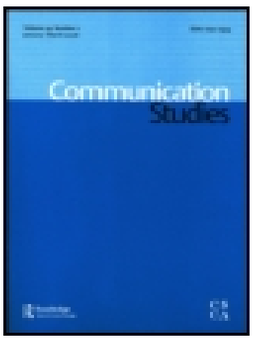

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Affection Deprivation Is Associated With Physical Pain and Poor Sleep Quality

Kory Floyd

Social bonds are necessary for human survival and affectionate communication is paramount for their formation and maintenance. Consequently, affection deprivation —the condition of receiving less affectionate communication than desired—is associated with social pain, and contemporary research indicates that social pain has substantial neurological overlap with physical pain. Thus, it was proposed that affection deprivation would be associated with the sensation of physical pain as well as with poor-quality sleep. Three studies involving a total of 1,368 adults from nearly all U.S. states and several foreign countries revealed significant associations between affection deprivation, physical pain, and multiple facets of disturbed sleep.

Keywords: *Affection; Affection Exchange Theory; Pain; Sleep*

For such a social species as *Homo sapiens*, the formation of significant social bonds is much more a necessity than a luxury. As Baumeister and Leary (1995) explained, humans have a fundamental, evolved drive to maintain close interpersonal attachments, and they thrive when this need is satisfied but suffer impairments when it is thwarted. Affection is one of the chief communication behaviors contributing to the formation (Owen, 1987), maintenance (Bell & Healey, 1992), and quality (Floyd & Morman, 1997, 1998, 2000a) of such relationships. For that reason, scholars and clinicians alike have long considered affection to be among the most fundamental of human needs (Floyd, 2006a; Rotter, Chance, & Phares, 1972; Schutz, 1958, 1966). Affection supports physical health (Floyd, Pauley, & Hesse, 2010), mental well-being

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(Hesse & Floyd, 2008), and academic performance (Steward & Lupfer, 1987) and mitigates loneliness (Downs & Javidi, 1990) and depression (Oliver, Raftery, Reeb, & Delaney, 1993). Although affection can be unwelcome in certain situations (Floyd & Burgoon, 1999; Floyd & Morman, 2000b; Floyd & Voloudakis, 1999), it is typically associated with numerous positive outcomes.

Any given need can be met, exceeded, or unsatisfied. All humans need food, for example, yet some people eat the amount required for good health, some eat more than is required, and some eat less than is required. Conceiving of affection as a need raises the same possibilities: Whereas some people receive adequate affection and others receive an abundance, still others experience *affection deprivation*. Floyd (2014) introduced affection deprivation as a theoretic construct indexing a state in which individuals receive a level of affectionate expression from others that is inadequate to meet their needs. Failing to meet any fundamental human need has negative consequences; whereas inadequate food intake leads to hunger, inadequate water intake leads to thirst, and inadequate sleep leads to fatigue, Floyd explained that inadequate affection leads to social pain that manifests in the form of loneliness, depression, feelings of isolation, and impaired interpersonal attachments.

Much contemporary research indicates, however, that social pain also manifests itself in the form of physical pain. Although people commonly think of "heartache" or "hurt feelings" only metaphorically, brain-imaging studies demonstrate that the body processes social and physical pain as similar sensory experiences. It therefore stands to reason that affection deprivation is associated with physical pain, and if it is, it may also be associated with detriments related to physical pain, such as poor-quality sleep.

That affection deprivation predicts social pain is suggested clearly by affection exchange theory, whose principles are reviewed below. Following that is a review of research linking social and physical pain and establishing that states similar to affection deprivation—such as loneliness and social rejection—are associated with physical pain and sleep disturbances. Hypotheses about the relationships between affection deprivation, pain, and sleep appear subsequently.

Affection Exchange Theory

Affectionate communication is conceptualized in affection exchange theory (AET; Floyd, 2006a) as an adaptive behavior that contributes to humans' superordinate motivations for viability (survival) and fertility (procreation). AET adopts a neo-Darwinian perspective by proposing that behavioral tendencies favorable to survival and procreation are reinforced through natural and sexual selection. These include social behaviors that contribute to the formation, maintenance, and stability of personal relationships. AET concurs with Baumeister and Leary's (1995) need-to-belong hypothesis that humans have an innate (i.e., unlearned) need to form and nurture close personal relationships, and AET goes beyond the need-to-belong hypothesis by claiming that affectionate communication is one of the principal behaviors responsible for satisfying that need.

Floyd (2006b) defined affectionate communication as comprising those behaviors used to convey feelings of fondness and positive affect for a target other. In their tripartite model of affectionate communication, Floyd and Morman (1998) distinguished three principal forms of affectionate expression. In their model, *verbal affection* includes affectionate expressions that are spoken or written, such as "I love you" and "I care about you." *Direct nonverbal affection* consists of nonverbal gestures that most observers would interpret as affectionate in meaning, such as kissing, handholding, and hugging. Finally, *socially supportive affection* comprises behaviors that convey affectionate sentiments through the provision of support, such as lending someone the use of a car or helping someone with a project. Floyd and Morman note that socially supportive affectionate behaviors are often the most covert, in that disinterested onlookers may not interpret them as affectionate, yet are the dominant and preferred form of affectionate communication in many close relationships. Multiple experimental and correlational experiments have confirmed associations between affectionate communication and relational satisfaction (Floyd, 2002; Morman & Floyd, 1999), as well as physiological benefits, such as the management of stress hormones (Floyd, 2006b; Floyd & Riforgiate, 2008), resting heart rate (Floyd et al., 2007b), resting blood pressure (Floyd, Hesse, & Haynes, 2007), blood lipids (Floyd et al., 2009; Floyd, Mikkelson, Hesse, & Pauley, 2007), and recovery from elevated distress (Floyd et al., 2007a, 2010).

In multiple ways, therefore, affectionate behavior contributes to evolutionary fitness, making it logical to presume that affection deprivation—conceptualized as less affectionate communication than one desires—is detrimental to fitness. In an initial test of that hypothesis, Floyd (2014) surveyed 509 adults and found significant associations with affection deprivation across five broad domains: general well-being, social well-being, mental health, physical health, and interpersonal attachment. Specifically, affection deprivation was positively related to loneliness, depression, stress, fearful avoidant attachment, preoccupied attachment, and alexithymia (a personality trait characterized by the inability to understand emotions and to decode emotion displays). It was also related to the number of diagnosed mood/anxiety disorders and the number of diagnosed secondary (i.e., acquired) immune disorders. Conversely, affection deprivation was negatively associated with happiness, general health, social support, secure attachment, and satisfaction in one's primary relationship. These findings are in concert with a robust literature demonstrating health and relational deficits associated with similar states of deprivation, such as loneliness (Cacioppo et al., 2002), ostracism (Hitlan, Cliffton, & DeSoto, 2006), stigmatization (Smart Richman & Leary, 2009), rejection (Baumeister, Brewer, Tice, & Twenge, 2007), social exclusion (Eisenberger, Lieberman, & Williams, 2003), and bullying (Hansen et al., 2006).[1] Considered collectively, these studies confirm that conditions reflecting inadequate or poor-quality personal relationships are associated with detriments to physical health, mental and emotional health, and social wellness, as both AET and the need-to-belong hypothesis would predict.

Affection Deprivation and Social Pain

Scholars (e.g., Masten, Morelli, & Eisenberger, 2011) use the term *social pain* to describe the aversive state caused when an individual's attempts to maintain close, satisfying personal relationships are thwarted. Experimental studies show that social pain—colloquially referred to as "hurt feelings"—is induced when individuals feel excluded from interpersonal interaction (MacDonald & Jensen-Campbell, 2011), even when rejected online by complete strangers (Vangelisti, Pennebaker, Brody, & Guinn, 2014). That failing to maintain adequate social bonds would cause distress is in line with the proposition of both AET and the need-to-belong hypothesis that positive, meaningful social relationships are paramount for the health and well-being of humans.

Thornhill and Thornhill (1989) took a similar evolutionary approach in their pain theory by positing that the functions of emotional or social pain are analogous to those of physical pain: to focus attention on threatening or harmful events and to promote corrective and preventative actions. For instance, the physical pain of touching a hot stove typically prompts immediate attention and alarm, the swift corrective action of removing one's hand from the stove, and extra care to prevent the event from reoccurring. Likewise, social pain caused by isolation, ostracism, or loneliness focuses attention on a person's solitary status and can prompt corrective action in the form of repairing damaged relationships or seeking new ones. It may also produce a level of resolve to avoid such isolation in the future.

Alongside rejection, isolation, and ostracism, affection deprivation is a similarly aversive state, insofar as it reflects the lack of adequate affectionate communication. AET hypothesizes that adequate affection is necessary for well-being, and a voluminous literature confirms the mental, physical, and relational benefits of affectionate communication (for recent reviews, see Floyd, 2016; Floyd, Hesse, & Generous, 2015). It is therefore logical to presume that being deprived of receiving a sufficient level of affection from others is associated with experiences of social pain, and previous research confirms the relationship of affection deprivation to various manifestations of social pain, such as anxiety, insecure attachment, loneliness, and depression (Floyd, 2014).

Despite a tendency to think of social or emotional pain as a psychological experience distinct from that of physical pain, research indicates substantial sensory overlap between them. Therefore, although social pain is aversive on its own, it may also manifest in the body in the form of physical-pain sensations, making physical pain a potential correlate of affection deprivation.

Connections to Physical Pain

Nearly four decades ago, Panksepp and colleagues advanced the argument that social and physical pain are similar sensory experiences (Herman & Panksepp, 1978; Panksepp, Herman, Conner, Bishop, & Scott, 1978; Panksepp, Vilberg, Bean, Coy, & Kastin, 1978). They argued that as natural selection prepared animals for increased social interaction, instead of creating novel systems to react to socially distressing

events (such as exclusion or rejection), it piggybacked those responses onto existing systems already prepared to respond to physical pain.

Compelling evidence in support of Panksepp's proposition comes from neuroimaging studies showing that social and physical pain activate similar neural structures. Chief among these structures is the anterior cingulate cortex (ACC; Bush, Luu, & Posner, 2000; Kimbrell et al., 1999; Nelson & Panksepp, 1998), specifically the dorsal subdivision (dACC; Eisenberger & Lieberman, 2004), which is active in both the affective and attentional concomitants of pain sensation, according to meta-analyses of research using positron emission tomography (PET) and functional magnetic resonance imaging (fMRI; Peyron, Laurent, & García-Larrea, 2000). As Eisenberger et al. (2003) reported, the anterior cingulate cortex is also activated by experiences of social rejection. Participants in their study were scanned by fMRI while playing a virtual ball-tossing game ("Cyberball"), in which they were ultimately excluded by their coplayers. As in studies of physical pain, Eisenberger and colleagues found that the anterior cingulate cortex was more active when participants were socially excluded than when they were included, and that activation correlated positively with self-reports of distress.

Other neurological structures show similar overlap between physical and social pain. Kross, Berman, Mischel, Smith, and Wager (2011) found that experience of social rejection activated the secondary somatosensory cortex and dorsal posterior insula, both of which are normally associated with (and highly diagnostic of) the sensory experience of physical pain. The periaqueductal gray, located in the midbrain, has also been linked to both physical and social pain (An, Bandler, Öngür, & Price, 1998; Floyd, Price, Ferry, Keay, & Bandler, 2000).

The discovery that the brain processes physical and social pain similarly helps to explain why experiences of social deprivation show reliable associations with physical pain. Specifically, physical pain is positively associated with loneliness (Cacioppo & Patrick, 2008; Jaremka et al., 2013), social exclusion (MacDonald & Leary, 2005; but see DeWall & Baumeister, 2006), ostracism (Williams, 2007), and loss of an important social relationship (Panksepp, 2003). Common to these conditions is the inability to meet one's need for meaningful social bonds. As affection deprivation also represents an impairment to fundamental social needs, the following is hypothesized:

H1: Affection deprivation is directly associated with physical pain (known hereafter as the "pain hypothesis").

Connections to Sleep Quality

The social pain resulting from the lack of meaningful connections can manifest itself in ways other than physical pain. One candidate is the quality of sleep people experience. Kurina et al. (2011) offered an evolutionary argument for why social deprivation might impair sleep:

> Humans must have relied on a safe social surround to survive and thrive. The absence of a secure social environment results in perceptions of social isolation that, in turn, have been shown to increase vigilance for threat and to heighten feelings of vulnerability. This heightened vigilance may be manifested during the sleep period in greater restlessness or more fragmented sleep. (p. 1519)

In support of their argument, Kurina and colleagues (2011) found a positive relationship (β = .06) between loneliness and sleep fragmentation, an index of restlessness. They also found that loneliness predicted lower sleep duration (β = -.13), although previous studies of loneliness had generally failed to find an association with sleep duration (e.g., Mahon, 1994). Steptoe, Owen, Kunz-Ebrecht, and Brydon (2004) likewise found a positive association (β = .15) between loneliness and sleep problems, a relationship that was independent of age, sex, marital status, and employment status. Other investigations have also documented that poor sleep quality is associated with bullying (Niedhammer, David, Degioanni, Drummond, & Philip, 2009) and negative mood (Thomsen, Mehlsen, Christensen, & Zachariae, 2003).

The argument offered by Kurina et al. (2011) reflects the presumption of AET and the need-to-belong hypothesis that strong social relationships are paramount to human survival and wellness. Failure to meet that need results in heightened distress (in the form of vulnerability and increased vigilance) that disturbs sleep, according to Kurina and colleagues. Insofar as affection deprivation also reflects the failure to maintain adequately close personal relationships, is the following is hypothesized:

> H2: Affection deprivation is inversely associated with sleep quality (known hereafter as the "sleep hypothesis").

Three studies are reported here to test the hypothesized relationships between affection deprivation, pain, and sleep quality. The first study tests the pain hypothesis only, whereas the second and third studies test both predictions.

Study 1

The purpose of the first study is to determine the validity of the pain hypothesis, which predicted a significant linear association between affection deprivation and pain.

Participants

Participants (N = 572) were 314 men and 258 women. Most (68.4%) self-identified as White/Caucasian, whereas 17.8% were Asian/Pacific Islander, 8.4% were Black/African American, 5.2% were Hispanic/Latino(a), 1.9% were Native American, and 1.6% claimed other ethnic origins. Ages ranged from 18 to 72 years (M = 33.49 years, SD = 11.41). Participants came from every U.S. state, except North and South Dakota, and also from the District of Columbia and nine foreign countries (Angola, Argentina, Bulgaria, Canada, Egypt, India, The Netherlands, Romania, and the United Arab Emirates).

Procedure

All procedures were approved by the university's institutional review board. Participants were recruited via the Amazon.com Web Services crowdsourcing marketplace Mechanical Turk (MTurk). MTurk is an online venue where workers—called *providers*—perform functions provided by companies or organizations—called *requesters*—in exchange for payment in the form of money or Amazon.com gift cards. In the case of the present study, a work assignment—called a *hit* on MTurk—was created in which providers were asked to take part in a survey about social relationships. Those who elected to participate clicked on a link to an online questionnaire. At the conclusion of the questionnaire, providers received a code to enter on the MTurk site to verify their completion of the task. Participation was limited to providers 18 years of age or older who qualified as MTurk "masters" (indicating consistently high-quality work) and who had completed at least 100 previous hits with an approval rating of or exceeding 95%. Providers received $2US in exchange for filling out the questionnaire, which took the average provider 11 minutes, 55 seconds to complete. A recent study found that samples recruited on MTurk for academic research are often more representative of the U.S. population than are in-person convenience samples (Berinksy, Huber, & Lenz, 2012; see also Paolacci, Chandler, & Ipeirotis, 2010).

Measures

Affection deprivation was measured with a modified version of the scale developed by Floyd (2014). Items address participants' dissatisfaction with the amount of affection they receive from other people (e.g., "I don't get enough affection from others," "I often wish I got more affection in my life"). The scale employed a 9-point Likert-type scale wherein higher scores reflect a greater level of affection deprivation ($\alpha = .92$).

Physical pain was measured using the pain subscale of the RAND Corporation Short Form (SF) Health Survey 36 (see Hays, Sherbourne, & Mazel, 1995). The items on the pain subscale were "How much bodily pain have you had during the past 4 weeks?" and "During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?" with a modified 9-point scale in which higher scores indicate greater pain ($\alpha = .93$). The SF-36 has been extensively validated as a primary health-care assessment (Brazier et al., 1992), and as Kurina et al. (2011) pointed out, the pain subscale of the SF-36 is beneficial compared to alternate measures because it is not tied to any specific pathology.

Results

The pain hypothesis predicted a significant association between affection deprivation and physical pain. As shown in Table 1, affection deprivation had a significant bivariate correlation with physical-pain intensity. As Table 1 reflects, pain was significantly associated with participant age, and it also varied by sex, such that women ($M = 3.13$, $SD = 2.84$) reported significantly higher pain than did men ($M = 2.34$, $SD = 2.35$), $t(483) = -3.35$, two-

Table 1 Multiple Regression Analysis for Physical Pain: Study 1 (N = 572)

Step	Predictors	Zero-order r	B	$SE\ B$	β	ΔR^2
1	Age	.12**	0.02	0.01	.10*	
	Sex	–	0.48	0.22	.09*	
2	Affection deprivation	.14**	0.16	0.05	.12**	.014**

Notes. R^2 = .037; adjusted R^2 = .031; $F(3, 563) = 7.13$, $p < .001$. Sex was dummy coded, so no zero-order correlation was calculated.
*$p < .05$. **$p < .01$.

tailed $p < .001$. The hypothesis was therefore tested in a hierarchical regression in which age and sex (dummy coded as male = 0) were entered in the first step and affection deprivation was entered in the second step. Collinearity diagnostics were unremarkable (tolerance and variance inflation factor values were all near 1). The regression produced a significant omnibus model, and, after controlling for the effects of age and sex, affection deprivation was significantly associated with physical pain, β = .12, p = .004. Full regression results appear in Table 1. The pain hypothesis is supported.

Discussion

The first study supported the preliminary hypothesis that affection deprivation is associated with physical pain. Although the association (net of the effects of age and sex) was modest in magnitude, it was in line with the result of studies focused on other forms of social exclusion (for instance, Jaremka et al. (2013) identified an association between pain and loneliness of β = .16). Whereas affection deprivation shows a significant association with pain, this result suggests the need for replication and caution against exaggerating its magnitude.

Study 2

The second study was designed to replicate the test of the pain hypothesis and also to test the sleep hypothesis, which predicted a significant inverse association between affection deprivation and sleep quality.

Participants

Participants (N = 399) were 212 men, 183 women, and 4 who declined to report their biological sex. Most (69.9%) self-identified as White/Caucasian, whereas 17.5% were Asian/Pacific Islander, 7.3% were Black/African American, 6.5% were Hispanic/Latino (a), 2.0% were Native American, and 0.8% claimed other ethnic origins. Ages ranged from 18 to 74 years (M = 33.86 years, SD = 11.14). Participants came from 42 U.S. states, the District of Columbia, Puerto Rico, and six foreign countries (Canada, India, Ireland, Mexico, South Korea, and Sweden).

Procedure

Procedures were identical to those of Study 1 except that the online questionnaire on MTurk included a sleep-quality measure. Participants again received $2US in exchange for their involvement.

Measures

Affection deprivation was again measured with a modified version of the scale developed by Floyd (2014; α = .94). *Physical pain* was again measured using the pain subscale of the RAND SF-36 (Hays et al., 1995; α = .93).

Sleep disturbance was measured with the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The instrument contains 19 items that generate seven component scores: (a) sleep quality; (b) sleep latency; (c) sleep duration; (d) habitual sleep efficiency; (e) sleep disturbances; (f) use of sleeping medications; and, (g) daytime dysfunction. Total possible scores ranged from 0 to 21, with higher scores indicating poorer sleep quality (i.e., more problematic sleep; α = .68). Previous research has extensively validated the PSQI as a sleep-quality assessment (Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002; Beck, Schwartz, Towsley, Dudley, & Barsevick, 2004; Carpenter & Andrykowski, 1998).

Results

The pain hypothesis predicted a significant association between affection deprivation and physical pain. As shown in Table 2, affection deprivation had a significant bivariate correlation with physical-pain intensity. As Table 2 reports, pain was significantly associated with participant age, and it also varied by sex, such that women (M = 3.18, SD = 2.85) reported significantly higher pain than did men (M = 2.44, SD = 2.31), $t(374) = -3.14$, two-tailed $p = .002$. The hypothesis was therefore tested by a hierarchical regression in which age and sex (dummy coded as male = 0) were entered in the first step and affection deprivation was entered in the second step. Collinearity diagnostics were unremarkable. The regression produced a significant omnibus model, and, after controlling for the effects of age and sex, affection

Table 2 Multiple Regression Analysis for Physical Pain: Study 2 (N = 399)

Step	Predictors	Zero-order r	B	$SE\ B$	β	ΔR^2
1	Age	.17**	0.04	0.01	.16**	
	Sex	–	0.89	0.26	.17**	
2	Affection deprivation	.03	0.19	0.06	.15**	.023**

Notes. R^2 = .09; adjusted R^2 = .08; $F(3, 389) = 12.35$, $p < .001$. Sex was dummy coded, so no zero-order correlation was calculated.
*$p < .05$. **$p < .01$.

deprivation was significantly associated with physical pain, β = .15, p = .002. Full regression results appear in Table 2. The pain hypothesis is again supported.

The sleep hypothesis predicted that affection deprivation is associated with poor sleep quality. As Table 3 shows, affection deprivation had a significant bivariate correlation with low-quality sleep (the correlation coefficient with sleep disturbance is positive because higher scores on the sleep-quality index correspond to lower sleep quality). Sleep-quality scores differed by sex, such that women (M = 6.13, SD = 3.61) reported significantly higher sleep disturbance than did men (M = 5.40, SD = 3.03), t (383) = −2.40, two-tailed p = .02. The hypothesis was therefore tested in a hierarchical regression in which sex was entered in the first step and affection deprivation was entered in the second step. Collinearity diagnostics were unremarkable. The regression produced a significant omnibus model, and after controlling for the effect of sex, affection deprivation was significantly associated with sleep disturbance, β = .29, p < .001. Full regression results appear in Table 3. The sleep hypothesis is supported.

Discussion

As in the first study, affection deprivation was associated with pain (net of the effects of age and sex) to a slightly stronger degree (βs = .12 in Study One and .15 in Study Two). Affection deprivation also showed a moderate relationship with overall sleep quality, despite a modest interitem reliability for the PSQI, indicating that affection-deprived individuals experience poorer quality sleep than their nondeprived counterparts. This result supports the sleep hypothesis. Importantly, zero-order correlations show that affection deprivation is related most strongly to sleep disturbances, sleep quality, and daytime dysfunction but does not predict the use of sleeping medications.

Although the significant effect of sex on sleep quality was controlled in the test of the sleep hypothesis, one limitation of Study 2 is that other potential moderators of sleep quality—such as exercise habits, tobacco and alcohol use, current illness, and body mass—were not accounted for. Each of these factors has the potential to affect sleep quality independently of affection deprivation, so accounting for their possible moderating effects would strengthen confidence in the findings. Study 3 was conducted to remedy this limitation.

Table 3 Multiple Regression Analysis for Sleep Quality: Study 2 (N = 399)

Step	Predictors	Zero-order r	B	$SE\ B$	β	ΔR^2
1	Sex	–	0.95	0.33	.14**	
2	Affection deprivation	.27**	0.47	0.08	.29**	.084**

Notes. R^2 = .11; adjusted R^2 = .10; $F(2, 392) = 22.94$, p < .001. Sex was dummy coded, so no zero order correlation was calculated.

*p < .05. **p < .01.

Study 3

The third study was designed to replicate the tests of the pain and sleep hypotheses while controlling for the potential moderating effects on sleep quality of exercise, tobacco use, alcohol use, current illness, and body mass.

Participants

Participants (N = 397) were 232 men, 160 women, and 5 who declined to report their biological sex. Most (76.8%) self-identified as White/Caucasian, whereas 11.3% were Asian/Pacific Islander, 9.3% were Hispanic/Latino(a), 5.8% were Black/African American, 2.3% were Native American, and 0.5% claimed other ethnic origins. Ages ranged from 18 to 68 years (M = 32.66 years, SD = 10.24). Participants came from 44 U.S. states, the District of Columbia, and three foreign countries (Canada, Trinidad and Tobago, and the United Kingdom).

Procedure

Procedures were identical to those of Study 2 except for the addition of measures of potential sleep-quality moderators. Participants received $2US in exchange for their involvement.

Measures

Affection deprivation was again measured with a modified version of the scale developed by Floyd (2014; α = .95). *Physical pain* was again measured using the pain subscale of the RAND SF-36 (Hays et al., 1995; α = .91). *Sleep disturbance* was again measured with the PSQI (Buysse et al., 1989; α = .66). *Exercise* was measured by asking participants to report how many hours they have spent in the past week jogging, walking, swimming, riding a bicycle, or doing other forms of exercise. *Tobacco and alcohol use* were each measured by asking participants to report on how many days (0–7) in the past week they have used tobacco products or consumed alcohol. *Body mass index* (BMI) was calculated based on participants' reports of their height and weight, using the Centers for Disease Control and Prevention (CDC) formula. *Current illness* was measured by asking participants whether they currently had a cold, flu, or other illness.

Results

The pain hypothesis predicted a significant association between affection deprivation and physical pain. As shown in Table 4, affection deprivation had a significant bivariate correlation with physical-pain intensity. As Table 4 shows, pain was significantly associated with age, and it also varied by sex, such that women (M = 3.11, SD = 2.32) again reported significantly higher pain than did men (M = 2.41,

Table 4 Multiple Regression Analysis for Physical Pain: Study 3 (N = 397)

Step	Predictors	Zero-order r	B	$SE\ B$	β	ΔR^2
1	Age	.14**	0.02	0.01	.09	
	Sex	–	0.60	0.22	.15**	
2	Affection deprivation	.14**	0.15	0.05	.15**	.022**

Notes. R^2 = .06; adjusted R^2 = .06; $F(3, 388) = 7.91$, $p < .001$. Sex was dummy coded, so no zero-order correlation was calculated.
*$p < .05$. **$p < .01$.

SD = 1.80), $t(390) = -3.36$, two-tailed $p < .001$. The hypothesis was therefore tested in a hierarchical regression in which age and sex (dummy coded as male = 0) were entered in the first step and affection deprivation was entered in the second step. The regression produced a significant omnibus model, and, after controlling for the effects of age and sex, affection deprivation was significantly associated with physical pain, β = .15, $p < .001$. Full regression results appear in Table 4. The pain hypothesis is again supported.

The sleep hypothesis predicted that affection deprivation is associated with sleep disturbance. Potential covariates were examined before testing the prediction. Sleep disturbance showed nonsignificant associations with exercise (r = -.04, two-tailed p = .45), tobacco use (r = .10, two-tailed p = .053), and alcohol use (r = .09, two-tailed p = .07) and did not vary as a function of current illness, $t(393) = -1.24$, two-tailed p = .22. As Table 5 shows, however, sleep disturbance was significantly related both to BMI and to age. BMI and age were therefore entered in the first step of a hierarchical regression and affection deprivation was entered in the second step. The regression produced a significant omnibus model, and after controlling for the effect of age and BMI, affection deprivation was significantly associated with sleep disturbance, β = .26, $p < .001$. Full regression results appear in Table 5. The sleep hypothesis is again supported.

Discussion

As in the first two studies, affection deprivation was again associated with pain, manifesting the same magnitude of relationship in Study 2 and Study 2 (βs = .15). Although the association is not particularly strong, it is consistent across all three

Table 5 Multiple Regression Analysis for Sleep Quality: Study 3 (N = 397)

Step	Predictors	Zero-order r	B	$SE\ B$	β	ΔR^2
1	Age	.11*	0.03	0.02	.08	
	BMI	.12*	0.08	0.03	.15**	
2	Affection deprivation	.27**	0.46	0.09	.26**	.07**

Notes. R^2 = .10; adjusted R^2 = .09; $F(3, 389) = 14.02$, $p < .001$. BMI = body mass index.
*$p < .05$. **$p < .01$.

samples and, as indicated earlier, it is consistent with the magnitude of associations found in loneliness research. We can therefore conclude that affection deprivation covaries at least to a modest degree with the experience of physical pain in adults. The pain hypothesis is therefore supported across all three studies.

Affection deprivation again showed a moderate relationship with overall sleep quality, with the magnitude of association in Study 3 ($\beta = .26$) being similar to that of Study 2 ($\beta = .29$). The sleep hypothesis is therefore supported across both studies. Zero-order correlations again show that affection deprivation is related to sleep quality, sleep disturbance, and daytime dysfunction, as well as sleep latency.

Among the potential moderators of sleep quality, only body mass index showed a correlation with sleep quality, which is consistent with research on sleep and obesity (see Gupta, Mueller, Chan, & Meininger, 2002; Javaheri, Storfer-Isser, Rosen, & Redline, 2008). BMI was therefore controlled in the analysis testing a relationship between sleep quality and affection deprivation. Sleep quality showed no significant associations with exercise, tobacco use, and alcohol use or current illness. Insofar as these factors have been shown in previous studies to affect sleep (e.g., King, Oman, Brassington, Bliwise, & Haskell, 1997; Patten, Choi, Gillin, & Pierce, 2000; Singleton & Wolfson, 2009), their failure to moderate sleep quality in the current study may be a function of measurement, warranting replication in a future study with more psychometrically sound instruments.

General Discussion

A robust literature has identified a broad range of mental- and physical-health benefits associated with expressing and receiving affection. Some forms of affectionate communication, such as kissing (Floyd et al., 2009) and hand-holding (Grewen, Anderson, Girdler, & Light, 2003), have even been shown to improve specific health parameters. Besides demonstrating that the exchange of affection is beneficial, this research—along with affection exchange theory and the need-to-belong hypothesis—also implies that the absence of adequate affection may be detrimental to well-being and quality of life. In line with that argument, two parameters of wellness—physical pain and sleep quality—were shown in the present studies to have reliable associations with the experience of affection deprivation.

These findings join those of Floyd (2014), who found that affection deprivation is associated with poorer physical health (in the form of diagnosed secondary immune disorders) as well as mental and social health (e.g., depression, insecure attachment). Considered collectively, these two projects advance the concept of affection deprivation as a detriment to wellness across a range of life domains. Whereas multiple previous studies have articulated associations between communication behavior and emotional well-being (such as satisfaction or happiness; see, e.g., Litzinger & Gordon, 2005; Pettit, Goris, & Vaught, 1997), the present studies are among the first to link communication behavior to concrete health impairments such as pain and sleep disturbances.

The implied causal pathway to physical pain articulated in the present studies is relatively straightforward: Affection deprivation leads to experiences of social pain, which share significantly overlapping neural pathways with physical pain. Regarding the mechanism behind the association of affection deprivation and sleep quality, however, various options are possible. Kurina et al. (2011) articulated the broad evolutionary argument that impaired social relationships (such as might be reflected by affection deprivation) heighten insecurity and increase vigilance, leading to poorer sleep. Steptoe et al. (2004) raised another possibility: Social deprivation stimulates activation of neuroendocrine, immune, and autonomic responses (such as waking levels of the steroid hormone cortisol, given that sleep debt can disturb the hypothalamic-pituitary-adrenal rhythm; Spiegel, Leproult, & Van Cauter, 1999) that could interfere with sleep quality.

The present studies benefited from the inclusion of samples that were both geographically and demographically diverse. As others (e.g., Berinsky et al., 2012) have noted, the use of Amazon.com's crowdsourcing tool makes such broad and diverse sampling practical for empirical research, increasing the external validity of the results compared to those produced from convenience samples of communication undergraduates. Of course, the samples were necessarily limited to those with access to computers and Internet service, as well as the ability to read and write English and the decision to become MTurk workers, so, although they reflected considerable diversity, they cannot be considered random samples.

Although these studies identified significant relationships between affection deprivation, pain, and sleep quality, future research can improve on certain limitations. With respect to potential moderators of sleep quality, studies would benefit from using more established, psychometrically sound assessments of exercise, tobacco use, and alcohol use and should also assess caffeine consumption. Even though exercise, tobacco use, and alcohol use showed nonsignificant associations with sleep quality in Study 3, the probability remains that these activities do, in fact, influence sleep quality and should therefore be controlled when assessing its relationship to affection deprivation. In that vein, future research may also benefit from the use of a different pain measure, one that assesses multiple aspects of physical pain (such as location, duration, intensity). Moreover, although the modest interitem reliabilities of the Pittsburgh Sleep Quality Index did not prevent significant relationships from emerging, suboptimal reliability does attenuate statistical power, suggesting that a measure with better internal reliability might yield associations of even greater magnitude.

The present studies assessed physical pain as an outcome based strongly on the robust literature indicating that physical and social pain are neurologically similar events. Despite significant associations identified in these studies between affection deprivation and physical pain, it may well be the case that the relationship between affection deprivation and physical pain is mediated by social pain. This possibility awaits adjudication in future empirical work.

Similar to Floyd's (2014) study of affection deprivation, the present studies were cross-sectional and therefore cannot support any causal inferences. Affection exchange

theory suggests that creating affection deprivation would lead to deficits in wellness and impede optimal functioning. It is also plausible that the experiences of physical pain or poor quality sleep could also inhibit affection exchange with others. Indeed, both causal pathways may be accurate: Affection deprivation may lead to pain and sleep problems, which may lead to further affection deprivation. Identifying the relative variance accounted for by each pathway is a task for future, experimental studies.

Given the significant associations between affection deprivation, pain, and sleep quality, however, another potentially useful task for future research is to determine whether psychological or behavioral interventions aimed at reducing affection deprivation can yield improvements in pain or sleep. As noted above, some previous experiments (Floyd et al., 2009; Grewen et al., 2003) have effected improved health parameters via behavioral interventions that increased affectionate contact. If a similar intervention can produce even a modest reduction in physical pain or an increase in sleep quality, it would have applied benefit for those who suffer chronically from one or both of those conditions. It is important to bear in mind, however, that the effect sizes linking affection deprivation to sleep problems and, especially, to physical pain in the present studies were not substantial. On average, affection deprivation accounted for approximately 7.5% of the variance in sleep quality and approximately 2% of the variance in physical pain, so this should certainly qualify expectations about the clinical significance of interventions. From a theoretic standpoint, the effect sizes suggest that sleep quality and pain are not principal pathways for the detriments of affection deprivation, and that affection deprivation may exert greater influence in mental-health outcomes such as anxiety or depression.

In summary, meaningful social relationships are a requirement for the human species, and affectionate communication is one of the principal behaviors contributing to their formation and maintenance. Like deprivations in food, water, or other fundamental needs, affection deprivation is associated with multiple significant impairments in functioning. Among these are the existence of physical pain (a product of the social pain produced by affection deprivation) and the lack of adequate high-quality restorative sleep.

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Note

1. This observation raises the possibility that affection deprivation may not be sufficiently distinct, conceptually or empirically, from these related states to qualify as a separate construct. Of these related states, loneliness perhaps shares the greatest conceptual space with affection deprivation, considering the focus of both constructs on a deficit in social connection. However, Floyd and Hesse (in press) recently demonstrated in a series of studies that affection deprivation and loneliness are both conceptually and empirically distinct, allowing their use as separate constructs.

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