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Linguistic Markers of Emotion Regulation and Cardiovascular Reactivity Among Older Caregiving Spouses

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Abstract

This study examined linguistic markers of emotion regulation and cardiovascular stress reactivity in spousal caregivers. Fifty-three individuals were audiotaped while they privately disclosed an instance of partner suffering and a typical partner interaction (i.e., a meal together). Systolic blood pressure, diastolic blood pressure, and heart rate (HR) were measured. Linguistic analysis determined emotion and cognitive processing word use. Results revealed that using more positive emotion words was associated with lower HR reactivity in each verbal account. Caregivers who used fewer cognitive processing words (e.g., think, realize, because) overall had the highest HR reactivity to talking about the partner's suffering. These findings have implications for interventions for all caregivers as well as distinguishing more resilient caregivers from those who may be at a higher risk for caregiver burden.

Keywords

emotion; caregiving; suffering; linguistic content; cardiovascular reactivity

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Exposure to the suffering of a loved one is a stressful experience—one that can take an emotional and physical toll on a person. However, not all people are affected by their partners' suffering in the same way. Some people are able to stay positive and find meaning in these situations, whereas others do not. The goal of this research is to examine the degree to which spousal caregivers regulate their emotions by focusing on positive emotions and cognitively process information in the face of a partner's suffering and how this relates to cardiovascular reactivity—a potentially important pathway linking stress to health outcomes.

In the present study, we examine cognitive processing and emotional words used by spouses of osteoarthritis (OA) patients to describe a potentially stressful experience, their partner's suffering, and a typical daily interaction with the partner (i.e., having a meal together). OA

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is a common chronic condition in later life that often entails pain, disability, and suffering (Centers for Disease Control and Prevention, 2004), and spouses of people with OA are likely to be exposed to their partner's suffering on a daily basis.

Having a close partner who is chronically ill and providing care for that partner can be stressful. A large body of research shows that providing care to older adult family members (1) generates physical and psychological strain, (2) is accompanied by high levels of unpredictability and uncontrollability, (3) has the capacity to generate secondary stress in multiple life domains, and (4) frequently requires high levels of vigilance on the part of the caregiver (Vitaliano, Zhang, & Scanlan, 2003). Furthermore, caregiving often involves witnessing the suffering of a loved one over an extended period of time which has important implications for psychological and physical health (Monin & Schulz, 2009). However, there are likely to be individual differences in the extent to which caregiving spouses effectively regulate their emotions in the face of their partners' suffering—impacting their emotional and cardiovascular reactivity to this stressor.

In the past decade, there has been a growing emphasis on examining how positive affect influences resiliency and health outcomes in reaction to acute (Bonnano, 2004) and chronic stress situations (Folkman & Moskowitz, 2000). It has been theorized that under stressful conditions, when negative emotions are predominant, positive emotions may provide a psychological break, facilitate continued coping efforts, and replenish resources that have been depleted by the stress (Lazarus, Kanner, & Folkman, 1980). Similarly, Fredrickson's (1998) broaden-and-build theory suggests that positive emotions are functional in that they broaden the individual's attentional focus and behavioral repertoire and as a consequence, build social, intellectual, and physical resources— that may have been depleted by the chronic stressor.

Separate from the effects of positive emotion, creating meaning and trying to understand a stressful situation has long been conceptualized as being central to effective coping (Lazarus, 1966; Lazarus & Folkman, 1984). Determining the personal significance of a stressful situation in relation to one's beliefs, goals, values, or commitments is thought to shape the emotions the person experiences and lead to problem solving. In Gross's process model of emotion regulation (1998), this process is called "cognitive change" or "cognitive reappraisal"[1]. Although there is empirical evidence that positive affect buffers people against adverse physiological consequences of stress (e.g., Fredrickson & Levenson, 1998) and cognitive change has the potential to dampen physiological arousal in potentially-distressing contexts (Gross, 2002), no research has examined how the use of these particular emotion regulation strategies—or individual differences in the use of these strategies—relate to older adult spouses' reactions to their chronically ill partners' suffering.

To examine caregiving spouses' emotion regulation strategies, we further examine data from a previous study that showed that talking about the suffering of a partner compared to talking about a typical interaction with the partner increased blood pressure (BP) and heart rate (HR; Monin et al., 2010). The findings from this previous study suggested that cardiovascular reactivity caused by exposure to suffering is a pathway through which caregiving leads to negative health consequences.

In the present study, we operationalized emotion regulation strategies using an analytic technique developed by Pennebaker, Mayne, and Francis (1997)—examining the linguistic content of verbal expression. In researching the health effects of expressive writing,

[1]Although some researchers focus only on the effects of cognitive change in which positive meaning is created, referred to as "positive reappraisal," we are interested in cognitive change more broadly.

Pennebaker and colleagues found that two components of writing were particularly important in dealing with a traumatic event. The first is the construction of an organized and coherent explanation of the event, and the second is the labeling of emotions. Using a text analysis program (Linguistic Inquiry and Word Count [LIWC]; Francis & Pennebaker, 1993; Pennebaker & Francis, 1996), Pennebaker and colleagues confirmed that participants' use of cognitive processing words (e.g., because, think, realize) and positive emotion words (e.g., happy, joy, love), but not negative emotion words (e.g., angry, cried), was associated with better physical health (e.g., self-reported health, number of physician visits) across multiple writing experiments (Pennebaker et al., 1997). It is important to note that positive emotionality and cognitive processing were separately related to better health outcomes in these studies. The effects from Pennebaker and colleagues' (1997) study have been replicated in written and verbal expressive disclosure paradigms among HIV patients (Eisenberger, Kemeny, & Wyatt, 2003; Rivkin, Gustafson, Weingarten, & Chin, 2006) and chronically stressed caregivers of older adults (Mackenzie, Wiprzycka, Hasher, & Goldstein, 2008).

In addition to being used to assess the effectiveness of emotional disclosure interventions, LIWC can be used to examine the way people discuss meaning through language (Pennebaker & King, 1999). For example, researchers have examined social words and pronouns (e.g., describing the "self" vs. "other") in written and verbal accounts as an individual difference predicting health outcomes (e.g., Pressman & Cohen, 2007; Simmons, Gordon, & Chambless, 2005). Emotion regulation word use in a variety of contexts has also been associated with health indicators. For example, Graham and colleagues (2009) found that individuals who used more cognitive processing words during a conflict discussion—but not a nonconflictive discussion—showed smaller increases in cytokines to stress and wound healing over 24 hours, and they also had lower levels of cytokines 24 hours after baseline. The authors suggested that the high use of cognitive words may reflect an active process of meaning-making—a process that involves beginning to understand, and perhaps even resolving, conflict-producing issues of great personal relevance. Likewise, in a study of breast cancer patients, Low, Stanton, and Danoff-Burg (2006) found that greater use of cognitive processing words in their written disclosures was associated with more HR habituation (a peak-end index computed by subtracting HR observed during the last 1 min of writing from the peak 1-min HR observed during a 20-min writing period). Low and colleagues suggested that grappling with the meaning of the cancer experience facilitated habituation to the stressor.

No studies, to our knowledge, have examined associations between emotion regulation word use and stress reactivity when talking about the suffering of a relationship partner. Based on previous research and theory (e.g., Fredrickson, 1998; Gross, 1998), in the present study we hypothesized that (1) use of positive emotion words in caregivers' disclosures of the chronically ill partner's suffering and a typical interaction with that partner would be associated with decreased cardiovascular reactivity, and (2) use of cognitive processing words would be associated with decreased reactivity when talking about the partner's suffering but not the typical daily interaction with the partner. We predicted that cognitive processing would be associated with lower reactivity only in the suffering account because theoretically there is no regulatory need to make sense of a mundane situation and decrease arousal. Cognitive processing should only dampen physiological responses when dealing with stressful information. Our examination of negative emotion word use was exploratory given the inconsistency of past findings. However, traditional psychological models of stress suggest that people react to social environmental threats with negative emotion, and negative emotion leads to heightened physiological arousal (Feldman, Cohen, Hamrick, & Lepore, 2004).

There are two ways to examine these hypotheses. One way is to examine the extent to which condition-specific (suffering or meal account) word use is associated with physiological reactivity within an individual. For example, when an individual uses more positive emotion words in a particular condition—compared to his or her average positive emotion word use across conditions—does he or she have lower reactivity? Another approach is to examine the extent to which individual differences in average word use, between participants, moderate the effects of condition on reactivity. For example, do people who use more cognitive processing words, compared to other participants in the sample, have higher reactivity in a particular condition? We examined our hypotheses using each of these approaches. Also, in order to examine the extent to which the act of focusing on positive and negative emotions and using cognitive processing was associated with physiological reactivity beyond the effects of more stable personality or relationship characteristics, we accounted for depressive symptoms and marital satisfaction in our hypothesis testing. In addition, we conducted qualitative analyses to provide more information about the content of the narratives in an effort to augment our understanding of potential word count findings.

Method

Participants

Fifty-three older adults with OA and their caregiving spouses participated in the study. Only data from the caregiving spouse was used for analyses in the present study. See Table 1 for participant characteristics. Participants were recruited from the Gerontology Research Registry at the University of Pittsburgh, which is a database composed of participants from concurrent or past research studies of older adults at the University of Pittsburgh. In order to be eligible to participate in the present study, participants with OA had to be more than 45 years old, had experienced pain of at least moderate intensity over the past month, had difficulty with at least one instrumental activity of daily living (IADL), and received assistance from the spouse with at least one IADL. Participants had to meet a standard criterion (i.e., at least 7 of 10 items answered correctly) for cognitive functioning as measured by the Short Portable Mental Status Questionnaire (Pfeiffer, 1975). Finally, couples were excluded if the caregiving spouse took beta blockers because this medication affects HR—one of the primary outcomes of the study. However, spouses were asked to provide a list and reasons for taking other medications. Medications were evaluated using the *Physician's Desk Reference* and classified into a categorical variable for analyses as (1) either having a primary effect or having a 10% frequency of a side effect on BP and HR, or (2) no effect (56.6% of spouses took medications that had an effect on BP and HR). Eligibility criteria were assessed over the phone before scheduling a laboratory appointment. Each couple member was paid $35 for participating in the study.

Procedure

Baseline—Caregiving spouses were seated in a comfortable chair in a sound and electrically shielded chamber. The experimenter then explained to the caregiving spouse that he or she would be talking about some experiences while his or her BP and HR were monitored. The experimenter explained how the physiological equipment worked, and he tried to allay any of the spouses' anxiety. The experimenter then attached three silver-silver chloride electrodes to the spouse—using a modified lead II electrode placement—for measurement of the electrocardiogram (ECG), and he placed a standard BP cuff on the upper nondominant arm connected to a General Electric Dinamap Vital Signs Monitor (Model 8100; Critikon; Tampa, FL). The experimenter then left the room and took baseline measurements of systolic and diastolic BP and HR for 3 min. BP measurements were taken three times, and HR was monitored continuously during this period. All subsequent conditions also lasted 3 min—with BP measurements taken three times and HR continuously monitored.

Verbal accounts of a typical interaction and an episode of physical, psychological, and existential suffering—As described in Monin et al. (2010), caregiving spouses were asked to give two verbal accounts about the partner, alone—without the partner in the room.[2] A similar procedure has been used by Vitaliano, Russo, Bailey, Young, & McCann (1993). Spouses were provided with written guidelines around which to organize their accounts. For one of the accounts, spouses were asked to spend 3 min describing an interaction with the partner during a meal together. For the other account, spouses were asked to spend 3 min talking about a specific instance in which the spouse felt that the partner was suffering. Spouses were asked to elaborate on three dimensions of suffering: (1) physical, (2) psychological, and (3) existential or spiritual aspects. The verbal accounts were counterbalanced. If participants stopped speaking before the 3-min mark, they were asked to sit quietly and think about the event. If they could think of anything more to say, they were free to start talking again.

During this time, the partner with OA was in a separate room from the spouse, and they could not hear the verbal account. The partner with OA was aware that the spouse would be talking about his or her experience with the partner's chronic condition in general. In the beginning of the study we told participants that we were "interested in the ways people think, feel, and behave in their relationships when one person has a chronic illness"; however, participants were not told about specific hypotheses until the end of the study when they were thoroughly debriefed.

Measures

Linguistic content analysis—Caregiving spouses' verbal accounts of an instance of their partner's suffering and a typical meal with their partner were audiotaped and transcribed. The text was then analyzed with the computerized text analysis program, Linguistic Inquiry and Word Count program (LIWC; Francis & Pennebaker, 1993; Pennebaker & Francis, 1996). The LIWC program searches the text files, and it computes the percentages of words judged to reflect content categories. The relevant LIWC content categories were positive emotion words (e.g., happy, joy), negative emotion words (e.g., angry, cried), and use of words reflecting cognitive processing, such as insight and causal reasoning (e.g., because, think, realize). Percentage scores for each text category, as well as an overall word count, were computed for each verbal account.

Depressive symptoms—In a baseline questionnaire administered at the beginning of the laboratory session, caregiving spouses reported on the frequency of depressive symptoms over the past week using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) with a response scale from 0 (*rarely or none of the time; less than 1 day*) to 3 (*most or all of the time; 5–7 days*). Items included "I was bothered by things that don't usually bother me" and "I felt depressed." Sum scores were calculated ($M = 9.75$, $SD = 7.93$).

Marital satisfaction—Caregiving spouses were also asked to report their level of marital satisfaction using the Marital Adjustment Test (MAT; Locke & Wallace, 1959) in the baseline questionnaire. The 16-item measure includes one question about the participant's general level of happiness in the marriage using a scale from 1 (*very unhappy*) to 7

[2]These verbal accounts were given after another task in which caregiving spouses watched videotapes of their partners and strangers perform a pain-eliciting household task (see Monin et al., 2010).

(*perfectly happy*), eight questions about agreement or disagreement with the spouse on issues such as handling finances, friends, and philosophy of life on a scale from 1 (*always agree*) to 6 (*always disagree*), and seven questions that explore issues such as whether spouses confide in their partner, whether they would marry the same person again, and whether they have similar interests in activities. The scores for the different items are weighted based on their criterion validity in predicting maladjustment and divorce (Locke & Wallace). The range of possible scores is 2 – 158—with higher scores indicating greater marital satisfaction. The mean marital satisfaction score using the MAT for U.S. samples is 100 (SD = 15; Locke & Wallace). As reported in Monin et al. (2010) in the present study, spouses' average marital satisfaction score was 92.54 (SD = 13.60).

BP and HR—For each condition, a systolic blood pressure (SBP) mean and a diastolic blood pressure (DBP) mean were calculated by averaging each of the three automated measurements taken over the 3-min periods. To assess mean HR during each period, R-wave markers in the ECG signal were assessed for artifacts by visual inspection, and they were assessed by an automatic artifact detection algorithm available in a customized software package (Mindware Heart Rate Variability Scoring Module, version 2.16; Mindware Technologies Ltd, Columbus, OH). Following manual corrections of suspected artifacts, the Mindware program estimated the mean HR for each spouse for the baseline period and each verbal account.

We used difference scores between baseline measures and each verbal account condition measure as our outcomes in the present study. This allowed us to account for baseline differences due to factors such as gender and age. As described in Monin et al. (2010), men had higher SBP and DBP than women, $b = .34$, $t(50) = 2.56$, $p < .05$ and $b = .38$, $t(50) = 2.81$, $p < .05$, respectively. We also found that older spouses had higher SBP at baseline, $b = .28$, $t(50) = 2.12$, $p < .05$. Medications did not have a significant effect on any of the physiological indicators. We also examined whether baseline physiology was correlated with the difference scores. Because these correlations were not significant (r values ranged from −.07 to .11 for SBP, −.09 to .00 for DBP, and −.21 to −.15 for HR), we used the unadjusted difference scores in our analyses. See Table 2 for intercorrelations between physiological indicators in each condition. See Table 4 for descriptive statistics and results of paired t tests comparing physiological reactivity in each condition. The results of the paired t tests are also reported in Monin et al., 2010.

Qualitative analyses

The transcribed verbal accounts were coded by two trained analysts using Atlas.ti (Version 6.2, Berlin, Germany). Twenty-seven codes were generated after the analysts reviewed a subsample of the verbal accounts (n = 8) to ascertain the most common themes. The resulting list was augmented with additional codes of theoretical importance as hypothesized by the primary investigator. See Table 3 for the top five codes for each account, their descriptions, and the interrater reliability Fleiss' Kappa scores. The overall mean Fleiss' Kappa score was 0.76 — indicating adequate interrater reliability.

Quantitative analysis strategy—Given that this was a repeated measures design, and given that we had measurements of physiological reactivity and word usage on each caregiver in two conditions (meal and suffering), we conducted multilevel regression analyses to test for associations between these variables using PROC MIXED in Statistical Analysis System. Specifically, we tested two-level model—in which the two conditions were modeled as nested within individual caregivers. Intercepts were modeled as randomly varying across caregivers to account for the interdependence of the two observations made on the same caregiver. In other words, this model accounted for between-subjects variance in the outcome variables. Given the limited degrees of freedom (i.e., only two observations on each caregiver), effects of Level 1 (i.e., condition-specific) predictor variables were modeled as fixed rather than randomly varying across caregivers. These predictor variables were centered on each caregiver's mean to isolate within-person effects (see Enders & Tofighi, 2007). Given that all coefficients are unstandardized, we use the symbol *b* to denote associations of predictor variables with outcomes. Specific equations are provided in the results section. We present proportionate reduction of residual variance as an estimate of effect size, which is analogous to R^2 in OLS regression models (Snijders & Bosker, 1999).

In addition to conceptualizing word use as a construct that varies from one condition to the next for each caregiver, we conducted additional analyses in which we conceptualized word use as a person-level variable by averaging each caregiver's word usage across both meal and suffering conditions. We sought to determine whether individual differences in average word use moderated effects of the experimental condition on physiological reactivity criterion variables.

Results

Qualitative Results

The five most common topics covered in the meal account were (1) descriptions of an ordinary meal, (2) family and friends, (3) shared enjoyment, (4) secondary/leisure activities, and (5) the setting/environment. The five most common topics covered in the suffering account were (1) discussion of the caregiver's emotional response to the partner's pain, (2) the caregiver's perceptions of the partner's emotional response to pain, (3) the partner's medical/ health issues, (4) the partner's physical pain, and (5) the couple's values/meaning or purpose in life. See Table 3 for the frequencies of codes applied in the suffering and meal accounts.

Preliminary Analyses

Variance decomposition—Initial unconditional models (Nezlek, 2001) decomposed the variance in physiological reactivity and word usage into between-subjects and within-subjects components. A prototypical equation appears below:

$$y_{ij}=\beta_{0j}+r_{ij} \quad (1)$$

In this model, an outcome variable *y* is measured on specific occasions (during each of the repeated experimental conditions, subscripted *i*) for each caregiver (subscripted *j*). This outcome variable is modeled as a function of the intercept for each caregiver (β_{0j}, which represents the mean of the outcome variable for caregiver *j*) and error (r_{ij}, which represents deviation of the outcome from the caregiver's mean score on the outcome). The variance of this error term is the Level 1 random variance. It represents the extent to which the outcome variable varies within the same caregiver. In turn, each caregiver's intercept is modeled as a function of a grand mean and another error term, as shown below:

$$\beta_{0j}=\gamma_{00}+u_{0j} \quad (2)$$

The intercept for each caregiver, (β_{0j}, is modeled as a function of the grand mean (γ_{00}) and error (u_{0j}, which represents the deviation of caregiver *j* from the grand mean). The variance of this error term is the Level 2 random variance. It represents the extent to which the caregivers' mean score on the outcome variable varies across caregivers. A comparison of Level 1 and Level 2 variance components indicates whether outcome variables vary more within or across caregivers. This comparison indicates whether variables are better conceptualized and modeled as condition-specific or individual difference phenomena.

Results of these models are presented in Table 4. A compound symmetry error structure was specified in place of the typical variance components specification in models of variables that exhibited a negative within-person correlation across the two conditions. This modification produces estimates of the covariance across the two conditions (which can be less than 0) rather than estimates of Level 2 variance (which cannot be less than 0).

Level 1 variance components were significant, indicating that individual caregivers exhibited significant variability of word use and physiological reactivity across the two experimental conditions. This does not indicate a systematic fixed effect of condition for any of the word use variables; rather, it indicates significant within-caregiver variance in word use across the conditions.

Level 2 variance was significant for total word count and the physiological reactivity measures, suggesting some individual difference variation in these variables. That is, caregivers with high (low) word counts and physiological reactivity in the meal account tended to have high (low) levels in the suffering account, too. This also does not indicate a fixed effect of condition for any of the word use variables; it indicates significant between-caregiver variance in word use overall.

Did word use differ between the meal and suffering accounts?—Caregivers used more overall words, less positive words, more negative words, and less cognitive processing words in the suffering account compared to the meal account. See Table 4 for descriptive statistics and results of the paired *t* tests. There were no significant associations between each type of word use in each condition.

Was Word Use Associated With Physiological Reactivity in Each Verbal Account?

To test the prediction that word use within a particular condition would be associated with physiological reactivity independently of experimental condition, the following Level 1 equation was tested:

$$y_{ij}=\beta_{0j}+\beta_{1j}(\text{Condition}\ \ \text{Word}\ \ \text{Use})+\beta_{2j}(\text{Condition})+r_{ij}$$

In this model, a physiological outcome variable (y_{ij}) was regressed on condition-specific word use—centered on each caregiver's mean—and the condition dummy variable. At Level 2, each of these coefficients—Level 1 intercept, condition word use slope, and condition slope—was predicted by a Level 2 intercept. An error term was added to model the Level 1 intercept as randomly varying across caregivers (as shown in Equation 2). We tested these models for each outcome variable (HR, SBP, and DBP reactivity), and we tested these models for each type of word usage examined (positive emotion, negative emotion, and cognitive mechanism).

Positive emotion word use—Supporting hypothesis 1, positive emotion word use predicted decreased HR reactivity, $b = -.37$, $t = -2.19$, $p < .05$. However, it did not significantly predict BP reactivity, *ps* > .13. In verbal accounts characterized by especially high positive emotion word use (relative to the caregiver's average tendency), caregivers exhibited especially low HR reactivity. These effects did not significantly vary as a function of order of administering the experimental conditions, *ps* > .68. This model explained a significant portion of the total Level 1 (within-subjects) variance in HR reactivity ($R^2 = .16$). Positive emotion word use also explained significant variance beyond the variance explained by condition (R^2 change = .08). Controlling for negative word use did not significantly change the finding that positive emotion word use was associated with decreased HR reactivity, $b = -.37$, $t = -2.18$, $p < .05$.

Negative emotion word use—Analogous models examining effects of negative emotion word usage did not produce any significant effects, *ps* > .16.

Cognitive mechanism word use—A near-significant trend was found for cognitive mechanism word usage predicting SBP, $b = -.47$, $t = -1.86$, $p < .07$. In verbal accounts characterized by especially high cognitive mechanism word usage (relative to the caregiver's average tendency), caregivers tended to exhibit lower SBP reactivity. This effect did not vary by task order, $p > .79$. This model explained a significant portion of the total Level 1 variance in SBP reactivity ($R^2 = .23$), and cognitive mechanism word use explained variance beyond variance explained by condition (R^2 change = .14). Other effects of cognitive mechanism word use were not significant, *ps* > .42.

Because we were also interested in whether cognitive word use was associated with less physiological reactivity in the suffering condition but not in the meal condition (hypothesis 2), in additional analyses we added a product term representing the interaction of condition with the word use variables. However, the effects were not significant for HR or BP reactivity, *ps* > .56.

Were Individual Differences in Average Word Use Associated With Physiological Reactivity?

To determine whether individual differences in average word use moderated effects of the experimental condition (suffering vs. meal account) on physiological reactivity variables, we used the following Level 1 equation:

$$y_{ij}=\beta_{0j}+\beta_{1j}(\text{Condition})+r_{ij}$$

This equation examines effects of condition on physiological reactivity within participants. The following Level 2 model was used to examine moderating effects of average word use (averaged across the two conditions):

$$\begin{aligned}&\text{Intercept:}\beta_{0j}=\gamma_{00}+\gamma_{01}(\text{Average Word Use})+u_{0j}\\&\text{Condition:}\beta_{1j}=\gamma_{10}+\gamma_{11}(\text{Average Word Use})\end{aligned}$$

This equation models each caregiver's intercept and condition slope as a function of their average word use (averaged across the two conditions). The effect of word use on the condition slope is a cross-level interaction. It examines whether caregivers' average word usage moderates the effect of condition on reactivity. We estimated the effect of average word use on the intercept to control for the main effect of word use on physiological reactivity.

Positive emotion word use—Average positive emotion word use did not moderate effects of condition on HR or BP reactivity, *ps* > .56.

Negative emotion word use—The condition X average negative emotion word use interactions did not significantly predict HR or BP reactivity, *ps* > .56.

Cognitive mechanism word use—The condition x average cognitive word use interaction was a significant predictor of HR reactivity, $b = .53$, $t = 2.85$, $p < .01$. Consistent with hypothesis 2, caregivers who were low in average cognitive word use exhibited greater HR reactivity in the suffering condition relative to the meal condition, $b = -1.89$, $b = -3.91$, $p < .01$. In contrast, condition did not significantly predict HR reactivity for caregivers who were high in average cognitive word use, $p > .72$ (see Figure 1). This model explained a significant proportion of the Level 1 variance in HR reactivity ($R^2 = .21$), and the interaction term explained an additional 12% of the Level 1 variance beyond the main effects. Average cognitive word use did not moderate effects of condition on BP, *ps* > .43.[3]

Discussion

In this study we examined the degree to which spousal caregivers regulated their emotions by focusing on positive emotions and cognitively processing information about a partner's suffering and how this related to their cardiovascular reactivity. As hypothesized, we found that using more positive emotion words when talking about the partner was associated with lower cardiovascular reactivity. Also we found that people who use less cognitive processing words, on average, were particularly reactive to talking about the partner's suffering. People who used more cognitive processing, on the other hand, seemed to be better at regulating their emotions, experiencing less reactivity when discussing both the partner's suffering and a typical interaction with the partner. These results are novel. No studies to our knowledge have examined how linguistic markers of emotion regulation impact cardiovascular reactivity when talking about a chronic interpersonal stressor.

Our results support past research and theory that expressing positive emotions (Folkman & Moskowitz, 2000) and cognitively processing information (Pennebaker et al., 1997) are adaptive ways of coping with stress. Whereas some research suggests that "working through" negative thoughts, memories, and emotions is not always helpful in the face of trauma or loss (e.g., Bonanno & Field, 2001), cognitively processing information about their partner's suffering seemed to be adaptive for caregivers in our sample. It is important to note that we did not find that using more negative emotion words was associated with more or less cardiovascular reactivity—suggesting that the effects were not due to catharsis. Furthermore, we did not find that negative emotion and positive emotion word use was related in either condition—indicating these processes were independent (Zautra, Berkhof, & Nicolson, 2002).

Our results are also consistent with research showing that there are individual differences in the extent to which people are analytical (i.e., use rational, controlled information processing) versus experiential (i.e., use emotional or automatic information processing), and that people who are more analytical tend to cope better with stress (e.g., Epstein, Pacini, Denes-Raj, & Heier, 1996; Tugade, Fredrickson, & Barrett, 2004). Our findings did not, however, support our hypothesis that cognitive processing is only helpful when discussing a stressor. Instead, we found that taking a more analytical perspective may help regulate one's emotions in a variety of contexts.

Results of our qualitative analyses showed that caregivers followed our instructions when asked to discuss their partner's suffering or to describe a typical meal. In the suffering account, caregivers thought about the partner's chronic condition and suffering in terms of physical, emotional, and existential (i.e., meaning and purpose in life) aspects. In doing so,

[3]Additional analyses were conducted to examine whether total word count explained any of the effects. All of the effects presented in the text remained significant (or marginal when they were originally marginal) when we controlled for total word count. In addition, the results were not qualified by depressive symptoms, marital status, or blood pressure medication use.

caregivers focused on themselves as well as their partners. When talking about the typical meal, most caregivers described the mundane aspects of the meal including information about the environment (e.g., they were in the kitchen) and what else they were doing at the time (e.g., watching TV). They also described topics of conversation with their partner during the meal— which was most frequently about friends and family—and their enjoyment of the meal and the time spent with the partner. Thus, the emotional content was distinct between the two conditions. However, we showed that there was variability in emotional valence and analytical depth within each context that related to cardiovascular reactivity.

Limitations of this study include the small sample size and the fact that we did not have information about dispositional positivity—which may have been more informative than depressive symptoms or marital satisfaction in disentangling the nature of the individual difference effects. Also, we did not find any gender effects. This will be important to investigate with larger sample sizes because research on written emotional disclosure suggests that women use more causal/insight words than men (Epstein, Sloan, & Marx, 2005). In addition, although the LIWC system is an extremely useful methodology, it does not consider words within the semantic context in which they are spoken. This can introduce noise into the results in the form of homographs or, in the case of emotion words, the target words being used in non-emotional phrases.

Also, we only found one marginally significant effect of emotion regulation related word use on systolic blood pressure reactivity, which is thought to be a more clinically relevant health indicator than HR reactivity (Jennings et al., 2004; Manuck, Marsland, Kaplan, & Williams, 1995). This may be due to the fact that heart rate was measured continuously whereas blood pressure was taken three times during each period, making the HR measurement more sensitive than the BP measurement. That being said, HR reactivity is associated with risk for cardiovascular disease (Chida & Steptoe, 2010; Manuck, Kaplan, Adams, & Clarkson, 1989). Research would benefit from using continuous blood pressure monitoring equipment, and it would benefit from having a larger sample size. Future research should also examine how linguistic markers relate to cardiovascular recovery beyond reactivity, especially given the literature on the effects of positive emotions on health (Fredrickson & Levenson, 1998).

These findings have implications for who should be targeted for caregiving interventions and how interventions are designed. It is important for caregivers to empathize with their care recipients' suffering but also to stay in tune with their positive emotions in everyday life, even when stressful events arise. Caregivers who are less able to access positive feelings and who are less analytical in their thinking may benefit from interventions that redirect their attention to positive aspects of everyday life more than other caregivers. Also, all caregivers may benefit from interventions that incorporate elements of cognitive–behavioral therapy, such as the reconstrual principle which emphasizes reframing automatic maladaptive thoughts to disconnect them from negative affect and generate latent emotional resources to preserve well-being (Hill, 2011). Finally, this research highlights the importance of not only focusing on the content of caregivers narratives of their partner's suffering but also the words they use to describe the content.

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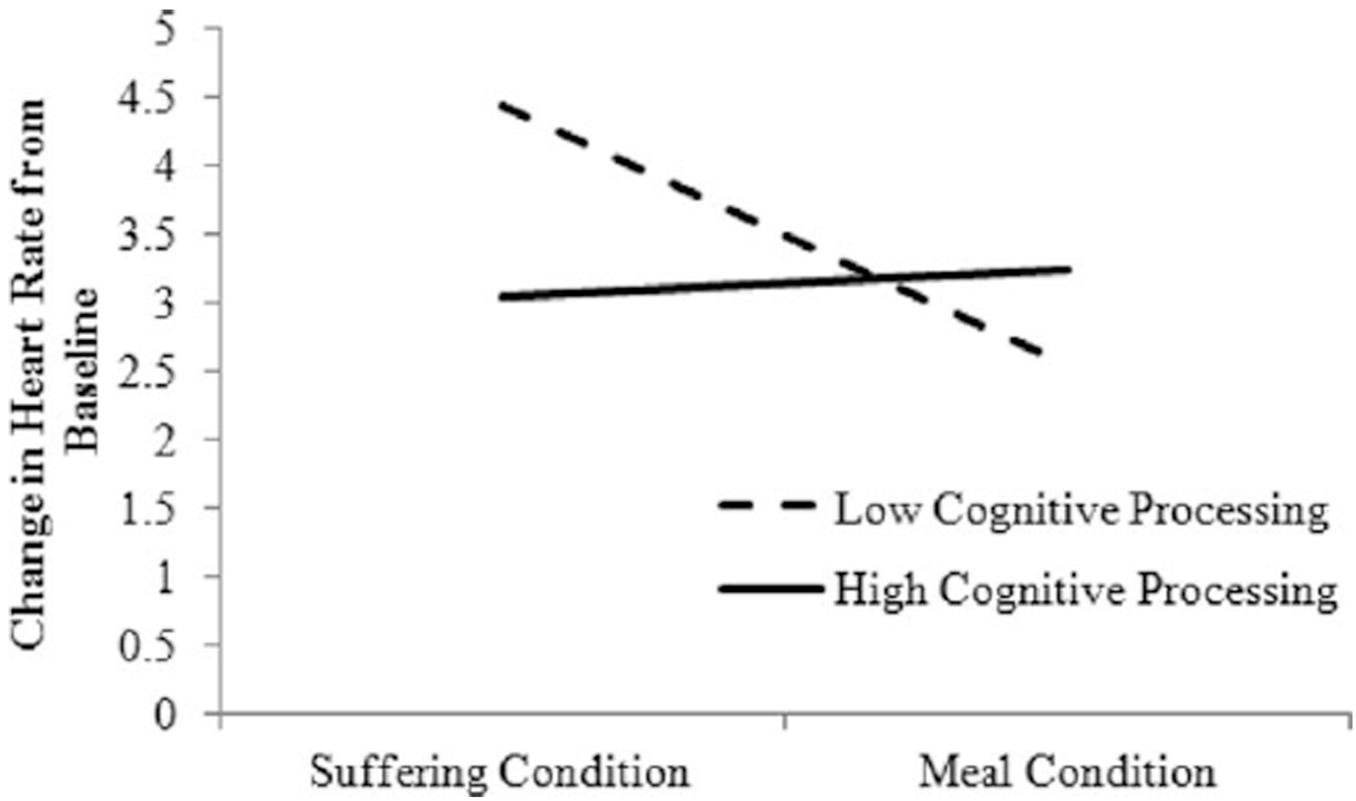

Figure 1.
Association between average cognitive processing word use and change in mean HR from baseline to meal and suffering conditions.

Table 1

Sample Characteristics

Sample characteristic	Care recipient (*N* = 52)		Caregiver (*N* = 53)	
Age				
Mean (*SD*)	69.67 (8.69)		68.75 (9.80)	
Median (IQR)	70 (46–84)		69 (46–85)	
Gender				
Female (%)	26	50	26	49.1
Male	26	50	27	50.9
Education				
Less than high school	2	3.8	3	5.7
High school	12	23.1	11	20.8
More than HS	38	73.1	39	73.5
Employment				
Employed	12	23.1	15	38.3
Homemaker	6	11.3	4	7.5
Retired	32	60.4	32	60.4
Unemployed	2	3.8	2	3.8
Race				
White	44	83	44	83
African American	6	11.3	6	11.3
Other	2	3.8	3	5.7
Income*				
<20,000			7	14
20,000–39,999			16	32
40,000–59,999			8	16
>60,000			19	38

*Three caregivers refused to report income and one care recipient refused to complete the entire questionnaire.

Table 2

Intercorrelations Between Reactivity Measures in the Suffering and Meal Conditions

	Suffering condition			Meal condition		
	SBP	**DBP**	**HR**	**SBP**	**DBP**	**HR**
Suffering condition						
SBP	1	.67**	.09	.72**	.45**	.02
DBP	—	1	.24	.59**	.57**	.17
HR	—	—	1	− .07	.03	.83**
Meal condition						
SBP	—	—	—	1	.49**	− .02
DBP	—	—	—	—	1	.11
HR	—	—	—	—	—	1

Note. SBP= systolic blood pressure; DBP= diastolic blood pressure; HR = heart rate.

** $p < .01$.

Table 3

Coding Schema, Frequency of Codes, and Interrater Reliability in the Meal and Suffering Accounts

Codes	Description	Frequency in the meal account	Frequency in the suffering account	Fleiss' Kappa
Meal-Ordinary	A meal that is described as a normal daily activity. It can take place at home, in a long term care facility, or a restaurant (if it is clear that dining at that restaurant is a habitual activity rather than a special occasion).	40	0	0.83
Setting and environment	Descriptions of the setting and surrounding environment, including descriptions of the weather.	24	10	0.40
Enjoyment	Enjoyment in a shared experience with their spouse.	32	0	0.65
Secondary/leisure activity	Reference to a secondary activity such as watching TV, listening to the radio, or listening to music, etc.	24	1	0.89
Family and friends	Discussion of the couple's family or friends.	33	17	0.81
Medical/health issues	Reference to any type of health problems (excluding chronic pain related problems), medical procedures (e.g., surgery), or interactions with health care professionals (e.g., physicians).	8	39	0.77
Physical pain	Physical pain other than arthritis or lower back pain.	6	35	0.72
Partner's emotional pain	References to pain that are not physical in nature or more generally to psychological issues especially stress, anxiety, or even depression.	4	37	0.78
Caregiver's emotional pain	Emotional response by the caregiver to the physical or emotional pain experienced by their spouse.	4	46	0.77
Values/meaning and purpose in life	Discussion of the shared values of the couple, especially in regards to references to finding meaning and purpose in life as motivational (or de-motivating) factors.	2	24	0.80

Table 4

Level 1 and 2 Variance Decomposition, Descriptive Statistics, and Paired T*-Tests of Word Use and Physiological Reactivity Variables*

Variable	Level 1 variance	Level 2 (co)variance	Range of scores	Mean (*SD*) in suffering condition	Mean (*SD*) in meal condition	*t*	*df*
Total word count	8570.03***	8102.77**	73–627	359.60 (110.58)	308.13 (140.17)	3.26**	49
Positive emotion words	4.35**	−.80	0–7.69	2.40 (1.23)	4.36 (1.81)	−6.92***	49
Negative emotion words	4.53***	−1.57***	0–7.60	3.21 (1.50)	.81 (.88)	9.88***	49
Cognitive words	11.80***	−2.12	11.88–28.89	20.79 (2.75)	22.92 (3.11)	−3.48***	49
Systolic blood pressure	40.34***	86.16***	− 11–50	11.17 (12.07)	8.20 (10.21)	2.46*	51
Diastolic blood pressure	28.61***	41.82***	−9–41	8.88 (9.46)	6.08 (6.34)	2.23*	51
Heart rate	3.63***	13.45***	−5–20	3.82 (4.56)	2.89 (3.68)	2.48*	48

Note. Level 1 variance represents the extent to which the outcome variable varies within the same caregiver. Level 2 variance represents the extent to which the caregiver's mean score on the outcome variable varies across caregivers.

* $p < .05$.

$p < .01$.

$p < .001$.