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The Contribution of Individual Differences in Hostility to the Associations Between Daily Interpersonal Conflict, Affect, and Sleep

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Adults of both sexes completed phone interviews assessing interpersonal conflict, state negative and positive affect (NA and PA), and sleep from the previous night on 7 consecutive evenings. Greater interpersonal conflict was associated with increased NA and decreased PA that day and increased sleep disturbance that night (measured on the next day). Mediational analyses were consistent with NA on the conflict day (but not PA) being a partial mediator of the prospective relation between greater conflict and greater sleep disturbance. Greater NA was associated with retrospective reports of obtaining less sleep and experiencing greater sleep disturbance the previous night but conflict was not associated with NA or PA on the following day. The associations between conflict and greater NA and sleep disturbance were exacerbated among individuals higher in cynical hostility. This exacerbation was not due to individuals higher in hostility reporting a greater number conflicts or more severe conflicts.

Interpersonal conflicts are reported to have deleterious consequences for mental and physical health. Enduring social conflicts are associated with increased depressed affect (Finch & Zautura, 1992), increased susceptibility to infectious illness (Cohen et al., 1998), and the down-regulation of cellular immunity (Kielcolt-Glaser et al., 1987). Despite this evidence, the exact psychological and behavioral pathways through which conflict influences health remain unknown. One possibility is that conflict alters affect and disregulates restorative behaviors such as sleep. Several studies indicate daily conflict is associated with increased same-day negative affect (NA) (Bolger, DeLongis, Kessler, & Schilling, 1989; Eckenrode, 1984; Stone, 1987). However, the possibility that daily conflict is associated with alterations in sleep quality has not been evaluated. The present study examined relations between daily interpersonal conflict, daily affect, and sleep quality.

There is accumulating evidence that sleep has implications for both physical and mental health. For example, self-rated sleep quality is a prospective predictor of increased risk for mortality (Newman et al., 2000) and the development of clinical depression (Chang, Ford, Mead, Cooper-Patrick, & Klag, 1997). Sleep plays an important role in maintaining host resistance (Horne, 1988), with laboratory-induced sleep deprivation resulting in disruptions in neuroendocrine (Leproult, Coponschi, Buxton, & Van Cauter, 1997), metabolic (Spiegel, Leproult, & Van Cauter, 1999), and immune functioning (Born, 1999; Dinges, Douglas, Hammarman, Zaugg, & Zapoor, 1995). Sleep disruption out-

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side the laboratory also interferes with the body's ability to confer immunity. For example, self-reports of low sleep efficiency, percentage of time sleeping after getting into bed, were associated with greater risk of developing a cold among those subsequently exposed to a rhinovirus (Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997). Similarly, self-reported periods of reduced sleep preceded recurring herpes simplex virus infections (Dalkvist, Wahlin, Bartsch, & Forsbeck, 1995).

Daily interpersonal conflicts may disrupt sleep by altering people's affective states. Several studies indicate a relation between NA and sleep outcomes. For example, heightened anxiety is positively associated with concurrent reports of taking longer to fall asleep (Moffitt, Kalucy, Kalucy, Baum, & Cooke, 1991) and increased anger is associated with greater cardiovascular activity during sleep (Shapiro, Jamner, & Goldstien, 1997). Moreover, enduring states of depression and anxiety have been linked with both self-report and laboratory-assessed sleep disruption (Hall et al., 1997; Ironson et al., 1997). There are also data indicating that poor sleep quality may cause increases in NA. For example, experimental studies of sleep deprivation (Dinges et al., 1995; Meney, Waterhouse, Atkinson, Reilly, & Davenne, 1998) and diary studies of mood and sleep (Totterdale, Reynolds, Parkinson, & Briner, 1994) show that reductions in sleep are associated with elevations in NA on the following day.

In this study, we tested the hypothesis that daily conflict leads to subsequent sleep disruption by increasing negative affect (NA). We also tested the hypothesis that conflict is associated with greater NA the following day among those who experience greater sleep disruption after conflict. Several studies indicate that daily conflicts are associated with greater NA the same day (Bolger et al., 1989; Eckenrode, 1984; Stone, 1987). However, the existing data are inconclusive as to whether conflicts are associated with affect on the following day. Whereas several studies have failed to demonstrate a lagged relation between daily life-events and affect on the next day (Affleck, Tennen, Urrows, & Higgins, 1994; Stone & Neale, 1984), others have observed such a relation (Bolger & Zuckerman, 1995; Gable, Reis, & Elliot, 2000). In this study, we tested the possibility that a day-lagged association between conflict and affect might exist among those experiencing greater sleep disturbance in response to their conflicts.

We also examined the associations between daily conflict, sleep disruption, and positive affect (PA). Although there has been considerable research concerning the impact of daily conflict on NA, the possibility that daily conflict is associated with alterations in PA has received less attention. One hypothesis is that daily interpersonal conflict would be associated with reductions in PA. However, empirical and theoretical work concerning the independence of PA and NA (see Diener & Emmons, 1984; Watson & Clark, 1997) raises the possibility that daily PA may not covary with reports of daily conflict and co-occurring increases in NA. In this study, we tested these competing predictions.

Although past research indicates daily conflicts are associated with greater NA for most individuals, there is evidence that some people are more responsive to social conflict than others (Bolger & Zuckerman, 1995; Suls, Martin, & David, 1998). One individual difference that might identify individuals who are more responsive to conflict is cynical hostility. Cynical hostility is a stable disposition characterized by cynical attitudes about others, mistrust, hostile affect, aggressive responding, and defensiveness (Barefoot, Dodge, Peterson, Dahlstrom, & Williams, 1989; Smith, 1992). People high in cynical hostility are at increased risk for a number of adverse health outcomes, including incidence of coronary heart disease (CHD), CHD death, and cancer death, and all cause mortality (Miller, Smith, Turner, Guijarro, & Hallet, 1996; Smith, 1992). One widely held explanation for this is that they exhibit amplified physiological and emotional responses to stressors and, in particular, to interpersonal stressors they encounter (Smith, 1992; Suls & Wan, 1993).

Experimental studies indicate that those greater in cynical hostility display greater anger (Pope, Smith, & Rhodewalt, 1990) and increased cardiovascular and neuroendocrine changes in response to conflict (Hardy & Smith, 1988; Powch & Houston, 1996; Suarez, Harlan, Peoples, & Williams, 1993). However, there is less evidence concerning whether greater cynical hostility is associated with greater reactivity to naturalistic conflicts. Jamner and colleagues (Jamner, Shapiro, Goldstien, & Hug, 1991) found that among paramedics greater cynical hostility was associated with greater increases in diastolic blood pressure (DBP) in response to being in a conflict-laden environment, a hospital's emergency room. However, because they did not measure conflict it is unclear whether the amplified DBP response observed among those higher in hostility was a reflection of their reaction to interpersonal conflict in the emergency room. Moreover, Räikkönen, Matthews, Flory, and Owens (1999) found that greater cynical hostility was associated with greater systolic and diastolic blood pressure (SBP and DBP) and greater NA among adults who participated in 3 days of ambulatory monitoring. However, those higher in hostility did not show greater increases in NA or cardiovascular activity during assessment periods in which they reported an interpersonal conflict.

In this study, we tested the hypothesis that people higher in cynical hostility display more pronounced increases in NA and decreases in PA in response to their naturally occurring daily conflicts. In addition, we extended previous work on hostility and naturalistic conflict by testing the hypothesis that those higher in cynical hostility also display greater sleep disruption following conflict, presumably as a consequence of their amplified affective response.

METHOD

Participants

The participants were 47 community volunteers (29 women, 18 men) recruited by phone from a sample of volunteers who participated in a study of susceptibility to the common cold during the prior 6 months (see Cohen et al., 1998, for a description). A total of 85 individuals from the prior study were phoned. Of these 85 individuals, 8 could not be reached because they had moved or their phones had been disconnected. Of the individuals who were contacted, 61% (47 out of 77) consented to participate. Participants' mean age was 34 (*SD* = 10.7, range 18 to 54); 64% were Caucasian, 32% were African American, and 4% were Hispanic. Of the volunteers, 41% had completed high school or less, 33% had completed high school and less than 2 years of college, and 36% had completed at least 2 years of college. Volunteers received $5 for completing each of seven phone interviews and a $40 bonus payment for completing all seven interviews on consecutive days. Of these 47 individuals, 45 completed all seven interviews. The remaining 2 participants each missed a single interview.

Procedure

The present study consisted of a baseline training session and a 7-day interview follow-up. During training, volunteers received instruction regarding the format of the daily phone interviews they were to complete and were given written descriptions of the interview questions. They also completed the 13-item cynicism scale of the Cook Medley Hostility Scale (Barefoot et al., 1989; Cook & Medley, 1954). Approximately 1 week following the training session, participants completed interviews assessing social interactions, mood, and sleep behavior on a daily basis for 7 consecutive days.

Daily phone interviews were administered between 6 p.m. and 10 p.m. Each individual's interviews were scheduled at the same time on all 7 days. The one-time-a-day interview provides assurance that each record is completed on the day and at the time intended and can be less intrusive than techniques requiring online monitoring of daily social behavior. Moreover, work by Stone and his colleagues (Hedges, Jandorf, & Stone, 1985; Stone, Kennedy-Moore, Newman, Greenberg, & Neale, 1992) and our own pilot work indicate that evening reports provide accurate estimates of daily mood and social activity over the day.

We employed a cueing procedure to facilitate participants' recall of the day's events. During the phone interviews, we first asked participants about social interactions occurring during the time between the previous night's interview and when they went to bed. Then we asked about interactions between when they woke up and noon, and so on. We used a total of four time periods to structure the interview: (a) between the prior night's interview and when the participants went to bed, (b) between the time they woke up and noon, (c) between noon and 4 p.m., and (d) between 4 p.m. and the current night's interview. For each of the four time periods, participants indicated with whom they had had social interactions. We used a definition of an interaction that was based on the Rochester Interaction Record (RIR) (Reis & Wheeler, 1991). Participants used a time-based criterion (spending time with a person or persons for 10 min or longer) for determining whether a given social encounter was to be considered an interaction. For each one-on-one or group interaction participants reported having, they indicated with whom they interacted, when it started and ended, who initiated the interaction, the pleasantness of the interaction, whether they gave or received any support, and the level of disagreement or conflict (if any). Participants reported an average of 5.32 (*SD* = 2.31) interactions each day. At the end of the interview, participants answered questions about their mood since they woke up and their sleeping behavior from the night before.

Measures

Daily conflict. We derived our measure of conflict from the daily phone interviews. For each social interaction lasting 10 min or longer participants reported retrospectively on the level of disagreement or conflict that occurred during the interaction (*none*, *mild*, *moderate*, or *severe*). For each day, we recorded the intensity of the most severe conflict reported on a 4-point scale (0 = *none*, 1 = *mild*, 2 = *moderate*, 3 = *severe*). This served as our measure of daily conflict.

Daily mood. At the end of each phone interview, participants reported their mood across the day. Mood was assessed using 21 adjectives taken from the Profile of Mood States (McNair, Lorr, & Droppleman, 1971) and a factor analysis of the Mood Adjective Checklist (MACL) (Usala & Hertzog, 1989). Three, three-item subscales reflecting well-being (i.e., *happy*, *cheerful*, *pleased*), vigor (i.e., *energetic*, *full of pep*, *lively*), and serenity (i.e., *calm*, *relaxed*, *at ease*) represented positive affect (PA) states. Four 3-item subscales reflecting anger (i.e., *hostile*, *resentful*, *angry*), anxiety (i.e., *on edge*, *tense*, *nervous*), depression (i.e., *depressed*, *sad*, *unhappy*), and fear (i.e., *frightened*, *fearful*, *afraid*) represented negative affective states. Participants indicated to what extent each adjective described how they felt since they woke up that morning on a 5-point scale (from 1 = *not at all* to 5 = *extremely*). Consistent with empirical work demonstrating that negative and positive affective states are only moderately correlated on a daily basis (Diener & Emmons, 1984; Stone, 1995), we combined the daily adjectives to create a 9-item measure (PA) and a 12-item measure (NA) that differed in their affective valence. The average within-person correlation between the measure of PA and the measure of NA across the seven interviews was $r = -.48$, $p < .001$. Day-level internal consistencies for the 9-item measure of PA and the 12-item measure of NA were computed for the 1st, 4th, and 7th days of the data collection period, with resulting reliabilities of .81, .75, and .80 for PA and .84, .90, and .87 for NA.[1]

Sleep. During each of the daily interviews, participants reported retrospectively on their sleeping behavior from the previous night. Participants indicated (a) when they went to bed the previous night and when they got out of bed the current day, (b) the minutes of sleep (if any) they lost as a result of not being able to fall asleep or waking up and not being able to get back to sleep, and (c) the minutes (if any) they spent in bed intentionally awake (i.e., reading or watching TV). We constructed two measures from these questions. Time sleeping was a retrospective report of the total time in bed minus the amount of sleep lost and the amount of time spent intentionally awake in bed. Sleep disturbance was the number of minutes sleep participants reported losing sleep as a result of not being able to fall asleep or waking up and not being able to get back to sleep. The average within-person correlation between participants' nightly estimates of sleep disturbance and nightly estimates of time sleeping across the 7 days was $r = -.15$, $p < .05$.

To establish the validity of our daily sleep measures we correlated individuals' average nightly sleep disturbance and time sleeping with two scales (sleep quality and habitual sleep efficiency) from the Pittsburgh Sleep Quality Index (PSQI), a self-report sleep measure that assesses typical sleeping behavior (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Participants completed these two scales between 2 and 6 months prior to the start of the present study as part of an earlier study on susceptibility to the common cold (see description in Cohen et al., 1997). Average sleep disturbance across the 7 days was inversely correlated with habitual sleep efficiency ($r = -.40$, $p < .05$) and sleep quality ($r = -.35$, $p < .05$) as measured by the PSQI. Average time sleeping was neither correlated with sleep quality ($r = -.03$, *ns*) nor sleep efficiency ($r = .18$, *ns*). Consistent with our findings concerning the sleep disturbance measure, Monk et al. (1994) reported a correlation of $r = .26$ between participants' total PSQI and average duration of their nightly awakenings (measured on a daily basis). Moreover, they also reported that participants' daily reports of the duration of their nightly awakenings were positively correlated ($r = .43$) with estimates of time spent awake during the night derived from wrist actigraphs worn by participants (Monk et al., 1994, p. 117). That our daily measures of sleep disturbance were moderately correlated with the measures of habitual sleep efficiency assessed 2 to 6 months prior and that daily reports of minutes of disturbed sleep have been demonstrated to correlate with behavioral measures of sleep provides evidence of its validity.

Hostility. Cynical hostility was assessed using 13 items from the Cynical Hostility scale (Ho)—a scale derived from the Minnesota Multiphasic Personality Inventory (MMPI) (Cook & Medley, 1954).[2] Participants indicated the extent to which they agreed or disagreed with each of 13 items using a 4-point scale (1 = *strongly agree*, 2 = *agree*, 3 = *strongly disagree*, 4 = *strongly disagree*). These items had previously been identified as reflecting cynical beliefs about others (Barefoot et al., 1989). Participants completed this measure during the diary training session (1 week before the seven daily interviews). This scale displayed adequate internal reliability, $\alpha = .83$. The mean score 13-items was 30.28, with scores ranging from 13 to 43. (For data regarding Ho scores in a nationally representative study, see Barefoot et al. [1991].)

Statistical Analyses

The daily diary data collected have a nested structure, with the daily measures of conflict, affect, and sleep being nested within the individual participants. Failing to take account of this nesting by treating the observations as independent can result in inflated estimates of the associations among daily measures. Moreover, doing so precludes one from testing whether the day-to-day association between two variables (e.g., conflict and affect) differs across individuals. Random coefficient models provide an appropriate means of testing hypotheses concerning day-to-day within-person variation between measures of psychological states and behaviors while accounting for the variation in these measures that is due to the individuals (Bryk & Raudenbush, 1992; Littell, Milliken, Stroup, & Wolfinger, 1996). These models express the daily variation in an outcome (e.g., NA) using two linked models: one at the daily level (Level 1) and another at the person level (Level 2). Because these models consist of two linked models, random coefficient models are often referred to as hierarchical linear models (Bryk & Raudenbush, 1992). The Level 1 portion of the model expresses day-to-day variation in an outcome, for example, NA, as the sum of an intercept for the individual, the slopes for any other daily processes hypothesized to be relevant to day-to-day variation in NA (e.g., conflict), and random error.

$$\text{NAij} = \beta_{0j} + \beta_{1j}(\text{conflict}) + r_{ij}.$$

The Level 2 portion of the model expresses the individual intercepts and slopes generated from the Level 1 portion of the model as the sum of an overall mean and deviations from that mean. In the model below, γ_{00} and γ_{10} refer to the portion of the intercept and slope estimates that is fixed and u_{1j} and u_{0j} refer to the portion of these parameters that varies across individuals (i.e., the random effects).

$$\beta = \gamma + u,$$
$$\beta(\text{conflict}) = \gamma + u.$$

The inclusion of random effects has two primary advantages over other estimation methods such as ordinary least squares (OLS). First, modeling the random effects at the individual level allows for a more appropriate estimate of the standard errors for the fixed effects. Second, in modeling the random effects one can test whether differences between subjects can account for the significant variability in the fixed effects. The model below extends the hypothetical model presented previously in that the variability in slopes and intercepts is modeled as a function of between-person differences in hostility.

$$\text{NAij} = \beta + \beta(\text{conflict}) + r,$$
$$\beta = \gamma + \gamma(\text{hostility}) + u,$$
$$b(\text{conflict}) = \gamma + \gamma(\text{hostility}) + u.$$

The addition of γ_{01}(hostility) and γ_{11}(hostility) to the previous model tests whether the individual variation in the intercept for NA and the slope for conflict (as determined by the random effects) can be explained by differences in the cynicism at the person level.

In determining the appropriate models to test study hypotheses, we considered several issues (see Nezlek, 2001; Schwartz & Stone, 1998, for a consideration of these and other issues). This included whether to specify effects as fixed or random, whether to center the daily (Level 1) and between-person (Level 2) measures, and how to specify the structure of variance-covariance matrix for the intercepts and slopes (i.e., the random effects). All of the models we report included random intercepts. All slopes were modeled initially to include random effects. However, slopes that did not have a significant variance component (as indicated by a significant tau, τ) were treated as fixed effects (i.e., the random effects for the slope were dropped from the model). The daily, within-person measures were mean-centered at the person level and therefore represent the extent to which individuals deviated from their mean on a given day. We used a maximum likelihood (ML) estimation method and an unstructured (UN) specification for the parameter covariance matrix. The unstructured specification allows the parameters in the covariance matrix to be determined by the data (Littell et al., 1996; Singer, 1998). Analyses were conducted using SAS PROC MIXED (SAS Institute, 1995).[3]

TABLE 1: Results of Random Coefficient Models of the Association Between Daily Conflict and Affect

	Estimates of Fixed Effects			*Estimates of Random Effects*		
	γ	t	p	τ	z *Score*	p
Negative affect (NA)						
Intercept	14.6	24.33	< .001	7.52	2.00	< .05
Slope (conflict)	2.68	4.45	< .001	9.41	2.69	< .01
Positive affect (PA)						
Intercept	30.59	30.70	< .001	38.35	4.25	< .001
Slope (conflict)	–1.37	3.12	< .001	1.10	<1	*ns*

RESULTS

We used random coefficient models to test our hypotheses concerning the associations between daily affect, conflict, and sleep. In the analyses reported, we used the level of the most severe conflict participants reported each day as an indication of degree of conflict on that day.[4] Nine individuals did not report experiencing interpersonal conflict of any severity over the course of the 7 days. Because our study questions concerned the correlates of the within-person variation in conflict, and because SAS PROC MIXED only includes cases with variability on within-person predictors in its estimates of the fixed and random effects, data from these individuals were not included in the analyses reported. Participants who did not report conflict did not differ from those who did in hostility, average PA, or average minutes of time sleeping (all ts < 1). However, these individuals reported less NA over the seven interviews (20.45 vs. 25.77), $t(46) = 2.88$, $p < .05$, and less sleep disturbance (4.42 vs. 22.18), $t(46) = 4.26$, $p < .001$, than did those reporting conflict.

Do Daily Interpersonal Conflicts Disrupt Sleep by Altering Daily Affect?

To begin to test the hypothesis that conflict leads to sleep disruption by altering PA and NA, we first examined whether interpersonal conflicts were associated with day-to-day variation in PA and NA. In these analyses, participants' daily affect reports were predicted from the level of conflict they experienced on that day. We constructed separate models for NA and PA. The results of these models are summarized in Table 1. As indicated there, results indicate that participants reported greater NA and lower PA on days in which they reported having more severe conflicts. As also indicated in Table 1, there was significant variability in the slope of conflict for NA but not in the slope of conflict for PA.

Next, we tested whether conflict was associated with time sleeping and sleep disturbance that night (assessed the next day). In separate random coefficient models, reports of time sleeping and sleep disturbance were modeled as a function of conflict from the previous day and current NA. Greater NA was associated with reports of getting less sleep, $\gamma = -2.55$, $t(35) = 2.44$, $p < .05$, and experiencing greater sleep disturbance, $\gamma = 1.21$, $t(35) = 3.08$, $p < .01$, on the previous night. Previous conflict was not associated with time sleeping, $\gamma = -7.83$, $t(34) = 1.25$, *ns*, that night but was significantly associated with greater sleep disturbance, $\gamma = 7.23$, $t(35) = 2.41$, $p < .05$. In addition, there was significant individual variability in the slope for conflict on sleep disturbance, $\tau = 94.33$, $z = 1.98$, $p < .05$, suggesting that the association between conflict and sleep disturbance varied across individuals. Because conflict was measured on the day before sleep disturbance was assessed, we can be sure that conflict preceded the reported sleep disturbance. Moreover, because we controlled for levels of NA on the day in which sleep disturbance was assessed, we can be sure that this finding was not a reflection of current mood on reports of sleep disturbance.

We conducted a series of analyses to evaluate whether the association between conflict and sleep disturbance was due to conflict disrupting affect. The sequence of these analyses matched the sequence used to establish mediation in using OLS regression (Baron & Kenny, 1986). First, we examined whether participants' PA and NA on the conflict day (the potential mediators) were associated with their subsequent reports of sleep disturbance that night (assessed the next day). Greater NA was associated with increased sleep disturbance that night, $\gamma = 1.09$, $t(35) = 2.27$, $p < .05$, but PA was unrelated to reports of subsequent sleep disturbance, $\gamma = -.34$, $t(35) < 1$, *ns*. Then we assessed whether controlling for the potential mediator, NA on the conflict day, reduced the within-person association between conflict and subsequent sleep disturbance (represented by the fixed effect). Adding NA on the conflict day to our model reduced the association between conflict and sleep disturbance was reduced from $\gamma = 7.23$, $t(35) = 2.27$, $p < .05$ to $\gamma = 6.01$, $t(35) = 1.91$, $p = .08$. That controlling for NA on the conflict day reduced the association between previous conflict and sleep disturbance is consistent with NA being a partial mediator of the relation between conflict and subsequent sleep disturbance. However, that the overall reduction in the fixed effect for conflict on sleep disturbance was relatively modest (17%) suggests that factors other than NA contributed to the reports of greater sleep disturbance days in which greater conflict was reported.[5]

The finding that reports of previous disturbance were associated with greater current NA suggested that previous sleep quality might represent a third factor that could account for why conflict was associated with greater NA. Poor sleep might contribute to people's levels of NA and simultaneously lead them to be more likely to report engaging in more severe interpersonal conflicts. To evaluate this interpretation of our findings we tested whether participants reported greater sleep disturbance (from the previous night) on days in which they reported more severe interpersonal conflict. Then we examined whether the relations between conflict and greater NA were reduced when we statistically controlled for reports of previous sleep disturbance.

On days in which they reported conflict, participants reported greater sleep disturbance, $\gamma = 9.33$, $t(35) = 3.23$, $p < .01$, from the previous night. However, statistically controlling for reports of time sleeping and sleep disturbance did not reduce the relation between conflict and greater same-day NA, $\gamma = 2.39$, $t(35) = 3.65$, $p < .001$. These results suggest that people's previous sleeping behaviors could not account for their reporting greater NA on days in which they reported experiencing conflict.

Does Conflict Lead to Greater NA and Less PA on the Following Day for Those Experiencing Greater Sleep Disruption?

To begin to determine whether conflict was associated with greater NA and less PA on the next day among those who reported greater sleep disturbance following conflict, we evaluated whether conflict on a given day was prospectively associated with changes in NA and PA from that day to the next. In separate models, daily reports of PA and NA were predicted from NA and PA from the previous day and conflict from the current day and previous day. Although the degree of conflict on the current day remained a significant predictor of current NA, $\gamma = 2.63$, $t(35) = 3.96$, $p < .001$, and PA, $\gamma = -1.32$, $t(35) = 3.16$, $p < .01$, conflicts from the previous day were neither associated with NA, $\gamma = .58$, $t(35) < 1$, *ns*, nor PA, $\gamma = -.38$, $t(35) < 1$, *ns*, on the following day. Moreover, the estimates of the random effects for the slopes of previous conflict indicated there was insufficient variability in the within-person associations between conflict and PA ($\tau = 2.66$, $z = 1.24$, *ns*) and NA ($\tau = .59$, $z < 1$, *ns*) on the following day to be predicted by differences in sleep disturbance. Thus, our findings did not support the hypothesis that conflict leads to greater NA and less PA on the next day for those who experience greater sleep disruption.

Is Greater Cynical Hostility Associated With Greater Emotional Reactivity to Daily Conflict?

To test the hypothesis that people high in cynical hostility show an amplified affective response to conflict, we added terms to the Level 2 portion of our models testing whether the significant variability in the slope for conflict on affect could be explained by between-person differences in cynical hostility. We also tested whether hostility predicted variability in the intercepts for PA and NA. For NA, the coefficient representing the fixed effect of conflict was significant, $\gamma = 2.21$, $t(35) = 4.31$, $p < .001$, indicating a greater degree of conflict was associated with reports of greater NA. In addition, between-person differences in cynical hostility were associated with the variability in the slopes for conflict, $\gamma = 1.50$, $t = 2.26$, $p < .05$, with those higher in cynical hostility reporting greater increases in NA in response to increases in daily conflict severity. For PA, the coefficient representing the fixed effect of conflict was significant, $\gamma = -1.26$, $t = 2.71$, $p < .05$. However, between-person differences in cynical hostility did not moderate the within-person association between greater conflict severity and decreased PA on that day, $\gamma = -.59$, $t = 1.07$, *ns*.

Is Greater Cynical Hostility Associated With Greater Conflict-Induced Sleep Disruption?

To test the hypothesis that people higher in cynical hostility experience greater sleep disruption following conflict, we added terms to the Level 2 portion of our models testing whether the significant variability in the slope for conflict on sleep disturbance could be explained by between-person differences in cynical hostility. The coefficient representing the fixed effect of conflict on subsequent sleep disruption was significant, $\gamma = 7.86$, $t(35) = 2.59$, $p < .05$. In addition, and as expected, between-person differences predicted variability in the within-person associations between conflict and subsequent sleep disturbance, $\gamma = 8.44$, $t = 2.64$, $p < .01$, with those higher in cynical hostility reporting greater subsequent sleep disruption with greater conflict severity from the previous day.

DISCUSSION

We replicated previous studies indicating that daily conflict is associated with greater NA and extended them by demonstrating that conflict is associated with reduced PA and greater sleep disturbance. Participants reported greater NA and less PA on days in which they reported more severe conflicts and greater sleep disturbance (but not time sleeping) that night (measured the next day). Moreover, our data are consistent with the proposal that NA on the conflict day (and not NA at the time sleep was assessed) was a partial mediator of the relation between conflict and greater sleep disturbance.

Although the findings reported are consistent with the interpretation that daily conflicts elicit greater NA and reduced PA, because these analyses were based on cross-sectional data we cannot be certain that conflict preceded the changes in affect. An alternative explanation is that greater NA led people to have conflicts or report that their social interactions contained conflict (Clark & Teasdale, 1982). However, because conflict was assessed on the day before sleep disturbance, we are certain that conflict preceded the changes in sleep disturbance. Moreover, because we controlled for participants' levels of NA at the time they reported on their levels of sleep disturbance, we also are certain that the relation between conflict and greater sleep disturbance was not a reflection of mood on reports of sleep disturbance.

Our finding that NA on the conflict day accounted for only a small percentage of the relation between conflict and greater subsequent sleep disturbance raises questions about other mediators. One possibility is that individuals' coping efforts contributed to their subsequent sleep loss. For example, certain behavioral strategies that people have been demonstrated to use to cope with interpersonal difficulties, such as alcohol consumption (e.g. Mohr et al., 2001), can directly lead to sleep disturbance (Horne, 1988). A second possibility is that participants may have experienced intrusive thoughts or ruminations about the day's events when attempting to fall asleep that were not reflected in our affect measures (Baum, 1990). Finally, a third explanation is participants reported on NA they experienced during the entire day and not their affect at the time of the interview. Participants' mood when they go to bed may be more strongly associated with sleep loss than their reports regarding mood states they experience during the course of the day.

Our use of a continuous measure of conflict implies that individuals are sensitive to day-to-day increases and decreases in daily interpersonal conflict. However, this can be argued to be counter to our own phenomenological experience of conflict as being either present or absent in our daily social interactions. To address this issue, we also conducted our statistical analyses using dichotomous measures of conflict. First, we distinguished between days in which participants reported at least one interaction with at least mild conflict (conflict days) and all other days (nonconflict days), then we distinguished between days in which participants reported at least one interaction with at least moderate conflict (moderate conflict days) and all other days (nonconflict days). Participants reported greater NA and less PA on conflict days, as compared to nonconflict days, regardless of the criteria used for determining a conflict day. However, they were only found to report significantly greater sleep disturbance on nights following days in which they reported having a social interaction with at least moderate conflict. This is consistent with the interpretation that a greater level of daily conflict is necessary to alter sleep as compared to affect.[6]

We did not find a day-lagged association between conflict and subsequent on NA or PA for the entire sample or among those who reported greater sleep disturbance following conflict. This is consistent with studies indicating that associations between daily stressors and mood are confined to the day of which the stressor is reported (Affleck et al., 1994; Stone & Neale, 1984). However, it is inconsistent with both the proposal that conflict influences NA and PA on the next day by disrupting sleep during the intervening night and studies demonstrating an effect of daily events on mood on the next day (Bolger & Zuckerman, 1995; Gable et al., 2000). One explanation for the discrepancies in the literature regarding day-lagged effects of daily events on affect concerns the manner in which the lagged analyses were conducted. Past studies demonstrating an association between daily events and affect on the following day have not controlled for the occurrence of events on the day affect is measured, in spite of negative events on one day being associated with their occurrence on the next day (e.g., Gable et al., 2000).

We did, however, find an association between participants' current levels of NA and reports regarding how they slept the previous night. On days in which participants reported greater NA, they reported getting less sleep and experiencing greater sleep disturbance the previous night. Although these findings are consistent with studies indicating that sleep deprivation causes increases in NA (Dinges et al., 1995; Meney et al., 1998), they are based on cross-sectional analyses and hence we cannot rule out that participants' NA influenced their perceptions of how they slept the previous night. However, that previous studies indicate reports of daily sleep disturbance correlate with other more objective measures of sleep awakenings, measures of nightly movement from wrist actigraphs, suggests our sleep measures were not solely a reflection of concurrent NA (Monk et al., 1994).

Participants in our study who were higher in cynical hostility reported greater increases in NA on days when they reported greater increases in daily conflicts and greater sleep disturbance (measured the next day). These results are consistent with the proposal that a hostile disposition influences an individual's reactivity to potentially stressful environmental stimuli and translates into affective and behavioral changes relevant to health (Smith, 1992). An important contribution of the present work is its implication that day-to-day sleep quality represents a behavioral pathway that links hostility to physical health. A definitive test of this hypothesis will require studies with more objective measures of sleep and verifiable health outcomes.

One question that remains is why high hostile individuals reported greater NA and sleep disruption following conflict than their less hostile counterparts. One possibility is that the exacerbated response of those higher in hostility was due to the number or severity of the daily conflicts they experienced (Smith, 1992). A second possibility is that as compared to those who are low in hostility, those who are high cope less effectively with their conflicts (Blumenthal, Barefoot, Burg, & Williams, 1987). Participants higher in hostility reported experiencing more conflicts ($r = .33$, $p < 05$), but they did not report their conflicts to be more severe than those less hostile ($r = .22$, *ns*). In addition, controlling for between-person differences in the average severity of conflicts reported and total number of conflicts reported could not account for the stronger associations between conflict and NA that existed among those greater in hostility. Because the self-report measure of conflict severity we used likely captures both the objective severity of the conflicts and the individuals' perceptions of the severity of the conflicts, we cannot rule out that those higher in hostility had more severe conflicts. Irrespective of this, our data indicate that those greater in cynical hostility did not report greater NA on conflict days because they experienced more conflicts or perceived their conflicts to be more severe. Future work will be necessary to evaluate other explanations for why individuals high in cynical hostility show more pronounced affective reactions to their naturally occurring conflicts.

In sum, we replicated previous studies showing that naturally occurring daily conflicts are associated with increased same-day NA and decreased same-day PA and extended them by demonstrating a prospective relation between conflict and greater self-reported sleep disruption and by showing that NA may represent a partial mediator of this relation. In addition, we found that the relations between conflict and greater NA and conflict and greater sleep disruption were exacerbated among hostile individuals. Taken together, our findings elucidate a plausible behavioral pathway through which daily conflict might affect health and raise the possibility that sleep may represent a pathway through which a hostile disposition is linked to health.

NOTES

1. We initially subjected the negatively skewed NA assessments to square root transformations to provide approximately normal distributions. However, because the results obtained using the square-rooted transformed data were comparable to the results obtained when using the transformed data, we report the analyses we conducted using

untransformed data because they generated coefficients that are more easily interpreted than the ones resulting from the transformed data.

2. Although the majority of studies referenced in the introduction used the entire 50-item Cynical Hostility scale (Ho) from the Minnesota Multiphasic Personality Inventory (MMPI) to assess cynical hostility (Cook & Medley, 1954), only the 13 items from the cynicism subscale (Barefoot, Dodge, Peterson, Dahlstrom, & Williams, 1989) were included in the battery of questionnaires participants completed. That we obtained results using the 13-item cynicism scale consistent with what others have found using the entire 50-item Ho suggests the 13-item subscale can serve as an adequate, albeit less desirable, substitute for the Ho.

3. In spite of the precise specifications used in formulating the models reported, the effects reported were robust across model specifications and centering options (i.e., although the actual estimates of the coefficients differed, the direction and significance of these effects were comparable).

4. We also conducted our analyses using a simple count of the number of daily conflicts (i.e., number of interactions with at least mild conflict) and a weighted count of the daily conflicts (i.e., number of interactions with at least mild conflict weighted by conflict severity). Both the count ($r = .70$, $p < .001$) and weighted count ($r = .79$, $p < .001$) measures were highly correlated with participants' daily reports of the most severe conflict they reported. Comparable results were obtained using these alternative conflict measures.

5. We also quantified the extent of mediation by comparing the reduction in the residual variance in the Level 1 model (the within-person residual) associated with entering conflict into the model both when the proposed mediator was included and absent from the model. We obtained an estimate of the total amount of the variance in the Level 1 model (i.e., the variability in sleep disturbance within persons) by specifying an unconditional means model (see Bryk & Raudenbush, 1992, pp. 62-66; Singer, 1998, pp. 327-330). Adding conflict to the model reduced the Level 1 residual by 7% when the proposed mediator (negative affect, NA) was absent, but by only 5.5% when NA was included in the model. This estimate of the extent of mediation (1.5%/7% = 21%) is roughly equivalent to the extent of mediation reflected in the drop in the fixed effect.

6. Results are available upon request from the first author.

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