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Article *in* Journal of Social and Clinical Psychology · January 2015

DOI: 10.1521/jscp.2015.34.1.50

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Journal of Social and Clinical Psychology, Vol. 34, No. 1, 2015, pp. 50-63

SLEEP PROBLEMS EXACERBATE THE EMOTIONAL CONSEQUENCES OF INTERPERSONAL REJECTION

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Previous literature has established a link between experiences of interpersonal rejection and hurt feelings. However, little research has examined intra-individual differences in sensitivity to rejection. We address this gap in research through examining daily fluctuations in sensitivity to rejection and poor sleep as a risk factor for these increases in sensitivity. Participants were 77 heterosexual college-student couples who completed daily diary measures of previous night's sleep quality, as well as daily experiences of rejection and hurt feelings over a period of 7 days. During this time, participants also wore an actigraph in order to obtain objective measures of sleep quality and duration. The association between perceived rejection and hurt feelings was manifest only under conditions of poor sleep (lower quality and quantity). Results highlight the importance of sleep for coping with daily interpersonal events and improve understanding of intra-individual differences in sensitivity to rejection.

Rejection in any form can be highly distressing (MacDonald & Leary, 2005), resulting in psychological and physical health consequences

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(Richman & Leary, 2009). Yet not all individuals are at equal risk for negative outcomes following rejection; inter-individual differences may increase susceptibility to interpersonal rejection (DeWall, Deckman, Pond, & Bonser, 2011). In this study, we argue that there are also intra-individual differences in the susceptibility to perceive and react to rejection. Given its importance for cognitive and emotional functioning, we examine sleep quality and quantity as factors influencing intra-individual differences in sensitivity to rejection.

People may differ in their vulnerability to rejection (Gyurak & Ayduk, 2008; Gyurak et al., 2012). Downey and Feldman (1996) proposed that some individuals are more rejection sensitive (RS) than others, due to their parenting experiences. Other researchers have shown differences in personality (Richman & Leary, 2009), self-esteem (Leary & Baumeister, 2000), and attachment styles (DeWall et al., 2012) to be at the heart of differential vulnerability to rejection. These differences are conceptualized as stable traits; some people are more or less sensitive to rejection. We propose that sensitivity to rejection can vary not just between persons, but also from situation to situation within the same person (intra-individual differences).

Sociometer theory (Leary, Tambor, Terdal, & Downs, 1995) may provide one key to understanding sensitivity to rejection. It proposes an internal working mechanism designed to help gauge and promote experiences of acceptance in interpersonal relationships. Due to the evolutionary advantages associated with living in communities, humans evolved an internal system designed to maximize the odds of social inclusion by detecting and reacting quickly to cues of social threat or reward (Hazan & Shaver, 1987; Leary et al., 1995). This system, the sociometer, allows individuals to infer information on the thoughts and feelings of others, even following limited contact (Leary & Baumeister, 2000). The sociometer is responsible for triggering negative emotions following the detection of a threat to an interpersonal relationship (Scherer, 2005). In accordance with the functionalist perspective on emotion (Lazarus, 1991), the intense negative emotions produced by this system draw the individual's attention to the decline in relational quality and provide motivation—via negative reinforcement—to counteract the threat (Baumeister, Zell, & Tice, 2007; Bradley & Lang, 2000). Calibration differences in the sociometer may underlie individual differences in sensitivity to perceive and react to cues of social rejection (see Murray, Griffin, Rose, & Bellavia, 2003).

We propose that intra-individual differences in sensitivity to rejection may be influenced by sleep, due to the role of sleep in the restoration and regulation of the anterior cingulate cortex (ACC) and the prefrontal cortex (PFC), the neurological regions responsible for processing social rejection (Eisenberger, Lieberman, & Williams, 2003; Etkin, Egner, & Kalisch, 2011). While the ACC is responsible for detecting and reacting to cues of rejection from a bottom-up approach, the right ventral portions of the PFC are responsible for mitigating the distress-response of pain in a top-down fashion (for example, by reappraisal of a painful situation; Etkin et al., 2011). Individuals who are more rejection sensitive demonstrate greater activity in the ACC and less activity in the prefrontal cortex (Burklund, Eisenberger, & Lieberman, 2007; Kross, Enger, Ochsner, Hirsch, & Downey, 2007). The implication is a heightened affective experience of pain.

The activity of these neural regions is influenced by sleep (Beebe & Gozal, 2002; Choo, Lee, Venkratraman, Sheu, & Chee, 2005; Durmer & Dinges, 2005). Without sufficient sleep—quantity or quality—cognitive and affective processing abilities become dysregulated (Walker, 2009). Areas of the brain associated with bottom-up processing become hyperactive (e.g., the ACC), while top-down controls (e.g., the prefrontal cortex) become hypoactive, decreasing executive control of emotional experience (Motomura et al., 2013; Van der Helm & Walker, 2011; Yoo, Gujar, Hu, Jolesz, & Walker, 2007). Practically speaking, this means that sleep deprivation not only causes individuals to be more highly reactive to emotionally salient stimuli, but simultaneously less capable of regulating these intense emotions. In other words, sleep problems may increase sensitivity to perceive and react to rejection. Accordingly, increased sensitivity to physical pain—which is processed by the same regions as social pain—occurs following sleep deprivation (Lee, Kim, & Shin, 2013; Schuh-Hofer et al., 2013). For the current study, we hypothesized that nights characterized by poor sleep would be followed by greater perceptions of rejection and feelings of hurt in response to rejection the next day.

The current study examines sleep deprivation and rejection within the context of romantic relationships. Research in this domain has examined social rejection predominantly at the hands of confederates and computer programs. As such, there is merit in considering the impact of rejection in ongoing, socially meaningful relationships (DeWall & Bushman, 2011). The pain of rejection may be especially

distressing when experienced by a romantic partner: individuals often report feeling more intense hurt following perceived rejection by a romantic partner than by a friend or family member (Vangelisti & Crumley, 1998). In addition, the current study examines social rejection in a sample of undergraduates. The impact of sleep problems may be especially relevant to this population. According to the National Sleep Foundation (2006), college students average only about 6.9 hours of sleep per night—two hours less than their recommended daily amount. Thus, the study of intra-individual differences in sensitivity to rejection is particularly relevant to romantic relationships among college students.

METHOD

PARTICIPANTS

Participants were 77 heterosexual undergraduate couples from a large, public university in the Southeastern United States. Couples were considered eligible to participate in the study if they had been in a dating relationship with their partner for at least 3 months. Relationship length was reported as: between 3 and 6 months (24%), between 6 and 12 months (21%), between 12 and 18 months (14.5%), between 18 and 24 months (8.5%), and over 24 months (32%). Mean age was 19.40 years (SD = 1.27); 88.36% of participants were Caucasian, 7.5% were African American, 2.1% were Asian, and 2.1% identified as other race. Students were awarded course credit in their Introduction to Psychology course for their participation. Partners who were not enrolled in Introduction to Psychology were entered into a raffle to win $50.

PROCEDURE

This study was conducted with the approval of the institution's internal review board and informed consent was obtained from both members of the couple. Both participants completed questionnaires in an initial session at a university laboratory. Following their completion of the questionnaires, at least one member of the dyad was given an actigraph—a small, wrist-watch like device—designed to obtain objective measures of sleep parameters. In the majority

of cases, female participants were chosen to wear the actigraph, as there were not enough actigraphs for both members of the dyad. However, some males were also provided with actigraphs (approximately 39% of the couples), when supplies permitted. Participants were asked to wear actigraphs on their nondominant wrist each night for 7 nights. Participants were given the URL of a secure server to record their feelings and behaviors each night for 7 days. Nightly emails were sent to each participant to remind them to complete the diaries and wear the actigraphs. Compliance for actigraphy was acceptable, according to Acebo (2005) criteria: A total of 488 days of actigraphy was provided by 89 participants (M = 5.48 days). Compliance for daily diaries was also acceptable: A total of 884 days of data were provided by 154 participants (M = 5.74), yielding a response rate of 82%.

MEASURES

Daily Perceived Rejection. Participants rated daily feelings of rejection from their romantic partner on a one-item measure: "today, how much has your partner made you feel rejected?" Participants were asked to respond using a scale from 0 (not at all) to 8 (very much).

Daily Hurt Feelings. Participants also rated daily hurt feelings caused by their partner on a one-item measure: "today, how much has your partner made you feel hurt?" Participants were asked to respond using a scale from 1 (not at all) to 8 (very much).

Daily Relationship Satisfaction. Participants completed a one-item measure assessing relationship satisfaction: "how satisfied are you, overall, with your relationship partner today?" Participants were asked to respond using a scale from 0 (not satisfied at all) to 8 (completely satisfied).

Daily Naps. On each daily diary, participants recorded how much time (in minutes) they napped each day.

Subjective Sleep Quality. Participants rated their subjective nightly sleep quality on a 10-point scale from 1 (very poor quality) to 10 (very high quality).

Objective Sleep Quality and Duration. Motionlogger Octagonal Basics with Light Sensor (Ambulatory Monitoring, Inc., Ardsely, NY) were used. Motion was monitored in continuous 1-minute epochs

using zero crossing mode. Data were analyzed with the Octagonal Motionlogger Interface using ACTme Software and Analysis Software Package (ActionW4). Epochs were scored as sleep or wake using the Sadeh algorithm (Sadeh, Acebo, Seifer, Aytur, & Carskadon, 1995). Sleep parameters included: (a) Sleep Onset Time (not used in analyses), scored as the first of 3 consecutive sleep minutes; (b) Morning Awakening Time (not used in analyses), scored as the last of 5 consecutively scored sleep minutes prior to a large period of activity; (c) Sleep Minutes: total minutes scored as sleep from Sleep Onset to Morning Awakening (higher values indicate longer sleep duration); (d) Sleep Efficiency: percent of minutes from Onset to Awakening that were scored as sleep. Sleep efficiency accounts for night wakings and tossing and turning during the night. Higher values indicate higher quality sleep.

Analyses

We used multilevel modeling to analyze our data (Nezlek, 2011). Models had three levels: within person, between person, and between couple. Our first hypothesis was that nights characterized by poor sleep would be followed by days with higher perceived rejection. Separate models were fit for the three measures of sleep problems (subjective sleep quality, objective sleep minutes, and objective sleep efficiency) as independent variables predicting perceived rejection each day. Our second hypothesis was that rejection would be associated with greater hurt feelings more strongly after a poor night's sleep. Separate models were again fit for the three different measures of sleep problems. Interactions were tested by including cross-products between the measure of sleep and the score for perceived rejection. All variables relevant to study hypotheses (sleep, rejection, and hurt feelings) were within-person (level 1) variables. All models controlled for daily relationship satisfaction (level 1), daily nap length (level 1), and participant gender (level 2). Daily predictors were group-mean centered (i.e., person-centered), thereby eliminating the influence of person-level differences on parameter estimates of mean daily partner rejection, sleep quality, relationship satisfaction, and nap length, respectively (Nezlek, 2011). Analyses were conducted using HLM Version 6.08 (Raudenbush, Bryk, & Congdon, 2000). Missing data were handled with full information maximum likelihood estimation.

TABLE 1. Grand Means and Standard Deviations of Study Variables

	μ	*SD*
Nap length (in minutes)	31.05	21.32
Relationship Satisfaction	7.04	.74
Subjective Sleep Quality	6.91	.93
Sleep Efficiency	88.87	3.78
Sleep Duration (in minutes)	367.34	30.77
Rejection	.42	.53
Hurt Feelings	.63	.58

RESULTS

Table 1 presents means and standard deviations of study variables. Table 2 provides model results for those models that tested interaction effects.

ASSOCIATIONS BETWEEN SLEEP AND PERCEPTIONS OF REJECTION

As expected, analyses revealed a significant association between subjective sleep quality and perceptions of rejection, $b = -0.06$, $t(73) = -3.08$, $p < .01$, such that on days following poor subjective quality sleep, individuals reported higher levels of rejection. Fewer sleep minutes was marginally associated with greater perceived rejection the next day: $b = -.001$, $t(73) = -1.95$, $p = .055$. Sleep efficiency was not significantly associated with perceived rejection.

SLEEP PARAMETERS AS MODERATORS OF THE ASSOCIATION BETWEEN DAILY PERCEIVED REJECTION AND HURT FEELINGS

As expected, analyses revealed a significant rejection × sleep quality interaction (model 1), along with significant rejection × sleep duration (model 2) and rejection × sleep efficiency (model 3) interactions. The first-order effect for partner rejection was significant in all models, such that on days when people reported more partner

TABLE 2. Model Results for Interactions Between Perceived Rejection and Sleep Parameters

	Model 1				Model 2				Model 3			
	B	***SE***	***T*-ratio**	***DF***	***B***	***SE***	***T*-ratio**	***DF***	***B***	***SE***	***T*-ratio**	***DF***
Intercept	.63	.08	8.31***	73	.64	.10	6.46***	73	.64	.10	6.86***	73
Nap Length	–.04	.08	–.46	73	–.06	.07	–.94	73	–.09	.11	–.79	73
Satisfaction	–.25	.06	–3.81***	73	–.24	.12	–2.08*	73	–.25	.10	–2.57*	73
Sleep	–.02	.02	–.88	73	.0002	.001	.31	73	.004	.006	.711	73
Rejection	.52	.09	5.99***	73	1.00	.10	9.95***	73	1.09	.10	12.61***	73
Male	–.13	.06	–2.12*	750	–.07	.09	–.74	386	–.06	.09	–.79	386
Rejection × Sleep	–.18	.06	–3.08**	750	–.16	.08	–1.96*	386	–.14	.07	–2.00*	144

Note. *$p < .05$; **$p < .01$; **$p < .001$

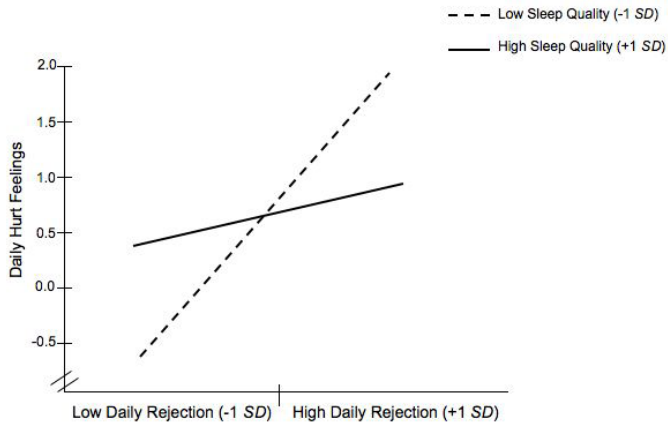

FIGURE 1. Sleep quality moderates the association between daily partner rejection and daily hurt feelings.

rejection, they also reported more hurt feelings. First order effects were not observed for any of the sleep measures.

We next probed the interactions by plotting the association between daily perceived rejection and hurt feelings on days after which there were relatively low (-1SD) or high (+1SD) values on the sleep measures (Aiken & West, 1991). On days after which participants experienced relatively poor sleep, partner rejection predicted increased daily hurt feelings, $b = 0.95$, $t = 7.98$, $p < .0001$. However, on days after which participants experienced relatively good quality sleep, the association between partner rejection and hurt feelings was not significant, $b = 0.15$, $t = 0.67$, $p = .50$. See Figure 1.

On days after which participants experienced relatively low sleep minutes, partner rejection was related to higher daily hurt feelings, $b = 18.80$, $t = 2.06$, $p = .04$. However, on days after which participants experienced relatively high sleep minutes, the association between partner rejection and hurt feelings was not significant, $b = -16.80$, $t = -1.85$, $p = .07$; see Figure 2.

On days after which participants experienced relatively low sleep efficiency, partner rejection was related to increased daily hurt feelings, $b = 2.32$, $t = 3.73$, $p = .0004$. However, on days after which participants experienced relatively high sleep efficiency, the association between partner rejection and hurt feelings was not significant, $b = -0.13$, $t = -0.22$, $p = .83$; see Figure 3.

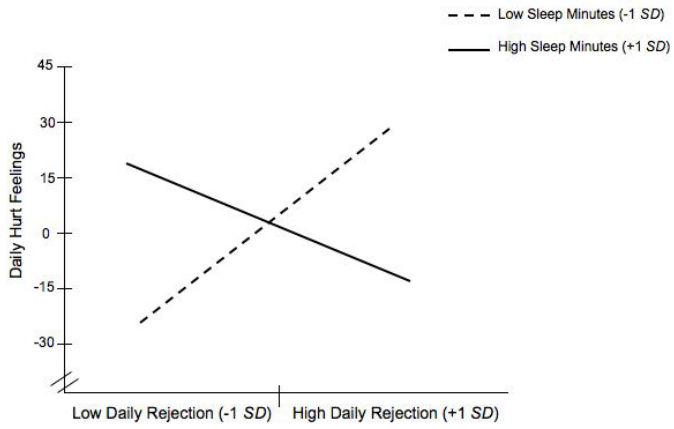

FIGURE 2. Sleep minutes moderate the association between daily partner rejection and daily hurt feelings.

DISCUSSION

The current study examined the role of sleep in the association between daily perceived rejection from romantic partners and hurt feelings. Findings are consistent with previous research demonstrating the association between interpersonal rejection and hurt feelings (Baumeister et al., 2007). As hypothesized, individuals were more likely to report greater rejection following nights of poorer sleep. Further, the association between perceived rejection and hurt feelings was significantly moderated by sleep quality and duration; perceived rejection was only associated with hurt feelings following nights of poor sleep.

Study findings demonstrate some of the first evidence that the sociometer may fluctuate in its sensitivity within individuals. Alterations in emotion regulation abilities may explain these fluctuations. Blackhart and colleagues suggest that a lack of hurt feelings following rejection may be evidence for the use of deliberate and automatic defense mechanisms (such as emotional inhibition) in response to rejection (Blackhart, Nelson, Knowles, & Baumeister, 2009). They argue that these defenses serve the adaptive purpose of ameliorating negative affect. The null association between perceived rejection and hurt feelings after a good night's sleep in the current study is consistent with this hypothesis. High quality sleep may provide

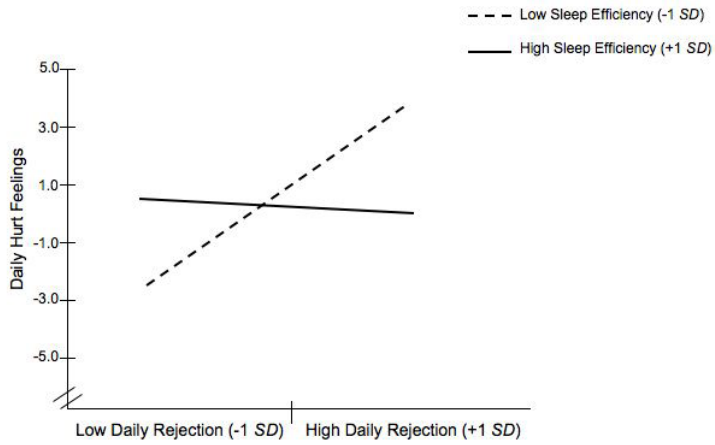

FIGURE 3. Sleep efficiency moderates the association between daily partner rejection and daily hurt feelings.

the cognitive and affective resources that an individual needs to engage these defense mechanisms and successfully down-regulate negative emotions. In contrast, poorer sleep quality prior to rejection would hinder emotion regulation, leading to heightened experiences of negative affect. Indeed, previous research demonstrates that individuals are less capable of controlling emotional impulses when faced with interpersonal stress, especially in the context of sleep deprivation (Keller, Blincoe, Gilbert, Haak, & DeWall, 2014). However, future research is needed to explicitly study the processes through which rejection leads to hurt feelings among individuals with poor sleep.

The correlational nature of the study precludes definitive claims of causality. However, the findings of the current study are largely consistent with previous experimental work, providing complimentary support for theories of the social pain of rejection and previous findings linking sleep with physical pain sensitivity (Lee et al., 2013; Schuh-Hofer et al., 2013). Results should also be considered in light of the sample used. The sample was predominately Caucasian and the majority of couples had been together for less than two years. All participants were also college students. As such, care should be taken about generalizing results to other populations.

Despite these limitations, the current study provides a valuable examination of day-to-day intra-individual changes in sensitivity to rejection in the context of romantic relationships. Study findings

demonstrate the merit in examining the risk and resiliency factors associated with intra-individual susceptibility to experiences of rejection. Findings also provide support for the role of sleep in adaptive emotional functioning.

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