measures

Relationship Satisfaction

The Couples Satisfaction Inventory, 32-item version (CSI; Funk & Rogge, 2007) was used to measure relationship satisfaction. All 32 items are summed to create a single scale score where higher scores indicate greater levels of satisfaction. Inspection of scale scores revealed a small number of extremely low scores and post hoc diagnostics of multilevel models revealed that these scores were functioning as outliers. These four scores were therefore winsorized by replacing the original scores with a score equal to -2 SD (CSI-32 = 108) and models were rerun using these winsorized values. Cronbach alphas were .973 for husbands and .957 for wives.

Time Spent Together

Time spouses spend together was assessed using a four-item measure created for the current study. Participants were asked to report how much time they spend in the same physical location as their spouse, how much time they spend engaged in an activity with their spouse, how much time they spend speaking with their spouse, and how much time they spend arguing with their spouse to the nearest quarter hour for a typical day. These questions were added after the beginning of the study and no data were collected for the first 10 couples who participated. When a time range was given, the average was used unless the range exceeded 2 hours. Answers giving a range greater than 2 hours were considered missing data. For analyses, three new variables were created by dividing time spent engaged in an activity, time spent speaking with spouse, and time spent arguing with spouse by total amount of time spent with spouse.

Physiological Measures

Electrocardiogram (ECG) waveforms were collected for each spouse using a Dual Wireless Respiration and ECG BioNomadix module pair. HR and HF-HRV values were derived from interbeat intervals using MindWare analysis software and condensed into 60-second segments for analysis. Waveforms and R peak placement were visually inspected for accuracy, and manually edited when necessary. Any segment requiring imputation of more than 10% of heartbeats (between 6 and 10 beats, depending on the participants' average heart rate) was not included in final analyses. Four participants' data did not fit expected QRST wave patterns or showed abnormal inconsistency in interbeat intervals, suggesting the possibility of arrhythmia or other abnormality in cardiac functioning. One participant's data showed a resting heart rate in the tachycardic range (HR > 100). One participant's data showed much greater disparity in HF-HRV from segment to segment than expected. Data from these 6 participants were not included in final analyses.

Body Mass Index

Body mass index (BMI) is a measure of body fat based on the ratio of an individual's height and weight. Each spouse's height and weight were measured using a Healthometer beam scale and used to calculate BMI with the following formula: BMI = 703 X (weight (lbs)/height^2 (in^2))(Centers for Disease Control and Prevention, 2015). Two BMI scores were winsorized to two standard deviations above the mean (BMI= 37.3) using the same procedures as for relationship satisfaction.

RESULTS

Table 1 presents means and standard deviations for, as well as correlations between, all study variables. Average HF-HRV and HR values were consistent with values typically observed in healthy adult samples (e.g., Thayer & Lane, 2007). Also consistent with expectations, HF-HRV and HR were positively and significantly correlated, and BMI was negatively and significantly correlated with HF-HRV and positively and significantly correlated with HR.

Differences in Type of Time Spent Together

A 3 (type of time spent together; within subjects factors) x 2 (sex; between subjects factor) mixed-effects Analysis of Variance (ANOVA) was used to test the first hypothesis. Consistent with predictions, there was a significant main effect for type of time spent together, $F(2,80) = 95.147$, $p < .001$. A post hoc pairwise comparison of this effect indicated that spouses reported spending significantly more time engaged in activity ($\Delta M = .569$, $SE = .045$) and talking ($\Delta M = .521$, $SE = .045$) than arguing ($M = .055$, $SE = .008$; $p < .001$). There was no significant difference between time spent engaged in activity and time spent talking ($\Delta M = .048$, $SE = .047$, $p = 0.314$). Neither the main effect for sex, $F(1, 40) = .200$, $p = .658$, nor the sex by type of interaction, $F(2,80) = .517$, $p = .598$, effects were significant.

Changes in HF-HRV Across Baselines

A 2 (first baseline vs. second baseline; within subjects factor) x 2 (husband vs. wife; between subjects factor) x 2 (couple reunited vs. separated; between subjects factor) mixed-effects ANOVA was used to assess the second hypothesis. For HF-HRV, a significant effect emerged for the two-way interaction between baseline order and reunited vs. separated, $F(1, 52) = 6.940$, $p = .011$. Decomposition of this interaction with dependent samples *t*-tests revealed that HF-HRV was significantly lower when couples were together vs. apart in the reunite condition, $\Delta M = -.15$, $t(30) = -2.39$, $p = .023$. In contrast, HF-HRV was nonsignificantly higher when couples were together vs apart in the separate condition, $\Delta M = .15$, $t(24) = 1.50$, $p = .147$. A significant effect also emerged for the two-way interaction between spouse and reunite condition. Decomposition of this interaction revealed a significant difference in direction of change across spouses in the reunite condition and that the magnitude of the change itself was nonsignificant in both cases. All other main effects and interactions were nonsignificant.

Sensitivity analyses were run to test for stability of findings when BMI and relationship satisfaction were added to the model as covariates as illustrated in the following series of equations:

Level-1 Model

$$RSA5_{ij} = \beta_{0j} + \beta_{1j}*(Separate_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Spouse_j) + \gamma_{02}*(Reunite_j) + \gamma_{03}*(Spouse\ X\ Reunite_j) + \gamma_{04}*(CSI32) + \gamma_{05}*(BMI_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(Spouse_j) + \gamma_{12}*(Reunite_j) + \gamma_{13}*(Spouse\ X\ Reunite_j) + \gamma_{14}*(CSI32)$$

$+ \gamma_{15} * (BMI_j)$

where *i* indexes baselines and *j* indexes individuals. The random effect, $u_{0j},$ included at level two allows for individual differences in average HF-HRV. Consistent with ANOVA results, significant two way interactions emerged between separate versus together baseline and reunite condition (B = .31, p < .001) and spouse and reunite condition (B = -1.31, p = .046) when BMI and relationship satisfaction were included in the model. These effects were in the same direction as those in the ANOVA. Table 2, Model 1 presents results of the full model.

To test hypothesis 3, a two-level MLM was estimated where the main effect of relationship satisfaction and interactions between relationship satisfaction and reunite condition, and relationship satisfaction and separate versus together baseline were added as predictors as illustrated in the following series of equations:

Level-1 Model

$$RSA5_{ij} = \beta_{0j} + \beta_{1j} * (Separate_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (Spouse_j) + \gamma_{02} * (Reunite_j) + \gamma_{03} * (Spouse\ X\ Reunite_j) + \gamma_{04} * (CSI32) +$$
$$\gamma_{05} * (Reunite\ X\ CSI32_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (Spouse_j) + \gamma_{12} * (Reunite_j) + \gamma_{13} * (Spouse\ X\ Reunite_j) +$$
$$\gamma_{14} * (CSI32) + \gamma_{15} * (Reunite\ X\ CSI32_j)$$

In contrast to hypothesis 2, the interaction between reunite condition and separate versus together baseline emerged as nonsignificant (B=.20, p=.388). Additionally, a trend emerged for the main effect of relationship satisfaction (B = .016, p = .065), but no other effects of interest were significant.

Similar to hypothesis 2, sensitivity analyses were run where BMI was added to the model as a covariate as illustrated in the following series of equations:

Level-1 Model

$$RSA5_{ij} = \beta_{0j} + \beta_{1j}*(Separate_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(Spouse_j) + \gamma_{02}*(Reunite_j) + \gamma_{03}*(Spouse\ X\ Reunite_j) +$$

$$\gamma_{04}*(CSI32) + \gamma_{05}*(Reunite\ X\ CSI32_j) + \gamma_{06}*(BMI_j) + u_0$$

$$_j\beta_{1j} = \gamma_{10} + \gamma_{11}*(Spouse_j) + \gamma_{12}*(Reunite_j\ ) + \gamma_{13}*(Spouse\ X\ Reunite_j\ ) +$$

$$\gamma_{14}*(CSI32)\quad + \gamma_{15}*\ (Reunite\ X\ CSI32_j) + \gamma_{16}*(BMI\_WIN_j)$$

Consistent with results for hypothesis 2, a significant two-way interaction emerged between spouse and reunite condition (B = -1.34, p = .025) and a trend main effect emerged for relationship satisfaction (B = .016, p = .084). No other main effects or interactions were significant. Table 2, Model 2 presents results of the full model.

Changes in HR Across Baselines

Identical models were run to test for differences in HR across baselines and for the effect of relationship satisfaction on these differences. All main effects and interactions in all models were nonsignificant. Table 3 presents results of the full models.

Table 1. *Means, Standard Deviations, and Correlations for Couple HF_HRV, HR, BMI, CSI32, and Form of Time Spent Together*

Variable	Mean (*SD*)	HF-HRV	HR	BMI	CSI32	Activity	Talking	Arguing
HF-HRV	6.340 (.96)		-.55***	-.49***	.14	.36*	.39**	.15
HR	72.908 (8.57)			.35**	-.06	-.24	-.26	-.32*
BMI	29.956 (4.41)				-.12	-.06	-.17	.09
CSI32	133.478 (20.65)					.28	.35*	-.28
Activity	.442 (.24)						.58***	.17
Talking	.424 (.27)							.30*
Arguing	.038 (.04)							

Note. Time variables used are time spent engaged in activity, time spent talking, and time spent arguing, calculated as a proportion of the total amount of time spent together.
**p*< or = .05. ***p*< or = .01. ****p*< or = .001.

Table 2. *Multilevel Modeling Coefficients for Models of the Predictors of High-Frequency Heart Rate Variability (HF-HRV)*

Parameter	Model 1 B SE B	Model 2 B SE B
Intercept	5.195 (1.37)***	4.500 (1.23)***
BMI	-.027 (.03)	-.027 (.03)
Spouse	.351 (.31)	.357 (.31)
Reunite	-.564 (.28)*	.633 (2.58)
Spouse X Reunite	-1.314 (.57)*	-1.34 (.58)*
Separate vs. Together	-.797 (.44)	-.601 (.77)
Separate vs. Together X Spouse	.062 (.17)	.060 (.19)
Separate vs. Together X Reunite	.308 (.11)**	-.030 (.90)
Separate vs. Together X Spouse X Reunite	.197 (.23)	.204 (.22)
Separate vs. Together X Rel. Sat.	.005 (.00)	.003 (.01)
Separate vs. Together X Reunite X Rel. Sat.	---	.002 (.01)
Separate vs. Together X BMI	-.009 (.01)	-.010 (.01)
Rel. Sat.	.011 (.01)	.016 (.01)+
Reunite X Rel. Sat.	---	-.009 (.02)

Note. Robust standard errors are reported in parentheses. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3. *Multilevel Modeling Coefficients for Models of the Predictors of Heart Rate (HR)*

Parameter	Model 1 B SE B	Model 2 B SE B
Intercept	72.907 (12.04)***	88.662 (16.66)***
BMI	.307 (.27)	.299 (.26)
Spouse	2.108 (3.84)	-2.254 (3.79)
Reunite	-.256 (2.65)	-27.409 (24.12)
Spouse X Reunite	9.595 (5.26)$^{+}$	10.165 (5.14)$^{+}$
Separate vs. Together	-1.684 (2.27)	.223 (2.75)
Separate vs. Together X Spouse	-.384 (.82)	-.401 (.82)
Separate vs. Together X Reunite	-.250 (.57)	-3.537 (4.34)
Separate vs. Together X Spouse X Reunite	-.421 (1.13)	-.352 (1.12)
Separate vs. Together X Rel. Sat.	.014 (.02)	.000 (.02)
Separate vs. Together X Reunite X Rel. Sat.	---	.024 (.03)
Separate vs. Together X BMI	.027 (.05)	.026 (.05)
Rel. Sat.	.012 (.09)	-.125 (.12)
Reunite X Rel. Sat.	---	.196 (.17)

Note. Robust standard errors are in parentheses. + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

DISCUSSION

This study examined the amount of time that spouses spend in high- and low-salience interactions and tested differences in HF-HRV and HR when in the presence of a spouse as compared with when alone. Relationship satisfaction was also tested as a moderator of hypothesized differences in HF-HRV and HR. Consistent with predictions, spouses reported spending significantly different amounts of time engaged in activity and talking with one another than arguing with one another. Hypothesis 2 was partially supported by a significant difference in HF-HRV when spouses are reunited with their spouse relative to when alone. Contrary to predictions, relationship satisfaction did not moderate differences in physiological activity. I consider the implications of these findings for understanding how low-salience interactions impact relationships in turn below.

Amount of Time Spent in Low- and High-Salience Interactions

As hypothesized, significantly more time was spent engaged in interactions and talking than arguing as a proportion of total time spent together. This finding supports the idea that couples spend more time engaged in low-salience interactions than in high-salience interactions. Contrary to expectations, there was not a significant difference between amount of time spent engaged in activities and amount of time spent talking. Consistent results are seen in findings documenting that most daily communication between spouses revolves around nonintimate topics and that self-disclosure is relatively rare (Duck, Rutt, Hurst, & Strajek, 1991). Likewise, Dainton and Stafford (1993) found that couples most frequently cited sharing tasks and simply being together as behaviors important to maintaining their relationship. Taken together, these findings suggest that what happens in the course of low-salience interactions, and the frequency with which they occur, may be of great importance to relationship functioning and deserves greater attention in future research and theory development.

One unexpected finding that emerged in reviewing the time spent together data is that several couples reported spending more time talking than the total amount of time they reported being together, suggesting that these couples were including electronic communication in their estimation. Technological advances in communication have outpaced the literature on how these communications function in relationships. Previous research on instant messaging has shown that the content and word choice included in messages between intimate partners predicts relationship outcomes (Slatcher & Pennebaker, 2006; Slatcher, Vazier, & Pennebaker, 2008). Should frequency of communication prove to impact relationship outcomes, as suggested, more research will be needed to determine how this impact may differ by various forms of communication.

Difference in HF-HRV When With the Spouse Versus Being Alone

HF-HRV findings partially supported the hypothesis that individual physiological activity is significantly different in the presence of a spouse versus alone. There was a significant decrease in HF-HRV when spouses were reunited with their partners after being alone. This effect was in the opposite direction of hypotheses and contrary to the prediction that presence of spouse would have a consistent effect.

One possible explanation for this pattern of findings is that spouses experienced the baseline tasks as mildly stressful. Consistent with the neurovisceral integration model (Thayer & Lane, 2000), increased HF-HRV during the separate baseline could indicate that spouses engaged in additional regulatory effort when they were alone and that they relaxed the intensity of their regulatory effort when reunited with their partner. It is also possible that this same pattern of findings could indicate that spouses were able to mount a more energetically efficient response to a mildly stressful situation when reunited with their partners relative to when they were apart from their partners. Future work is needed to investigate these possibilities as it is not possible to distinguish between them with the available data.

Though it is not possible to distinguish between these two possibilities, it is clear that neither interpretation is fully consistent with Social Baseline theory (Beckes & Coan, 2011), Polyvagal Theory (Porges, 2007), or the neurovisceral integration model (Thayer & Lane, 2000) because differences in HF-HRV were only observed when spouses were reunited and not when spouses were separated. One possibility for this finding is that spouses can serve as a classically conditioned stimulus for one another rather than as an overall safety cue (Duits et al., 2015). When spouses are in separate rooms initially, the reintroduction of the partner may provoke a response in the other spouse. However, when spouses begin in the same room, the partner is not reintroduced to the other spouse, thus no conditioned response is evoked. Furthermore, each participant has already been given a brief overview of the study and is therefore made aware that they will be asked to discuss areas of conflict with their spouse before completing the baseline measurement. It is possible that this anticipation turns the partner into a temporary stressor, eliciting a stress response when being reintroduced. Further research is needed to elucidate these connections, particularly studies including both sympathetic and parasympathetic activity.

It is important to note that this pattern of differences in HF-HRV continued to emerge as significant when relationship satisfaction was included as a covariate and that relationship satisfaction did not moderate this pattern of differences. This set of findings indicates that this effect is a stable response consistent across the range of satisfaction. To the best of our knowledge, this is the first study to document spouse-related effects across a wide range of relationship satisfaction including both highly satisfied and distressed couples who are below the threshold for clinical distress.

Findings did not support the prediction that relationship satisfaction moderates differences in physiological functioning. It may be that the influence of the presence of one's spouse is similar regardless of relationship functioning. It has been suggested that anticipation about the upcoming study may cause the presence of one's partner to be interpreted as a stressor, in which case it would be difficult to parse apart how individuals would respond to their partners in neutral settings, and what role relationship satisfaction may play in those circumstances. It is also possible that relationship factors other than relationship satisfaction (e.g., negative attitudes about one's partner or frequency of negative interactions) may moderate the observed differences in physiological functioning. Such a possibility should be examined in future research.

Contrary to predictions, there were no significant differences in HR observed across baselines. Since HF-HRV is derived from HR, they typically display an inverse relationship as is the case in the current study. As the variability in heart beats increases, heart rate decreases, and vice versa (Grossman & Taylor, 2007). It is possible, however, that these changes were observed in HF-HRV but not in HR because of differences in the sensitivity of the measures chosen. Another possible explanation is related to the differential influence of the sympathetic and parasympathetic nervous systems on HR and HF-HRV. HR reflects the influence of both the sympathetic (SNS) and parasympathetic nervous systems (PNS) while HF-HRV reflects the influence of only the PNS. If participants experience the baseline as a mildly stressful task and respond with parasympathetic withdrawal as suggested earlier, such a response may be an energetically efficient response to that stress in the presence of a partner. This explanation would suggest a shift in balance of activation between the SNS and PNS that may be observable in a measure of each system separately, but may not result in a noticeable fluctuation in HR because of the combined SNS and PNS influences.

The results of this study should be considered in light of several limitations. First, individuals varied in whether or not they included sleep in their self-report of total time spent together, and in time spent engaged in activity. As these analyses used forms of time spent together as a proportion of total time spent together for within person comparisons, it is unlikely that these inconsistencies had any effect on overall findings. Second, observations in this study were limited to measures of parasympathetic activation. Although there are strong theoretical reasons to focus on parasympathetic activity, the parasympathetic and sympathetic nervous systems work in tandem. Thus, lack of data on sympathetic functioning limited the ability to interpret unexpected findings in parasympathetic functioning. Finally, the sample tested in this manuscript included only 1 same-sex couple, and it was therefore not possible to test for differences in effects across sexual orientation which may limit the generalizability of findings.

These findings support the notion that couples spend a majority of their time engaged in low-salience interactions suggesting that greater attention should be paid to such interactions in future research on romantic relationships. Additionally, further research is needed to elucidate the connections between spouse's presence, physiological functioning, and stress. Although these data did not show an overall effect of spouse's presence during baseline functioning, previous research has demonstrated some benefits during periods of high stress (Coan et al., 2006). Additional research is needed to determine the effects of spouse presence on autonomic nervous system stress response and recovery, and to determine which, if any, relationship factors may moderate these effects.

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