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Interpersonal Emotional Behaviors and Physical Health: A 20-Year Longitudinal Study of Long-Term Married Couples

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Abstract

Objectively coded interpersonal emotional behaviors that emerged during a 15-minute marital conflict interaction predicted the development of physical symptoms in a 20-year longitudinal study of long-term marriages. Dyadic latent growth curve modeling showed that anger behavior predicted increases in cardiovascular symptoms and stonewalling behavior predicted increases in musculoskeletal symptoms. Both associations were found for husbands (although cross-lagged path models also showed some support for wives) and were controlled for sociodemographic characteristics (age, education) and behaviors (i.e., exercise, smoking, alcohol consumption, caffeine consumption) known to influence health. Both associations did not exist at the start of the study, but only emerged over the ensuing 20 years. There was some support for the specificity of these relationships (i.e., stonewalling behavior did not predict cardiovascular symptoms; anger behavior did not predict musculoskeletal symptoms; neither symptom was predicted by fear nor sadness behavior), with the anger-cardiovascular relationship emerging as most robust. Using cross-lagged path models to probe directionality of these associations, emotional behaviors predicted physical health symptoms over time (with some reverse associations found as well). These findings illuminate longstanding theoretical and applied issues concerning the association between interpersonal emotional behaviors and physical health and suggest opportunities for preventive interventions focused on specific emotions to help address major public health problems.

Keywords

Interpersonal emotional behavior; physical health; relationships; marriage

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Interpersonal Emotional Behaviors and Physical Health: A 20-Year Longitudinal Study of Long-Term Married Couples

Intimate relationships are hotbeds of emotions and emotion-related behaviors (e.g., Butler, 2011; Levenson, Haase, Bloch, Holley, & Seider, 2013). Multiple lines of evidence underscore the influence of social relationships on physical health (e.g., Hawkey & Cacioppo, 2010; Robles & Kiecolt-Glaser, 2003; Robles, Slatcher, Trombello, & McGinn, 2014). Strong connections between emotions and health have been found repeatedly (e.g., DeSteno, Gross, & Kubzansky, 2013) along with some intriguing suggestions that there may be links between specific emotional behaviors and specific health problems (e.g., Chida & Steptoe, 2009; Friedman & Rosenman, 1959). Despite this, research examining links between specific interpersonal emotional behaviors and specific physical health symptoms has been rare. In the present study, we examine data from a 20-year longitudinal study of emotion and marriage to explore how two common interpersonal emotional behaviors during a marital conflict discussion (i.e., anger and stonewalling) predict the development of two common physical health symptoms (i.e., cardiovascular and musculoskeletal symptoms) in husbands and wives.

Interpersonal Emotional Behaviors and Physical Health

Numerous lines of research document the intimate connection between social relationships and physical health (e.g., Hawkey & Cacioppo, 2010; Robles & Kiecolt-Glaser, 2003; Robles et al., 2014). Among those social relationships, marital relationships play a particularly important role for most people (at age 65, over 96% of US Americans have been married at least once according to the 2009 US census). Poor marital quality has been identified as a core predictor of poor physical health (Kiecolt-Glaser & Newton, 2001; Robles et al., 2014). Several underlying mechanisms for this relationship have been examined, with emotions looming large (Robles et al., 2014). Most of our emotions are thought to occur in social contexts (e.g., Butler, 2011; Levenson et al., 2013; Smith, Glazer, Ruiz, & Gallo, 2004) and intimate relations are often the stage for particularly powerful emotions. This may be especially true in later life when close relationships become increasingly important (Carstensen, Isaacowitz, & Charles, 1999).

Emotions have the capacity to produce intense activation of both expressive behaviors (e.g., face, body) and physiological systems (e.g., autonomic, somatic, endocrine) that help prepare the organism to cope with critical challenges and opportunities. A considerable body of research shows that emotions can “get under the skin,” predicting proximal health-relevant outcomes such as hormone and immune functioning (e.g., Adam, Hawkey, Kudielka, & Cacioppo, 2006) as well as distal health outcomes such as cardiovascular disease (e.g., Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Salovey, Rothman, Detweiler, & Steward, 2000).¹ When studying the emotional qualities of marriage, having spouses discuss areas of conflict has become quite common (e.g., Levenson & Gottman, 1983; Levenson et al., 2013). A large number of laboratory-based studies of marital

¹Positive emotions have important consequences for physical health (e.g., Pressman & Cohen, 2005), but in this paper we focus on negative emotional behaviors.

interaction have shown that the interpersonal emotional behaviors that ensue are strongly related to spouses' physical health (e.g., Gottman & Levenson, 1986; Levenson et al., 2013; Smith, Baron, & Grove, 2014).

Anger and stonewalling behavior—In a marital discussion, interpersonal emotional behaviors can emerge when a partner is speaking or when a partner is listening (Gottman, 1994). Among the “speaker behaviors,” anger is one of the most common emotional behaviors observed during marital conflict (Gottman, 1994). Anger is a response to an offense against “me or mine” (Lazarus, 1991) and is thought to arise when one person has the experience of being slighted or hurt by intentional acts of another person. Among the “listener behaviors,” stonewalling is particularly prominent (Gottman, 1994). Stonewalling consists of a total lack of listening behavior and “tuning out” in response to a partner's requests to change through criticism, concerns, and “nagging” (Gottman, 1989) and is often seen when couples engage in patterns of demand-withdraw behavior (cf. Eldridge & Christensen, 2002; Holley, Haase, & Levenson, 2013).

Expressive behaviors associated with anger include lowered eyebrows, widened eyes, and pressed lips (Ekman & Friesen, 1971) as well as changes in vocal expressions including sudden increases in pitch, amplitude, and tempo (Gottman, 1989; Scherer, Banse, & Wallbott, 2001). Expressive behaviors associated with stonewalling include the face appearing stiff or frozen, a clenched jaw, and rigid neck muscles as well as changes in verbal expressions including monosyllabic answers or silence (Gottman, 1989). In terms of autonomic and somatic activity, anger is typically associated with elevated somatic activity and cardiovascular activation (Levenson, Ekman, & Friesen, 1990) and, if anger becomes chronic, cardiovascular hyperreactivity (Chida & Hamer, 2008). In contrast, stonewalling has been associated with decreased overall somatic activity (less overt movement), increased muscle tension (e.g., in the neck and back), and increased electrodermal activation (Gottman, 1994).

Cardiovascular and musculoskeletal symptoms—The present study focuses on two kinds of physical symptoms, cardiovascular and musculoskeletal. Cardiovascular symptoms include pain in the heart or chest, heart thumping or racing, or getting easily out of breath. Musculoskeletal symptoms (here we focus on symptoms related to muscle tension) include pain in the back, arms, or legs (Brodman, Erdmann, & Wolff, 1974). Both cardiovascular and musculoskeletal symptoms constitute major public health problems. Cardiovascular disease is the leading cause of death and a major cause of disability worldwide (Matthews, 2013). Musculoskeletal symptoms such as back pain are among the most frequently reported health problems in industrialized countries (Woolf & Pfleger, 2003). For both kinds of symptoms, there has been important research on behavioral and psychological risk factors that lead to their development (e.g., Matthews, 2013; Woolf & Pfleger, 2003; Yusuf et al., 2004).

Anger/stonewalling behavior and cardiovascular/musculoskeletal symptoms—The notion that negative emotions may harm physical health is not new; however, it is considerably less clear how specific these associations are. Early psychosomatic models envisioned considerable specificity in the emotion-health link, detailing how specific

emotional behaviors were linked to specific diseases (e.g., Alexander, 1950; Grace & Graham, 1952). Later, some of the best-established links between specific personality characteristics and specific health risk (e.g., type A personality and cardiovascular risk; Friedman & Rosenman, 1959) were found to have emotional sources (e.g., expression of hostility; Williams, Haney, Lee, Kong, Blumenthal, & Whalen, 1980). Over the years, these specific relationships received far less attention, replaced by a focus on how general negative affect (both state and trait) predicts a range of poor health outcomes. Consistent with this more general focus, a number of studies have documented concurrent and longitudinal links between negative affect (e.g., Watson, 1988), distress shared across negative affect dispositions (e.g., Suls & Bunde, 2005), neuroticism (e.g., Lahey, 2009), stress (e.g., McEwen, 2013), and poor health.

In the present study, we revisit the notion that there may be greater specificity in the link between interpersonal emotional behaviors and health. In our characterizations of the physiological differences between anger and stonewalling, both were depicted as high-arousal states associated with negative emotion. However, between the two, anger is more closely associated with higher levels of cardiovascular activation, whereas stonewalling is more closely associated with higher levels of muscle tension. This difference leads to the primary specificity hypothesis tested in the present study. We predict that higher levels of anger will, over time, lead to excessive wear and tear on the cardiovascular system and the development of cardiovascular symptoms. Similarly, higher levels of stonewalling will, over time, lead to excessive wear and tear on the musculoskeletal system and the development of musculoskeletal symptoms.

Previous research on specific links—Anger has long been thought of as a major risk factor for developing cardiovascular symptoms (cf. Friedman & Rosenman, 1959). Plausible pathophysiological models are available that can help explain this effect: Anger strongly activates the cardiovascular system (Levenson et al., 1990); chronic hemodynamic perturbations can lead to endothelial injury in the blood vessels, plaque formation, and subsequent cardiovascular disease (Manuck, Marsland, Kaplan, & Williams, 1995; Rozanski, Blumenthal, & Kaplan, 1999). Despite these plausible models, empirical findings regarding the association between anger and cardiovascular symptoms are mixed. While a number of studies support a positive link (e.g., Rosenberg et al., 2001; Smith et al., 2004), other studies indicate negative (e.g., Hällström, Lapidus, Bengtsson, & Edstrom, 1986), negligible (e.g., Myrtek, 2001), or nonspecific associations (e.g., Suls & Bunde, 2005). It is noteworthy that studies supporting a positive association assessed anger in interpersonal paradigms using objective measures (e.g., Rosenberg et al., 2001; Smith et al., 2004), as opposed to single-subject paradigms using questionnaire measures.

Compared to anger, the link between stonewalling and physical health symptoms has received much less attention. In one study of marital interaction, stonewalling predicted deteriorations in husbands' physical health (Gottman, 1991). Interestingly, and consistent with our hypothesis, in the “golden era” of specificity research in psychosomatic medicine, the “desire of the individual to walk out of his situation” (p. 247), which is akin to stonewalling behavior, was linked to back pain (Grace & Graham, 1952). The authors

interpreted this association as a consequence of heightened muscle tension as the individual wants to walk away, but does not.

Methodological considerations—Studies that examine links between interpersonal emotional behaviors and physical health may (a) examine interpersonal emotional behaviors using self-report or objective measures; (b) utilize concurrent or longitudinal designs; (c) examine associations that are not controlled vs. controlled for potential confounds; and (d) can consider general or more specific relationships.

As for measuring emotion, self-report measures have many virtues, but they do not always track actual emotional behavior well (e.g., Reisenzein, Bördgen, Holtbernd, & Matz, 2006), are vulnerable to bias (Robinson & Clore, 2002), and can be difficult to obtain without interrupting the flow of natural behavior (e.g., during a marital conflict discussion). As for the study design, longitudinal designs have advantages over concurrent designs when studying associations between emotions and symptoms, such as those involving the cardiovascular system, that can take decades to develop (Matthews, 2013). As for confounds, it is critical to control for other factors that have well-established associations with emotion and health such as socioeconomic status (Adler & Stewart, 2010) and health-related behaviors (McGinnis, Williams-Russo, & Knickman, 2002). Finally, rather than lumping all emotional behaviors together into a single emotion variable or into broad valence-based negative and positive emotion categories and lumping all health problems together into a general health variable, it is important to consider relationships between specific health problems and specific emotional behaviors. This allows determination of whether emotion-health associations achieve certain criteria of specificity, such as whether (1) emotional behavior A predicts symptom X, but not symptom Y and emotional behavior B predicts symptom Y, but not symptom X (i.e., double dissociations; see Smith, 2000) or (2) emotional behavior A predicts symptom X, but not symptom Y and emotional behavior B predicts symptom Y, but not symptom X and both associations remain stable when controlling for the other emotional behavior not in focus (and other covariates).

The Present Study

The present study examined associations between specific interpersonal emotional behaviors and changes in specific physical health symptoms over 20 years in a sample of middle-aged and older long-term married couples. We focused on two emotional behaviors that are common during marital conflict, one speaker behavior (i.e., anger) and one listener behavior (i.e., stonewalling), as predictors of two common physical health symptoms (i.e., cardiovascular and musculoskeletal symptoms). We hypothesized that anger would predict increases in cardiovascular symptoms and stonewalling would predict increases in musculoskeletal symptoms. Our hypotheses focused on within-spouse associations (one spouse's emotional behavior predicting the development of his or her own health symptoms) because we were interested in the physical health consequences of a specific emotional behavior emerging in one's *own* body (as opposed to witnessing someone else's emotional behavior).

The study was designed to meet several methodological criteria. Emotional behaviors were objectively coded using a well-validated observational coding system (Gottman, 1989) during a naturalistic dyadic interaction in which spouses discussed an area of conflict in their marriage. The study design was longitudinal, with emotional behaviors and health symptoms measured repeatedly over 20 years. Analyses were controlled for confounding factors including sociodemographic characteristics (age, education) and health behaviors (exercise, smoking, alcohol consumption, caffeine consumption). In addition, we probed for specificity of the associations by (1) evaluating whether the other emotional behavior not in focus (i.e., anger when analyzing stonewalling and vice versa) as well as two additional negative emotional behaviors that often arise in marital conflicts (i.e., fear and sadness) predicted the development of physical symptoms and (2) examining whether associations remained stable when controlling for the other emotional behaviors not in focus as well as global marital satisfaction (Kiecolt-Glaser & Newton, 2001). Finally, to determine the directionality of the emotion-health associations, we examined how each spouse's emotional behavior predicted her or his own physical symptoms and vice versa.

Method

Participants

Participants were drawn from an ongoing longitudinal study of long-term marriages ($N=156$ couples) comprised of a middle-aged cohort (age 40-50, 82 couples) and an older cohort (age 60-70, 74 couples). The original sample was recruited starting in 1989 from the San Francisco Bay Area, California so that it matched sociodemographic characteristics (socioeconomic status, religion, ethnicity) of marriages in these age groups in the area. The resulting sample was primarily Caucasian (86%; 6% Black; 3% Hispanic; 3% Asian; 1% other), Protestant or Catholic (61%), relatively well-off socioeconomically, and with children (95% of couples had at least one child; one additional middle-aged couple was expecting their first child). Complete details of the sampling and recruitment procedures have been reported previously (e.g., Levenson, Carstensen, & Gottman, 1993). Several prior studies have been reported using data from this sample, mostly focusing on the early waves of assessment. The data pertaining to emotion and health and analyses in the present study have not been reported previously.

Procedure

Data were assessed at four time points over a range of 20 years (Couples at Time 1: 1989/90, $N=156$; Time 2: 1995/96, $n=132$; Time 3: 2001/02, $n=102$; Time 4: 2008/09, $n=59$). Couples discontinued participation in the study for the following reasons (cumulative frequencies): (a) divorce (T2: $n=5$; T3: $n=8$; T4: $n=8$); (b) death of a spouse (T2: $n=10$; T3: $n=26$; T4: $n=45$), or (c) declined/unknown reasons (T2: $n=9$; T3: $n=20$; T4: $n=44$). None of the primary study variables (i.e., emotional behaviors or physical health symptoms) examined here predicted drop-out over time, $ps > .05$, with two exceptions: Higher wives' sadness behavior, $p = .047$ and higher husbands' musculoskeletal symptoms, $p = .046$, at T1 predicted greater drop-out at T4. Moreover, wives and husbands' higher age predicted greater drop-out at T4, $ps < .05$. To estimate missing data, we used a Full Information Maximum Likelihood Algorithm (e.g., Schafer & Graham, 2002). To ensure that estimating

missing data did not unduly influence our findings, we repeated all hypothesis tests using only couples who participated in at least 3 out of 4 waves of data collection ($n = 101$) and found that the results were unchanged.

At each time point, couples completed a set of questionnaires (see below) and participated in a laboratory session. In the laboratory session, using well-established procedures for studying marital interactions (Levenson & Gottman, 1983), couples engaged in three 15-minute conversations: (a) events of the day or events since the last assessment; (b) conflict topic – an issue of ongoing disagreement in their marriage; and (c) pleasant topic – something they enjoyed doing together. Partially hidden cameras were used to make video recordings of each interaction for subsequent behavioral coding (see below). The present study used data obtained during the conflict conversations at T1, T2, and T3.²

Measures

Emotional behavior (T1, T2, T3)—Emotional behavior was determined by coding the 15-minute conflict conversation using SPAFF (Gottman, 1989). Trained coders (blind to participants' physical health and study hypotheses) viewed the video recordings of the conversations and generated ratings of each spouse's emotional behaviors on a second-by-second basis. SPAFF coding is based on a gestalt of verbal content, voice tone, context, facial expression, gestures, and body movements. There are five positive speaker codes (interest, affection, humor, validation, joy), nine negative speaker codes (anger, contempt, disgust, belligerence, domineering, defensiveness, fear/tension/worry, sadness, whining), a neutral speaker code, and four listener codes (positive, negative, neutral, stonewalling). Inter-rater reliability of the SPAFF coding was satisfactory. The overall mean kappa was .64, the mean kappa for speaker codes was .60, and the kappa for listener codes was .71 (for detailed information see Carstensen, Gottman, & Levenson, 1995).

The present study focused on: (a) *anger behavior* (e.g., irritation/annoyance, frustration, commands, lips pressed together, lowered eyebrows, constrained anger, voice is lowered or raised beyond limits of normal tone, tight jaw)³; and (b) *stonewalling behavior* (e.g., “away” behavior, automanipulation, no verbal or nonverbal backchannels, face appears stiff and frozen, little or no eye contact, no head nods, clenched jaw, rigid neck muscles). To determine whether associations between emotion and health were specific to these two negative emotional behaviors, we also included two other SPAFF codes of negative emotional behaviors: (c) *fear behavior* (e.g., frequent eye movements, speech disturbances/incoherence, excessive fidgeting or shifting, nervous laughter, voice tone shifting between lower and higher pitch) and (d) *sadness behavior* (e.g., passiveness, crying, sighing, helpless behavior, pouting/hurt). For all SPAFF behaviors, rates were calculated by dividing the number of seconds that behavior was coded by the total number of seconds coded. In terms of change over time, negative emotional behavior decreased over time (for details see

²When this study was conducted, second-by-second SPAFF coding for these 15-minute conversations had been completed for all conflict conversations at T1, T2, and T3. SPAFF coding for the conflict conversation at T4 and for the pleasant and neutral conversations has not yet been completed.

³Interestingly, there is considerable overlap between the SPAFF code for anger behavior (Gottman, 1989) examined in the present study and behaviors coded as Type A by Friedman and Rosenman (1959), including tense facial musculature, and yelling or raising the voice.

Verstaen, Haase, & Levenson, 2015). Across spouses, wave-to-wave stabilities (r_s) ranged between .24 and .42 for anger, and between .27 and .40 for stonewalling.

Physical symptoms (T1, T2, T3, T4)—Physical symptoms were measured at each of the four time points using a well-established self-report instrument, the Cornell Medical Index (CMI, Brodman et al., 1974). A large body of research supports the validity of the CMI, showing high convergence with medical evaluations of health and predicting morbidity over time (Weaver, Ko, Alexander, Pao, & Ting, 1980). Because we wanted to focus on *current* physical symptoms, we excluded CMI items that assessed family history of physical symptoms (this has also been done in previous studies using the CMI; e.g., Aldwin, Spiro, Levenson, & Cupertino, 2001). Because it is a symptom checklist, lower scores on the CMI are associated with higher physical health. To reduce skewness, scales were recoded (0 = no symptom; 1 = at least one symptom) following established procedures (e.g., Duncan, Duncan, & Strycker, 2006).

Cardiovascular symptoms were measured using 11 items from the CMI (e.g., pains in the heart or chest, diagnosis of high blood pressure, diagnosis of heart problems; we removed one item from the original CMI scale that assessed low blood pressure because we were primarily interested in high-activation cardiovascular symptoms). Among husbands, at T1 45% ($SD = .50$), at T2 50% ($SD = .50$), at T3 58% ($SD = .50$), and at T4 64% ($SD = .48$) reported at least one cardiovascular symptom (linear categorical latent growth curve modeling [LGM] showed that the slope mean was .66, $p = .002$, indicating an average 6.6 percentage point increase from wave to wave). Among wives, at T1 60% ($SD = .49$), at T2 70% ($SD = .46$), at T3 74% ($SD = .44$), and at T4 76% ($SD = .43$) reported at least one cardiovascular symptom ($M_S = .63$, $p = .053$). Overall, at T1 53% and at T4 70% of spouses reported at least one cardiovascular symptom. Across spouses, wave-to-wave stabilities (r_s) ranged between .52 and .59.

Musculoskeletal symptoms were measured using 5 items from the CMI (e.g., severe pains in arms or legs; muscles and joints feeling constantly feel stiff; back pain; we removed two items from the original CMI scale that assessed inflammation-related musculoskeletal symptoms because we were primarily interested in tension-related musculoskeletal symptoms). Among husbands, at T1 15% ($SD = .36$), at T2 24% ($SD = .43$), at T3 22% ($SD = .41$), and at T4 29% ($SD = .46$) reported at least one musculoskeletal symptom ($M_S = .52$, $p = .118$). Among wives, at T1 30% ($SD = .46$), at T2 35% ($SD = .48$), at T3 39% ($SD = .49$), and at T4 36% ($SD = .48$) reported at least one musculoskeletal symptom ($M_S = .37$, $p = .159$). Overall, at T1 22% and at T4 32% of spouses reported at least one cardiovascular symptom. Across spouses, wave-to-wave stabilities (r_s) ranged between .41 and .51 from T1 to T4.

Covariates (T1)—*Sociodemographic characteristics* included age (in full years) and education (in years). *Health behaviors* included lack of physical exercise, smoking, alcohol consumption (≥ 2 drinks a day), and caffeine consumption (≥ 6 cups of coffee or tea a day) from the CMI (recoded as 0 = no, 1 = yes). *Marital satisfaction* scores for husbands and wives were averaged across two measures: (a) Locke-Wallace Marital Adjustment Test (e.g., “Do you confide in your mate?”; 15 items; Locke & Wallace, 1959); and (b) Locke-

Williamson Marital Relationship Inventory (e.g., “How happy would you rate your marriage?”; 22 items; Burgess, Locke, & Thomes, 1971). These measures showed high internal consistency ($\alpha = .76$).

Statistical Analyses

Data were analyzed within a structural equation modeling framework using AMOS 20. As indicators of model fit in SEM, we inspected χ^2 . Nonsignificant χ^2 values ($p > .05$) indicated satisfactory fit. In addition, we inspected the comparative fit index (CFI), using values of $> .90$ as an indicator of reasonable fit, and the root mean square error of approximation (RMSEA), using values of $< .08$ as an indicator of reasonable fit. Analyses proceeded in three steps.

First, preliminary analyses (e.g., examining intercorrelations among variables) were conducted. Second, dyadic latent growth curve modeling (LGM) (Olsen & Kenny, 2006) was used to examine how wives' and husbands' emotional behaviors at T1 predicted changes in their physical symptoms over the ensuing 20 years (T1-T4). Building on Olsen and Kenny (2006), we included (a) linear LGMs for wives' and husbands' physical symptoms with intercepts (indicating baseline levels of physical symptoms at T1) and slopes (indicating change in physical symptoms from T1 to T4); (b) wives' and husbands' emotional behavior at T1 as predictors; (c) correlations between wives' and husbands' emotional behavior at T1 and between wives' and husbands' intercepts of physical symptoms; (d) regression paths of the predictor variables to wives' and husbands' slopes of physical symptoms; and (e) correlations between the two slope residuals. Figure 1 shows the conceptual dyadic LGM. To test our hypotheses, we examined within-spouse associations between one spouse's emotional behavior at T1 predicting her or his own physical symptoms slope.

To prepare the LGM analyses, we determined the appropriate change model for each physical symptom scale. Linear LGM with intercept loadings of 1,1,1,1 and slope loadings of 0,1,2,3 showed satisfactory fit for all scales for husbands and wives, $\chi^2(5) = 9.05$, $ps > .107$; CFI = .96; RMSEA = .072. We proceeded to examine the dyadic LGM to model changes in wives' and husbands' physical symptoms. The dyadic LGM for cardiovascular symptoms showed good fit, $\chi^2(22) = 24.83$, $p = .306$; CFI = .99; RMSEA = .029. The dyadic LGM for musculoskeletal symptoms showed satisfactory fit, $\chi^2(21) = 31.07$, $p = .073$; CFI = .92; RMSEA = .056. In the latter LGM we allowed for one residual intraclass covariance at T4, $p < .05$, to enhance model fit following Olsen and Kenny (2006). Across models, changes in spouses' cardiovascular and musculoskeletal symptoms were not significantly correlated, $ps > .05$. Nonetheless, we used dyadic LGM in step 2 to account for shared variance between husbands' and wives' physical symptoms, even if nonsignificant.

Third, cross-lagged path models (Kline, 2011) were used to examine how one spouse's emotional behavior predicted her or his own physical symptoms over time and vice versa and thus determine the directionality of the associations at a within-person level. We set up these cross-lagged path models for emotional behaviors and physical symptoms measured at T1-3 as emotional behavioral data were not available at T4. Building on previous work (Keijsers, Loeber, Branje, & Meeus, 2011), we included stability paths between adjacent and nonadjacent time points, correlations between emotional behavior and physical health at T1,

and residual correlations at subsequent time points (see Figure 2). To test our hypotheses, we examined cross-lagged paths between emotional behaviors and physical symptoms between adjacent and nonadjacent time points (Young, Furman, & Laursen, 2011).

Across analyses, we controlled for sociodemographic characteristics (i.e., age, education) and health behaviors (i.e., exercise, smoking, alcohol and caffeine consumption) at T1 by entering these variables as predictors into separate logistic or linear regression analyses for each of the study variables and then conducting all analyses using the standardized residuals. This approach greatly reduces the number of parameters compared to the alternative of including the covariates in the structural equation models. With this approach, we obtained residual scores, which were continuously distributed, allowing us to use statistical methods suited for continuous variables (e.g., LGM). When we repeated hypothesis tests using the original (i.e., unresidualized) variables (including the original categorical physical symptoms variables) using statistical methods suited for categorical variables, the results remained stable.

In addition, we examined whether the anger-cardiovascular and stonewalling-musculoskeletal LGM associations passed two tests for specificity. First, we examined whether the three other negative emotional behaviors (i.e., stonewalling, fear, and sadness when examining anger; anger, fear, and sadness when examining stonewalling) predicted cardiovascular and musculoskeletal symptoms in separate additional LGM. Second, we examined whether associations remained stable when controlling for the three other negative emotional behaviors and marital satisfaction at T1 in the same LGM (using residualized variables as described above).

Results

Preliminary Analyses

Intercorrelations between key study variables at T1 are presented in Table 1. Several cross-spouse correlations were found between emotional behaviors, $p < .05$. Spouses' cardiovascular and musculoskeletal symptoms were not significantly correlated, $p > .05$.

Interpersonal Emotional Behaviors and Physical Symptoms: Dyadic LGM

We examined associations between interpersonal emotional behaviors at T1 and changes in physical symptoms from T1-T4 using a series of dyadic LGMs. Almost all models showed satisfactory fit (χ^2 values, $p < .05$; CFI $> .90$; RMSEA $< .08$); exceptions are noted below.

Anger behavior and cardiovascular symptoms: Dyadic LGM—We first examined associations between anger behavior and cardiovascular symptoms. Examining within-spouse associations, husbands' anger behavior at T1 predicted husbands' slope of cardiovascular symptoms, $B = .12$, $SE(B) = .05$, $\beta = .40$, $p = .008$, indicating that husbands who showed higher anger behavior at T1 experienced greater increases in cardiovascular symptoms over time. Wives' anger behavior at T1 did not predict wives' slope of cardiovascular symptoms, $B = .02$, $SE(B) = .03$, $\beta = .07$, $p = .592$. No within-spouse correlations were found between either spouse's anger behavior at T1 and the intercept of that spouse's cardiovascular symptoms, $p > .05$. Table 2 presents results from the dyadic

LGM for anger behavior at T1 predicting change in cardiovascular symptoms over time. To illustrate the results, Figure 3 shows the development of cardiovascular symptoms over 20 years for husbands with low vs. high anger behavior at T1.

In terms of specificity, (1) none of the three other emotional behaviors predicted cardiovascular symptoms, $ps > .05$, and (2) the anger-cardiovascular association for husbands remained stable when controlling for these three other emotional behaviors and marital satisfaction, $B = .10$, $SE(B) = .05$, $\beta = .31$, $p = .029$.

Finally, although our hypotheses focused on within-spouse associations, we also explored cross-spouse associations. Higher wives' sadness behavior at T1 predicted greater increases in husbands' cardiovascular symptoms over time, $B = .06$, $SE(B) = .03$, $\beta = .28$, $p = .044$. All other cross-spouse associations were nonsignificant, all $ps > .05$.

Stonewalling behavior and musculoskeletal symptoms: Dyadic LGM—We first examined associations between stonewalling behavior and musculoskeletal symptoms. Examining within-spouse associations, husbands' stonewalling behavior at T1 predicted husbands' slope of musculoskeletal symptoms, $B = .06$, $SE(B) = .03$, $\beta = .25$, $p = .031$, indicating that husbands who showed higher stonewalling behavior at T1 experienced greater increases in musculoskeletal symptoms over time. Wives' stonewalling behavior at T1 did not significantly predict wives' slope of musculoskeletal symptoms, $B = -.06$, $SE(B) = .07$, $\beta = -.08$, $p = .415$. No within-spouse correlations were found between either spouses' stonewalling behavior at T1 and the intercept of that spouse's musculoskeletal symptoms, $ps > .05$. Table 2 presents results from the dyadic LGM for stonewalling behavior at T1 predicting change in musculoskeletal symptoms over time. To illustrate the results, Figure 4 shows the development of musculoskeletal symptoms over 20 years for husbands with low vs. high stonewalling behavior at T1.

In terms of specificity, (1) none of the three other emotional behaviors predicted musculoskeletal symptoms, $ps > .05$, and (2) the stonewalling-musculoskeletal association for husbands remained positive, but was no longer significant when controlling for these three other emotional behaviors and marital satisfaction, $B = .03$, $SE(B) = .03$, $\beta = .15$, $p = .232$. Note that several of these specificity models showed suboptimal fit, $\chi^2(29) = 49.57$, $p = .01$; CFI = .83; RMSEA = .068).

Finally, we explored cross-spouse associations. Higher husbands' sadness behavior at T1 predicted greater increases in wives' musculoskeletal symptoms over time, $B = .10$, $SE(B) = .05$, $\beta = .21$, $p = .023$. None of the other cross-spouse associations were significant, $ps > .05$.

Summary—Results from dyadic latent growth curve modeling showed that anger behavior for husbands at T1 was not associated with cardiovascular symptoms at T1, but did predict increases in husbands' cardiovascular symptoms over the ensuing 20 years. Similarly, stonewalling behavior for husbands at T1 was not associated with musculoskeletal symptoms at T1, but did predict increases in husbands' musculoskeletal symptoms over the ensuing 20 years. These associations were found only for husbands and not for wives. Both

associations passed the first criterion of specificity. Only anger behavior predicted cardiovascular symptoms; none of the other negative emotional behaviors (stonewalling, fear, sadness) did. Similarly, only stonewalling behavior predicted musculoskeletal symptoms; none of the other negative emotional behaviors (anger, fear, sadness) did. In addition, the anger-cardiovascular association passed the second criterion of specificity, remaining stable when controlling for the other emotional behaviors and marital satisfaction.

Interpersonal Emotional Behaviors and Physical Symptoms: Cross-Lagged Path Models

We explored cross-lagged associations between interpersonal emotional behaviors and physical symptoms across T1-T3 using cross-lagged path models for each spouse (T4 data was not available for emotional behaviors). All models were fully identified.

Anger behavior and cardiovascular symptoms: Cross-lagged path models—

We first examined cross-lagged associations between anger behavior and cardiovascular symptoms for *husbands*. Results showed that, for husbands, anger behavior predicted cardiovascular symptoms over time. Specifically, husbands' anger behavior at T1 predicted increases in husbands' cardiovascular symptoms from T1 to T3, $B = .31$, $SE(B) = .11$, $\beta = .23$, $p = .005$. The reverse paths from cardiovascular symptoms predicting anger behavior over time were not significant, $ps > .05$. In terms of specificity, (1) none of the three other emotional behaviors predicted cardiovascular symptoms, $ps > .05$, and (2) the anger-cardiovascular association remained stable when controlling for the three other emotional behaviors and marital satisfaction, $B = .24$, $SE(B) = .10$, $\beta = .19$, $p = .021$.

Next, we examined cross-lagged associations between anger behavior and cardiovascular symptoms for *wives*. Although the associations did not reach conventional significance levels, there was evidence for a small association between wives' anger behavior and increases in wives' cardiovascular symptoms as well as for a small reverse association. Specifically, wives' anger behavior at T1 predicted marginal increases in wives' cardiovascular symptoms from T1 to T2, $B = .11$, $SE(B) = .06$, $\beta = .14$, $p = .054$. Conversely, wives' cardiovascular symptoms at T1 predicted marginal increases in wives' anger behavior from T1 to T2, $B = .18$, $SE(B) = .09$, $\beta = .16$, $p = .055$. In terms of specificity, (1) none of the other emotional behaviors predicted cardiovascular symptoms, $ps > .05$, and (2) the anger-cardiovascular association was marginally significant when controlling for the three other emotional behaviors and marital satisfaction, $B = .11$, $SE(B) = .06$, $\beta = .13$, $p = .071$.

Stonewalling behavior and musculoskeletal symptoms: Cross-lagged path models—

We examined cross-lagged associations between stonewalling behavior and musculoskeletal symptoms for *husbands*. Results showed that, for husbands, stonewalling behavior predicted musculoskeletal symptoms and musculoskeletal symptoms predicted stonewalling behavior over time. Specifically, husbands' stonewalling behavior at T1 predicted increases in husbands' musculoskeletal symptoms from T1 to T3, $B = .14$, $SE(B) = .06$, $\beta = .21$, $p = .024$. Conversely, musculoskeletal symptoms at T1 predicted increases in stonewalling behavior from T1 to T3, $B = .38$, $SE(B) = .12$, $\beta = .26$, $p = .001$. In terms of specificity, (1) none of the three other emotional behaviors predicted musculoskeletal

symptoms, $p_s > .05$, and (2) the stonewalling-musculoskeletal association fell below conventional significance levels when controlling for the three other emotional behaviors and marital satisfaction, $B = .12$, $SE(B) = .06$, $\beta = .18$, $p = .067$.

Next, we examined cross-lagged associations between stonewalling behavior and musculoskeletal symptoms for *wives*. Results showed that wives' stonewalling behavior predicted increases in musculoskeletal symptoms over time. Specifically, wives' stonewalling behavior at T2 predicted increases in wives' musculoskeletal symptoms from T2 to T3, $B = .58$, $SE(B) = .23$, $\beta = .24$, $p = .012$. The reverse paths from musculoskeletal symptoms predicting stonewalling behavior were not significant, $p_s > .05$. In terms of specificity, (1) none of the three other emotional behaviors predicted musculoskeletal symptoms, $p_s > .05$, and (2) the stonewalling-musculoskeletal association fell below conventional significance levels when controlling for the three other emotional behaviors and marital satisfaction, $B = .40$, $SE(B) = .21$, $\beta = .17$, $p = .056$.

Summary—Results from cross-lagged path modeling showed that, for husbands, anger behavior predicted increases in cardiovascular symptoms and stonewalling behavior predicted increases in musculoskeletal symptoms. Both associations passed the first criterion of specificity, but only the anger-cardiovascular association passed the second criterion as well. In contrast, although the dyadic LGM had not shown associations for wives (when the focus was on predicting changes in physical health symptoms over longer time intervals), the cross-lagged path models revealed associations in the hypothesized directions for wives between adjacent time points (i.e., 5-6 year intervals). For wives, anger behavior predicted marginal increases in cardiovascular symptoms (T1 to T2); stonewalling behavior predicted increases in musculoskeletal symptoms (T2 to T3). Both associations passed the first criterion of specificity, but not the second one. In terms of reverse associations, there were significant associations between physical health symptoms predicting emotional behaviors for husbands (with musculoskeletal symptoms predicting increases in stonewalling behavior) and wives (with cardiovascular symptoms predicting marginal increases in anger behavior).

Discussion

The present study examined the link between interpersonal emotional behaviors, assessed from objectively coded behaviors that occurred during a marital conflict discussion, and physical health symptoms in a 20-year longitudinal study of long-term marriages. Dyadic LGM results indicated that higher levels of husbands' anger behaviors at the start of the study predicted greater increases in cardiovascular symptoms over time. Similarly, higher levels of husbands' stonewalling behaviors at the start of the study predicted greater increases in musculoskeletal symptoms over time. Importantly, these findings were obtained after controlling for sociodemographic characteristics (i.e., age, education) and a number of health-related behaviors (i.e., exercise, smoking, alcohol consumption, caffeine consumption). Cross-lagged path models (but not the dyadic LGM) revealed some support for these same associations for wives as well. Support was found for the specificity of both the anger-cardiovascular and stonewalling-musculoskeletal relationships. For both, none of the other negative emotional behaviors predicted the respective health symptom. In addition,

the anger-cardiovascular association remained stable when controlling for the other negative emotional behaviors and marital satisfaction).

Interpersonal Emotional Behaviors and Physical Health: Some Evidence for Specificity

The connection between the quality of marital relationships and physical health has been widely documented, although findings show substantial heterogeneity (Robles et al., 2014). Thus, there has been a pressing need for studies that examine particular mechanisms (e.g., affective processes, Robles et al., 2014). The present study focused on two interpersonal emotional behaviors that are commonly expressed during marital conflict, anger and stonewalling.

In this study, we revisited an old idea, once very prominent in psychosomatic research, that specific health symptoms have specific emotional profiles (Alexander, 1950). A classic example can be found in work (Graham, 1962) showing that individuals with particular “psychosomatic” disorders (e.g., hives; hypertension) were more likely to identify with certain attitudes depicted in cartoon-like drawings (e.g., hives was associated feelings like you were taking a beating and were helpless to do anything about it; hypertension was associated with feeling like you were being threatened and had to be on guard) (see also Graham, Kabler, & Graham, 1962). Despite early promise, these kinds of studies declined, although the notion of specificity re-emerged in studies of the role of anger and hostility (as manifest in the Type A personality³) in the etiology of heart disease (Friedman & Rosenman, 1959) and in studies of autonomic differences among emotions (Ekman, Levenson, & Friesen, 1983; Levenson, 2003). Despite these echoes of specificity, most of the modern literature has adopted a more undifferentiated approach, exploring links between poor health in general and factors such as negative affect (e.g., Watson, 1988), negative emotion (e.g., Kiecolt-Glaser et al., 2002), distress (e.g., Suls & Bunde, 2005), neuroticism (e.g., Lahey, 2009), and stress (e.g., McEwen, 2013).

The present study revisited and provided new support for earlier ideas that relationships between behavioral/affective factors and health could be more specific. Our findings provide evidence that anger and stonewalling, two emotional behaviors that often emerge during marital conflict, each predict different physical health symptoms (cardiovascular and musculoskeletal symptoms respectively) with some degree of specificity (with evidence strongest for anger predicting cardiovascular symptoms). Whenever relationships between emotional behaviors and health are found, it is reasonable to raise the question of how meaningful these are in real-world contexts. In response, we would argue that the present findings are quite meaningful. First, cardiovascular and musculoskeletal symptoms and disease are both major public health problems (Matthews, 2013; Woolf & Pfleger, 2003). Second, these are both conditions that become increasingly important as individuals age, thus creating a growing burden for aging individuals and aging societies alike (Heidenreich et al., 2011). Third, the strength of these relationships is sizeable. To place this in context, the standardized regression coefficients associated with emotional behaviors predicting physical symptoms in the present study ranged from approximately .15-.40. To illustrate this, the regression coefficient for anger behavior at T1 predicting the slope of cardiovascular symptoms at T1 for husbands was .40; thus, husbands who expressed anger behavior at 1 *SD*

above the mean at T1, experienced a 0.40 *SD* higher increase in cardiovascular symptoms over time, controlling for covariates. These effect sizes are similar to or even larger (Chen, Cohen, & Chen, 2010) than those associated with well-established risk factors such as obesity or lack of exercise predicting cardiovascular disease outcomes (Yusuf et al., 2004).

Connecting Interpersonal Emotional Behaviors and Physical Symptoms

It is hard to imagine conducting an experimental study that measures the health of spouses who have been randomly assigned to chronically experience one but not another emotion over decades. Thus, establishing links between specific interpersonal emotional behaviors and specific diseases has to rely on other empirical strategies. The present study is based on a fairly straightforward theoretical model: (a) different emotional behaviors produce different patterns of activation in the autonomic and somatic nervous system, (b) high levels of activation of particular physiological systems, when maintained chronically, hastens wear and tear of these systems and creates actual disease or establishes conditions of heightened vulnerability to disease. Controversy over the first assertion of specificity has raged for over a century (e.g., Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000; Cannon, 1927; Ekman et al., 1983; Feldman Barrett, 2006; James, 1884; Kreibig, 2010; Levenson, 2003; Zajonc & McIntosh, 1992) and shows little indication of lessening. The second assertion is arguably less controversial. For example, there are good pathophysiological models that link hemodynamic perturbations associated with chronic cardiovascular activation with permanent damage to blood vessels (e.g., Gimbrone, Topper, Nagel, Anderson, & Garcia-Cardena, 2000; Ross & Glomset, 1973). There are also longitudinal studies with non-human animal models showing how chronic stressors (e.g., those associated with social upheavals) can produce high levels of physiological reactivity and lead to cardiovascular of disease over time (e.g., Manuck et al., 1995).

By using 20-year longitudinal data and examining actual emotional behaviors that occurred in a highly ecologically valid social context, marriage (cf. Smith et al., 2014), the present study enabled testing specific relationships between interpersonal emotional behaviors and future health symptoms in ways that to our knowledge have never been previously available. For example, models of the ways that psychological factors influence disease often suggest that the pathophysiological cascade that produce health symptoms takes decades to develop (e.g., Matthews, 2013; Miller, Chen, & Parker, 2011). Consistent with these models, in the present study, the associations between anger and cardiovascular symptoms and between stonewalling and musculoskeletal symptoms did not exist at the start of the study. Rather, the effects only emerged after a considerable incubation period (for husbands this spanned the ensuing 20 years). This emergent quality of these relationships between emotional behaviors and health, coupled with the statistical controls for demographic and individual difference variables, argue against the alternative hypothesis that the ultimate health differences reflected pre-existing differences between individuals who end up in emotionally different kinds of marriages.

Husbands and Wives

The associations found between specific interpersonal emotional behaviors and particular physical symptoms were notably strongest for husbands, with evidence for wives being

weaker (only emerging in the cross-lagged models but not the dyadic LGM). This finding is consistent with a theoretical model we proposed earlier (Gottman & Levenson, 1988) that emphasized the greater vulnerability of men to health effects associated with negative emotion in marriage. It is also consistent with findings that (a) hostility and anger during marital conflict predict heightened cardiovascular reactivity (Smith & Gallo, 1999) and increases in blood pressure (Miller, Dopp, Myers, Stevens, & Fahey, 1999) for men in particular, (b) stonewalling during marital conflict predicts lower physical health (Gottman, 1991) for men in particular, and (c) early psychosocial interventions have stronger effects on long-term health outcomes for men than women (Campbell, Conti, Heckman, Moon, Pinto, Pungello, & Pan, 2014). However, the issue of gender differences in vulnerability to the health consequences of emotion is far from settled, with other studies reaching different conclusions (Kiecolt-Glaser & Newton, 2001; see also Zucker & Beery, 2010). We expect that whether gender differences are found and their direction is influenced in important ways by other characteristics of participants (e.g., biological factors that dampen or amplify emotional reactivity; Haase et al., 2013), the outcome being measured (e.g., marital satisfaction vs. physical health; Bloch, Haase, & Levenson, 2014), the context being studied (e.g., social versus individual), the way emotions and health outcomes are measured (objectively versus subjectively), and birth cohort (e.g., historical changes in gender roles in different generations).

Reverse Associations and Cross-Spouse Associations

Although not the primary focus of the present study, we also explored reverse associations (i.e., physical health predicting interpersonal emotional behaviors) and cross-spouse associations (i.e., one spouse's interpersonal emotional behaviors predicting the other spouse's physical symptoms). In terms of reverse associations, results from cross-lagged path modeling revealed that not only did emotional behaviors predict physical health, physical health symptoms also predicted emotional behaviors for husbands (with musculoskeletal symptoms predicting increases in stonewalling behavior) and wives (with cardiovascular symptoms predicting marginal increases in anger behavior). This finding is consistent with findings of the toll that physical health symptoms can take on marriage (e.g., Booth & Johnson, 1994), although clearly more research is needed to understand these associations more fully.

In terms of cross-spouse associations, one spouse's sadness behaviors emerged as particularly important, predicting increases in the other spouse's health symptoms. These findings suggest that when one spouse expresses sadness, which serves to elicit sympathy and empathy in the partner (Izard & Ackerman, 2000), it has an untoward effect on the other spouse's health. In some ways this is reminiscent of research showing the heavy health burden associated with caregiving (Schulz & Sherwood, 2008). Clearly, this is an important area for future research.

Strengths and Limitations

The present study had several methodological strengths, including (a) measuring actual interpersonal emotional behavior during marital conflict objectively, (b) using a longitudinal design of sufficient duration to be sensitive to slow development of physical symptoms over

decades, (c) controlling for sociodemographic and health factors thought to influence health outcomes, and (d) testing both specific and general associations between multiple emotions and multiple symptoms. To our knowledge, there have been no prior studies that have met all of these criteria and few that have met most.

There are also several limitations that bear mention. First, our measure of interpersonal emotional behavior was based on a thin slice of social behavior, a 15-minute snapshot of the couple's interaction. These kinds of thin slices have proven to be extremely useful in prior research including our own (e.g., Ambady & Rosenthal, 1992; Carstensen et al., 1995), but they raise the question of whether they accurately capture the emotional life of the couple. Second, our study focused on negative emotional behaviors that emerged during the discussion of a marital conflict (Carstensen et al., 1995). Studying positive emotions that emerge during other kinds of interactions between close relationship partners (Yee, Gonzaga, & Gable, 2014) might reveal other kinds of specific associations between emotions and health outcomes, perhaps including specific positive emotions that convey specific health benefits. Third, our data were derived from a particular sample that was designed to be representative of long-term marriages of certain ages and a certain geographical region. Thus, it remains to be seen whether these findings would generalize to other samples of couples and to couples from other cultures and other historical periods. Fourth, when working with an older sample like this, sample retention is affected by factors that are not as salient with younger participants (e.g., in 29% of our couples at least one spouse died over the 20-year period). We used statistical techniques to protect against this, but it is always possible that sample mortality influenced our findings in unknown ways.

Finally, we should note the pros and cons associated with using a self-report instrument to measure physical symptoms, rather than alternative measures. When we started this study in 1989 the CMI was considered to be one of the best measures in the field and widely used (e.g., Aldwin et al., 2001). Moreover, a large body of research supported its validity as a measure of health (Weaver et al., 1980). Self-reported health measures in general have been found to predict mortality even when including many relevant covariates (Idler & Benyamini, 1997). More "direct" health measures (e.g., doctors visits, prescription drug use) have their advantages but also come with limitations (e.g., Goldman, 2001; Osterberg & Blaschke, 2005). If we were to start this study anew today, we would likely include a broad sampling of health measures, including self-report measures, direct measures, and health "biomarkers" (e.g., measures of inflammation and immune system response). In addition, the CMI contained more items to measure cardiovascular than musculoskeletal symptoms. It is possible that with a more comprehensive measure of musculoskeletal symptoms, the stonewalling-musculoskeletal link would have exhibited greater robustness.

Conclusion

According to the 2009 census, 96% of Americans over the age of 65 had been married at least once in their life. Findings from the present 20-year longitudinal study suggest that specific interpersonal emotional behaviors expressed during marital conflicts are linked to the development of specific health problems over time. Specifically, husbands' anger behavior predicted increases in cardiovascular symptoms and husbands' stonewalling

behavior predicted increases in musculoskeletal symptoms. Both associations showed evidence of specificity in terms of emotion and symptoms and there was some evidence for similar associations for wives. The present findings contribute to our understanding of the powerful links between interpersonal emotional behaviors and health. They also point to promising opportunities for preventive interventions that target specific interpersonal emotional behaviors in addressing major public health problems.

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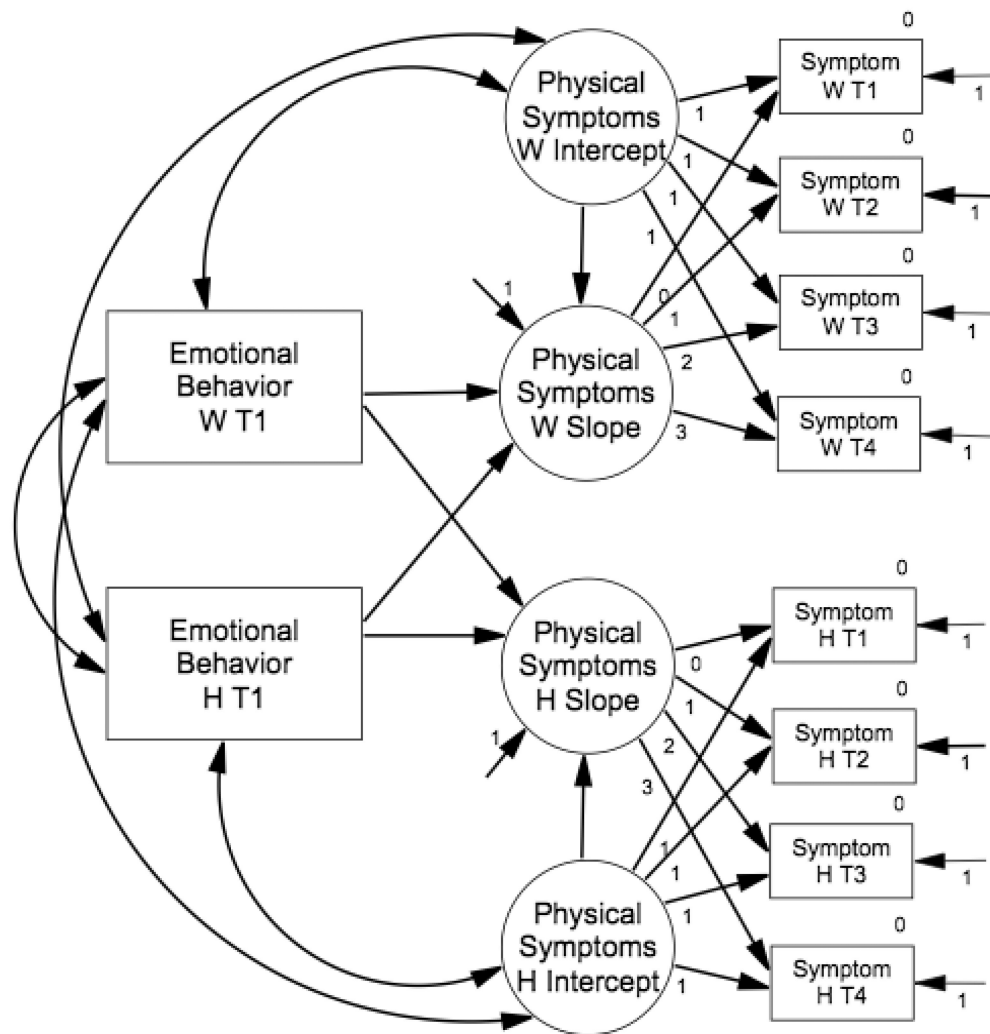


Figure 1. Emotional behaviors and physical health symptoms: Conceptual dyadic LGM
Note. Conceptual dyadic latent growth curve model based on Olsen and Kenny (2006). Cross-spouse correlations between physical symptoms intercepts and slope residuals as well as cross-spouse paths between physical symptoms intercepts and slopes were also modeled but are omitted here for sake of clarity. W = Wives. H = Husbands. T1: 1989/90. T2: 1995/96. T3: 2001/02. T4: 2008/09.

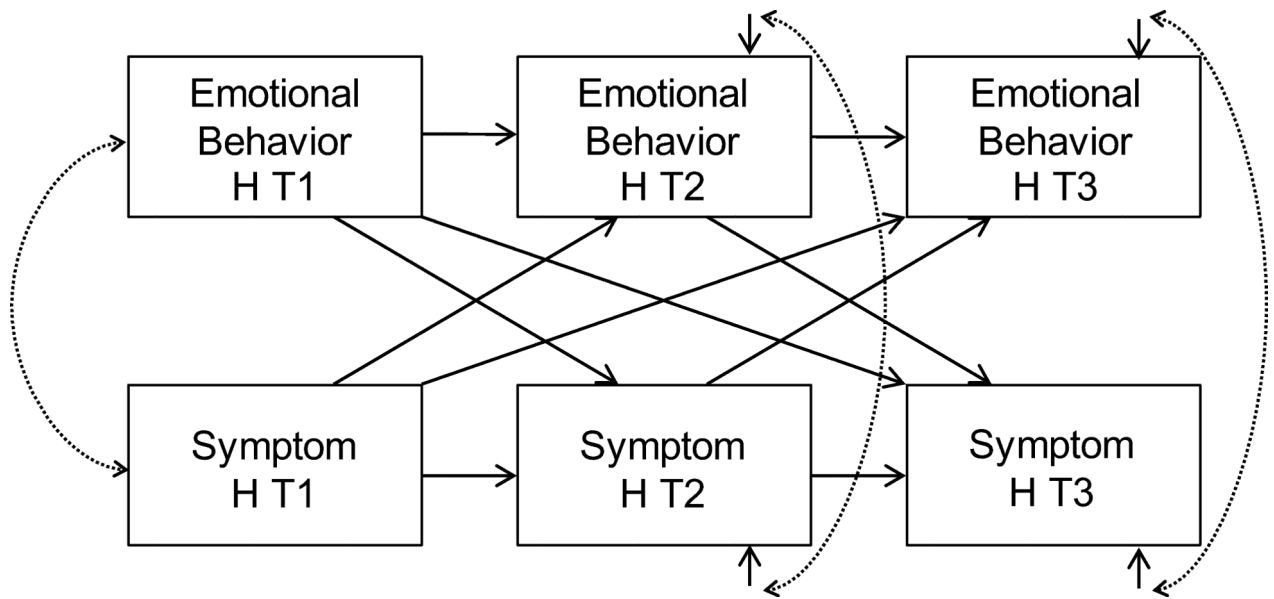


Figure 2. Emotional behaviors and physical health symptoms: Conceptual cross-lagged model
Note. Stability paths for emotional behavior and stability T1-T3 also included in the model, but not shown here. H = Husbands. T1: 1989/90. T2: 1995/96. T3: 2001/02.

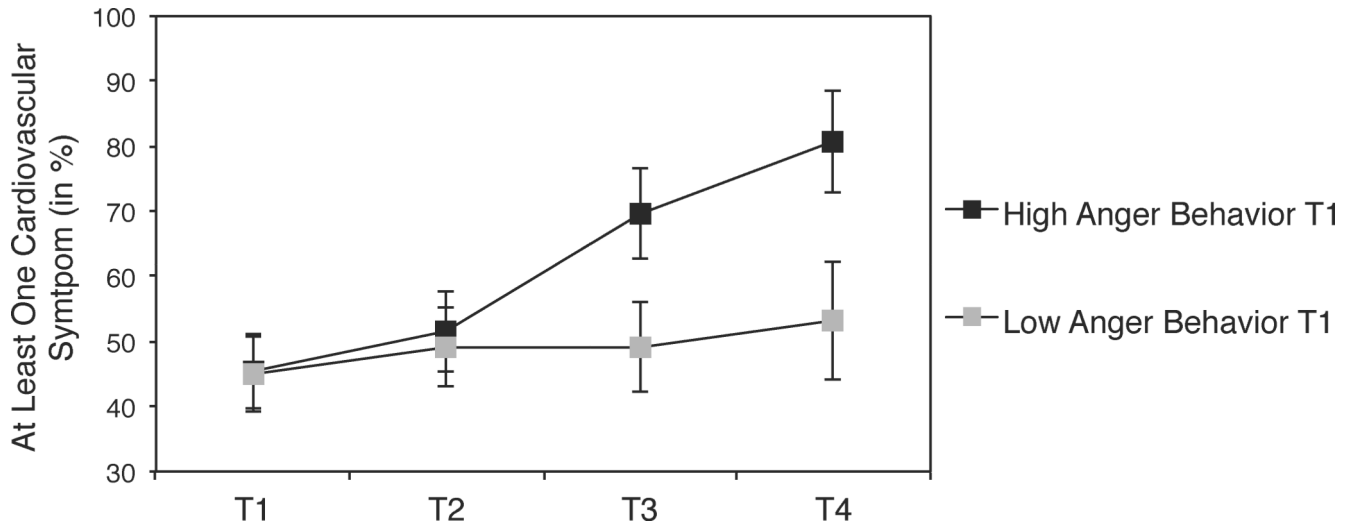


Figure 3. Husbands' Anger Behavior at T1 and Cardiovascular Symptoms over 20 Years
Note. M and SE(M). Low and high anger behavior were defined by median split. T1: 1989/90. T2: 1995/96. T3: 2001/02. T4: 2008/09.

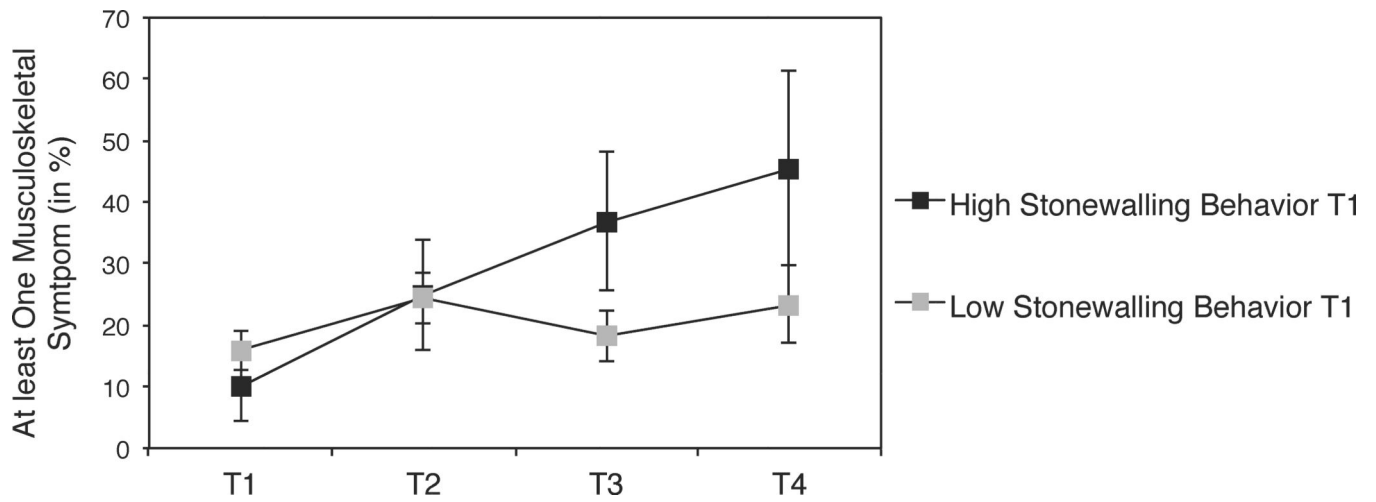


Figure 4. Husbands' Stonewalling Behavior at T1 and Musculoskeletal Symptoms over 20 Years
Note. M and $SE(M)$. Low and high stonewalling behavior were defined by sample-based split (80% showed low stonewalling behavior = 0 seconds coded as stonewalling). T1: 1989/90. T2: 1995/96. T3: 2001/02. T4: 2008/09.

Table 1

Intercorrelations between Key Study Variables at T1

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Anger T1 W	-											
2. Anger T1 H	.40***	-										
3. Stonewalling T1 W	.04	.13	-									
4. Stonewalling T1 H	.24**	.18*	.08	-								
5. Fear T1 W	-.04	-.06	-.10	-.03	-							
6. Fear T1 H	.07	.11	-.09	-.05	.33***	-						
7. Sadness T1 W	.32***	.16*	.12	.15	.15	.14	-					
8. Sadness T1 H	.02	.21**	.10	.02	-.11	.10	.22**	-				
9. Cardiovascular symptoms T1 W	-.02	-.01	-.05	.08	.12	.10	-.01	.03	-			
10. Cardiovascular symptoms T1 H	-.18*	-.03	-.05	.03	-.04	.08	-.09	-.02	.10	-		
11. Musculoskeletal symptoms T1 W	.06	-.10	.06	.01	.02	.06	.05	-.01	.25**	.17*	-	
12. Musculoskeletal symptoms T1 H	.07	.14	.06	.03	-.02	.07	.08	.13	.04	.24**	.12	-

Note. T1: 1989/90. W = Wives. H = Husbands.

* $p < .05$.

** $p < .01$.

*** $p < .001$

Table 2
Anger and Stonewalling Behavior at T1 as Predictors of Changes in Cardiovascular and Musculoskeletal Symptoms over 20 Years

	Cardiovascular Symptoms		Musculoskeletal Symptoms	
	Slope (T1-T4) H	Slope (T1-T4) W	Slope (T1-T4) H	Slope (T1-T4) W
Anger T1 W	-.15	.07	.09	.13
Anger T1 H	.40**	.02	.14	-.01
Model fit	$\chi^2(30) = 37.98, p = .150; CFI = .97; RMSEA = .041$		$\chi^2(29) = 48.73, p = .012; CFI = .87; RMSEA = .066$	
Stonewalling T1 W	.07	-.05	.00	-.08
Stonewalling T1 H	-.01	-.08	.25*	.11
Model fit	$\chi^2(30) = 29.41, p = .496; CFI = 1.00; RMSEA = .000$		$\chi^2(29) = 42.05, p = .056; CFI = .90; RMSEA = .054$	

Note. Results from four separate dyadic LGM. Standardized regression coefficients (β) for emotional behaviors at T1 predicting physical symptom slopes shown. Analyses controlled for sociodemographic characteristics (i.e., age, education) and health behaviors (i.e., exercise, smoking, alcohol consumption, caffeine consumption). T1: 1989/90. T2: 1995/96. T3: 2001/02. T4: 2008/09. W = Wives. H = Husbands. CFI = Comparative Fit Index. RMSEA = Root Mean Square Error of Approximation.

*
 $p < .05$.

**
 $p < .01$.