The authors draw upon social, personality, and health psychology to propose and test a self-and-social-bonds model of health. The model contends that lower self-esteem predicts health problems and that poor-quality social bonds explain this association. In Study 1, lower self-esteem prospectively predicted reports of health problems 2 months later, and this association was explained by subjective reports of poor social bonds. Study 2 replicated the results of Study 1 but used a longitudinal design with 6 waves of data collection, assessed self-reports of concrete health-related behaviors (i.e., number of visits to the doctor and classes missed due to illness), and measured both subjective and objective indicators of quality of social bonds (i.e., interpersonal stress and number of friends). In addition, Study 2 showed that poor-quality social bonds predicted acute drops in self-esteem over time, which in turn predicted acute decreases in quality of social bonds and, consequently, acute increases in health problems. In both studies, alternative explanations to the model were tested.

**Keywords:** self-esteem, health, social realtionships

The distinction between mind and body is an artificial dichotomy, a discrimination which is unquestionably based far more on the peculiarity of intellectual understanding than on the nature of things.

—Carl Jung, *Modern Man in Search of a Soul*

Common illnesses such as allergies, migraines, asthma, and colds cost the U.S. economy an estimated $70 billion annually (see Fendrick, Monto, Nightengale, & Sarnes, 2003). To put this whopping sum into perspective, the cost of these common illnesses equals the gross domestic product of the state of Nebraska for 2005 and exceeds the economic contribution of an additional 14 states for that same year (U.S. Bureau of Economic Analysis, 2006). The common cold alone costs almost $40 billion annually, including $8 billion in largely unnecessary visits to the doctor and an additional $23 billion in missed workdays (Fendrick et al., 2003). Although the estimated economic cost of these common illnesses is staggeringly high, the cost is much higher if one includes hard-to-quantify personal costs to well-being such as physical discomfort, negative mood, lost productivity, and lost leisure time and socializing.

If one falls prey to the “peculiarity of intellectual understanding” described by Jung (1933, p. 74) in the quote that begins our article, one may assume that psychology cannot elucidate potential causes of, and solutions to, vulnerability to illness. However, in the present research, we proposed and tested a self-and-social-bonds model of health that demonstrates the inherent connection between mind and body. To foreshadow the arguments to come, we note that our integrative model combines findings from social, personality, and health psychology to propose that lower self-esteem is a psychological risk factor that leaves one vulnerable to health problems, whereas higher self-esteem is a psychological resource that supports good health. Moreover, we propose that the quality of one’s social bonds mediates the association between self-esteem...
and health: Social and personality psychology research has shown that self-esteem predicts the quality of one’s social bonds (e.g., Murray, Holmes, & Collins, 2006), and pioneering medical and health psychology research provides evidence that the quality of one’s social bonds is a major predictor of health outcomes (e.g., Cacioppo, Hawkley, & Bernston, 2003; Cohen, 2004).

The Hypothesis: Self-Esteem Predicts Health Outcomes

For better or worse, self-esteem is one of psychology’s greatest cross-over success stories. Not only has it spawned a research boom within the academic psychology community—more than 8,000 articles have been published on the topic since 1975—but self-esteem became a media darling in the early 1990s and is currently a mainstay of the self-help industry. Despite people’s apparent interest in the topic, basic psychology research thus far has failed to demonstrate convincingly that self-esteem predicts concrete life outcomes. In 2003, Baumeister, Campbell, Kreuger, and Vohs conducted a large-scale review of the self-esteem literature and concluded that although self-esteem predicts happiness, life satisfaction, and other highly subjective, and conceptually overlapping, indicators of well-being, feelings of self-worth are not strongly or reliably predictive of concrete life outcomes like academic or job success, popularity, the likelihood of marrying or having children, and the propensity to smoke, abuse drugs or alcohol, or commit crimes. Therefore, if we find that lower self-esteem is associated with increases in health problems over time, whereas higher self-esteem is associated with decreases in health problems, such a finding would demonstrate that self-esteem indeed predicts one of the most important concrete life outcomes of all, one’s general health.

Medical and health psychology research offers hints that self-esteem predicts health outcomes. The first hint is that people lower in self-esteem (LSEs) have an elevated cortisol response to stress compared with people higher in self-esteem (HSEs; e.g., Kirschbaum et al., 1995; Prüssner, Hellhammer, & Kirschbaum, 1998; Seeman et al., 1995). Because elevated cortisol levels can, over time, damage the endocrine system and lead to negative health outcomes (e.g., Uchino, Cacioppo, & Kiecolt-Glaser, 1996), this evidence suggests that LSEs will experience more health problems than HSEs. Another hint in the literature that supports our hypothesis is the finding that self-disclosure of negative events benefits the immune system (Pennebaker, Kiecolt-Glaser, & Glaser, 1988). Because LSEs are less likely than HSEs to express negative emotions (Gaucher, Wood, Stinson, Holmes, & Logel, 2007), LSEs may enjoy better health than LSEs. Furthermore, optimism, even unrealistically positive optimism, predicts increased longevity in HIV-positive men (Taylor, Kemeny, Reed, Bower, & Gruenwald, 2000), and LSEs are lower in optimism than HSEs (e.g., Scheier, Carver, & Bridges, 1994; Taylor & Brown, 1988), suggesting that LSEs may not fare well in the face of terminal illness. Finally, higher trait negative affectivity, or neuroticism, predicts a suppressed immune response to vaccination (Marsland, Cohen, Rabin, & Manuck, 2001) and heightened self-reports of health problems (Watson & Pennebaker, 1989). LSEs are higher in negative affectivity than HSEs (Watson, Suls, & Haig, 2002; Wood, Michela, & Giordano, 2000), suggesting that LSEs may have more negative health outcomes than HSEs. Finally, lower self-esteem predicts poor self-care in older adults (Smits & Kee, 1992) and poor self-care and health maintenance behavior in the years following a heart attack (Conn, Taylor, & Hayes, 1992), both of which suggest that LSEs will experience poorer health than HSEs. This indirect evidence supports our hypothesis that self-esteem predicts the incidence of health problems over time.

However, very few studies have examined directly the association between self-esteem and incidence of health problems, and we could not find any studies that proposed or examined mechanisms to explain the association between self-esteem and health outcomes. Results of past research suggest a negative correlation between concurrently assessed self-esteem and self-reported health problems (e.g., Antonucci & Jackson, 1983; Robins, Hendin, & Trzesniewski, 2001). A few impressive longitudinal studies of critically ill patients’ health outcomes also support our contention that lower self-esteem is a psychological risk factor for physical illness. Lower self-esteem predicted poor health outcomes in female cardiovascular patients (Fortzhofer, Janz, Dodge, & Clarke, 2001), and in men with existing signs of coronary heart disease, lower self-esteem predicted an increased likelihood of heart attack 10 years later (Nirkko, Lauroma, Siltanen, Tuominen, & Vanhala, 1982). In addition, O’Connor and Vallerand (1998) demonstrated that lower self-esteem prospectively predicted mortality for nursing-home patients. Given that the participants in these longitudinal studies were already ill at the start of the study period, it is difficult to infer causation from these studies. Nevertheless, these longitudinal studies support our hypothesis that self-esteem predicts health outcomes. However, in the present research, we take this hypothesis one step further to propose and test a mechanism to explain this association: We suggest that the relation between self-esteem and general health is explained by the quality of one’s social bonds.

The Mechanism: Quality of Social Bonds

Self-Esteem Predicts the Quality of One’s Social Bonds

Theorists have long argued that self-esteem is a fundamentally interpersonal construct (e.g., Ainsworth, 1989; Cooley, 1956; James, 1890). Recently, Leary and his colleagues proposed a sociometer model of self-esteem that sought to unify these arguments under a single theoretical umbrella (e.g., Leary & Baumeister, 2000; Leary, Tambor, Terdal, & Downs, 1995). Sociometer theory proposes that one’s feelings of self-worth are a barometer of one’s perceived past, present, and future value as a relational partner. HSEs feel that they were, are, and will be valued by others, whereas LSEs doubt their value as relational partners and project these doubts onto future relationships.

Chronic feelings of higher or lower self-esteem influence the quality of one’s social bonds because chronic feelings of self-worth influence one’s beliefs and social behaviors. For example, LSEs believe that they are less valuable interaction partners than do HSEs (e.g., Leary et al., 1995), have less confidence that their romantic partner loves them and regards them positively (Murray, Holmes, & Griffin, 2000), and anticipate less acceptance from novel interaction partners (Anthony, Wood, & Holmes, 2007).
Thus, it appears that LSEs’ chronically low sociometers cause them to be overly vigilant for, and reactive to, cues regarding their relational value (Murray, Holmes, & Collins, 2006). As a result, LSEs’ signature social motivation and behavior reflect a self-protective style aimed at limiting the hurt and embarrassment that could result from the rejection that they seem to anticipate (e.g., Anthony et al., 2007; Baumeister, Tice, & Hutton, 1989; Murray et al., 2006). In contrast, HSEs’ social confidence acts as a psychological insurance policy that allows them to adopt a risky, but rewarding, relationship-promoting interpersonal style aimed at fostering closeness with others.

Adopting a chronically self-protective interpersonal style has negative consequences for the subjective and objective quality of LSEs’ social bonds. In contrast, HSEs’ relationship-promoting interpersonal style promotes high-quality social bonds. LSEs’ social doubts cause them to miss out on new social opportunities because they are hesitant to seek new social relationships unless acceptance is virtually guaranteed, whereas HSEs eagerly seek new social opportunities, regardless of whether or not acceptance is assured (Anthony et al., 2007). Furthermore, LSEs are less satisfied with and committed to their relationships than HSEs, feel less close to their loved ones, and rate the general quality of their relationships more negatively (e.g., Murray et al., 2006). These doubts about their value cause LSEs to behave badly in their close relationships by derogating or acting distant from their loved ones when they are feeling insecure. Conversely, following a threat to their relationship security, HSEs actually engage in relationship-promoting behaviors that increase their loved ones’ regard. Although the differing reactions of LSEs and HSEs to relationship stressors have been observed in relationships with friends (DeHart, Pelham, & Murray, 2004), parents (DeHart, Murray, Pelham, & Rose, 2003), and romantic partners (e.g., Murray, Bellavia, Rose, & Griffin, 2003), the consequences of these behaviors have been studied primarily in romantic relationships: Over time, LSEs’ hostile and distancing behavior in response to insecurity causes LSEs’ romantic partner to feel less positively toward them in the short term (i.e., the day after the bad behavior; Murray, Bellavia, et al., 2003), and LSEs’ social doubts and bad behavior actually predict decreases in their romantic partner’s love and satisfaction in the longer term (i.e., 1 year later; Murray, Griffin, Rose, & Bellavia, 2003). LSEs are also more likely than HSEs to adopt a possessive and jealous approach to their romantic relationships (Hendrick, Hendrick, & Adler, 1988), which, when combined with alcohol, could result in domestic violence (MacDonald, Zanna, & Holmes, 2000). On the basis of this evidence, we hypothesized that self-esteem predicts the quality of one’s social bonds, such that LSEs have poorer quality social bonds than HSEs.

The Quality of One’s Social Bonds Predicts Health Outcomes

Medical and health psychology research shows that poor-quality social bonds are a significant risk factor for broad-based morbidity and mortality, with an age-adjusted relative risk ratio greater than that for smoking (for a review, see House, Landis, & Umberson, 1988). Health psychologists have identified three primary biological pathways by which poor-quality social bonds undermine health: Poor-quality social bonds undermine the cardiovascular system, the endocrine system, and the immune system (for reviews see Cacioppo et al., 2003; Cohen, 2004; Uchino et al., 1996). For example, investigators have shown that people with poor-quality social bonds exhibit an inhibited immune response to the flu vaccine (Pressman et al., 2005) and are more likely than people with high-quality social bonds to develop colds after being exposed to the cold virus in a controlled experimental setting (Cohen et al., 1998). In addition, people with poor-quality social bonds receive less adequate care from medical professionals than do people with high-quality social bonds, and individuals with poor-quality social bonds have less efficient and effective restorative sleep than people with high-quality social bonds, both of which undermine one’s health outcomes (Cacioppo et al., 2003).

Because the evidence demonstrates a strong link between poor-quality social bonds and negative health outcomes, psychologists have sought to understand the features that determine the quality of one’s social bonds. In their review of the literature, Uchino et al. (1996) concluded that the quality of one’s social bonds can be indexed by two broad classes of variables (see also Cohen, 2004). The quality of one’s social bonds can be indicated by structural, or objective, features of one’s social environment, such as the number of friends or siblings that one possesses and one’s depth of integration into one’s social network. The quality of one’s social bonds can also be indicated by functional, or subjective, aspects of one’s social environment, such as emotional support, instrumental support, and informational support. Although there is little agreement about how to define the functional aspects of social bonds, most current research incorporates subjective impressions of affection, caring, reassurance of worth, advice and guidance, proximity to caregivers, coping assistance, opportunities to nurture, and tangible assistance as functional characteristics that signify high-quality social bonds (Reis, Collins, & Berscheid, 2000).

The Self-and-Social-Bonds Model of Health

In the studies that we present in this article, we tested our self-and-social-bonds model of health, which is depicted in Figure 1. First, we expected that chronic self-esteem would be negatively associated with experiences of health problems (Path c), such that LSEs would experience more health problems than HSEs. Moreover, because chronic self-esteem predicts one’s interpersonal style (LSEs adopt a self-protective style that can undermine their relationships, whereas HSEs’ relationship-promoting style fosters high-quality social bonds), we expected that chronic self-esteem would be positively associated with the quality of one’s social bonds (Path a). In turn, we expected that quality of social bonds would be negatively associated with health problems (Path b), such that poor-quality social bonds would predict increased health problems, and quality of social bonds would explain the initially observed association between self-esteem and health outcomes. Social bonds may fully explain the association between self-esteem and health outcomes. Alternatively, it is possible that when the mediator is included in the model, some shared variance will remain between self-esteem and health outcomes due to noninterpersonal factors (e.g., LSEs’ elevated cortisol stress response).

The preceding predictions focused on the association between chronic self-esteem and quality of social bonds. However, a social psychological perspective suggests that outcomes are predicted not only by chronic or trait factors but also by state or situational factors. Thus, we also expected to find that acute increases or
decreases in self-esteem would predict acute decreases or increases in health problems and that acute changes in the quality of one’s social bonds would explain this association (Paths f–h). If one experiences acute drops in self-esteem due to poor quality social bonds, this would predict additional decreases in the quality of one’s social bonds (Path f). Acute drops in self-esteem would result in a greater motivation for one to avoid rejection in order to prevent additional hurt and additional drops in one’s already depleted sociometer. Consequently, whether one’s self-esteem was previously high or low, acute drops in self-esteem should lead to an increased reliance on self-protective (and relationship-damaging) interpersonal behaviors that will undermine the quality of one’s social bonds, which in turn will undermine one’s health (Path g). To our knowledge, although a few studies have examined previously the possibility that chronic levels of self-esteem predict health outcomes, we are the first to propose that acute changes in self-esteem predict acute changes in quality of social bonds and health outcomes.

But what types of situational factors predict acute drops in self-esteem? If self-esteem is a sociometer that indexes the quality of one’s social bonds, then experiencing poor-quality social relationships would predict acute drops in self-esteem (Path d). Indeed, experimental evidence suggests that specific experiences of acceptance and rejection lead to acute changes in state self-esteem (Leary et al., 1995), and we expected to observe a similar link in the longitudinal field studies that we present in this article. In contrast, we were somewhat equivocal about whether health problems would predict changes in self-esteem over time (Path e). Mild health problems are unlikely to affect one’s value as a relational partner, thus mild health problems are unlikely to predict changes in self-esteem. However, chronic or severe health problems may interfere with one’s social relationships, leading to social isolation and drops in one’s sociometer. Thus, depending on the severity and duration of one’s illness, health problems may or may not predict acute changes in self-esteem over time. In the present studies, we tested our model with samples of relatively young and healthy university students, and so we expected that the types of health problems that our participants would experience would be relatively mundane and thus unlikely to predict changes in self-esteem.

Overview of Studies

In this article, we will describe the results of two longitudinal studies that tested our self-and-social-bonds model of health. In Study 1, we tested Paths a–e in the proposed model with a longitudinal design consisting of two waves of data collection separated by a 2-month interval. This first study assessed functional aspects of the quality of participants’ social bonds (i.e., comfort with closeness, relational doubts, and relationship satisfaction) and used a self-report measure of health problems. Study 2 replicated and extended the results of Study 1 with a more ambitious longitudinal design. In this second study, we tested our proposed model in its entirety with a 10-week study period consisting of six waves of biweekly data collection. In addition, we examined both functional (i.e., interpersonal stress) and structural (i.e., number of friends) determinants of the quality of participants’ social bonds. In Study 2, we also used self-reports of relatively concrete health-related behaviors to index health problems (i.e., frequency of visits to the doctor and classes missed due to illness). Both studies tested alternatives to the proposed model. Taken together, the results of these two studies illustrate the cost of lower self-esteem for health outcomes.

Study 1

In Study 1, we sought preliminary evidence for our hypothesis that self-esteem predicts health problems by examining Paths a–e in the proposed self-and-social-bonds model of health.

Method

Participants and Design

Participants in the present study were first-year University of Waterloo students who were recruited to be part of the Research on Early Adult Life (REAL) project, a large-scale longitudinal study designed to examine multiple aspects of young adults’ lives. Data reported in the present study were collected during the initial recruitment phase of REAL and during the first two waves of Internet-based data collection, which began 6 months after the recruitment phase. A total of 180 participants (78% female, 22% male; 76% White, 14% Asian, 4% mixed race, 3% East Indian, 3% other; age , M = 18.75 years, SD =
0.64) completed the first wave of online data collection (Time 1). Between 10 and 15 weeks later, 135 of these participants (79% female, 21% male; 78% White, 12% Asian, 4% mixed race, 6% other; age, \( M = 18.73 \) years, \( SD = 0.66 \)) also completed the second wave of data collection (Time 2). This represents an attrition rate of 25% between Time 1 and Time 2. All participants in this study were born in Canada and indicated that English was their first language. In appreciation for their time, participants received partial course credit for participating in the initial recruitment phase of the study and had their names entered in a drawing for prizes each time they completed a wave of online data collection.

**Procedure**

At the initial recruitment phase of the study, participants completed a large number of personality and background information questionnaires. Of import to the present study, participants completed the 60-item NEO Five-Factor Personality Inventory (Costa & McCrae, 1992), which included items designed to assess neuroticism. Participants indicated their agreement with each item using a 4-point scale (from 0, strongly disagree, to 4, strongly agree).

At each wave of online data collection, participants completed a four-item version of Rosenberg’s Self-Esteem Scale (1965). This shortened self-esteem scale consisted of the items: “I feel I am a person of worth, at least on an equal basis with others,” “I feel that I have a number of good qualities,” “I certainly feel useless at times,” and “At times, I think I am no good at all.” The latter two items are reverse coded prior to calculation of a global self-esteem score. Participants indicated their agreement with each of these statements using a 7-point response format (from 1, strongly disagree, to 7, strongly agree), which was expanded from Rosenberg’s original 4-point response format to capture greater variability in participants’ self-esteem scores.

Each wave of online data collection also assessed participants’ ratings of the quality of their social bonds. In the present study, we assessed the functional quality of participants’ social bonds by measuring participants’ comfort in being close to their family and friends (two items: “I am comfortable being close to my friends,” and “I am comfortable depending on my family”), their relational doubts about family and friends (two items: “I wonder whether my friends really care for me,” and “I worry that my family members don’t love me,” both reverse coded prior to calculating a total score), and their relationship satisfaction (two items: “In general, I am satisfied with my relationship with my parents,” “In general, I am satisfied with my friendships.”). Participants indicated their agreement with all six statements using a 7-point scale (from 1, strongly disagree, to 7, strongly agree). Finally, we assessed health problems at each wave of online data collection with a single dichotomous item that asked participants whether or not they had experienced health problems in the preceding 2 months.

**Results and Discussion**

**Testing the Self-and-Social-Bonds Model of Health**

Preliminary analyses indicated that the participants who completed both waves of online data collection did not differ from people who completed only the first wave of data collection in terms of self-esteem, quality of social bonds, probability of reporting health outcomes, gender, and ethnicity. Additional analyses indicated that gender and ethnicity did not moderate any of the findings that we report, so these variables were not included in the analyses that follow.

First, we computed self-esteem scores for Time 1 and Time 2. Negative items tapping self-esteem were reverse scored, and then all four items were averaged to create a reliable self-esteem score for each participant at each wave of data collection (\( \alpha = .75, M = 5.28, SD = 1.19 \) at Time 1; \( \alpha = .76, M = 5.34, SD = 1.22 \) at Time 2). Next we computed the quality of participants’ social bonds at Time 1 and Time 2. We reverse scored the negative items that we used to assess this construct and then averaged all six items at each wave of data collection to create two reliable indices of relational quality (\( \alpha = .71, M = 4.78, SD = 0.92 \) at Time 1; \( \alpha = .73, M = 4.71, SD = 0.96 \) at Time 2).

In the analyses that follow, we examine the hypothesized associations among chronic self-esteem, quality of social bonds, and health problems, and we also examine whether quality of social bonds predicts acute changes in self-esteem over time. These associations are represented in Paths a–e in Figure 1. We used Preacher and Hayes’ (2004, 2005) bootstrapping techniques to estimate the indirect effects in our proposed model (i.e., the product of Paths a and b, ab, in Figure 1). This technique is a statistically rigorous method for testing mediation hypotheses, and it does not assume that the sampling distribution of the indirect effect is normal, as do many other common statistical tests of mediation (e.g., Sobel’s test; Sobel, 1982). This assumption, which is often violated, results in an overly strict significance test for most samples. Bootstrapping works by generating a very large number of samples of size \( n \) (where \( n \) is the original sample size) from the data, sampling with replacement, and computing the indirect effect, ab, in each sample” (Preacher & Hayes, 2004, p. 722). Based on the results of these resamples, Preacher and Hayes’ technique provides a confidence interval (CI) for the strength of the indirect effect, and one may specify the CI level for a given test. If one specifies a 95% CI, and if the upper and lower limits of the CI do not include zero, one may conclude that the indirect effect is significantly different from zero at \( p < .05 \). In contrast, if one must specify a 90% CI to obtain upper and lower limits that do not include zero, the significance level of the indirect effect is only \( p < .10 \). In all of the mediation analyses that we report in this article, we specified 1,000 bootstrap resamples.

The results of the regression analyses that follow are depicted in Figure 2. To test our model, we controlled Time 1 relational quality and health problems in each regression analysis. Thus, our analyses controlled for preexisting associations among chronic self-esteem, relational quality, and health problems at Time 1. This technique also meant that the mediator and criterion variables in the analyses represented changes in relational quality and health problems from Time 1 to Time 2.

*Does chronic self-esteem prospectively predict health problems?* Our first step was to test whether self-esteem at Time 1 predicted changes in health problems from Time 1 to Time 2 in regression (Path c in the proposed model, in absence of the mediator variable). As predicted, lower self-esteem at Time 1 was

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2 We did not include romantic relationship quality in our index of quality of participants’ social bonds because only half the sample was in a romantic relationship.
associated with increases in the likelihood of reporting health problems at Time 2 (0 = no, 1 = yes; 29% said “yes”), $\beta = -0.27$, $t(134) = -3.38$, $p = .001$.\(^3\)

**Does quality of social bonds explain the association between chronic self-esteem and health problems?** We entered self-esteem at Time 1 into regression to predict relational quality, and results indicated that self-esteem predicted acute changes in relational quality from Time 1 to Time 2 (Path a in the proposed model), $\beta = 0.34$, $t(134) = 5.28$, $p < .001$, such that lower self-esteem predicted decreases in relational quality. Next, we entered self-esteem at Time 1 and relational quality at Time 2 simultaneously into regression to predict health problems at Time 2. When relational quality was included in the regression, self-esteem at Time 1 was no longer a significant predictor of changes in health problems between Times 1 and 2, $\beta = -0.13$, $t(134) = -1.46$, $p = .147$. Also, as hypothesized, decreases in relational quality from Time 1 to Time 2 predicted increases in health problems from Time 1 to Time 2 (Path b), $\beta = -0.37$, $t(134) = -3.35$, $p < .001$, and this indirect effect was statistically significant, CI = -0.12 to -0.02, $p < .05$.\(^4\)

**Does quality of social bonds predict acute changes in self-esteem?** To examine Paths d and e in the proposed model, we entered self-esteem at Time 1 and relational quality and health problems at Time 2 simultaneously into regression to predict self-esteem at Time 2. As predicted, health problems at Time 2 were unrelated to changes in self-esteem from Time 1 to Time 2, $\beta = 0.01$, ns, but acute changes in relational quality at Time 2 were related to acute changes in self-esteem from Time 1 to Time 2, $\beta = 0.31$, $t(134) = 3.87$, $p < .001$, such that drops in relational quality predicted acute drops in self-esteem.

**Testing Alternatives to the Proposed Model**

Next we examined two plausible alternative explanations for the associations among variables that were described in the preceding section of these results.

**Does neuroticism explain our results?** Neuroticism, or high trait negative affectivity, predicts heightened reports of health problems (e.g., Watson & Pennebaker, 1989). Moreover, neuroticism is negatively related to self-esteem (e.g., Heimpe1, Elliot, & Wood, 2006; Watson et al., 2002; Wood et al., 2000). Thus, in the present study, it is important to test whether our results are maintained when neuroticism is controlled. Although it was assessed 6 months prior to Time 1, neuroticism ($M = 1.84$, $SD = 0.71$) strongly predicted Time 1 self-esteem, $r = -0.57$, $p < .001$, and was moderately predictive of relational quality at Time 2, $r = -0.36$, $p < .001$. Despite these associations, controlling for neuroticism in the analyses described previously did not alter the magnitude of the path coefficients depicted in Figure 2.\(^5\) Moreover, when neuroticism was controlled in the mediation analysis, \(^3\)This result is the same using logistic regression, $b = -0.56$, $\chi^2(1, N = 135) = 9.02$, $p = .003$. Although it is appropriate to use logistic regression when analyzing data with a binary dependent variable (as is the case in the present study with the health problems dependent variable), we have reported the results of linear regression in the text and figures of this study. We made this choice because the regression weights resulting from linear regression are more intuitively understandable, and we sought to keep the meaning of the regression weights consistent throughout the entire set of mediation analyses, in which continuous predictor and mediator variables were used. However, we report the results of logistic regression in footnotes whenever we conduct analyses in which the “yes/no” health problems measure is the criterion variable.

\(^4\)In this bootstrapping analysis, Time 1 health problems and Time 1 relational quality were controlled. The results were also the same when logistic regression was used: Decreases in relational quality at Time 2 were associated with increases in the probability of reporting health problems, $b = -1.05$, $\chi^2(1, N = 135) = 8.73$, $p = .003$, and the direct path from self-esteem at Time 1 to health problems at Time 2 was no longer statistically significant, $b = -0.32$, $\chi^2(1, N = 135) = 2.13$, $p = .145$.

\(^5\)Controlling neuroticism in the logistic regressions did not alter the results described in Footnotes 3 and 4.
acute changes in relational quality still explained the association between self-esteem at Time 1 and changes in health problems at Time 2, CI = −.10 to −.03, p < .05 (for an explanation of how to include covariates in bootstrapping analyses, see Preacher & Hayes, 2005).

Does chronic self-esteem predict quality of social bonds, explained by health problems? Because relational quality and health problems were assessed concurrently in this study, it is important to examine the possibility that health problems explain the association between self-esteem and relational quality (i.e., self-esteem → health problems → relational quality). Although we believe that it is less plausible than our proposed model, it is possible that being sick causes one to feel socially isolated and thus to perceive one’s social bonds negatively. We have already described results indicating that lower self-esteem at Time 1 directly predicts both decreases in relational quality and increases in health problems at Time 2. When we entered self-esteem at Time 1 and health problems at Time 2 into regression simultaneously to predict relational quality at Time 2, increases in health problems predicted decreases in relational quality, $\beta = -.21, t(134) = -3.35, p = .001$, and this indirect path was significant, CI = −.10 to −.01, $p < .05$. However, the direct path from self-esteem at Time 1 to changes in relational quality at Time 2 remained strong and significant in this alternative model, $\beta = .28, t(134) = 4.44, p < .001$. In contrast, recall that the direct association between self-esteem at Time 1 and changes in health problems at Time 2 was reduced dramatically when relational quality was included as the mediator variable (see Figure 2). This suggests that our proposed mediation model—wherein quality of social bonds explains the association between self-esteem and health—may be a better fit for the data than the presently tested alternative mediation model. Because the design of Study 2 may offer a better test of this alternative model, we return to this issue in Study 2.

Limitations of the Current Study

The results of this longitudinal study support our proposal that self-esteem predicts health problems because of its association with the quality of social bonds, yet there are limitations in the current study that need to be addressed. First, our use of a very subjective indicator of health problems limits the conclusions that we can draw from these results. Are LSEs really ill, or are they just more likely to report health problems than HSEs? Research does support the validity of self-reports of health problems. Idler and Benyamini’s (1997) review of 27 studies found that self-reported health was significantly associated with objective health and mortality. However, it is important to replicate the findings of the present study using more concrete indicators of health problems. Second, in the present study, our measure of the functional quality of social bonds (i.e., comfort with closeness, relational doubts, and satisfaction) was, by definition, very subjective. Although controlling for self-esteem in our analysis of relational quality and health outcomes likely removed some of the important personality variance in perceptions of relational quality, one could still argue that other personality traits influence perceptions of relational quality and thus explain our findings. More persuasive evidence for our proposed model would be found if more objective, structural indicators of the quality of one’s social bonds also mediated the association between self-esteem and health problems. Finally, because the present study had only two waves of data collection, we could not test whether acute drops in self-esteem predict additional increases in health problems over time (i.e., Paths f–h in the proposed model). Study 2 was designed to address each of these limitations.

Study 2

In Study 2, we attempted to replicate and extend the findings from Study 1 and to address the limitations of Study 1 with a more ambitious longitudinal design.

Method

Participants and Study Design

Participants were first-year undergraduate students at the University of Waterloo who completed six biweekly surveys over the course of the first 10 weeks of their first semester at university. We chose to test our model on this particular sample of participants because first-year university students are experiencing a fairly stressful transition period in their lives, and thus such participants may experience heightened variability in self-esteem, quality of social bonds, and health problems. As at the start of the study period (Week 0), introductory psychology students completed a mass-testing questionnaire that included surveys relevant to the present study. Individuals who completed mass testing and identified themselves as first-year students living in one of the on-campus residences were invited to participate in the study by completing five additional online surveys, one every 2 weeks, for the rest of the semester. Two hundred and three participants (70% female, 30% male; 66% White, 17% Asian, 7% East Indian, 3% Middle Eastern, 7% other) who completed mass testing also agreed to participate in the online portions of the study. There was a very small degree of attrition over the course of the study period, with a 93% retention rate by the end of the semester (n = 199 at Week 2, n = 194 at Week 4, n = 193 at Week 6, n = 195 at Week 8, and n = 186 at Week 10). In appreciation for their time, participants received partial credit for their introductory psychology course.

Procedure and Materials

At Week 0 of the study period, participants completed Rosenberg’s Self-Esteem Scale (1965). Participants indicated their agreement with each of the 10 statements in Rosenberg’s scale using a 9-point response format (from 1, strongly disagree, to 9, strongly agree). At this time, participants also reported their gender and ethnicity. During Weeks 2–10 of the study period, participants were e-mailed an invitation to complete each of the five biweekly online surveys. To ensure confidentiality, participants were given a study identification number and password with which to access the online survey. To increase participants’ motivation to complete the online surveys in a timely manner, we informed participants that when they completed their survey, they could go to the staff desk at their student residence immediately to collect a chocolate bar in appreciation for their time.

The five biweekly online surveys were identical. In each survey, participants reported their self-esteem using Rosenberg’s (1965) Self-Esteem Scale, with the same 9-point response format described earlier, and reported their frequency of health problems in the previous 2 weeks by answering the questions, “How many...
times did you visit Health Services or another health care professional?” and “How many classes did you miss because you were not feeling well?” Each question used an 11-point response format (from 0, zero, to 10, 10 or more times).

We measured the functional aspects of participants’ social bonds by assessing the amount of stress that participants experienced from their interpersonal relationships with family, close friends, other students, romantic partner, and potential romantic or dating partners. Participants indicated the amount of stress they had experienced from each relationship during the previous 2 weeks using a 4-point scale (from 0, not a source of stress, to 3, severe source of stress). Participants also reported structural aspects of their social bonds by reporting the total number of friends that they had at university (from 0, zero, to 10, 10 or more) and the total number of friends they had outside university (from 0, zero, to 10, 10 or more).

In addition to assessing the preceding variables, we assessed participants’ noninterpersonal stress by asking participants to rate the amount of stress they had experienced from class workload and job workload during the previous 2 weeks, each using a 4-point scale (from 0, not a source of stress, to 3, severe source of stress). Participants also rated their ability to cope with each of the sources of stress that we assessed, both interpersonal and noninterpersonal, by indicating their agreement with the statement “I can handle the stress from [source],” using a 6-point scale (from 1, strongly disagree, to 6, strongly agree).6

Results and Discussion

Overview of Data-Analytic Strategy

In the present study, we used structural equation modeling (SEM) to test our hypotheses.7 Although our predictions could be tested using regression—and the results we will describe shortly are indeed similar to those obtained when using regression—SEM is a preferable data-analytic technique for several reasons. First, SEM allows us to include error terms for the variables that are modeled, and these error terms can be correlated with one another (indicating shared error variance between variables, such as method variance or perceptual bias), hence allowing for more precise estimates of path coefficients. In the results that follow, all variables were modeled with error terms, and unless otherwise specified, these error terms were uncorrelated with one another. Another benefit of SEM is that it offers options for dealing with missing data. One option is to exclude all participants who are missing even a single data point. A second option is to instruct the statistical program to use the full information maximum likelihood (FIML) method for estimating means, a technique that uses all available data without excluding participants and thus does not compromise statistical power (Arbuckle & Wothke, 1999). The FIML method has been rigorously tested and proven to be an accurate and reliable technique for dealing with missing data; hence we opted to use the FIML method in the analyses that follow.

A third benefit of SEM is that it allows us to test the fit of our model and thus allows us to determine which paths between variables are essential to creating a model that adequately explains the associations between variables and which paths are not essential. A model that fits the data well will have a nonsignificant chi-square statistic (which indicates a nonsignificant amount of variance left unexplained by the model), a comparative fit index (CFI) greater than 0.90, and a root-mean-square error of the approximation (RMSEA) less than 0.08. As a final caveat, we note that in the figures illustrating results, if a path between two variables is not depicted, the reader may assume two things: (a) the missing path was not statistically significant, and (b) excluding the path from the model did not adversely affect the fit of the model.

As in Study 1, we used Preacher and Hayes’ (2004, 2005) bootstrapping techniques for estimating the strength and significance levels of the indirect paths in our model (i.e., the product of Paths a and b and the product of Paths f and g in Figure 1). In each of the mediation tests that follow, we specified 1,000 bootstrap resamples.

Testing the Self-and-Social-Bonds Model of Health

Gender and ethnicity did not moderate any of the findings that we report, so these variables are not included in the results that follow.

Because the present study had six waves of data collection, we were able to test all of the hypotheses represented in the proposed model that is depicted in Figure 1. First we calculated self-esteem scores for each participant at Week 0 and Week 6 by reverse coding the negative items included in Rosenberg’s (1965) scale and then averaging all 10 items (αs = .94 and .93, respectively). We then entered self-esteem at Week 0 (M = 6.49, SD = 1.45) into regression to predict self-esteem at Week 6 (M = 6.64, SD = 1.72) and saved the unstandardized residual. This residual score represented change in self-esteem from Week 0 to Week 6 of the study period.

Our sample consisted of relatively young and healthy participants. Hence, self-reports of the health-related behaviors that we assessed in the present study (i.e., visits to the doctor and classes missed due to illness) were relatively infrequent and invariant at any single wave of data collection. Therefore, we summed visits to the doctor and classes missed due to illness at Weeks 2 and 4 to obtain a more reliable index of health problems during the first month of the semester (M = 2.99, SD = 3.84). We also summed visits to the doctor and classes missed due to illness at Weeks 8 and 10 (M = 3.27, SD = 4.26) and then residualized health problems at Weeks 8–10 on health problems at Weeks 2–4 to create an unstandardized residual score that represented

6 The online surveys also included some additional items assessing variables that are not relevant to the current study but are reported in detail elsewhere (see Logel, Spencer, Wood, Holmes, & Zanna, 2007).

7 We did not use SEM in Study 1 because AMOS, the most common statistical program used for SEM, which we also use, does not handle dichotomous dependent variables very well.

8 Note that the health problems variables were both positively skewed with modal responses of zero, which explains why the standard deviations of these variables were larger than their respective means. Data with skewed distributions can be log-transformed prior to analysis, which “pulls in” the tails of the distribution. For ease of presentation, we have opted to present the results of analyses conducted on the untransformed health problems variables. However, the results were the same when we used the log-transformed health problems variables. Most notably, the magnitude and significance level of the path coefficients depicted in Figure 3 were similar whether we used the untransformed or log-transformed health problems variables, and the fit of the model using the log-transformed health problems dependent variable was also excellent, χ²(12, N = 203) = 18.65, p = .097, CFI = 0.93, RMSEA = 0.052.
change in health problems from Weeks 2–4 to Weeks 8–10 of the study period.9

Next we created two indices of interpersonal stress that represented functional quality of social bonds at Weeks 2–4 and Weeks 8–10. We summed the amount of interpersonal stress that participants experienced from their relationships with friends, parents, roommates, romantic partner, and potential dating/romantic partners during Weeks 2–4 (M = 7.87, SD = 4.40) and Weeks 8–10 (M = 6.64, SD = 4.92). As we did with self-esteem and health problems, we residualized interpersonal stress at Weeks 8–10 on interpersonal stress at Weeks 2–4 to create an unstandardized residual score that represented change in interpersonal stress between Weeks 2–4 and Weeks 8–10.

To create an index of the structural quality of participants' social bonds, we summed the number of friends that participants reported at university and away from university at Weeks 2 and 4, and then averaged these estimates to create a number of friends index for Weeks 2–4 (M = 16.57, SD = 4.04).10 We did the same for reports of number of friends at Weeks 8 and 10 to create a number of friends index for Weeks 8–10 (M = 16.49, SD = 4.59). We then residualized number of friends at Weeks 8–10 on number of friends at Weeks 2–4 to create a change score from Weeks 2–4 to Weeks 8–10.

Number of friends was negatively correlated with interpersonal stress at Weeks 2–4, r = −.19, p = .008, and at Weeks 8–10, r = −.21, p = .002, and these modest correlations were even smaller when self-esteem was controlled, r = −.12, p = .082, and r = −.04, ns, respectively. Therefore, in the analyses that we describe, we treated number of friends (i.e., structural quality of social bonds) and interpersonal stress (i.e., functional quality of social bonds) as unique indicators of the quality of participants' social bonds.

The model that we tested in SEM using the aforementioned variables and the results of the analysis are depicted in Figure 3. The fit of this model was excellent: χ²(12, N = 203) = 17.30, p = .139, CFI = 0.953, RMSEA = 0.047. In addition to the paths depicted in the model, we specified that interpersonal stress and number of friends at Weeks 2–4 had correlated errors, and we specified that change in interpersonal stress and change in number of friends at Weeks 8–10 had correlated errors.

The model depicted in Figure 3 is not strictly identical to the proposed model depicted in Figure 1. Conceptually, however, the two models are identical. The conceptual model proposed in Figure 1 represents quality of social bonds as a single variable, whereas the model depicted in Figure 3 includes two unique indicators of the quality of participants' social bonds—functional (i.e., interpersonal stress) and structural (i.e., number of friends) aspects—as dual mediators of the association between self-esteem and health problems. In the following sections of these results, we provide a step-by-step interpretation of the model, including a discussion of how these results speak to each of the specific hypotheses that we sought to test.

Does chronic self-esteem prospectively predict health problems? The first hypothesis that we may address by examining Figure 3 is whether chronic self-esteem at the start of the semester predicted health problems during the first month of the study period. Results indeed indicated that when the mediator variables were not included in the analysis, lower self-esteem at Week 0 prospectively predicted increased incidence of health problems during the first month of the study period, β = −.15, z = −2.16, p = .030. Hence, these results replicate those obtained in Study 1, but this time the result was obtained using self-reports of relatively concrete health-related behaviors as the dependent variable: frequency of doctor visits and classes missed due to illness.

Does quality of social bonds explain the association between chronic self-esteem and health problems? As in Study 1, lower self-esteem at Week 0 predicted poor functional quality of social bonds, as indicated in the present study by higher levels of interpersonal stress at Weeks 2–4, β = −.37, z = −5.56, p < .001. But in the present study, lower self-esteem also predicted poor structural quality of social bonds: LSEs reported fewer friends than HSEs at Weeks 2–4, β = .20, z = 2.88, p = .004. In addition, higher levels of interpersonal stress at Weeks 2–4 predicted increased incidence of health problems at Weeks 2–4, β = .21, z = 2.89, p = .001, whereas having fewer friends was marginally related to health problems at Weeks 2–4, β = −.11, z = −1.64, p = .102. Mediation analyses indicated that interpersonal stress explained the association between self-esteem and health problems, CI = −.63 to −.01, p < .01, whereas number of friends did not explain a significant amount of the shared variance between health problems and self-esteem, CI = −.24 to .01, p > .05.11 Additional analyses using regression indicated that self-esteem did not interact with either interpersonal stress or number of friends to predict health problems.

Does quality of social bonds predict acute changes in self-esteem? Next we examined whether interpersonal stress and number of friends at Weeks 2–4 predicted changes in self-esteem from Week 0 to Week 6 of the study period. Replicating the finding of Study 1, health problems at Weeks 2–4 did not predict changes in self-esteem between Week 0 and Week 6, β = −.06, z < 1.00. However, interpersonal stress at Weeks 2–4 did predict changes in self-esteem at Week 6, β = −.26, z = −3.71, p < .001, such that people who experienced higher levels of interpersonal stress at Weeks 2–4 experienced decreases in self-esteem at Week 6. Number of friends also predicted changes in self-esteem at Week 6, β = .18, z = 2.64, p = .008, such that people who reported fewer friends in the first month of the semester experienced drops in self-esteem at Week 6 of the study period. These results are particularly impressive given that there was a high level of stability in self-esteem from Week 0 to Week 6, r = .75, p < .001. Follow-up analyses indicated that self-esteem at Week 0 did not interact with either interpersonal stress, number of friends, or health problems to predict changes in self-esteem at Week 6. There-

9 Results were similar when we tested the following hypotheses for doctor visits and classes missed due to illness separately, but we think that summing these two variables resulted in a better index of health problems because it assessed two common, but possibly opposite, techniques for dealing with health problems: actively going to a doctor versus passively staying home in bed.

10 The number of friends variables were negatively skewed with a modal response of 20, which is the upper limit of the scale. As with the health problems variable, we have opted to report the results of analyses using the untransformed number of friends variables. However, as with the health problems variables, the results were not significantly different when we used the log-transformed number of friends variables.

11 To obtain a CI that did not include zero for the indirect path from self-esteem at Week 0 to health problems at Weeks 2–4 through number of friends at Weeks 2–4, it was necessary to set the level of confidence to 99%, CI = −.21 to −.0003, suggesting that the significance level of this indirect path is p < .11.
fore, the results of the present study replicated and extended those of Study 1 by demonstrating that both the functional and structural quality of social bonds explained acute changes in self-esteem and health problems at Weeks 2–4 and whether acute changes in functional and structural quality of social bonds explained acute changes in self-esteem and health problems at Weeks 8–10 in Study 2. The fit of this model was excellent: χ²(12, N = 203) = 17.30, p = .139, CFI = 0.953, RMSEA = 0.047. Numbers in parentheses represent the unmediated path coefficients between self-esteem at Weeks 0 and 6 and health problems at Weeks 2–4 and 8–10. The dashed path from health problems at Weeks 2–4 to interpersonal stress at Weeks 8–10 was unpredicted but necessary to obtain adequate fit for this model. *p < .10. **p < .05. ***p < .01.

Do acute changes in self-esteem predict acute changes in health problems, explained by acute changes in quality of social bonds? The results that we have described thus far suggest that chronically lower self-esteem predicts higher incidence of health problems. Next, we examined whether acute drops in self-esteem at Week 6 of the study period predicted acute increases in health problems at Weeks 8–10 of the study period. We also examined whether acute increases in interpersonal stress and acute decreases in number of friends explained the association between changes in self-esteem and changes in health problems at Weeks 8–10.

When the mediators at Weeks 8–10 were not included in the model, acute drops in self-esteem at Week 6 predicted acute increases in interpersonal stress at Weeks 8–10, β = −.24, z = −3.45, p < .001, which in turn predicted acute increases in health problems at Weeks 8–10, β = .17, z = 2.51, p = .012. Mediation analysis indicated that acute increases in interpersonal stress explained part of the association between acute drops in self-esteem and acute increases in health problems, CI = −.28 to −.02, p < .05. Moreover, acute drops in self-esteem at Week 6 predicted drops in the number of friends that participants reported at Weeks 8–10, β = .18, z = 2.57, p = .010, which in turn predicted acute increases in health problems at Weeks 8–10, β = −.16, z = −2.37, p = .018. In this case, acute drops in number of friends explained part of the association between acute drops in self-esteem and acute increases in health problems, CI = −.25 to −.01, p < .05. These results offer a conceptual replication of our earlier findings that chronic lower self-esteem predicts chronic poor-quality social bonds, which in turn predict chronic health problems (i.e., Paths a–c in the proposed model). In the present analyses, we controlled for chronic levels of self-esteem, quality of social bonds, and health problems by removing from each variable shared variance with previous assessments of each variable at Week 0 (in the case of self-esteem) or Weeks 2–4 (in the case of social bonds and health problems). Hence, in the present findings, we used a situational approach to test our self-and-social-bonds model of health: Situational drops in self-esteem predicted situational drops in quality of social bonds and situational increases in health problems.
Testing Alternatives to the Proposed Model

Do acute changes in self-esteem predict acute changes in quality of social bonds, explained by acute changes in health problems? Once again, we examined the possibility that health problems explain the association between self-esteem and relational quality (i.e., self-esteem → health problems → relational quality). First, we re-modeled Figure 3 so that health problems at Weeks 2–4 mediated the association between self-esteem and interpersonal stress and number of friends at Weeks 2–4 and so that acute changes in health problems at Weeks 8–10 mediated the association between acute changes in self-esteem at Week 6 and acute changes in interpersonal stress and number of friends at Weeks 8–10. Because the same variables were modeled in the proposed model and in this alternative model, and because health problems and relational quality were assessed concurrently, it is not surprising that the fit of this alternative model was similar to the fit of our proposed model, χ²(12, N = 203) = 17.89, p = .119, CFI = 0.948, RMSEA = 0.049.

However, mediation analysis indicated that health problems at Weeks 2–4 did not explain the association between self-esteem at Week 0 and interpersonal stress or number of friends at Weeks 2–4, CI = −0.29 to 0.01, p > 0.05, and CI = −0.03 to 0.12, p > 0.05, respectively. At the end of the semester, changes in health problems at Weeks 8–10 did explain the association between changes in self-esteem at Week 6 and changes in interpersonal stress and changes in number of friends at Weeks 8–10, CI = −0.25 to −0.03, p < 0.05, and CI = 0.02 to 0.22, p < 0.05. These results suggest that our proposed model may be a better fit for the data at the start of the semester, but we cannot currently rule out this alternative model as an explanation of changes in self-esteem, health problems, and quality of social bonds at the end of the semester. We will consider this alternative model further when we discuss limitations to our studies in the General Discussion of this article.

Does noninterpersonal stress predict health problems and self-esteem? In the present study, we indexed the functional quality of social bonds by participants’ level of interpersonal stress (i.e.,

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12 This alternative model could not explain the associations between variables in Study 1 either. Relational quality at Time 1 was unrelated to changes in health problems at Time 2, β = −0.06, t < 1. Relational quality at Time 1 prospectively predicted changes in self-esteem, β = 0.15, t(154) = 2.37, p = 0.02, which in turn predicted changes in health problems, β = −0.15, z = −2.10, p = 0.036, but the indirect path was not statistically significant, CI = −0.01 to 0.14, p > 0.05. Hence, this alternative model was not supported by the data.
stress from relationships with parents, friends, romantic partner, and roommates). Results showed that interpersonal stress explained the association between self-esteem and health problems, but it is possible that interpersonal stress explained that association because interpersonal stress is a measure of general stress, not because it taps into quality of social bonds specifically. Lower self-esteem may predispose people to experience stress in all aspects of their lives, not just in their interpersonal relationships as our sociometer perspective suggests, and this general stress could be associated with poor health (see Uchino et al., 1996). To test this alternative hypothesis, we first summed the amount of stress that participants experienced based on their school and job workloads at Weeks 2 and 4 to create an index of noninterpersonal stress ($M = 5.07$, $SD = 1.07$). Participants’ reports of interpersonal and noninterpersonal stress were indeed correlated with one another, $r = .24, p < .001$. Next we used SEM to model Paths a–e in the proposed model, but expanded the model to include noninterpersonal stress as a competing mediator of the association between self-esteem at Week 0 and health problems at Weeks 2–4 and as a competing mediator of changes in self-esteem from Week 0 to Week 6. This model and the results of the analysis are depicted in Figure 5. We specified that interpersonal and noninterpersonal stress had correlated error terms. The fit of this model was poor, $\chi^2(1, N = 203) = 3.90, p = .048$, CFI = 0.961, RMSEA = 0.120, suggesting that the modeled associations between variables did not adequately explain variance in the data.

Results indicated that self-esteem at Week 0 was weakly associated with noninterpersonal stress at Weeks 2–4, $\beta = -.13$, $z = -1.79$, $p = .073$. Even though shared variance between interpersonal and noninterpersonal stress was controlled in this model by our stipulation that the variables’ error terms were correlated, interpersonal stress remained a statistically significant mediator of the association between self-esteem and health problems, CI = -.58 to -.05, $p < .05$, whereas noninterpersonal stress was unrelated to health problems, $\beta = .03$, $z < 1$, and was not related to changes in self-esteem from Week 0 to Week 6, $\beta = -.08$, $z = -1.07, ns$. These results were also the same when we used school workload stress as the sole noninterpersonal stress variable, excluding job workload stress from the index. Moreover, the associations among acute changes in self-esteem, interpersonal stress, and health problems at Weeks 8–10 were also unchanged when we controlled for acute changes in noninterpersonal stress at Weeks 8–10. Once again, these results offer strong support for the sociometer definition of self-esteem, because self-esteem was uniquely related to interpersonal stress but was only weakly related to noninterpersonal stress.

Do coping skills buffer the association between interpersonal stress and health problems? Although we found that interpersonal stress was associated with health problems for the students in our study—perhaps because of its adverse effects on immune system functioning (e.g., Cohen et al., 1998; Uchino et al., 1996)—there are psychological resources that could buffer this negative association (see Taylor et al., 2000). For example, believing that one is very effective at coping with stress could buffer the potentially negative association between interpersonal stress and health. To test this hypothesis, we averaged participants’ reports of how well they could effectively handle each of the five interpersonal stressors (e.g., relationships with family, friends, and so on.) at Weeks 2 and 4, creating two reliable indices of coping efficacy (α = .72 and .78, respectively). We then averaged these two indices to create a reliable coping efficacy index for Weeks 2–4 of the study period ($\alpha = .80, M = 4.95, SD = .84$). HSEs reported higher levels of coping efficacy than LSEs, $r = .44, p < .001$, and higher levels of coping efficacy were associated with lower levels of interpersonal stress, $r = -.58, p < .001$.

We used regression to test the hypothesis that coping efficacy moderates the association between interpersonal stress and health problems. First we entered self-esteem from Week 0 and interpersonal stress and coping efficacy at Weeks 2–4 (all mean centered) as main effects into Step 1 of the regression analysis to predict health problems at Weeks 2–4. Next we added the two-way interactions between the variables as predictors at Step 2 and the three-way interaction as an additional predictor at Step 3 of the regression. Results of Step 1 indicated that higher levels of coping
efficacy were associated with fewer health problems, $\beta = -0.20$, $t(200) = -2.32$, $p = .021$, but this effect was qualified by a two-way interaction between interpersonal stress and coping efficacy at Step 2, $\beta = -0.27$, $t(200) = -3.05$, $p = .003$. No other main effects or interactions emerged. The Interpersonal Stress $\times$ Coping Efficacy interaction is depicted in Figure 6. High coping efficacy appeared to buffer the association between interpersonal stress and health for all participants, regardless of level of self-esteem. For people with high coping efficacy (i.e., people scoring 1 standard deviation above the mean), interpersonal stress was unrelated to health problems, $\beta = -0.09$, $t < 1$, whereas for people with low coping efficacy (i.e., people scoring 1 standard deviation below the mean), higher levels of interpersonal stress were predictive of health problems, $\beta = 0.28$, $t(200) = 2.92$, $p = .004$.

Additional analyses examined whether coping efficacy buffered the negative association between interpersonal stress and self-esteem. Once again, self-esteem at Week 0 and interpersonal stress and coping efficacy at Weeks 2–4 (all mean centered) were entered as main effects into Step 1 of the regression analyses to predict self-esteem at Week 6, and we added the two-way interactions between the variables as predictors at Step 2 and the three-way interaction as an additional predictor at Step 3 of the regression. Results again indicated that interpersonal stress was directly related to decreases in self-esteem from Week 0 to Week 6, $\beta = -0.19$, $t(192) = -3.35$, $p = .001$. However, coping efficacy did not buffer this association, as indicated by a nonsignificant Interpersonal Stress $\times$ Coping Efficacy interaction, $\beta = 0.09$, $t < 1$. Therefore, although coping efficacy seems to buffer the negative association between interpersonal stress and health, coping efficacy does not buffer the negative association between interpersonal stress and self-esteem.

**General Discussion**

**Summary of Results**

In the studies that we presented in this article, we tested a dynamic self-and-social-bonds model of health that built upon findings from the fields of social, personality, and health psychology. Consistent with our model, the results of Study 1 indicated that chronic self-esteem predicted subjective reports of health problems, that the association between self-esteem and health problems was explained by functional quality of social bonds, and that functional quality of social bonds predicted acute changes in self-esteem over time. Study 2 replicated the results of Study 1, but self-reports of concrete health-related behaviors were used as indicators of health problems and demonstrated that both functional and structural quality of social bonds explained the association between self-esteem and health problems. Study 2 also extended the results of Study 1 to show that acute changes in self-esteem predicted acute changes in the structural and functional quality of social bonds, which in turn predicted acute changes in health problems. To our knowledge, these studies are among the first to examine the association between self-esteem and health outcomes, and are the first to draw upon research from social and personality psychology to propose and test mechanisms to explain the association between self-esteem and health outcomes.

These results allow us to estimate the economic cost of lower self-esteem. If we generalize the results of Study 2, our conservative estimate would be that lower self-esteem in first-year college students in the United States costs $127 million in a single month for missed classes and extra visits to the doctor. This analysis suggests that at least part of the staggering costs of health care in the United States is explained by lower self-esteem and could be reduced if people’s self-esteem and social relationships could be improved. Replication of these results is required before firm conclusions can be drawn, but in light of our findings, we think that such research is warranted.

A review article by Swann, Chang-Schneider, and McClarty (2007) also adds perspective for evaluating our findings. The authors pointed out that when outcomes are multiply determined, as is the case with health outcomes in the naturalistic, longitudinal studies that we conducted, a correlation of .30 actually approaches the upper limit of what can be found between any single predictor (i.e., self-esteem) and the criterion variable. Moreover, the strength of the associations between self-esteem and health outcomes that were observed in the two studies that we reported (i.e., $r$s in the .15–.31 range) are similar in magnitude to the predictive validity of many highly regarded medical tests. As Swann et al. pointed out,

\[13 \text{ Based on the results of Study 2, LSEs (i.e., people scoring 1 standard deviation below the mean) miss 1.16 more classes per month than HSEs (i.e., people scoring 1 standard deviation above the mean) and visit the doctor 0.39 more times than HSEs each month. In the United States, the average cost of tuition is $5,836 at public colleges and $22,218 at private colleges (College Board, 2006). Assuming that the average college student takes 10 classes per year and that each class runs for 15 weeks and meets three times per week, a single class costs $13 at public college and $50 at private college. There were 14,581,709 students enrolled in college in the United States in 2005, 80% of whom were in public colleges and 20% of whom were in private colleges (U.S. Census Bureau, 2005). Assuming that one quarter of these students were in their first year of college, the cost of missed classes in a single month was $85 million higher for LSEs (i.e., students scoring in the bottom half of the self-esteem distribution) than HSEs (i.e., students scoring in the upper half of the self-esteem distribution). A single visit to the doctor costs $58 (Fendrick et al., 2003). Therefore, the cost of extra visits to the doctor for LSE first-year university students compared with HSE first-year university students equals $42 million.} \]
an association of only $r = .03$ between taking aspirin and decreases in heart attacks was sufficient for doctors to recommend that all cardiac patients take aspirin daily, an effort that resulted in 10,000 fewer heart attacks annually. In a similar vein, an association between smoking and lung cancer of $r = .38$ (see Bushman & Anderson, 2001) spawned a worldwide anti-smoking health revolution that has drastically reduced the incidence of smoking-related illness. When assessed in this light, it appears that self-esteem is an important predictor of health outcomes that deserves additional study.

**Implications of These Results**

**Social and Personality Psychology**

The results that we presented suggest that self-esteem predicts one of the most important life outcomes of all, one’s general health. Although previous studies have shown that self-esteem correlates with reports of illness (e.g., Antonucci & Jackson, 1983) and that self-esteem in cardiovascular patients predicts mortality up to 10 years later (e.g., Forthofer et al., 2001), the studies that we presented add to these findings by proposing and testing a mechanism to explain these associations. Our proposed self-and-social-bonds model of health links two important theories about the nature of the interface between personality and social context. Consistent with Murray et al.’s (2006) risk regulation model, we found that lower self-esteem prospectively predicted poor-quality social bonds, perhaps because LSEs’ negative social expectancies caused them to behave in a self-protective, but relationship-damaging, manner, whereas HSEs’ social confidence caused them to behave in ways that strengthened their social bonds. In turn, consistent with sociometer theory (e.g., Leary & Baumeister, 2000), poor-quality social bonds predicted acute drops in self-esteem. However, our results also offer a novel contribution by demonstrating that acute drops in self-esteem predict acute drops in the quality of people’s social bonds. This finding speaks to the strength of the link between self-esteem and social experiences and the reciprocal nature of the relation between person and the situation.

**Health Psychology**

Our results offer further support for findings from medical and health psychology research by demonstrating once again the importance of social bonds for health outcomes (e.g., Cacioppo et al., 2003; Cohen, 2004). Yet our results also extend previous research in three ways. First, we identified an important personality predictor of the quality of people’s social bonds. We have proposed and demonstrated that self-esteem predicts the quality of participants’ social bonds, and our self-and-social-bonds model of health suggests avenues for health interventions that would have otherwise gone unexamined. In particular, we suggest that interventions aimed at improving health outcomes ultimately could fail unless they take into account the association between self-esteem and quality of social bonds and, in particular, the idiosyncratic self- and world-views that shape LSEs’ and HSEs’ social strategies. We will return to this issue shortly.

Second, although medical and health psychology research has demonstrated convincingly the link between chronic quality of social bonds and health outcomes, our research shows that acute drops in quality of social bonds also lead to acute increases in health problems. We observed this effect in just a 1-month period of time for generally healthy young adults in Study 2, highlighting the sensitivity and immediacy of the link between mind and body.14

Finally, our results offer empirical support for Uchino et al.’s (1996) contention that both structural and functional aspects of social bonds uniquely contribute to health outcomes. This is an important empirical validation of Uchino et al.’s distinction because interventions to improve health outcomes can be aimed at improving both the structural and functional quality of participants’ social bonds.

**Limitations of the Present Research**

We acknowledge that our results require replication with different populations before firm conclusions can be drawn about the nature of the associations among self-esteem, social bonds, and health outcomes. In particular, it is important to replicate these findings using older populations of adults. However, we suspect that the associations among variables that we proposed in our self-and-social-bonds model of health will be stronger in older adults in whom health problems are more prevalent and severe. It is also possible that the magnitude of certain paths in our model will be different in older populations. For example, Path e, which links health problems to changes in self-esteem, was not significant in our samples of healthy young adults. Older populations are more likely to suffer severe or chronic health problems that could adversely affect their social bonds. Thus, in older populations, increases in health problems may indeed predict drops in self-esteem. These possibilities should be tested empirically.

A second limitation of our research is that our measures of health problems were self-reports. Although in Study 2 we used self-reports of concrete health-related behaviors as an indicator of health problems (i.e., visits to the doctor and classes missed due to illness), it is possible that these reports were not particularly accurate due to poor or inaccurate recall. We think this possibility is unlikely. Participants in Study 2 were asked to report events from the previous 2 weeks only, so it is unlikely that they would not be able to recall their experiences accurately. In addition, it is possible that LSEs recalled more missed classes and visits to the doctor than HSEs due to biased recall rather than actual fact. Yet it is difficult to think of a plausible reason why self-esteem would bias reports of these mundane events, which are not obviously relevant to self-esteem.

It is possible that LSEs were not actually ill when they missed classes or visited the doctor more than HSEs. Future research should attempt to obtain medical records from participants to validate objectively participants’ reports. Such a method would also allow researchers to determine whether self-esteem is related to certain types of health problems and not to others. However,

14 Although some readers may doubt that illness can develop in such a short period of time, it is important to remember that the incubation period for common illnesses like the common cold can be as short as a few days (e.g., Cohen et al., 1998), suggesting that the participants in our Study 2 easily could have developed illness between Weeks 6 and 10 of the study period.
even if we assume that LSEs in the present research were not objectively ill when they visited the doctor or missed classes more often than HSEs, these health-related behaviors are still economically costly to the health care system and personally costly to LSEs’ academic performance.

Because quality of social bonds and health problems were assessed concurrently in both studies in this article, we could not rule out the possibility that health problems mediate the association between self-esteem and quality of social bonds. Being sick may cause one to feel socially isolated and thus to perceive one’s social bonds negatively. We believe that this alternative model is less plausible than our proposed model. Previous research examining the effect of social bonds on health persuasively supports our interpretation that poor-quality social bonds lead to health problems and offers little support for the alternative that health problems lead to poor-quality social relationships (e.g., Cohen, 2004; Uchino et al., 1996). In addition, health problems did not mediate the association between self-esteem and quality of social bonds at the start of the semester in Study 2. An unpredicted path in the proposed model that emerged in Study 2 also contradicts this alternative model. As noted in Figure 3, there was an unpredicted path between health problems at Weeks 2–4 and changes in interpersonal stress at Weeks 8–10 that was required to obtain adequate fit for the proposed model. This unpredicted path was statistically significant, but negative. More health problems predicted decreased interpersonal stress. If health problems explain the association between self-esteem and interpersonal stress, the association between health problems and changes in interpersonal stress should be positive. Although all of these points suggest that health problems do not mediate the association between self-esteem and interpersonal stress, the nature of our data set does not allow us to reject this alternative model definitively.15

Finally, although our longitudinal design offers support for our model, we cannot conclude that lower self-esteem causes negative health outcomes unless we experimentally manipulate the variables in our model. Of course, it is unethical to experimentally induce lower self-esteem or poor-quality social bonds to examine whether this induction leads to negative health outcomes. However, researchers can attempt to experimentally improve people’s self-esteem and the quality of their social bonds to determine whether such changes result in benefits to general health. Thus, we will close with a discussion of how our results speak to improving people’s health outcomes.

**Improving Health Outcomes**

Our model suggests three potential avenues for improving people’s health outcomes: (a) target Path c in our model and improve LSEs’ self-esteem; (b) target Path a and improve the quality of LSEs’ social bonds; and (c) target Path b and seek to improve the quality of everyone’s social bonds. We are not sure that researchers should attempt to improve people’s self-esteem directly. First, obvious and direct attempts to improve low self-esteem can actually backfire and cause LSEs to feel worse about themselves, perhaps because many direct techniques like positive feedback or positive self-statements serve to highlight evaluative standards and provoke a self-protective mind-set for LSEs (Wood, Anthony, & Foddis, 2006). In addition, increasing self-esteem directly does not address the underlying reasons why self-esteem was low to begin with. Thus, attempting to directly increase self-esteem could result in defensive or fragile higher self-esteem that simply hides one’s doubts and insecurities rather than ameliorating them (e.g., Crocker & Park, 2004). Although we have highlighted the interpersonal benefits of secure higher self-esteem, defensive or fragile higher self-esteem that focuses on self-aggrandizement has a dark side that actually hurts the quality of one’s social bonds (e.g., Baumeister, Smart, & Boden, 1996; Jordan, Spencer, Zanna, Hoshino-Browne, & Correll, 2003). Thus, attempts to increase self-esteem are unlikely to benefit health outcomes unless they actually dampen the underlying doubts and insecurities that plague LSEs’ interpersonal relationships.

We also suspect that targeting the link between social bonds and health problems (i.e., Path b in our model) would not be a good avenue for intervention if researchers ignore the influence of self-esteem on belief systems and social behavior. For example, if researchers attempt to increase isolated individuals’ social integration by having them join activity groups, HSEs are likely to benefit because they readily anticipate and perceive acceptance from novel interaction partners (Anthony et al., 2007) and thus will readily benefit from a larger social circle. However, socially isolated LSEs may not benefit from such a program because their interpersonal doubts make it less likely that they would actually follow through and join the group (Anthony et al., 2007), and even if they did join the group, LSEs’ self-protective behavior could inhibit them from forming new social bonds. Thus, we feel that interventions that target Path b in our model may not succeed unless they take into account LSEs’ uniquely self-protective motivations and social behavior.

Therefore, we believe that the most successful health interventions will target the link between lower self-esteem and poor-quality social bonds (Path a). Specifically, interventions should aim to decrease LSEs’ use of self-protective interpersonal strategies in the hopes that this will improve both the functional and structural quality of LSEs’ social bonds. Research suggests that simple interventions can improve the functional quality of LSEs’ social bonds (e.g., felt security, trust, and perceived regard). For example, subtly guiding LSEs to reframe compliments from a single concrete instance, which can be easily dismissed, into an abstract indicator of admiration can improve the functional quality of LSEs’ relationships (Marigold, Holmes, & Ross, 2007). It is important to note that research shows that LSEs’ loved ones actually value them and regard them as positively as HSEs’ loved ones (see Murray et al., 2006). Therefore, interventions designed to improve LSEs’ perceived regard and felt security would not be

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15 It is important to note that our objections to this alternative model (i.e., self-esteem → health problems → quality of social bonds) apply solely to the context of the present studies, wherein participants were relatively young and healthy adults. The types of health problems that these participants may have been experiencing were probably acute and transient (e.g., colds). We think it is unlikely that such common and relatively benign health problems would adversely affect one’s social bonds. However, chronic and severe health problems, such as cancer, can and do have strong interpersonal consequences (e.g., Bolger, Foster, Vinokur, & Ng, 1996). Thus, future research should examine the self-and-social-bonds model of health in the context of chronic disease to tease apart the potentially reciprocal relation between quality of social bonds and health for people experiencing severe and long-standing illness.
creating a false sense of security for LSEs. Instead, such interventions would probably help LSEs to more accurately perceive the love and support that their close relationships provide. If LSEs’ interpersonal doubts and insecurities can be assuaged with such techniques, this could change LSEs’ interpersonal behavior and allow LSEs to engage in relationship-promoting behaviors that would further strengthen their social bonds. Moreover, feeling secure in their social relationships could also improve the structural quality of LSEs’ social bonds by encouraging them to seek new social opportunities and strengthen the friendships they already possess. Not only would interventions to improve LSEs’ social relationships benefit their health outcomes in the short term, but in the long term, improvements in LSEs’ social relationships could result in increases in self-esteem that would further benefit their health outcomes.

These suggestions are of course somewhat preliminary, and further research is required. However, by taking into account research from social, personality, and health psychology, we believe that researchers could possibly develop a “psychological flu shot” that would help to provide both an immediate and long-term inoculation against illness.

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