Does Loneliness Moderate the Relations Between Interpersonal Events and Affect, Stress, Enjoyment, and Bodily Pain?

by

Laurie Dempsey

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Approved June 2012 by the
Graduate Supervisory Committee:

Mary Davis, Chair
Leah Doane
Alex Zautra

ARIZONA STATE UNIVERSITY

August 2012

ABSTRACT

Research has suggested that lonely people demonstrate distinct differences from nonlonely people in their behaviors, mood, and interpersonal experiences. Lonely people who are also enduring a chronic pain condition may be at an especially high risk for negative outcomes because of simultaneous issues such as stigma, mood disturbances, and pain-related disability. The current study examined chronic and transitory loneliness in a sample of 123 chronic pain patients. Participants completed daily diaries assessing the occurrence of positive and negative interpersonal events, appraisals of interpersonal events, pain, and mood. Multilevel modeling was used to examine effects of being a lonely person as well as having a lonely episode on daily life. Results indicated that both chronic and transitory loneliness were associated with more frequent negative and less frequent positive interpersonal events, higher levels of pain, more negative and less positive affect, and more stress and less enjoyment from social interactions. Loneliness did not affect reactivity to negative interpersonal events, but did influence responsivity to positive interpersonal events such that lonely people had greater boosts in enjoyment when experiencing more positive interpersonal events than usual. These findings suggest that both lonely people and individuals experiencing a lonely episode experience more negative consequences in their daily lives than nonlonely people. However, they can benefit from engaging in more frequent positive interpersonal events, which can help to inform future clinical interventions for lonely, chronic pain patients.

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

Social bonds provide a natural way of feeling that one belongs and is valued in his/her interpersonal world. When bonds are disrupted, individuals may experience a sense of social isolation, stemming from the feeling that they do not belong with others. One major consequence of perceived social isolation is loneliness, sometimes termed social pain. In the short term, the painful experience of loneliness may be adaptive, prompting individuals to reach out to drawn on or, if necessary, repair social bonds. However, if loneliness is sustained over time, individuals may cease trying to reconnect and withdraw from their social world, in part because they see social situations as opportunities to experience more rejection. In the long term, loneliness can have a profound effect not only on the way people perceive their social world, but also on the level of distress they experience. The mental and physical health effects of sustained loneliness can be substantial. Lonely individuals view daily events as more stressful and have less confidence in their ability to manage stress (Hawkley, Burleson, Berntson, & Cacioppo, 2003; Hawkley, Preacher, Cacioppo, 2007). They also engage in health behaviors that are maladaptive (Berkman et al., 2004; Hawkley, Thisted, and Cacioppo, 2009). Although research has been conducted on the relation between loneliness and affect in healthy individuals, little work has been conducted in chronically ill populations. In particular, for individuals who are managing the stress of a chronic pain condition, chronic loneliness may be especially relevant for at least two reasons. First, accruing evidence points to a neurobiological connection between social pain (e.g., loneliness) and bodily pain, suggesting that loneliness may impact the experience of pain episodes. Second,

for individuals with chronic pain who are already managing the burden of their symptoms, sustained loneliness may further impair their capacity to effectively draw on social resources to recover from pain and stress. Thus, exploring the mind-body connection between social and physical pain can enhance our understanding of how loneliness influences physical and emotional adaptations to chronic pain.

Defining Loneliness: What it is and What it is Not

Social connections occur naturally among people. In fact, the need to feel we belong is an inherent part of being human (Baumeister & Leary, 1995). As the need to belong is fundamental to humans, it is also natural to feel distress when these social needs are not met. Loneliness represents feelings of perceived isolation as a result of the discrepancy between the relationships an individual desires and the relationships that actually exist (Cacioppo, Hawkley, Crawford et al., 2002; Peplau & Perlman, 2000). Thus, loneliness can be characterized by feelings that relationships are unfulfilling due to a lack of intimacy or companionship (Steptoe, Owen, Kunz-Ebrecht, & Brydon, 2004). As a result, lonely individuals can feel like outsiders in social situations and/or feel they do not connect with other people in ways that are satisfying, regardless of how much time they spend with friends and family. Notably, it is the quality of social relationships, rather the quantity that is more predictive of loneliness (Pinquart & Sörensen, 2003).

The feeling of social disconnection can leave lonely individuals vulnerable to many negative affective consequences, including depression. Loneliness and depression are strongly related, but the existing evidence suggests that they are distinct constructs (Cacioppo, Hawkley, & Thisted, 2010). For example, a longitudinal study found that loneliness predicted depressive symptoms a year later even after accounting for previous depression (Cacioppo et al., 2010; Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006). Further, a second longitudinal study found that although loneliness predicted depression a year later, depression did not predict subsequent loneliness (Cacioppo et al., 2010). Such findings are important evidence supporting the notion that although loneliness and depression are related, they represent distinctive psychological phenomena. In fact, loneliness appears to be a risk factor for depression.

Intertwined in the relation between loneliness and depression are trait-like characteristics of lonely people in general that may account for their risk for depressive symptomatology. Lonely individuals may feel anxious, pessimistic, and fearful of negative evaluations from others, making it difficult for them to enjoy a social life in a way that is fulfilling (Cacioppo, Hawkley et al., 2006). In addition, they may also react to others with anger or avoidance because they do not feel the safety associated with social bonds (Cacioppo, Hawkley et al., 2006). Further, traits such as neuroticism and hostility are associated with both loneliness and depression making it difficult to tease apart the associations between the two (Cacioppo et al., 2010; Cacioppo, Hughes et al., 2006). Yet the link between loneliness and subsequent depression holds even when accounting for

confounding factors such as neuroticism and hostility (Cacioppo, Hughes et al., 2006; Cacioppo et al., 2010). Therefore, loneliness is an independent risk factor for depression above and beyond stable personality traits and past depression, suggesting it plays a unique role in emotional health. In addition to its role in emotional health, loneliness is also linked to physical health.

The concept of loneliness is not altogether different from the ways we construe physical pain. For example, people may say someone "ripped out my heart," "hurt my feelings," or "cut me to the core" as ways to describe the emotional distress they experience (MacDonald & Leary, 2005). Interestingly, this correspondence between physical and emotional pain descriptors is reflected in neurological studies of acute experiences of loneliness. Research on central neurological activity during lonely episodes has illustrated the involvement of neural structures in social isolation that are also triggered during physical pain. Specifically, evidence points to activation of common brain structures that are active to varying extents in response to both acute pain and feelings of social isolation (Cacioppo, Norris, Decety, Monteleone, & Nusbaum, 2008). For example, in a study of social exclusion using a ball-toss game, participants showed greater activity in the anterior cingulate cortex (ACC), a part of the brain that has also been shown to be activated by affective components of physical pain, when they were excluded compared to when they were included (Eisenberger, Lieberman, & Williams, 2003). Further, the pain reliever acetaminophen significantly reduced hurt feelings in participants who took the drug daily for three weeks compared to those who were administered placebo (DeWall et al.,

2010). Moreover, participants who were administered acetaminophen daily for three weeks showed less activity in the brain regions activated by both physical and social pain compared to those who were given placebo (DeWall et al., 2010). Thus, existing evidence points to an overlap between the neurophysiological systems in the brain for physical and emotional pain.

How Lonely People Behave: Social World, Stress, and Health Behaviors

The existing evidence points to deficits in social relations among lonely individuals that affect the way they approach social experiences (Hawkley, Preacher, & Cacioppo, 2007). One way that loneliness may affect an individual's social world is by moderating the associations between interpersonal events and subsequent mood. Whether between-person differences in loneliness moderates the relation between negative social interactions and subsequent negative and positive affect in healthy individuals has been explored in a daily diary study (Hawkley et al., 2007). Results indicated that neither the concurrent nor lagged effects of interaction quality on positive and negative affect were moderated by trait loneliness. Rather, high levels of trait loneliness were related to higher negative and lower positive affect overall in healthy people. Thus, the existing evidence drawn from daily experiences suggests that one major consequence of social isolation found in lonely individuals is the tendency to have negative perceptions of social interactions and to experience more negative affect as a result of poor social interactions (Hawkley et al., 2007).

Beyond experiencing greater social stress, an additional problem for lonely versus nonlonely individuals lies in the lack of positive reinforcement found in social interactions. For example, loneliness is linked to areas in the brain that are involved in social reward. In an fMRI study, results demonstrated that lonely individuals had less activation of reward-related brain activity in the ventral striatum when exposed to pleasant photos of people compared to nonlonely individuals (Cacioppo et al., 2008). Interestingly, lonely individuals exhibited greater reward-related brain activity in response to pleasant photos of non-social objects compared to photos of people; in contrast, nonlonley people experienced greater reward activation to social photos. Deficits in reward among lonely individuals have also been reported in research on oxytocin, a hormone positively related to social interactions. In a study of oxytocin and its beneficial effects on heart rate variability, lonely individuals did not experience the same cardiovascular benefits of oxytocin as nonlonely individuals (Norman et al., 2011). The lack of intrinsic reward from social interactions may lead lonely individuals to withdraw from social experiences to the point where they find themselves in a cycle of social isolation.

Some effort has been made to examine how sustained loneliness relates to behaviors that may be indicative of social withdrawal. For example, an investigation of self-reported coping styles revealed that lonely individuals were less likely than nonlonely people to reach out for instrumental or emotional support from others (Cacioppo et al., 2000). Lonely individuals also show an attention-shifting deficit relative to their nonlonely counterparts (Cacioppo et al.,

2000), leading to the suggestion that an inability to shift attention may make lonely people overwhelmed by new stimuli, including new stimuli in social situations. As a result, lonely people may become more distractible and withdrawn (Cacioppo et al., 2000). Although a possible link between attention-shifting deficits and social withdrawal in lonely people is intriguing, evidence pointing to such a link is scant at present.

Taking into account how loneliness can influence an individual's social perceptions, mood, and stress management abilities, it is reasonable to consider how loneliness may also impact an individual's ability to lead a healthy lifestyle. For example, lonely individuals are more likely to smoke cigarettes (Berkman et al., 2004; Lauder, Mummery, Jones, & Caperchione, 2006), and to be overweight and obese (Lauder et al., 2006) compared to those who are not lonely. Poor health behavior among the lonely extends to include physical inactivity. Lonely individuals report being less likely to have engaged in physical activity in the last two weeks compared to nonlonely individuals (Hawkley, Thisted, & Cacioppo, 2009).

Additionally, individuals who feel socially isolated may demonstrate reduced physical resilience because of deficits in restorative processes such as sleep that help the body replenish itself against future stress (Hawkley & Cacioppo, 2007). In fact, feelings of social isolation have been found to reduce the health benefits of sleep such that loneliness affects daytime dysfunction (i.e., feeling exhausted, fatigued, sleepy), regardless of the number of hours an individual slept (Hawkley, Preacher, & Cacioppo, 2010). Further, daytime

dysfunction can lead to subsequent lonely feelings thereby creating a cycle of social isolation (Hawkley et al., 2010). Individuals who are lonely also demonstrate poorer sleep efficacy and more time awake after initially falling asleep compared to nonlonely individuals, indicating that loneliness can affect physical resilience by disrupting restorative behaviors (Cacioppo, Hawkley, Berntson, et al., 2002). Thus, there is evidence that social isolation can not only affect emotional health, but also has connections to physical functioning within the body.

Who is Vulnerable to Becoming Lonely?

Although loneliness is prevalent among the general population, affecting roughly 36% of adults (Lauder, Sharkey, & Mummery, 2004), there are factors that are related to increased risk of loneliness. One such risk factor is chronic illness. A potential mechanism for increased loneliness among individuals with health issues is that they are often faced with a reduced ability to take part in social activities because of physical limitations. Even in the general population, lacking opportunities to socialize or deeming available opportunities as undesirable can result in increased loneliness (Hawkley et al., 2008). Individuals who already have a restricted ability to participate in social activities because of health issues could experience even greater feelings of loneliness. Physical limitations and uncertainty of day-to-day functioning resulting from chronic illness can leave individuals feeling that exerting extra energy for social activities is simply not worth the reward of interacting with others (Åsbring & Närvänen, 2002). Withdrawing from social activities because of subsequent emotional and

physical exhaustion may seem like a logical response to symptoms, but can ultimately result in more long-term distress because of the important role belonging plays in coping with an illness. Indeed, in a study of medical patients and the general population, individuals living with illnesses such as cancer and multiple sclerosis reported differing views of the causes of loneliness compared to the general population. Compared to healthy individuals, those with an illness rated unfulfilling intimate relationships, changes in mobility, and actual or perceived social rejection as significantly as more likely to be a cause of loneliness (Rokach, 2003). Interestingly, there were no differences in perceived causes of loneliness between disease types, suggesting that it is not the type of illness but poor health associated with it that predicts an individual's perception of loneliness (Rokach, 2003).

A second potential mechanism increasing vulnerability to loneliness among the chronically ill is the stigma that may be associated with the illness itself. Just as loneliness is a perception of social isolation, illness stigma is a perception of being alienated from others as a result of having an illness. A major component involved in the ability to cope with chronic conditions such as pain is the presence of strong social relationships. Individuals with a chronic illness need to know that there are people who care about their well-being and understand their physical and emotion pain. Illness stigma can stand in the way of this type of understanding. A qualitative study of chronic pain sufferers found that stigma can come in the form of obvious biases as well as more subtle clues, and is often experienced as emanating from health professionals, the community, friends and

family, co-workers, and even other chronic pain sufferers (Slade, Molloy, & Keating, 2009). In a study of pain patients, individuals reported feeling that friends and co-workers thought of their pain as simply an excuse to avoid working or participating in activities because, unlike a cast for a broken arm, chronic pain is not easily visible leaving self-report the only way to substantiate the pain (Slade et al., 2009). Interestingly, the study found that individuals may also stigmatize themselves due to the guilt and blame for having such a condition and needing additional care from others.

Some types of chronic illness may bring particular challenges with regard to stigmatization. In the case of chronic pain conditions such as fibromyalgia, where the illness is difficult to diagnose and based on unclear etiology, a great deal of uncertainty can be associated with the legitimacy of the illness (Åsbring & Närvänen, 2002). Consequently, although stigma can affect all individuals, pain-related stigma experienced by those with unclear chronic pain conditions like fibromyalgia may be especially distressing. Individuals may feel a lack of acceptance of their condition and thus a lack of understanding and sympathy regarding their pain, leaving them to feel alone in their pain, which in turn may trigger greater loneliness. Interviews of women with fibromyalgia and chronic fatigue syndrome revealed that they felt the credibility of the illness as well as their personal morality was often called into question by others who suggested that the condition involved malingering (Åsbring & Närvänen, 2002). Stigmatized individuals reported withdrawing from social situations as a strategy to avoid dealing with expectations about how they were supposed to act as well as

to avoid individuals who stigmatized them (Åsbring & Närvänen, 2002). Interestingly, self-concealment of symptoms that may result from stigma is related to greater bodily pain and lower psychological well-being, suggesting that efforts to reduce stigmatization may actually worsen pain (Uysal & Lu, 2011). Thus, stigma may play an important role in chronic pain conditions as sources of support may not seem readily available if the individual senses that they are being stigmatized by those close to them.

Why Loneliness May Matter for Adaptation in Chronic Pain Patients

How might loneliness impact the pain experience of chronic pain patients? As noted earlier, a growing body of evidence in social neuroscience suggests that the social pain of loneliness may in fact share common neurobiological underpinnings with bodily pain (MacDonald & Leary, 2005). If social and physical pain are indeed connected, then increases in loneliness could exacerbate vulnerability not only to emotional distress but to physical pain as well. For example, a community-based survey that included pain patients revealed that those who tend to experience hurt feelings more easily were also significantly more likely to report greater physical pain (MacDonald, Kingsburg, & Shaw, 2005). In a second study by the same authors, participants completed questionnaires on hurt feelings proneness and then wrote about a recent story of when they felt socially rejected or isolated (Macdonald et al., 2005). Following this task, participants viewed video clips of people experiencing a range of physical pain and then rated their own discomfort in watching the clips to assess adversity to physical pain. Results indicated that those who were more prone to

hurt feelings rated the painful videos as more aversive, indicating that they are more sensitive to physically threatening stimuli.

The emotional and physical implications of social disconnection are vast, but they are especially important when considered in the context of chronic pain as illness adds another layer of stress to a person's life. Existing evidence derived from chronic pain samples suggests that negative interpersonal events are sources of stress that are related to an increase in negative affect as well as a decrease in positive affect (Finan et al., 2010). Further, experiencing greater interpersonal stress across time is related to more negative affect during stressful periods (Zautra, Johnson, & Davis, 2005). In a study of stress in pain patients, financial and interpersonal stressors predicted increased health complaints and negative affect and were particularly detrimental when both stressors occurred during the same week (Skinner, Zautra, & Reich, 2004). Further, negative affect predicted greater pain, especially for those with higher average levels of negative affect and interpersonal stress (Skinner et al., 2004). Evidence demonstrating the relation between negative affect and pain and vice versa suggests a strong cyclic effect in chronic pain patients (Zautra et al., 2005). In a study of fibromyalgia patients, pain predicted increases in negative affect as well as decreases in positive affect (Zautra, Smith, Affleck, & Tennen, 2001). During periods of high stress, the relation between pain, increased negative affect, and decreased positive affect becomes stronger (Potter, Zautra, & Reich, 2000). Moreover, the impact of stress on pain and affect may continue over time (e.g., throughout the day or into the next day; Finan et al., 2010). The difficulty of coping with chronic stressors,

pain, and mood disturbances may be especially difficult for lonely individuals as they often find daily stressors more threatening, demanding, and stressful resulting in greater feelings of helplessness compared to their nonlonely counterparts (Hawkley et al., 2003; Hawkley and Cacioppo, 2007). Therefore, the pervasive impact of loneliness on an individual's daily mood, perceptions of social interactions, and ability to manage stress creates a substantial coping challenge for those who also experience the stress of a chronic health condition.

Current Study

The potential connection between physical and social pain within the body prompts the question of how adaptation to stress varies both between chronically lonely versus nonlonely people, and during episodes of acute loneliness. The current study examined how loneliness impacts the relations among interpersonal events, pain, and affect in individuals living with chronic pain. Because lonely individuals have a limited capacity both to draw on social resources and to engage in adaptive health behaviors, they may be more vulnerable to and less able to recover from stress than their nonlonely counterparts. The current study examined whether loneliness moderates the relations between negative interpersonal events and bodily pain, affect, and stress. (See Figure 1). Specifically, I tested two key hypotheses related to stress vulnerability. First, lonely versus nonlonely pain patients were predicted to show more pronounced interpersonal stress-related increases in pain, negative affect, and perceptions of stress as well as more pronounced decreases in positive affect. Second,

vulnerability across all participants to these stress-related effects was expected to be especially pronounced during acute episodes of increased loneliness.

The existing literature on loneliness also highlights the apparent lack of positive affect responses of lonely versus nonlonely people to positive stimuli, including positive social relations (Hawkley et al., 2007). Therefore, the current study also aimed to investigate the impact of loneliness on the relation of positive interpersonal events with positive affect and enjoyment appraisals. (See Figure 2). I proposed to test two key hypotheses regarding the relation between loneliness and responsivity to positive events. I predicted that positive affect and enjoyment appraisals following a positive interpersonal event would differ between lonely and nonlonely individuals, such that lonely individuals will experience less positive affect and less enjoyment related to positive interpersonal events compared to nonlonely individuals. Similarly, I also predicted that there would be diminished positive affect and enjoyment following positive events during lonely episodes across all participants.

Methods

Participants

A sample of individuals with chronic pain were recruited from the Phoenix metropolitan area using newspaper advertisements, online postings, and local doctors' offices as part of a larger study on psychological treatments for fibromyalgia. Individuals were included in the study if they: (1) were between the ages of 18 and 72; (2) had pain for three months or more in at least three of

four quadrants of the body, or in two quadrants of the body and substantial sleep disturbance and fatigue; (3) reported pain in at least 11 of 18 tender points during a home visit (described below), consistent with diagnostic criteria for FM established by the American College of Rheumatology (Wolfe et al., 1990); (4) did not have any autoimmune pain disorders; (5) were not currently in other research trials or receiving psychotherapy; and (6) were not pursuing litigation related to their pain condition.

Participant characteristics can be found in Table 1. The mean age of participants was 52 years old. Most participants were female, had 1-3 years of college, were married, Caucasian, and were not working. The modal annual family household income of participants was between $30,000 and $49,999. Most participants were Christian and attended religious services at least once a week.

Procedure

Interested participants were screened by phone to determine initial eligibility. Those who screened eligible underwent a tender point administered by a staff nurse. The nurse exam included administration of 4 kg of pressure delivered with a dolorimeter to each of 18 tender points and 3 control points. To qualify for study enrollment, participants had to report experiencing some pain in response to pressure on at least 11 of 18 tenderpoints. Upon enrollment, individuals read and signed a consent form and completed an initial questionnaire packet including measures of physical health, emotional health, and pain. Participants also completed a phone interview assessing psychological health and

life events. Next they completed pre-intervention assessments that included: (1) a laboratory assessment of physiological and affective responses to pain and emotion stimuli; (2) 21 days of diary reports regarding interpersonal events, pain, fatigue, sleep quality, mood, and coping; and (3) questionnaires regarding current symptoms and physical and emotional functioning. Participants were then randomly assigned to one of three 7-week treatment conditions. Following completion of treatment, they underwent post-intervention assessments identical to those in pre-assessment, and completed six- and twelve-month follow-up questionnaires.

The current study draws on data from the pre-intervention diaries of the first 123 individuals in the study who completed diary reports. To initiate the pre-intervention diary assessment, a member of the research team met with participants to provide them with a cell phone to use and detailed instructions and training on how to complete the phone diaries. Participants were prompted to complete diary reports four times per day for up to 21 days via an automated system that called the cell phone, delivered audio recorded questions, and collected responses via phone keypad input from participants. The morning call time was chosen by the participant while the other three calls came at 11:00 am, 3:30 pm, and 7:00 pm. If participants missed a call, they could call into the system within three hours of the automated call to complete the questions. Call completions were monitored by study staff, who routinely checked in with each participant on his/her progress. If participants missed several calls, they were contacted immediately by study staff members to remedy any potential barriers to

consistent completion. Participants were paid $2 for each day they completed diaries, with a bonus of $1/day for rates of completion that were 50%. The mean number of days completed by participants was 19.48 (*SD* = 5.71). The number of days completed ranged from 1 to 27. The main hypotheses for this study draw on the end-day-reports of pain, affect, events, stress, enjoyment, and loneliness.

Measures

Copies of all measures included in this project are available in Appendix A.

Pain. Daily pain was measured on a 101-point numerical scale used in numerous studies of chronic pain (Jensen, Karoly, & Braver, 1986) For end of day reports, participants were asked, "What was your overall level of pain today? Enter a number between 0 and 100 that best describes your pain level. A zero would mean "no pain" and a one hundred (100) would mean "pain as bad as it can be." Fifty-nine percent of the variance in pain scores was between-person and 41% of the variance was within-person.

Affect. Negative and positive affect was measured using 11 items drawn from the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) supplemented with an addition item created by the investigators. Participants rated the extent to which they experienced each affect during the day for 4 items reflecting negative affect and 7 items reflecting positive affect using a 5-point scale from 1 (not at all) to 5 (completely). A mean was created for items within each scale to create a positive and negative affect score for that day.

Sixty-six percent of the variance in negative affect scores was between-person and 34% of the variance was within-person. Fifty-six percent of the variance in positive affect scores was between-person and 44% of the variance was within-person. The within-person reliability for positive affect items was .74 and the within-person reliability for negative affect items was .58.

Loneliness. Loneliness was measured with the question, "Were you lonely?" Scores were rated on a 5-point scale from 1 (not at all) to 5 (completely). Fifty-four percent of the variance in lonely scores was between-person and 46% of the variance was within-person.

Occurrence of interpersonal events. Interpersonal events were measured using items from the Inventory of Small Life Events (ISLE) for older adults (Zautra, Schultz, & Reich, 2000). Items on the ISLE were supplemented with additional items created by study investigators. Participants were asked if 6 desirable and 8 undesirable events occurred with their spouse across the day by responding yes or no to each event. Examples of positive events include: "You celebrated with your spouse or partner," "You had a long conversation with your spouse or partner," and "You went out together with your spouse or partners (dinner, movies, dancing, etc.)". Examples of negative events include: "Your spouse or partner was critical or angry with you," "Your spouse or partner ignored you," and "Your spouse or partner was too busy to talk or go out." Participants were also asked about 10 desirable and 5 undesirable events with family across the day by listening to the event choices and keeping count of how many occurred in each category. Examples of positive events include: "You received a letter or

email from a family member," You talked with a family member you had not seen in a long time," and "Your child or children did something nice for you." Examples of negative events include: You were criticized or blamed for something by a family member," You had an argument with a family member," and "Your son or daughter was rude and irritable." Lastly, participants were asked about 6 desirable and 5 undesirable events involving friends or acquaintances that occurred across the day by listening to the event choices and keeping count of how many occurred in each category. Examples of positive events include: "You went to a party or other social gathering with friends," You met a new friend or acquaintance," and "You received a compliment from a friend or acquaintance." Examples of negative events include: "A friend or acquaintance did not return your call," You had a conflict with a friend or acquaintance," and "You had to deal with an unfriendly or rude person." Counts of total undesirable and desirable events across interpersonal domains were generated for each participant.

Appraisal of interpersonal events. After each set of questions about desirable events with a spouse, family, or friends and acquaintances, participants were asked how enjoyable their relations were within each domain. For example, after answering questions about desirable events with a spouse, participants were asked, "Overall, how enjoyable were your relations with your spouse or partner today, on a scale of 1 to 5?" The response scale included the following options: (1) is not at all; (2) a little; (3) some; (4) quite a bit; or (5) completely. Similarly, after each set of questions about undesirable events with a spouse, family, or

friends and acquaintances, participants were asked how stressful their relations were with each group using the same response scale. Appraisals across domains within a day were averaged to create daily stress and enjoyment scores.

Data Reduction and Analytic Plan

Multilevel modeling was the most appropriate approach to data analysis for the current project because the data were structured such that each participant provides end of day reports across a 21-day period. This design allows for both within- and between-person comparisons. Because observations per participant occurred over 21 days, there was a high likelihood of missing data. Multilevel modeling is useful in this respect because it includes observations from all participants, regardless of whether they completed every assessment.

The current study had two levels consisting of days (Level 1 or within-person) nested within individuals (Level 2 or between-person). To disaggregate the between- from the within-person variation included in the end-of-day reports, these reports were centered within-person. Specifically, each participant's daily score was subtracted from his/her mean score over all days of assessment. Thus, each centered score signified each day's deviations from an individual's mean across all their days of assessment (i.e., level 1 variable). The intercept was also centered within the sample by subtracting each participant's average score on a specific variable from the group's average on the same variable (grand mean centering). The individual's mean score on measures across days reflected the between-person differences (i.e., level 2 variable). As an example of the two levels, centered loneliness reflected the level 1 day-to-day deviations from an

individual's average loneliness score (i.e., "when" someone feels lonely) whereas mean loneliness across the 21 days represented the level 2 trait variable of loneliness (i.e., "who" feels lonely). Level 1 person-centered scores are uncorrelated with level 2 score on the same variable, facilitating interpretation of effects (Enders & Tofighi, 2007).

The first hypothesis predicted that trait loneliness would moderate the relations of negative interpersonal events with pain, stress appraisals, positive affect, and negative affect. Specifically, the links between negative interpersonal events and the dependent variables were expected to be stronger in high versus low lonely people in a maladaptive direction. The second hypothesis predicted that the relation of positive interpersonal events with enjoyment appraisals and positive affect would less pronounced for lonely rather than nonlonely individuals. Hypothesis three predicted that within-person fluctuations in loneliness would moderate the relations of negative interpersonal events with pain, stress appraisals, and affect in a maladaptive direction. Hypothesis four tested whether the relation of positive interpersonal events with enjoyment appraisals and positive affect were diminished during lonely episodes.

The following model depicts a sample equation testing Hypothesis 1 with regard to the moderating effects of trait loneliness in the links between negative interpersonal events and pain.

$$\text{daily pain} = \beta_0 + \beta_1 \textit{ change in negative interpersonal events} + \quad (1a)$$

β_2 *trait loneliness* + β_3 *change in negative interpersonal events X trait loneliness* + *r*.

In this equation, β_0 provides an estimate for the intercept for daily pain, β_1 represents the slope of the relation between the change in negative interpersonal events and daily pain, β_2 represents the slope of the relation between trait loneliness and daily pain, and β_3 represents the moderating effect of trait loneliness on the slope of the relation between change in negative interpersonal events and daily pain. Finally, *r* is the within-person residual. Similar models were evaluated for all hypotheses.

The grand mean of all the intercepts, the within-subjects residual/error (*r*), and the between-subjects error (deviation of each participant's mean from the grand mean) (u_0) were specified as random effects. The remaining variables in the model were specified as fixed effects. Autoregressive terms were included in models. To ensure that analyses involving affect as the dependent variable were not simply a reflection of more negative or positive affect and vice versa, analyses involving these dependent variables were repeated with the alternate affect included as a covariate. Because loneliness overlaps with negative affect, all analyses were repeated including person-centered and sample mean centered negative affect in the model. In models where negative affect was the dependent variable, person-centered and sample mean centered positive affect was included in the model. In addition, analyses were repeated with sample centered mean levels of events included. All tables of findings include models without covariates on the left and with covariates on the right side.

Exploratory Analyses

Analyses were also conducted to determine if trait loneliness moderated the association between negative interpersonal events, pain, stress appraisals, and affect during lonely episodes, with the prediction that outcomes would be poorest in circumstances of high trait loneliness combined with increases in state loneliness and increases in negative interpersonal events. This would be reflected as a significant triple interaction term (i.e., trait lonely X state lonely X negative interpersonal events) in the model.

Results

Preliminary Analyses

Preliminary analyses examining intercorrelations between demographic variables and key study variables revealed that several demographic variables were related to variables of interest in tests of study hypotheses. Intercorrelations can be found in Table 2. Females reported more enjoyment, positive events, and positive affect and less pain and stress than males. Older people reported more enjoyment and less loneliness than younger people. More educated people reported more positive affect and less loneliness, pain, and negative affect than less educated people. People who were married or living with a partner had more positive events and enjoyment and less loneliness than people who were not married or living with a partner. People who were employed had less pain than those who were unemployed. Caucasians had less loneliness and negative events than those who were not Caucasian. People with higher incomes had more

positive events, enjoyment, and positive affect and less loneliness, pain, stress, and negative affect than those with lower incomes. Those who were Christian had less negative affect than those who were not. People who attended religious services more frequently also had less negative events than those who attended religious services less frequently.

Descriptive Analyses

Means, standard deviations, ranges, and between-person intercorrelations correlations for study variables are presented in Tables 3 and 4. Trait loneliness was relatively low in this sample. On average, levels of daily pain were near the middle of the 0-100 scale. Participants reported more positive interpersonal events on average than negative interpersonal events. Similarly, participants reported higher levels of enjoyment compared to stress from social interactions. On average, participants reported more daily positive affect than negative affect. In general, trait loneliness was characterized by reports of higher pain, fewer positive events and more negative events, less interpersonal enjoyment and more perceived interpersonal stress, and lower positive affect and higher negative affect.

Intercorrelations between person-centered daily measures can be found in Table 5. State loneliness was characterized by higher reports of pain, more negative events, and fewer positive events. State loneliness was also associated with lower interpersonal enjoyment and higher perceived interpersonal stress and lower positive affect and higher negative affect.

Trait Loneliness and Events Predicting Pain, Stress and Enjoyment Appraisals, and Affect

Hypotheses 1 a – 1 d

Hypothesis 1a predicted that trait loneliness would moderate the relation between daily changes in negative interpersonal events and pain (see Table 6, left side). Changes in negative interpersonal events ($t = 2.08$, $p < .05$) and trait loneliness ($t = 4.07$, $p < .001$) significantly predicted more pain, but the interaction between trait loneliness and change in negative interpersonal events was not significant *(*$t = -.16$, $p = .87$). Thus, trait loneliness does not moderate the relation between changes in negative interpersonal events and pain. When the analysis was re-run with covariates, (see Table 6, right side) trait loneliness continued to significantly predict more pain, but changes in negative interpersonal events did not. Further, changes in negative affect significantly predicted more pain indicating that negative affect, accounted for the relations between negative events and pain.

Hypothesis 1b predicted that trait loneliness would moderate the relation between changes in negative interpersonal events and perceived interpersonal stress (see Table 6, left side). Changes in negative interpersonal events ($t = 23.32$, $p < .001$) and trait loneliness ($t = 6.26$, $p < .001$) both significantly predicted more perceived interpersonal stress. The interaction between changes in negative interpersonal events and trait loneliness was not significant ($t = 0.65$, $p = .52$. Thus, trait loneliness does not moderate the relation between changes in negative

interpersonal events and perceived interpersonal stress. When the analysis was re-run with covariates, (see Table 6, right side) trait loneliness and changes in negative events continued to significantly predict more stress. In addition, changes in negative affect and mean negative events also predicted more stress.

Hypothesis 1c predicted that trait loneliness would moderate the relation between changes in negative interpersonal events and positive affect (see Table 6, left side). Changes in negative interpersonal events (t = -4.09, p < .001) and trait loneliness (t = -4.07, p < .001) both significantly predicted less positive affect. The interaction between changes in negative interpersonal events and trait loneliness was not significant (t = 1.61, p = .11), indicating that trait loneliness does not moderate the relation between changes in negative interpersonal events and positive affect. When the analysis was re-run with covariates, (see Table 6, right side) trait loneliness and changes in negative events no longer significantly predicted positive affect. Changes in negative affect significantly predict less positive affect indicating that the relations between trait loneliness, changes in negative interpersonal events, and positive affect are accounted for by negative affect.

Hypothesis 1d predicted that trait loneliness would moderate the relation between changes in negative interpersonal events and negative affect (see Table 6, left side). Changes in negative interpersonal events (t = 9.67, p < .001) and trait loneliness (t = 13.64, p < .001) both significantly predicted more negative affect. The interaction between changes in negative interpersonal events and trait loneliness was not significant (t = -.53, p = .59), indicating that trait loneliness

does not moderate the relation between changes in negative interpersonal events and negative affect. When the analysis was re-run with covariates, (see Table 6, right side) trait loneliness and change in negative interpersonal events continued to predict more negative affect. In addition, changes in positive affect also significantly predicted less negative affect.

Thus, findings were not consistent with Hypotheses 1a-d. Trait loneliness did significantly predict higher levels of pain, perceived interpersonal stress, and negative affect, and lower levels of positive affect, above and beyond the variance accounted for by daily changes in negative interpersonal events. However, trait loneliness did not moderate the relations between changes in negative events and any outcome.

Hypotheses 2 a – 2 b

Hypothesis 2a predicted that trait loneliness would moderate the relation between changes in positive interpersonal events and perceived interpersonal enjoyment, such that the relations between positive events and enjoyment would be less pronounced for lonely people (see Table 7, left side). Changes in positive interpersonal events ($t = 14.91$, $p < .001$) significantly predicted more perceived interpersonal enjoyment, whereas trait loneliness ($t = -3.87$, $p < .001$) significantly predicted less enjoyment. The interaction between changes in positive interpersonal events and trait loneliness was significant ($t = 3.24$, $p < .01$), and the interaction is illustrated in Figure 3. Opposite of prediction, the positive relation between changes in positive events and enjoyment is stronger among less versus

more lonely individuals. Thus, Hypothesis 2a was not supported. When the analysis was re-run with covariates, (see Table 7, right side) trait loneliness no longer significantly predicted enjoyment. However, changes in positive interpersonal events and the interaction between positive events and trait loneliness remained significant. Mean levels of positive events significantly predicted more enjoyment and changes in negative affect significantly predicted less enjoyment suggesting that the relation between trait loneliness and enjoyment is accounted for by these variables.

Hypothesis 2b predicted that trait loneliness would moderate the relation between changes in positive interpersonal events and positive affect (see Table 7, left side). Changes in positive interpersonal events (t = 10.98, p < .001) significantly predicted more positive affect, whereas trait loneliness (t = -4.08, p < .001) significantly predicted less positive affect. The interaction between changes in positive interpersonal events and trait loneliness was not significant (t = -0.25, p = .81), indicating that trait loneliness does not moderate the relation between changes in positive interpersonal events and positive affect. When the analysis was re-run with covariates, (see Table 7, right side) trait loneliness no longer significantly predicted positive affect, but changes in positive events remained significant. Mean levels of positive events significantly predicted more positive affect and changes in negative affect significantly predicted less positive affect suggesting that the relation between trait loneliness and positive affect is accounted for by these variables.

In summary, findings were opposite from the predictions of Hypothesis 2a: high trait loneliness moderated the relation between changes in positive interpersonal events and perceived interpersonal enjoyment such that high lonely people benefitted more from positive events than low lonely people. With regard to Hypothesis 2b, although trait loneliness also predicted lower positive affect, it did not moderate the link between changes in positive interpersonal events and positive affect.

State Loneliness, Events, Pain, Stress and Enjoyment Appraisals, and Affect

Hypotheses 3 a – 3 d

Hypothesis 3a predicted that state loneliness would moderate the relation between changes in negative interpersonal events and pain (see Table 8, left side). State loneliness ($t = 4.23$, $p < .001$) significantly predicted increased pain, but neither changes in negative interpersonal events ($t = 1.44$, $p = .15$) nor the interaction between changes in negative interpersonal events and state loneliness significantly predicted pain ($t = .41$, $p = .68$). Thus, state loneliness does not moderate the relation between changes in negative interpersonal events and pain. When the analysis was re-run with covariates, (see Table 8, right side) changes in loneliness continued to significantly predict more pain. In addition, changes in negative affect and mean levels of negative affect significantly predicted more pain.

Hypothesis 3b predicted that state loneliness would moderate the relation between changes in negative interpersonal events and perceived interpersonal

stress (see Table 8, left side). Changes in negative interpersonal events (t = 22.51, p < .001) and state loneliness (t = 3.21, p < .01) both significantly predicted more perceived interpersonal stress. The interaction between changes in negative interpersonal events and state loneliness was not significant (t = 0.20, p = .84), indicating that state loneliness does not moderate the relation between changes in negative interpersonal events and perceived interpersonal stress. When the analysis was re-run with covariates, (see Table 8, right side) changes in negative interpersonal events continued to predict more stress, but changes in loneliness no longer significantly predicted stress. Changes in negative affect, mean levels of negative affect, and mean levels of negative interpersonal events also significantly predicted more stress suggesting that the relations between changes in loneliness and interpersonal stress are accounted for by these variables.

Hypothesis 3c predicted that state loneliness would moderate the relation between changes in negative interpersonal events and positive affect (see Table 8, left side). Changes in negative interpersonal events (t = -3.24, p < .01) and state loneliness (t = -10.45, p < .001) both significantly predicted less positive affect. The interaction between changes in negative interpersonal events and state loneliness was not significant (t = 1.50, p = .14), indicating that state loneliness does not moderate the relation between changes in negative interpersonal events and positive affect. When the analysis was re-run with covariates, (see Table 8, right side) changes in loneliness continued to predicted less positive affect, but changes in negative interpersonal events was no longer significant. In addition, changes in negative affect and mean levels of negative affect predicted less

positive affect suggesting that the relation between negative interpersonal events and positive affect is accounted for by trait and state levels of negative affect.

Hypothesis 3d predicted that state loneliness would moderate the relation between changes in negative interpersonal events and negative affect (see Table 8, left side). Changes in negative interpersonal events ($t = 8.55$, $p < .001$) and state loneliness ($t = 16.10$, $p < .001$) both significantly predicted more negative affect. The interaction between changes in negative interpersonal events and state loneliness was not significant ($t = -.06$, $p = .95$), indicating that state loneliness does not moderate the relation between changes in negative interpersonal events and negative affect. When the analysis was re-run with covariates, (see Table 8, right side) changes in loneliness and negative interpersonal events continued to significantly predict more negative affect. In addition, changes in positive affect and mean levels of positive affect significantly predicted less negative affect, and mean levels of negative events significantly predicted more negative affect.

In summary, findings were not consistent with Hypotheses 3a-d. These results indicate that state loneliness significantly predicted higher pain, perceived interpersonal stress, negative affect, and lower positive affect over and above the variance accounted for by changes in negative interpersonal events. It did not, however, moderate the relations between changes in negative interpersonal events and any of the outcomes.

Hypotheses 4 a – 4 b

Hypothesis 4a predicted that state loneliness would moderate the relation between changes in positive interpersonal events and perceived interpersonal enjoyment such that the relations between positive events and enjoyment would be less pronounced during lonely episodes (see Table 9, left side). Changes in positive interpersonal events ($t = 13.79$, $p < .001$) significantly predicted more perceived interpersonal enjoyment, whereas state loneliness ($t = -7.12$, $p < .001$) significantly predicted less enjoyment. The interaction between changes in positive interpersonal events and state loneliness was significant ($t = 1.99$, $p < .05$), indicating that state loneliness moderates the relation between changes in positive interpersonal events and enjoyment appraisals. The interaction is depicted in Figure 4, and shows that the relation between increased daily positive interpersonal events and enjoyment is stronger on days of increased (versus decreased) loneliness. Thus, the data were not consistent with Hypothesis 4a. When the analysis was re-run with covariates, (see Table 9, right side) changes in loneliness continued to predict less enjoyment and changes in positive events continued to significantly predict more enjoyment. However, the interaction between changes in loneliness and positive interpersonal events became marginally significant. In addition, mean levels of positive events significantly predicted more enjoyment and changes in negative affect and mean levels of negative affect significantly predicted less enjoyment suggesting that the interaction between positive events and state loneliness is accounted for by these variables.

Hypothesis 4b predicted that state loneliness would moderate the relation between changes in positive interpersonal events and positive affect (see Table 9, left side). Changes in positive interpersonal events ($t = 10.57$, $p < .001$) significantly predicted more positive affect, whereas state loneliness ($t = -9.94$, $p < .001$) significantly predicted less positive affect. The interaction between changes in positive interpersonal events and state loneliness was not significant ($t = -0.81$, $p = .42$), indicating that state loneliness does not moderate the relation between changes in positive interpersonal events and positive affect. When the analysis was re-run with covariates, (see Table 9, right side) changes in loneliness continued to predict less positive affect and changes positive interpersonal events continued to predict more positive affect. In addition, mean levels of positive interpersonal events predicted more positive affect and changes in negative affect and mean levels of negative affect significantly predicted less positive affect.

In summary, findings were opposite from the predictions of Hypothesis 4a: state loneliness moderated the relation between changes in positive interpersonal events and perceived interpersonal enjoyment such that people experiencing lonely episodes benefitted more from positive events than those not feeling lonely. With regard to Hypotheses 4b, although state loneliness predicted lower positive affect, controlling for changes in positive interpersonal events, it was not a moderator between changes in positive interpersonal events and positive affect.

Results of Exploratory Analyses

I probed whether trait loneliness would moderate the relation between changes in negative interpersonal events and pain (exploratory hypothesis 1), stress (exploratory hypothesis 2), positive affect (exploratory hypothesis 3), and negative affect (exploratory hypothesis 4) during lonely episodes (i.e., state loneliness). In each exploratory hypothesis, there were no significant triple interactions indicating that these outcomes are not exacerbated when lonely people have episodes of loneliness.

Discussion

Loneliness has been identified as a potent predictor of psychological and physical outcomes in recent years (Cacioppo, Hawkley et al., 2006; Hawkley et al., 2009; MacDonald and Leary, 2005). It can be considered both a stable individual difference as well as a transitory state. In the current study, the focus was on examining how both stable and transitory loneliness dimensions were related to the interpersonal experiences of individuals with chronic pain. A key question for the field is whether being a lonely person or experiencing a lonely episode is associated with more frequent reports of negative interpersonal events or greater maladaptive responses to those events. Conversely, it is also important to consider whether being a lonely person or experiencing a lonely episode is associated with less frequent reports of positive interpersonal experiences or less pronounced emotional benefits from those experiences.

Findings from the current study indicate that not only do lonely people have more negative interpersonal, affective, and pain experiences than nonlonely

people, but also individuals experiencing lonely episodes exhibit similar maladaptive patterns. Both lonely people and individuals when they are experiencing lonely episodes report more frequent negative and less frequent positive interpersonal events compared to nonlonely people and individuals experiencing nonlonely episodes, respectively. Stable and transitory loneliness are also associated with higher levels of pain, interpersonal stress, and negative affect, and less positive affect and interpersonal enjoyment than nonlonely individuals and episodes. Contrary to prediction, however, neither stable nor transitory loneliness moderated the relation between negative interpersonal events and pain, stress, negative affect, or positive affect. That is, neither being chronically lonely nor experiencing a lonely episode makes exposure to negative interpersonal events worse in terms of pain, stress, positive affect, or negative affect. Further, being chronically lonely or experiencing a lonely episode does not appear to limit the experience of positive affect associated with fluctuations in positive interpersonal events.

The strong association between loneliness and negative affect poses the question of whether they are one in the same. Current findings demonstrate that while the two constructs overlap, they are substantially unique experiences. With regard to pain, for example, the relations of stable and transitory loneliness with pain persist even when controlling for negative affect and negative interpersonal events. Thus, not only are chronically lonely people likely to report more pain, but also even having a lonely day may put an individual at risk for

higher pain. Moreover, loneliness may have direct effects on pain beyond the experience of negative affect and negative events.

Previous research has suggested that physical and social pain are connected via similar brain structures (Cacioppo et al., 2008; MacDonald & Leary, 2005). Connections have been drawn in previous research findings that a tendency to experience hurt feelings is linked to physical pain (MacDonald et al., 2005). Beyond being prone to hurt feelings, the current study expands on these findings by demonstrating that the actual experience of long-term social pain in the form of chronic loneliness can put individuals at greater risk for higher levels of chronic pain as well. In addition, the current study found that the ways that loneliness influences well-being extend beyond physical pain by also affecting stress and mood.

The current study's findings are also in line with previous research suggesting that chronically lonely individuals find daily events more stressful and have more negative and less positive affect than those who are not lonely (Hawkley et al., 2003; Hawkley & Cacioppo, 2007; Hawkley et al., 2007). Unlike previous research, however, the current study found that transitory loneliness also predicted more stress and negative affect, and less positive affect, suggesting that both chronic and transitory loneliness can have negative influences on a person's life. The relations between loneliness and interpersonal stress may be especially important in the context of chronic pain, given the additional stressors and mood disturbances present in a person's life that accompany a chronic pain condition. For example, many individuals with

fibromyalgia often report feeling stigmatized and misunderstood by others (Åsbring & Närvänen, 2002). Consequently, the intangible and uncertain nature of fibromyalgia may leave individuals feeling alone in their illness, thereby creating higher levels of stress when interacting with others who do not understand or support their disease. Combining research suggesting that lonely individuals are already less likely to reach out for support (Cacioppo et al., 2000) with the current findings that loneliness is associated with higher pain and stress suggests that it may be especially difficult for lonely individuals with chronic pain to remedy their lack of social connections due to issues of pain-related disability, stigma, and interpersonal stress.

Yet despite potential problems in interactions with others, lonely individuals do appear to have the ability to benefit from positive interpersonal events. A key finding of the current study is that lonely people and episodes of loneliness may confer the capacity to enjoy a boost in the benefits from positive interpersonal events. Contrary to what was predicted, chronically lonely people had greater boosts in enjoyment of their social relations on days with increased positive interpersonal events, than people who were not lonely. In a similar pattern, on days with increased loneliness, experiencing an increase in positive interpersonal events was associated with a greater boost in enjoyment of social relations compared to days of decreased loneliness. Therefore, for people *who* feel chronically lonely, and *when* people feel an increase in loneliness, days with more positive events than usual boost the sense of enjoyment of social ties. Previous research has found that lonely individuals may not find positive social

interactions as rewarding as nonlonely individuals and thus do not experience the many benefits that come from being socially connected (Cacioppo et al., 2008; Hawkley et al., 2007). The current study did find that lonely people have overall deficits in their ability to find enjoyment from positive interpersonal events. However, their ability to experience enjoyment during days when they experienced an increased frequency in positive interpersonal events was greater than nonlonely people. Such results are encouraging for an otherwise bleak outlook surrounding chronic loneliness because they suggest that although positive events may not happen as often for lonely people, such events can make a significant and positive difference in their level of enjoyment when they do occur more often.

The current study's findings regarding important influences of both chronic and transitory loneliness have several implications for clinical work with individuals experiencing chronic pain and loneliness. For example, understanding that chronic and transitory loneliness can have a major impact on physical pain and stress, future interventions for chronic pain can build in strategies to address loneliness by teaching individuals how to comfortably reach out to others for support when they are feeling distressed. Social support has been found to mediate the effects of loneliness on stress (Hawkley et al., 2003), suggesting that building in more social support for individuals with chronic pain may help reduce their stress and pain levels, particularly for lonely pain patients and for patients during lonely episodes. Further, building in more frequent positive social interactions into the lives of pain patients may be paramount to their well-being.

The finding that lonely individuals experience major boosts in their perceived enjoyment with others suggests that if they are given more opportunities to see social interactions as enjoyable, they may be able to feel more connected with others, which may reduce the negative effects of loneliness on other areas of their lives. Further, if lonely people have difficulty finding pleasure in interactions with others, increasing positive social experiences may be the key to showing them that they can find enjoyment in social interactions, which may increase their likelihood of continuing to connect with other people.

Despite the findings, the current study has several limitations. First and foremost, the study used a single question to assess loneliness rather than a multiple-item questionnaire. The results may have differed if a full scale measure of loneliness was used, such as the R-UCLA Loneliness Scale (Russell, Peplau, & Cutrona, 1980) that uses 20 questions to assess a full range perceptions and feelings associated with loneliness. In addition, concurrent relations based on end of day reports, rather than lagged effects, were examined in this study meaning that temporal precedence cannot be established. The variables of interest may exist in a different direction temporally. For example, instead of negative affect predicting pain, it could be that pain creates more negative affect and that phenomenon fuels a cycle of more pain. Similarly, a few of the proposed predictors in the current study may actually be mediators between other variables and outcomes. The current study also did not explore mechanisms such as cognitions or behaviors that may help clarify how loneliness operates. In regards to the sample, participants were from a chronic pain population rather than a

healthy population and their loneliness levels and/or reactions to loneliness episodes may be different than those without chronic pain, or who experience other chronic medical conditions.

The current study and previous research has also been unable to find that loneliness is associated with increased reactivity to negative events despite indications that lonely people report that they find events more stressful (Hawkley et al., 2003; Hawkley & Cacioppo, 2007). These findings pose the question of whether lonely people are more reactive in the moment to negative interpersonal events or whether they just have a global perception that social interactions in general are stressful. One potential mechanism that should be explored in future research is whether lonely people's stress appraisals of social events rather than the social events themselves may actually be responsible for the negative outcomes of lonely people. Hawkley and colleagues (2007) explored part of this notion by examining whether differences in stable loneliness moderated the relation between interaction quality and mood, but did not find significant evidence of this phenomenon. However, it may be that rather than how positive or negative a lonely person believes an interaction to be, either the extent to which they appraise the situation to be stressful or the impact of the situation on how they feel about themselves may influence their mood or pain levels. For example, if the social interaction makes a lonely person feel accepted, well-liked, and connected, they may experience more enjoyment versus feeling that they do not belong despite having a social interaction. Future research should invest in fine-grained evaluation of daily accounts of lonely individuals' social experiences to

determine whether it is their perceived stress level and subsequent perceptions of themselves rather than the interaction itself that drive their poor well-being. Further, investigations into how long lonely people maintain perceptions of themselves and their social world following interpersonal events may also provide insight into how long negative versus positive social experiences affect a lonely person's view over time. It may be that negative events leave a long lasting impression that social connections are not readily available, trustworthy, or worthwhile whereas positive events may only result in short-term improvements in a lonely person's view of the world.

In addition to exploring the stress and self-perceptions that occur during social interactions, future research should invest in understanding how chronically lonely people may be affected by days when they feel even more lonely than usual. The current study explored whether chronically lonely individuals experiencing a lonely episode would be at greater risk for negative consequences. Contrary to prediction, however, lonely people who experience a day when they feel more lonely than usual did not have more negative consequences on their pain, stress level, or mood than nonlonely individuals. Given the lack of evidence for poorer outcomes in lonely people experiencing lonely episodes, it is important to consider other potential factors that may be influencing the experience of a lonely person, such as appraisals and self-perceptions that occur during lonely episodes to determine if lonely people may be at greater risk for negative outcomes when they experience a lonelier day than usual.

Both chronic loneliness and episodes of loneliness can have negative consequences, especially in the lives of chronic pain patients. Increased levels of pain, stress, and poor mood are common experiences for lonely individuals. However, lonely individuals do experience significant boosts in enjoyment when they have more positive interpersonal events than usual. This is encouraging evidence that can inform interventions and clinical work with lonely individuals. Incorporating strategies to help lonely people reach out to others and experience positive events may be paramount to improving their level of social connection. Despite the poor outcomes for both chronically lonely individuals and those experiencing episodes of loneliness, capitalizing on the positive aspects of social relations may be the key to helping lonely people in chronic pain successfully cope with many of the negative interpersonal aspects of their condition.

Table 1

Sample Characteristics (N = 123)

Measures	Mean or % *(SD)*
Age	52.08 (11.30)
Male	15.3
Female	84.7
Education	
5-8 years	.8
Not completed high school	.8
Completed high school	10.0
Post high school/business/trade	13.3
1-3 years of college	32.5
4 years of college	19.2
Post graduate	23.3
Marital Status	
Never married	8.1
Married	54.0
Widowed	5.6
Divorced	25.0
Living with romantic partner	7.3
Employment	
Working/Volunteering	55.3
Not working or volunteering	44.7
Race/Ethnicity	
Caucasian	75.6
Black/African American	2.4
Asian	1.6
Hispanic	15.7
Native American	2.4
Native Hawaiian/Pacific Islander	3.1

Table 1

Sample Characteristics (N = 123)

Measures	Mean or % *(SD)*
Income	
Under $3,000-$20,999	18.6
$21,000-$39,999	23.0
$40,000-$59,999	21.2
$60,000-$99,999	25.7
$100,000-$149,999	9.7
$150,000 and over	1.8
Religious Preference	
Catholic/Christian	67.8
Other	32.2
Religious Service Attendance	
At least once a week	31.7
About two or three times a month	18.7
About once a month	5.7
Less than once a month but at least once a year	21.1
Never	22.8

Table 2

Intercorrelations of Demographic and Between-Person Study Variables

Measures	Trait Loneliness	Pain	Negative Events	Positive Events	Stress	Enjoyment	Negative Affect	Positive Affect
Female Gender	-.15	-.18*	-.03	.20*	-.18*	.20*	-.06	.22*
Age	-.26**	-.08	-.18	.09	-.12	.22*	-.17	.18
Education	-.21*	-.25**	.04	.18	-.08	.15	-.22*	.27**
Married/Partner	-.22*	-.004	.16	.50***	-.13	.22*	-.07	.001
Employed	.09	-.22*	.05	.004	.01	.05	-.03	.17
Caucasian	-.18*	.06	-.19*	.09	-.14	.04	-.16	.01
Income	-.36***	-.26**	.07	.48***	-.22*	.25**	-.25**	.26**
Catholic/Christian	-.16	-.08	.11	.10	.01	.04	-.22*	.10
Religious Attendance	.05	.07	-.27**	-.12	-.15	.08	.01	-.07

Note: * $p < .05$; ** $p < .01$; *** $p < .001$. The sample size for correlations ranges from 110 to 123.

Table 3

Descriptive Statistics of Between-person Variables Across All Days (N= 122)

Measures	*M (SD)*	Observed Range	Skewness	Kurtosis
Trait Loneliness	1.79 (.92)	1-5	1.52	1.85
Daily Pain	51.39 (20.07)	6-90	-.17	-.71
Daily Negative Events	1.26 (1.20)	0-6	1.63	3.0
Daily Positive Events	3.33 (1.80)	0-9	.85	.72
Interpersonal Stress	1.80 (.61)	1-4	.60	-.61
Interpersonal Enjoyment	3.63 (.77)	2-5	-.20	-.90
Negative Affect	1.73 (.75)	1-5	1.82	3.47
Positive Affect	2.64 (.62)	1-5	.62	1.27

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

Table 4

Intercorrelations of Between-person Variables Across All Days (N= 122)

Measures	1	2	3	4	5	6	7	8
1. Trait Loneliness	-							
2. Daily Pain	.33***	-						
3. Daily Negative Events	.30**	.09	-					
4. Daily Positive Events	-.20*	-.12	.07	-				
5. Interpersonal Stress	.51***	.32***	.73***	-.24**	-			
6. Interpersonal Enjoyment	-.33***	-.31***	-.41***	.44***	-.65***	-		
7. Negative Affect	.80***	.28***	.36***	-.11	.53***	-.32***	-	
8. Positive Affect	-.33***	-.42***	-.21*	.22*	-.38***	.60***	-.33***	-

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

Table 5

Intercorrelations of Daily Variables Centered Within-person

Measures	1	2	3	4	5	6	7	8
1. ΔLoneliness	-							
2. ΔDaily Pain	.10***	-						
3. ΔDaily Negative Events	.12***	.06*	-					
4. ΔDaily Positive Events	-.10***	-.00	.02	-				
5. ΔInterpersonal Stress	.12***	.08***	.49***	-.06*	-			
6. ΔInterpersonal Enjoyment	-.20***	-.11***	-.26***	.33***	-.31***	-		
7. ΔNegative Affect	.38***	.15***	.23***	-.07**	.26***	-.21***	-	
8. ΔPositive Affect	-.25***	-.26***	-.11***	.27***	-.17***	.35***	-.33***	-

Note: Δ reflects person-centered score. * $p < .05$; ** $p < .01$; *** $p < .001$.
The sample size for correlations ranges from 1819 to 2006.

Table 6

Hypotheses 1a-1d With Trait Loneliness, Centered Negative Interpersonal Events, Their Interactions, and Covariates as Predictors

	B(SE)	*df*	*p-value*	*B (SE)*	*df*	*p-value*
1a. Pain is DV						
Level 1						
ΔDaily Negative Events	.53 (.26)	1742	.037	.14 (.26)	1698	.59
Trait LonelinessXΔNegative Events	-.05 (.31)	1742	.87	-.01 (.31)	1698	.97
ΔNegative Affect	-	-	-	4.94 (.78)	1698	<.0001
Level 2						
Trait Loneliness	8.09 (2.00)	116	<.0001	6.52 (3.23)	114	.045
Mean Negative Events	-	-	-	-.81 (1.55)	114	.60
Mean Negative Affect	-	-	-	2.82 (3.96)	114	.48
1b. Interpersonal Stress is DV						
Level 1						
ΔDaily Negative Events	.25 (.01)	1739	<.0001	.24 (.01)	1698	<.0001
Trait LonelinessXΔNegative Events	.01 (.01)	1739	.52	.01 (.01)	1698	.38
ΔNegative Affect	-	-	-	.23 (.03)	1698	<.0001
Level 2						
Trait Loneliness	.35 (.06)	116	<.0001	.14 (.07)	114	.037
Mean Negative Events	-	-	-	.30 (.03)	114	<.0001
Mean Negative Affect	-	-	-	.14 (.08)	114	.10

Table 6

Hypotheses 1a-1d With Trait Loneliness, Centered Negative Interpersonal Events, Their Interactions, and Covariates as Predictors

1c. Positive Affect is DV						
Level 1						
ΔDaily Negative Events	-.04 (.01)	1706	<.0001	-.01 (.01)	1698	.24
Trait LonelinessXΔNegative Events	.02 (.01)	1706	.11	.01 (.01)	1698	.13
ΔNegative Affect	-	-	-	-.35 (.03)	1698	<.0001
Level 2						
Trait Loneliness	-.26 (.06)	116	<.0001	-.15 (.10)	114	.14
Mean Negative Events	-	-	-	-.06 (.05)	114	.25
Mean Negative Affect	-	-	-	-.13 (.13)	114	.30
1d. Negative Affect is DV						
Level 1						
ΔDaily Negative Events	.08 (.01)	1699	<.0001	.07 (.01)	1698	<.0001
Trait LonelinessXΔNegative Events	-.01 (.01)	1699	.59	-.0001 (.01)	1698	.99
ΔPositive Affect	-	-	-	-.29 (.02)	1698	<.0001
Level 2						
Trait Loneliness	.66 (.05)	116	<.0001	.61 (.05)	114	<.0001
Mean Negative Events	-	-	-	.07(.04)	114	.06
Mean Positive Affect	-	-	-	-.06(.07)	114	.42

Note: Trait loneliness, mean negative events, and mean negative and positive affect are sample-centered scores.

Table 7

Hypotheses 2a-2b With Trait Loneliness, Centered Positive Interpersonal Events, Their Interactions, and Covariates as Predictors

	B(SE)	*df*	*p-value*	*B (SE)*	*df*	*p-value*
2a. Interpersonal Enjoyment is DV						
Level 1						
ΔDaily Positive Events	.12 (.01)	1745	<.0001	.12 (.01)	1698	<.0001
Trait LonelinessXΔ Positive Events	.03 (.01)	1745	.001	.03 (.01)	1698	.005
ΔNegative Affect	-	-	-	-.28 (.03)	1698	<.0001
Level 2						
Trait Loneliness	-.30 (.08)	116	.0002	-.06 (.12)	114	.63
Mean Positive Events	-	-	-	.17 (.04)	114	<.0001
Mean Negative Affect	-	-	-	-.26 (.14)	114	.07
2b. Positive Affect is DV						
Level 1						
ΔDaily Positive Events	.07 (.01)	1706	<.0001	.06 (.01)	1698	<.0001
Trait LonelinessXΔ Positive Events	-.002 (.01)	1706	.81	-.01 (.01)	1698	.22
ΔNegative Affect	-	-	-	-.34 (.02)	1698	<.0001
Level 2						
Trait Loneliness	-.26 (.06)	116	<.0001	-.11 (.10)	114	.27
Mean Positive Events	-	-	-	.06 (.03)	114	.047
Mean Negative Affect	-	-	-	-.18 (.12)	114	.14

Note: Trait loneliness, mean positive events, and mean negative affect are sample-centered scores.

Table 8

Hypotheses 3a-3d With State Loneliness, Centered Negative Interpersonal Events, Their Interactions, and Covariates as Predictors

	B(SE)	*df*	*p-value*	*B (SE)*	*df*	*p-value*
3a. Pain is DV						
Level 1						
ΔLoneliness	2.23 (.53)	1698	<.0001	1.19 (.56)	1694	.034
ΔDaily Negative Events	.37 (.26)	1698	.15	.12 (.26)	1694	.66
ΔLonelinessXΔNegative Events	.12 (.30)	1698	.68	.13 (.29)	1694	.67
ΔNegative Affect	-	-	-	4.28 (.84)	1694	<.0001
Level 2						
Mean Negative Events	-	-	-	-.74 (1.57)	115	.64
Mean Negative Affect	-	-	-	8.96 (2.59)	115	.0008
3b. Interpersonal Stress is DV						
Level 1						
ΔLoneliness	.07 (.02)	1698	.001	.02 (.02)	1694	.47
ΔDaily Negative Events	.25 (.01)	1698	<.0001	.24 (.01)	1694	<.0001
ΔLonelinessXΔNegative Events	.003 (.01)	1698	.84	-.001 (.01)	1694	.95
ΔNegative Affect	-	-	-	.22 (.04)	1694	<.0001
Level 2						
Mean Negative Events	-	-	-	.31 (.03)	115	<.0001
Mean Negative Affect	-	-	-	.27 (.05)	115	<.0001

Table 8

Hypotheses 3a-3d With State Loneliness, Centered Negative Interpersonal Events, Their Interactions, and Covariates as Predictors

3c. Positive Affect is DV						
Level 1						
ΔLoneliness	-.18 (.02)	1698	<.0001	-.11(.02)	1694	<.0001
ΔDaily Negative Events	-.03 (.01)	1698	.001	-.01 (.01)	1694	.26
ΔLonelinessXΔNegative Events	.01 (.01)	1698	.14	.01 (.01)	1694	.12
ΔNegative Affect	-	-	-	-.29 (.03)	1694	<.0001
Level 2						
Mean Negative Events	-	-	-	-.06 (.05)	115	.22
Mean Negative Affect	-	-	-	-.27 (.08)	115	.001
3d. Negative Affect is DV						
Level 1						
ΔLoneliness	.24 (.02)	1695	<.0001	.20 (.02)	1694	<.0001
ΔDaily Negative Events	.06 (.01)	1695	<.0001	.06 (.01)	1694	<.0001
ΔLonelinessXΔNegative Events	-.001 (.01)	1695	.95	.003 (.01)	1694	.76
ΔPositive Affect	-	-	-	-.22 (.02)	1694	<.0001
Level 2						
Mean Negative Events	-	-	-	.17 (.05)	115	.002
Mean Positive Affect	-	-	-	-.31 (.10)	115	.003

Note: Mean negative events and mean negative and positive affect are sample-centered scores.

Table 9

Hypotheses 4a-4b With State Loneliness, Centered Positive Interpersonal Events, Their Interactions, and Covariates as Predictors

	B(SE)	*df*	*p-value*	*B (SE)*	*df*	*p-value*
4a. Interpersonal Enjoyment is DV						
Level 1						
ΔLoneliness	-.17 (.02)	1698	<.0001	-.11 (.02)	1694	<.0001
ΔDaily Positive Events	.11 (.01)	1698	<.0001	.11 (.01)	1694	<.0001
ΔLonelinessXΔ Positive Events	.03 (.01)	1698	.046	.02 (.01)	1694	.06
ΔNegative Affect	-	-	-	-.22 (.04)	1694	<.0001
Level 2						
Mean Positive Events	-	-	-	.17 (.04)	115	<.0001
Mean Negative Affect	-	-	-	-.31 (.09)	115	.0005
4b. Positive Affect is DV						
Level 1						
ΔLoneliness	-.16 (.02)	1698	<.0001	-.09 (.02)	1694	<.0001
ΔDaily Positive Events	.06 (.01)	1698	<.0001	.06 (.01)	1694	<.0001
ΔLonelinessXΔ Positive Events	-.01 (.01)	1698	.42	-.01 (.01)	1694	.23
ΔNegative Affect	-	-	-	-.29 (.03)	1694	<.0001
Level 2						
Mean Positive Events	-	-	-	.07 (.03)	115	.026
Mean Negative Affect	-	-	-	-.29 (.08)	115	.0003

Note: Mean positive events and mean negative affect are sample-centered scores.

Figure 1

Trait and State Loneliness Moderating the Relations Between Negative Events and Stress, Pain, and Affect

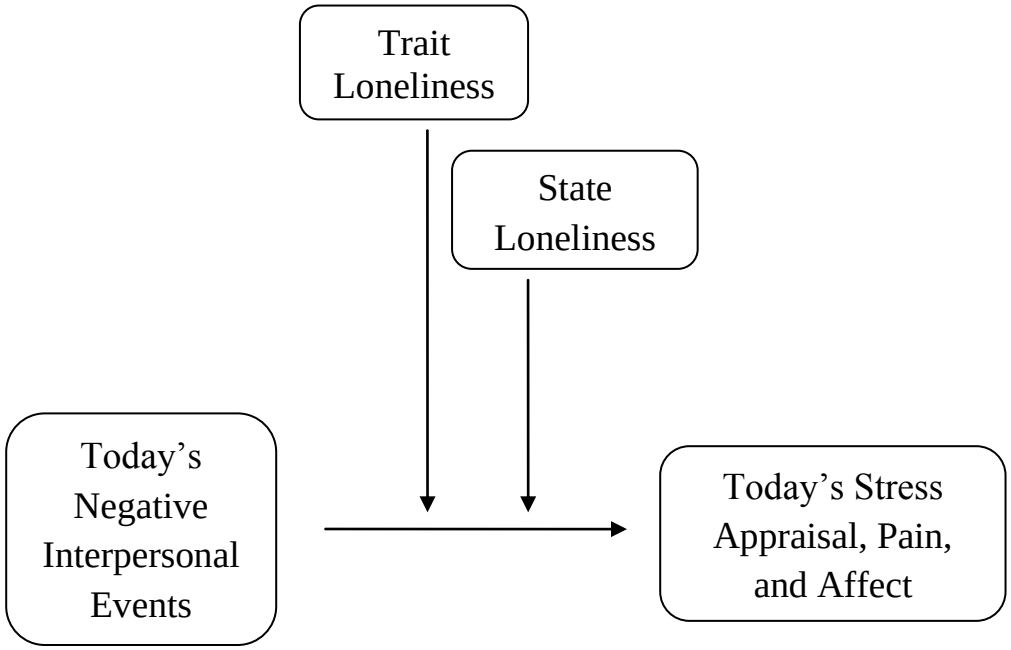


Figure 2

Trait and State Loneliness Moderating the Relations Between Positive Events and Affect and Enjoyment

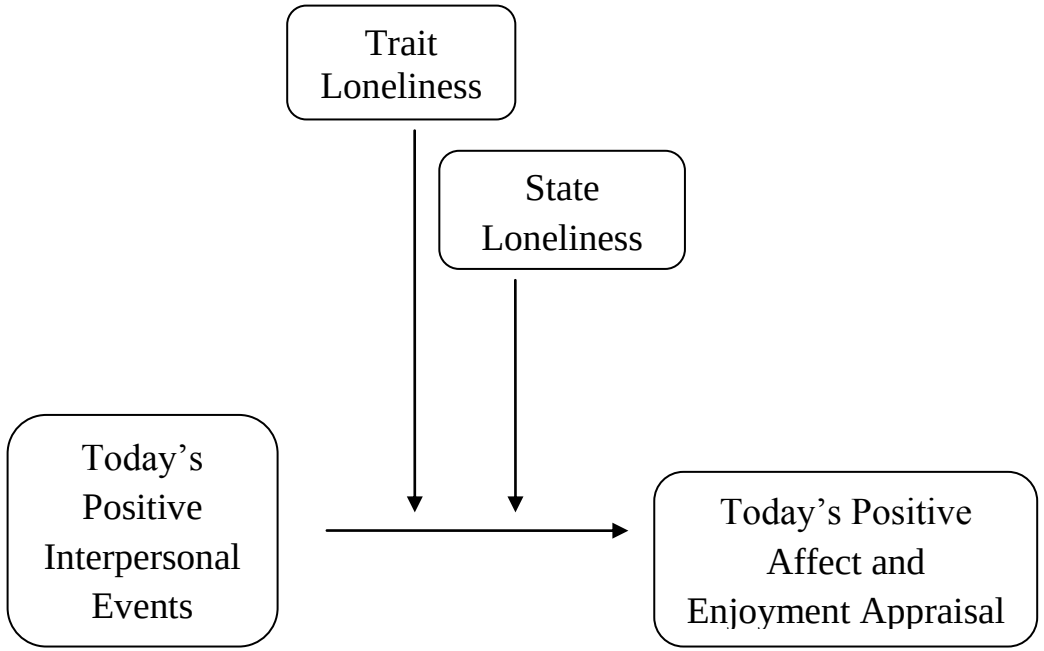
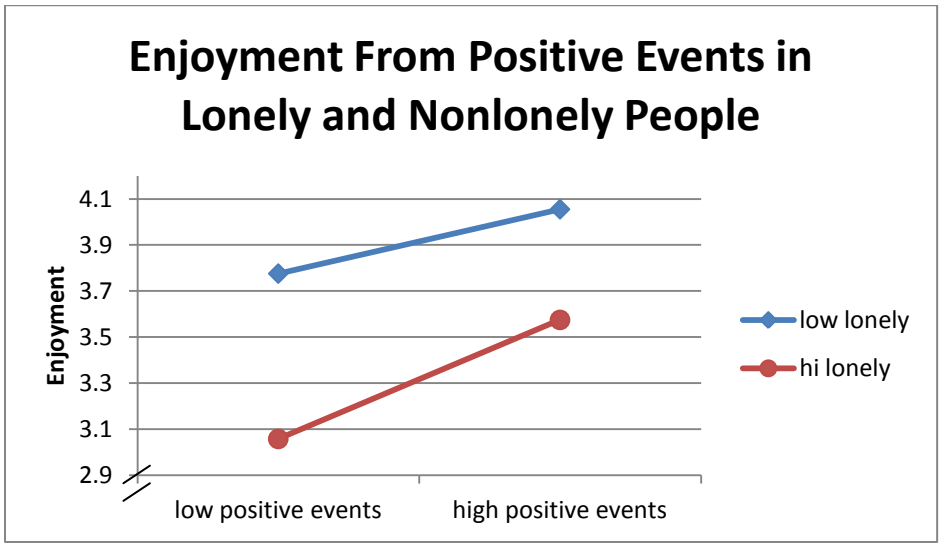
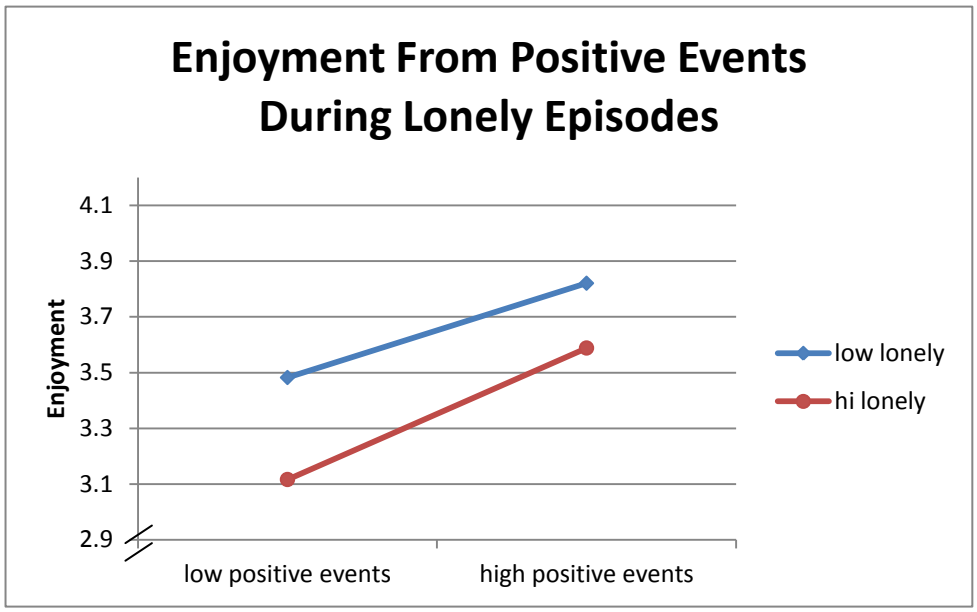


Figure 3



Note: Low positive events refers to scores below the median whereas high positive events refers to scores above the median. Low lonely refers to the lowest tertile of scores and hi lonely refers to the highest tertile of scores.

Figure 4



Note: Low positive events refers to scores below the median whereas high positive events refers to scores above the median. Low lonely refers to the lowest tertile of scores and hi lonely refers to the highest tertile of scores.

References

Åsbring, P. & Närvänen, A. (2002). Women's Experiences of Stigma in Relation to Chronic Fatigue Syndrome and Fibromyalgia. *Qualitative Health Research, 12*, 148-160.

Baumeister, R.F. and Leary, M.R. (1995). The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation. *Psychological Bulletin, 117*, 497-529.

Berkman, L.F., Melchior, M., Chastang, J., Niedhammer, I., Leclerc, A., & Goldberg, M. (2004). Social Integration and Mortality: A Prospective Study of French Employees of Electricity of France—Gas of France. *American Journal of Epidemiology, 159*, 167-174.

Cacioppo, J.T., Ernst, J.M., Burleson, M.H., McClintock, M.K., Malarkey, W.B., & Hawkley, L.C., et al. (2000). Lonely traits and concomitant physiological processes: The MacArthur Social Neuroscience Studies. *International Journal of Psychophysiology, 35*, 143–154.

Cacioppo, J.T., Hawkley, L.C., Berntson, G.G., Ernst, J.M., Gibbs, A.C., Stickgold, R., & Hobson, J.A. (2002). Do Lonely Days Invade the Nights? Potential Social Modulation of Sleep Efficacy. *Psychological Science, 13*, 384-387.

Cacioppo, J. T., Hawkley, L. C., Crawford, L. E., Ernst, J. M., Burleson, M. H., Kowalewski, R. B., Malarkey, W. B., Van Cauter, E., & Berntson, G. G. (2002). Loneliness and health: Potential mechanisms. *Psychosomatic Medicine, 64*, 407-417.

Cacioppo, J.T., Hawkley, L.C., Ernst, J.M., Burleson, M., Berntson, G.G., Nouriani, B., & Spiegel, D. (2006). Loneliness within a nomological net: An evolutionary perspective. *Journal of Research in Personality, 40*, 1054-1085.

Cacioppo, J.T., Hawkley, L.C., & Thisted, R.A. (2010). Perceived Social Isolation Makes Me Sad: 5-Year Cross-Lagged Analyses of Loneliness and Depressive Symptomatology in the Chicago Health, Aging, and Social Relations Study. *Psychology and Aging, 25*, 453-463.

Cacioppo, J.T., Hughes, M.E., Waite, L.J., Hawkley, L.C., & Thisted, R.A. (2006). Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses. *Psychology and Aging, 21*, 140-151.

Cacioppo, J.T., Norris, C.J., Decety, J., Monteleone, G., & Nusbaum, H. (2008). In the Eye of the Beholder: Individual Differences in Perceived Social Isolation Predict Regional Brain Activation to Social Stimuli. *Journal of Cognitive Neuroscience, 21*, 83-92.

DeWall, C.N., MacDonald, G., Webster, G.D., Masten, C.L., Baumeister, R.F., Powell, C.,…Eisenberger, N.I. (2010). Acetaminiophen Reduces Social Pain: Behavioral and Neural Evidence. *Psychological Science, 21*, 931-937.

Eisenberger, N.I., Lieberman, M.D., & Williams, K.D. (2003). Does Rejection Hurt? An fMRI Study of Social Exclusion. *Science, 302*, 290-292.

Enders, C.K. & Tofighi, D. (2007). Centering Predictor Variables in Cross-Sectional Multilevel Models: A New Look at an Old Issue. *Psychological Methods, 12*, 121-138.

Finan, P.H., Okun, M.A., Kruszewski, D., Davis, M.C., Zautra, A.J., & Tennen, H. (2010). Interplay of concurrent positive and negative interpersonal events in the prediction of daily negative affect and fatigue for rheumatoid arthritis patients. *Health Psychology, 29*, 429-437.

Hawkley, L. C., Burleson, M. H., Berntson, G. G., & Cacioppo, J. T. (2003). Loneliness in everyday life: Cardiovascular activity, psychosocial context, and health behaviors. *Journal of Personality & Social Psychology, 85*, 105-120.

Hawkley, L.C. & Cacioppo, J.T. (2007). Aging and Loneliness: Downhill Quickly**?** *Current Directions in Psychological Science, 16*, 187-191.

Hawkley, L.C., Hughes, M.E., Waite, L.J., Masi, C.M., Thisted, R.A., & Cacioppo, J.T. (2008). From Social Structural Factors to Perceptions of Relationship Quality and Loneliness: The Chicago Health, Aging, and Social Relations Study. *Journal of Gerontology: Social Sciences, 63B*, 375-384.

Hawkley, L. C., Preacher, K. J., & Cacioppo, J. T. (2007). Multilevel modeling of social interactions and mood in lonely and socially connected individuals: The MacArthur Social Neuroscience Studies. In A.D. Ong, & M.H.M. van Dulmen (Eds.), *Oxford Handbook of Methods in Positive Psychology* (pp. 559-575). New York: Oxford University Press.

Hawkley, L.C., Preacher, K.J., & Cacioppo, J.T. (2010). Loneliness Impairs Daytime Functioning but Not Sleep Duration. *Health psychology, 29*, 124-129.

Hawkley, L.C., Thisted, R.A., & Cacioppo, J.T. (2009). Loneliness Predicts Reduced Physical Activity: Cross-Sectional & Longitudinal Analyses. *Health Psychology, 28*, 354-363.

Jensen, M. P., Karoly, P., & Braver, S. (1986). The measurement of clinical pain intensity: A comparison of six methods. *Pain, 27*, 117-126.

Lauder, W., Sharkey, S., & Mummery, K. (2004). A community survey of loneliness. *Journal of Advanced Nursing, 46*, 88-94.

Lauder, W., Mummery, K., Jones, M., & Caperchione, C. (2006). A comparison of health behaviours in lonely and nonlonely populations. *Psychology, Health, and Medicine, 11*, 233-245.

MacDonald, G., Kingsbury, R., & Shaw, S. (2005). Adding insult to injury: Social pain theory and response to social exclusion. In K. D. Williams, J. P. Forgas & W. von Hippel (Eds.). *The social outcast: Ostracism, social exclusion, rejection, and bullying* (pp. 77-90). New York: Psychology Press

MacDonald, G. & Leary, M.R. (2005). Why Does Social Exclusion Hurt? The Relationship Between Social and Physical Pain. *Psychological Bulletin, 131*, 202-223.

Norman, G.J., Cacioppo, J.T., Morris, J.S., Malarkey, W.B., Berntson, G.G., & DeVries, A.C. (2011). Oxytocin increases autonomic cardiac control: Moderation by loneliness. *Biological Psychiatry, 86*, 174-180.

Peplau LA, Perlman D. Loneliness. A sourcebook of current theory, research, and therapy. New York: Wiley Interscience; 2000.

Pinquart, M., & Sörensen, S. (2003). Risk factor for loneliness in adulthood and old age – A meta-analysis. In S. P. Shohov (Ed.), *Advances in Psychology Research, Vol. 19* (pp. 111-143). Hauppauge, NY: Nova Science Publishers.

Potter, P.T., Zautra, A.J., & Reich, J.W. (2000). Stressful events and information processing dispositions moderate the relationship between positive and negative affect: implications for pain patients. *Ann Behav Med, 22*, 191-198.

Rokach, A. (2003). Causes of Loneliness of Those Afflicted with Life-Threatening Illnesses. *Social Behavior and Personality, 31*, 663-674.

Russell, D., Peplau, L.A., & Cutrona, C. (1980). The revised UCLA Loneliness Scale: Concurrent and discriminant validity. *Journal of Personality and Social Psychology, 39*, 472-480.

Skinner, M.A., Zautra, A.J., & Reich, J.W. (2004). Financial Stress Predictors and the Emotional and Physical Health of Chronic Pain Patients. *Cognitive Therapy and Research, 28*, 695-713.

Slade, S.C., Molloy, E., & Keating, J.L. (2009). Stigma Experienced by People with Nonspecific Chronic Low Back Pain: A Qualitative Study. *Pain Medicine, 10*, 143-154.

Steptoe, A., Owen, N., Kunz-Ebrecht, S.R., & Brydon, L. (2004). Loneliness and neuroendocrine, cardiovascular, and inflammatory stress responses in middle-aged men and women. *Psychoneuroendocrinology, 29*,593-611.

Uysal, A., & Lu, Q. (2011). Is Self-Concealment Associated With Acute and Chronic Pain?. *Health Psychology*, 30, 606-614.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology, 47*, 1063–1070.

Wolfe, F., Smythe, H. A., Yunus, M. B., Bennett, R. M., Bombardier, C., Goldenberg, D. L., . . . Sheon, R. P. (1990). The American College of Rheumatology 1990 Criteria for the Classification of Fibromyalgia. Report of the Multicenter Criteria Committee. *Arthritis and Rheumatism, 33*(2), 160-172.

Zautra, A.J., Johnson, L.M., & Davis, M.C. (2005). Positive Affect as a Source of Resilience for Women in Chronic Pain. *Journal of Consulting and Clinical Psychology, 73*, 212-220.

Zautra, A. J., Schultz, A. S., & Reich, J. W. (2000). The role of everyday events in depressive symptoms for older adults. Dordrecht, Netherlands: Kluwer Academic Publishers.

Zautra, A., Smith, B., Affleck, G., & Tennen, H. (2001). Examinations of Chronic Pain and Affect Relationships: Applications of a Dynamic Model of Affect. *Journal of Consulting and Clinical Psychology, 69*, 786-795.

APPENDIX A

MEASURES

Pain

What was your overall level of pain today? Enter a number between 0 and 100 that best describes your pain level. A zero would mean "no pain" and a one hundred (100) would mean "pain as bad as it can be". Please enter your answer now. Remember all your answers should be followed by the # key.

Occurrence of Interpersonal Events

Spouse/Partner Desirable Events

I am now going to read a list of 6 desirable events involving your spouse or partner that may have occurred today. For each event I read, I would like you to press 1 if that event occurred and 2 if the event did NOT occur.

> You received a gift from your spouse or partner – Press 1 for yes or 2 for no
>
> You expressed love to your spouse or partner - Press 1 for yes or 2 for no
>
> You celebrated with your spouse or partner - Press 1 for yes or 2 for no
>
> You had a long conversation with your spouse or partner - Press 1 for yes or 2 for no
>
> You kissed and/or had pleasing physical contact with your spouse or partner - Press 1 for yes or 2 for no
>
> You went out together with your spouse or partner (dinner, movies, dancing, etc.) - Press 1 for yes or 2 for no

Spouse/Partner Undesirable Events

I am now going to read a list of 8 undesirable events involving your spouse or partner that may have occurred today. For each event, press 1 if the event occurred and 2 if the event did NOT occur.

> You argued with your spouse or partner about money - Press 1 for yes or 2 for no

You were angry or critical of your spouse or partner's behavior - Press 1 for yes or 2 for no

Your spouse or partner was critical or angry with you – Press 1 for yes or 2 for no

Your spouse or partner ignored you - Press 1 for yes or 2 for no

Your spouse or partner turned down your request for time together - Press 1 for yes or 2 for no

Your spouse or partner was ill-behaved - Press 1 for yes or 2 for no

Your spouse or partner stopped being affectionate - Press 1 for yes or 2 for no

Your spouse or partner was too busy to talk or go out - Press 1 for yes or 2 for no

Family Desirable Events

I am now going to read a list of 10 desirable events involving your other family members that may have occurred today? This includes parents, children, and ex-spouses. Please keep count to yourself as I read the list

You were praised by a family member

You received a letter or email from family member

A family member or members not living at home visited

You talked with family member you had not seen for a long time

You helped a family member

You received a gift from a family member

You worked out a problem with ex-spouse

Your child or children did something nice for you

You taught your child or grandchild something new

You went out to lunch/dinner, movie, etc. with a family member

How many of those 10 desirable events occurred today? Please press a number on the keypad between 0=no events up to 10=all 10 of those events occurred today.

Family Undesirable Events

I am now going to read a list of 5 undesirable events involving your other family members that may have occurred today? This includes parents, children, and ex-spouses. Please keep count as I read this list.

You were criticized or blamed for something by a family member

You had an argument with a family member

You argued with ex-spouse

Your son or daughter was rude or irritable

You had to deal with a stressful family problem

How many of those 5 undesirable events occurred today? Please press a number on the keypad between 0=no events up to 5=all 5 of those events occurred today.

Friend/Acquaintance Desirable Events

I'm now going to ask you about your relations with your friends and acquaintances. I'm going describe 6 desirable events involving your friends or acquaintances that may have occurred today. As I do this, I want you to keep a count to yourself of how many of these events occurred. I will then ask you to indicate how many of those events occurred today.

You went to a sport, game, or played cards with friends

You went to a party or other social gathering

You went to a club or organized group meeting

You met a new friend or acquaintance

You went out with friends to lunch, etc

You received a compliment from a friend or acquaintance

How many of those 6 desirable events with friends and acquaintances occurred today? Please press a number on the keypad between 0=no events up to 6=all 6 of those events occurred today.

Friend/Acquaintance Undesirable Events

I am now going to read a list of 5 undesirable events involving your friends or acquaintances that many have occurred today. Again, keep a count to yourself about how many of these events occurred.

A friend or acquaintance canceled or did not show up for a meeting

A friend or acquaintance did not return your call

You had a conflict with friend or acquaintance

You had to deal with an unfriendly or rude person

You received angry email or phone message from someone you knew

How many of those 5 undesirable events occurred today? Please press a number on the keypad between 0=no events up to 5=all 5 of those events occurred today.

Appraisal of Interpersonal Events

Spouse/Partner

Overall, how enjoyable were your relations with your spouse or partner today, on a scale of 1 to 5?

1 is not at all

2, a little

3, some

4, quite a bit, or

5, completely

Overall, how stressful were your relations with your spouse or partner today on a scale of 1 to 5?

1 is not at all

2, a little

3, some

4, quite a bit, or

5, completely

Family

Overall, how enjoyable were your relations with your family today on a scale of 1 to 5?

1 is not at all

2, a little

3, some

4, quite a bit, or

5, completely

Overall, how stressful were your relations with your family today on a scale of 1 to 5?

1 is not at all

2, a little

3, some

4, quite a bit, or

5, completely

Friends/Acquaintances

Overall, how enjoyable were your relations with your friends or acquaintances today on a scale of 1 to 5?

1 is not at all

2, a little

3, some

4, quite a bit, or

5, completely

Overall, how stressful were your relations with your friends or acquaintances today on a scale of 1 to 5?

1 is not at all

2, a little

3, some

4, quite a bit, or

5, completely

Affect

Please answer the following questions on a scale of 1 to 5, where 1=not at all and 5 = completely

Today did you feel like you had a lot of energy?

Attentive?

Serene ?

Loved?

Afraid?

Calm?

Sad?

Angry?

Ashamed?

Cheerful?

Enthusiastic?

Loneliness

Please answer the following questions on a scale of 1 to 5, where 1=not at all and 5 = completely

Were you lonely?