Reducing social pain: Sex differences in the impact of physical pain relievers

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Abstract
There is evidence that social pain or “hurt feelings” and physical pain share the same neural system. Although researchers have found that a physical pain reliever can reduce social pain, studies suggest that sex differences may influence these findings. Our results indicate that women who took ibuprofen felt less hurt or social pain when they were excluded from a game and when they relived a painful experience than did women who took a placebo. Men who took the pain reliever, by contrast, felt more hurt in both situations than did those who took the placebo. Further, the sex difference revealed in men’s and women’s ratings of their social pain was reflected in their open-ended verbal descriptions of social and physical pain.

We have long been taught to think of social pain and physical pain as separate phenomena (only “sticks and stones can break your bones”). Yet there is growing sentiment among scholars that social pain—or hurt feelings—and physical pain are more closely related than previously thought. Indeed, some have argued that the two types of pain share the same neural system (Eisenberger & Lieberman, 2004; MacDonald & Leary, 2005). Evidence supporting this argument is compelling: Researchers have found that the neuroimaging data associated with social pain are similar in some ways to those associated with physical pain (Eisenberger, Lieberman, & Williams, 2003) and that acetaminophen, a medication commonly used to relieve physical pain, reduced people’s reports of the amount of social pain they experienced over a 3-week period of time (DeWall et al., 2010).

Although the link between social and physical pain has been well received, research on the way women and men experience pain suggests that it should be qualified (Dao & LeResche, 2000; Wiesenfeld-Hallin, 2005). The association between social and physical pain may be experienced and expressed in different ways by men and women. More specifically, there may be sex differences in the degree to which physical pain relievers reduce social pain. The purpose of the current study was to examine whether there are sex differences in the effect of physical pain relievers on people’s experience of social pain and to test how those differences are manifest. Three distinct indicators of social pain were examined: (a) acute responses to a socially painful experience, (b) responses...
to relived or reexperienced social pain, and (c) verbal descriptions of a socially painful experience.

The link between social and physical pain

Although we often think of social pain and physical pain as distinct, the two types of pain share a number of core features. Both occur as a consequence of individuals being injured or damaged. Social pain, or hurt, is conceived by most researchers and clinicians as a feeling that occurs in response to an emotional injury (Feeney, 2004; Folkes, 1982; L’Abate, 1977; Leary, Springer, Negel, Ansell, & Evans, 1998; Vangelisti, Maguire, Alexander, & Clark, 2007; Vangelisti & Young, 2000). More specifically, it is a “reaction to the perception that one is being excluded from desired relationships or being devalued by desired relationship partners or groups” (MacDonald & Leary, 2005, p. 202). Physical pain has been defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (International Association for the Study of Pain, 1994, pp. 209–214). The injuries or damage that bring about both types of pain—as well as the experience of pain itself—leave people vulnerable (Kelvin, 1977). When individuals experience social or physical pain, their ability to function is diminished and they are less able to protect themselves from further harm. Because social and physical pain render people vulnerable, individuals who withdraw from painful stimuli are afforded an advantage over those who do not.

Based on the premise that close relationships are advantageous to individuals’ survival, Panksepp and colleagues (Herman & Panksepp, 1978; Panksepp, 1998) argued that the social attachment system in humans may have coopted the physical pain system to promote well-being. In line with this argument, Eisenberger and Lieberman (2004) developed pain overlap theory. Pain overlap theory proposes that social pain and physical pain share parts of the same underlying processing system (Eisenberger & Lieberman, 2005). In line with the theory, Eisenberger and colleagues (2003) found similarities in neuroimaging data associated with social and physical pain. Their work demonstrated that participants who were excluded from a virtual ball-tossing game (Cyberball; Williams, Chung, & Choi, 2000), showed increased activity in the region of the brain typically associated with the affective experience of physical pain, the dorsal anterior cingulate cortex (dACC). Equally important, and consistent with embodiment views of emotion (e.g., Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009), the amount of activity in the dACC was strongly associated with the social distress reported by participants. Kross, Berman, Mischel, Smith, and Wagner (2011) similarly demonstrated that reliving or reexperiencing social pain was associated with increased activity in the parts of the brain that support the affective and sensory experience of physical pain. Riva, Romero Lauro, DeWall, and Bushman (2012) further found that stimulating the part of the brain linked to the regulation of pain (the right ventrolateral prefrontal cortex [rVLPFC]) reduced the painful effects of social exclusion.

If, as suggested by pain overlap theory, social and physical pain share parts of the same neural system, there should be a link between the reduction of the two types of pain. DeWall and colleagues (2010) tested this notion in two studies by having participants take acetaminophen, a common physical pain reliever, or a placebo for 3 weeks. In the first study, people who took the pain reliever reported lower social pain—or hurt feelings—starting on Day 9 of the investigation. In the second study, individuals who took acetaminophen showed less activity in the dACC when they were excluded from the Cyberball ball-tossing game than did those who took the placebo.

Sex differences in social and physical pain

Although evidence supporting the association between social and physical pain is relatively clear, it is important to note that the findings are based on samples that were predominantly female (DeWall et al., 2010; Eisenberger et al., 2003). As a consequence, researchers have been unable to test sex differences in the way the association is experienced and expressed...
or the influence of physical pain relievers on social pain. These differences may be explained by one of two different models. One of these is a physiological model, which emphasizes distinctions in the ways men and women experience physical pain and respond to physical pain relievers. Prior research suggests that women tend to experience more frequent daily pain (Berkley & Holdcroft, 1999) and more chronically painful conditions than do men (Berkley, 1997). Women also have lower physical pain thresholds than do men (Fillingrim, 2000). Although these, and other, sex differences in physical pain may be partly due to socialization (Kupers, 1997), there is substantial evidence suggesting that they are also biologically based (Wiesenfeld-Hallin, 2005). Indeed, there are differences in the way men and women respond to analgesic drugs that stem from biological variables such as absorption, tolerance, and central nervous system processing of pain (Giles & Walker, 2000). While research identifying the mechanisms behind these variables is nascent, a number of studies suggest that men sometimes respond more favorably to physical pain relievers like acetaminophen and ibuprofen than do women (Tanaka, 1999; Walker & Carmody, 1998).

Inasmuch as men are more responsive to physical pain relievers than are women, the effect of physical pain relievers on men’s social pain may be greater than it is for women. In short, the physiological model suggests that men who take a physical pain reliever should experience less social pain than women who take a physical pain reliever. A competing model that may explain sex differences in the tendency of physical pain relievers to reduce social pain is a social cognitive model. A social cognitive model stresses distinctions in the ways men and women think about and respond to their social pain. A substantial body of research suggests that men are more likely than women to suppress their emotions (see, e.g., Gross & John, 2003)—and that they are particularly likely to suppress emotions that involve vulnerability (Brody & Hall, 2008). Indeed, men report experiencing less social pain than do women (Miller & Roloff, 2005). Because men are comparatively likely to curb their emotional pain, it is possible that men who take a physical pain reliever will display a disinhibition effect. That is, when men take a physical pain reliever, their cognitive response may act to blunt or inhibit their tendency to suppress their emotional pain. The cognitive processes underlying such a disinhibition effect are akin to those underlying what Storms and Nisbett (1970) called the reverse placebo effect. Storms and Nisbett found that insomniacs who were given a placebo “arousal” pill had an easier time sleeping than did those who were given a placebo “relaxer” pill. The researchers reasoned that insomniacs who took the arousal pill were able to sleep better because they attributed their arousal to the pill rather than themselves or their insomnia. In a similar way, men who are given a physical pain reliever may attribute any suppression of pain they experience to the pill rather than to themselves or their efforts to curb their pain. If this is the case, they may report feeling more hurt after taking the pill. Women, by contrast, should not display a disinhibition effect because they are relatively unlikely to suppress their pain. In brief, the social cognitive model suggests that men who take a physical pain reliever should feel more social pain than women who take a physical pain reliever.

The current study

Although researchers have not yet tested sex differences in the effects of physical pain relievers on social pain, their work offers guidance as to how such differences should be evidenced. First, it suggests that taking a physical pain reliever should have an acute effect on social pain and that effect should differ for men and women. Second, men and women who take a physical pain reliever should differ in terms of their ability to relive or reexperience social pain. Third, taking a physical pain reliever should differentially affect the way men and women express their social and physical pain.

The first aim of this study was to test whether there are sex differences in the influence of a physical pain reliever on individuals’ acute responses to social pain. While the reduction in self-reported social pain found by DeWall and his colleagues (2010) did not...
emerge until Day 9 of their 3-week diary study, acetaminophen had an immediate effect on the dACC in their second study. More specifically, the fMRI data analyzed by DeWall and colleagues indicated that people who took a physical pain reliever daily for a 3-week period had less activity in the dACC immediately after being excluded from a ball-tossing game than did those who took a placebo.

Together with the literature on sex differences in social and physical pain, the findings of DeWall and his colleagues (2010) suggest that taking a physical pain reliever should yield an acute but differential effect on men’s and women’s social pain. If the physiological model is supported, then men who take a physical pain reliever should report experiencing less pain or hurt than women when they are excluded from a game. If the social cognitive model holds, then men who take a physical pain reliever should report experiencing more pain than women when they are excluded from a game.

The second aim of this study was to examine whether taking a physical pain reliever influences men’s and women’s ability to relive their social pain in different ways. Kross and his colleagues (2011) found that relived social pain, like concurrent social pain, shares the same neural system as physical pain. Kross and his colleagues asked individuals who recently experienced an unwanted break-up to view a photograph of their former partner and think about being rejected. Their fMRI data indicated that the regions of the brain that support both the affective and sensory components of physical pain became active when people thought about the rejection experience.

If, as indicated by prior research, there are sex differences in social and physical pain, the Kross and colleagues (2011) findings suggest that the influence of a physical pain reliever on men’s and women’s ability to relive their social pain should differ. If the physiological model holds, then men who take a physical pain reliever should report experiencing less pain or hurt than women when they relive their experiences of social pain. By contrast, if the social cognitive model prevails, then men who take a physical pain reliever should report experiencing more pain or hurt than women when they relive their socially painful experiences.

The third aim of the current investigation was to explore whether taking a physical pain reliever differentially affects the way men and women express their social pain. The way individuals think about and describe traumatic experiences such as social pain is important because it can influence their mental and physical health (Pennebaker, 1993; Pennebaker & Francis, 1996; Pennebaker, Mayne, & Francis, 1997. Although extant work indicates that social and physical pain involve similar regions of the brain (Eisenberger et al., 2003), and that acetaminophen can reduce neural activity in those same regions (DeWall et al., 2010), it does not indicate whether the use of a physical pain reliever can affect the way people express their social and physical pain. Studies on physical pain, however, hint that this may be the case. For instance, research suggests that people who express concern with the immediacy of painful experiences tend to seek pain relief and have relatively lower pain thresholds, whereas those who focus on the meaning of pain exhibit more anxiety about their pain and have relatively higher pain thresholds (Sternbach & Tursky, 1965; Zborowski, 1952). In short, there is a link between the way individuals express or articulate their pain and the way they experience pain (Pennebaker, 1982). Given this link, individuals who take a physical pain reliever should describe their painful experiences differently than those who do not take a pain reliever.

Prior research suggests that two linguistic indicators may be particularly relevant to the way individuals express their social and physical pain: the use of first-person pronouns and the use of emotion words. More specifically, people who are experiencing emotional pain tend to use a relatively high proportion of first-person pronouns than do those who are not (Rude, Gortner, & Pennebaker, 2004). Further, individuals’ emotional involvement in traumatic situations is associated with the frequent use of emotion words (Tausczik & Pennebaker, 2010). Given these findings, the frequency of first-person pronouns and emotion words employed in individuals’ descriptions of their painful experiences should be
affected by whether or not they take a physical pain reliever. If the physiological model is supported, then men who take a physical pain reliever should use a lower proportion of first-person pronouns and emotion words than women when describing their relived social and physical pain. If the social cognitive model holds, then men who take a physical pain reliever should use a higher proportion of first-person pronouns and emotion words when describing their relived pain.

**Method**

**Participants**

Data were collected from 138 undergraduate students enrolled in communication courses at a large Southwestern university. Of the total, 62 were male and 76 were female. The average age of respondents was 20.97 years ($SD = 2.95$). Eighty-eight (63.8%) of the participants were Caucasian, 20 (14.5%) were Asian, 18 (13.0%) were Latino, 9 (6.5%) were African American, 1 (.7%) was Pacific Islander, and 2 (1.4%) listed their ethnicity as “other.” All of the respondents were given extra course credit. They were told that their participation in the study was completely voluntary and that alternative opportunities for extra credit were available for those who opted not to participate. One male individual decided not to participate after reading the second consent form (see below) because he did not want to take ibuprofen. None of the other respondents opted to complete the alternate projects.

**Procedures**

Prior to their participation, individuals went to a website that provided a brief description of the study. The description said that the study was being conducted to examine the link between physical and emotional pain and that, as part of the investigation, participants would be asked to take either ibuprofen or a placebo. Those interested in participating read a consent form, indicated their consent, and completed a brief, online questionnaire. The questionnaire was designed to screen out anyone who might have adverse physical reactions either to ibuprofen or to the placebo (lactose). A series of seven items asked participants to note, for example, whether they had experienced any negative reactions to ibuprofen, had a history of medical problems associated with their liver, were a binge drinker, were lactose intolerant, had any allergies to milk, or were currently pregnant. Individuals who responded negatively to all seven items were eligible to participate in the study.

When they arrived at the laboratory, participants were given a brief introduction to the study and were asked to read over and sign a second consent form (the consent form was a paper copy of the form they already completed online). Respondents also completed the screening questionnaire a second time to ensure that they did not have a history of adverse reactions to ibuprofen or to the placebo. Participants then were asked to complete a series of randomly ordered questionnaires including measures of their physical symptoms and their current feelings.

The current feelings of participants were measured using a modified version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS includes a series of 20 different feelings or emotions. Respondents are asked to indicate the extent to which they experience each feeling or emotion at a particular point in time. In this study, participants rated the extent to which they felt hurt; the other required them to indicate the degree to which they felt emotionally injured. These two items were averaged to measure individuals’ social pain prior to engaging in the tasks related to the study ($\alpha = .79$).

After completing the questionnaires, one half of the participants took 400 mg of ibuprofen; the other half received a placebo. Both the ibuprofen and the placebo were placed in identical capsules so that they were indistinguishable. After taking either the ibuprofen or the placebo, participants were told that they would
complete the remainder of the study in 45 min and that they could study, rest, or read magazines in the laboratory during that time period. Participants were not allowed to eat, access their course grades online, or engage in interaction with anyone outside the laboratory setting (e.g., via e-mail, phone, or text messages).

When 45 min passed, participants completed a two-part experiment. The two portions of the experiment were counterbalanced to minimize order effects. In one part of the experiment, individuals engaged in a virtual ball-tossing game on computers in which they were socially excluded. The game, Cyberball, has been used in prior research to elicit hurt feelings (Eisenberger et al., 2003; Williams & Jarvis, 2006). After they played the ball-tossing game, all of the participants were asked to rate how they felt using a modified version of the PANAS. This version of the PANAS was exactly the same as the one completed by participants when they first arrived at the laboratory. Once again, two items were added to the PANAS to assess participants’ social pain or hurt feelings. The alpha reliability for these two items was .88.

The second portion of the experiment differed from the first part in that it assessed participants’ relived social and physical pain and, as a consequence, used a different procedure to elicit pain. Participants were asked to relive and provide a detailed written description of a situation when they experienced betrayal by a close relational partner and a situation when they experienced physical pain. Both of these writing tasks have been used in prior research to study individuals’ response to relived social and physical pain, respectively (Chen, Williams, Fitness, & Newton, 2008). The sequence in which individuals wrote about these two painful experiences was counterbalanced to prevent order effects. When they finished the two writing tasks, participants were asked to rate their feelings on a modified version of the PANAS. This version of the PANAS was the same as the one completed by participants after they engaged in the ball-tossing game. Again, two items were added to the PANAS to assess participants’ hurt feelings. These two items were averaged to create a measure of individuals’ social pain after reliving the socially painful experience (α = .94) and the physically painful experience (α = .90).

After completing the experiment, participants were debriefed and thanked for their time.

Results

Preliminary analyses

Two preliminary analyses were conducted. First, to ensure that there was not a difference in the initial, baseline level of social pain experienced by men and women, a t test was conducted. The results indicated that there was not a significant difference in the social pain reported by men (M = 1.59, SD = 0.96) and women (M = 1.48, SD = 0.91) prior to engaging in the tasks associated with the study, t(136) = −0.86, ns. The second analysis was run to test whether the two social pain manipulations (the ball-tossing game and the written description of a betrayal) were effective. If the two tasks were effective in eliciting social pain, participants should have reported significantly higher levels of social pain after engaging in the tasks than they did prior to engaging in the tasks. Four planned t tests were conducted to test whether this was the case. The findings revealed that in the placebo group, participants’ social pain after playing the ball-tossing game was significantly higher (M = 2.07, SD = 1.31) than it was prior to playing the game (M = 1.52, SD = 0.86), t(67) = −3.84, p < .001. The level of social pain individuals in the placebo group felt after writing about a betrayal also was significantly higher (M = 3.12, SD = 1.62) than it was prior to the writing task (M = 1.52, SD = 0.86), t(67) = −8.91, p < .001. Similarly, in the treatment group, participants reported their social pain was higher after playing the ball-tossing game (M = 1.93, SD = 1.11) than it was before playing the game (M = 1.54, SD = 1.01), t(68) = −3.67, p < .001. Individuals in the treatment condition also felt more social pain after writing about a betrayal (M = 3.04, SD = 1.71) than they did beforehand (M = 1.52, SD = 0.98), t(65) = −7.59, p < .001.
Main analyses

A repeated measures analysis of covariance (ANCOVA) was conducted to test whether individuals who took ibuprofen reported different levels of social pain when they were excluded from the ball-tossing game than did those who did not take ibuprofen and to probe whether sex influenced the effects of ibuprofen on social pain. The treatment or experimental condition (ibuprofen vs. placebo) and sex (male vs. female) served as the between-subjects factors. Participants’ weight was controlled in order to account for any influence that weight may have had on the dosage of ibuprofen. The analysis yielded a significant three-way interaction of Social Pain × Treatment × Sex, $F(1, 128) = 3.84$, $p < .05$, partial $\eta^2 = .03$. The effect of being excluded from the ball-tossing game was stronger for women who took the placebo and for men who took ibuprofen. A follow-up analysis testing the anticipated Treatment × Sex interaction was significant, $F(1, 128) = 4.91$, $p < .03$, partial $\eta^2 = .04$. Women who took ibuprofen reported feeling less social pain after being excluded from the game ($M = 1.76$, $SD = 1.00$) than did those who did not take ibuprofen ($M = 2.30$, $SD = 1.45$). By contrast, men who took ibuprofen noted they felt more social pain ($M = 2.23$, $SD = 1.21$) after being excluded than did men who did not take the pain reliever ($M = 1.81$, $SD = 1.11$). Figure 1 illustrates the interaction.

To examine whether ibuprofen influenced individuals’ relived experience of social pain and whether the effects of ibuprofen on relived pain were influenced by sex, a repeated measures ANCOVA was conducted. The treatment (ibuprofen vs. placebo) and sex (male vs. female) were the between-subjects factors. The degree of social pain experienced by participants (measured once prior to the task and once after the task) served as the within-subjects factor. Individuals’ weight was controlled. The results of the analysis revealed a significant three-way interaction of Social Pain × Treatment × Sex, $F(1, 125) = 5.81$, $p < .02$, partial $\eta^2 = .04$. The influence of reliving their social pain was stronger for women who took the placebo and for men who took ibuprofen. A follow-up test probing the expected Treatment × Sex interaction was significant, $F(1, 125) = 5.87$, $p < .02$, partial $\eta^2 = .05$. Women who took ibuprofen said they felt less social pain ($M = 2.76$, $SD = 1.67$) than their female counterparts who did not take the pain reliever ($M = 3.50$, $SD = 1.72$), whereas men who took the pain reliever felt more social pain ($M = 3.28$, $SD = 1.63$) than their male counterparts who did not ($M = 2.58$, $SD = 1.40$). Figure 2 provides a graphic representation of the interaction.

Participants’ written descriptions of their relived social and physical pain were examined to test whether individuals who took ibuprofen expressed their painful experiences differently than those who did not take the pain reliever. The written descriptions were analyzed with the Linguistic Inquiry and Word Count (LIWC) program (Pennebaker, Booth, & Francis, 2007). The LIWC program uses an extensive dictionary of over 4,000 words to categorize the words that make up a given text. The program was designed to search a text file and calculate the total number of words in the file that reflect over 80 categories or dimensions. The sums of each category or dimension are converted to a percentage of the total number of words in each text to account for differences in text length between participants. Although the LIWC program includes over 80 dimensions, the analyses for the current study focused only on the use of first-person singular pronouns (e.g., *I*) and affect or emotion words. Increased use of *I*-words and negative emotion words have been linked to elevated reports of depression, physical, and emotional pain (Pennebaker, 2011).

Repeated measures ANCOVAs were conducted to examine whether ibuprofen affected people’s descriptions of their relived social and physical pain and whether the effects of ibuprofen were influenced by sex. The between-subjects factors were the treatment or experimental condition (ibuprofen vs. placebo) and sex (male vs. female). The within-subjects factor in each analysis was the percentage of words that comprised the relevant LIWC
category or dimension (i.e., the percentage of first-person pronouns or emotion words) measured once for participants’ description of their relived social pain and once for their description of their relived physical pain. Participants’ report of their social pain prior to engaging in the task and their weight were controlled. The results revealed a significant interaction between treatment and sex for first-person pronouns, $F(1, 126) = 4.96$, $p < .03$, partial $\eta^2 = .04$, and a marginally significant Treatment × Sex interaction for emotion words, $F(1, 126) = 2.71$, $p < .10$, partial $\eta^2 = .02$. Women who took ibuprofen used proportionally fewer first-person pronouns in their descriptions ($M = 9.45$, $SD = 3.17$ for social pain; $M = 10.74$, $SD = 2.82$ for physical pain) than did those who did not take ibuprofen ($M = 10.48$, $SD = 2.78$ for social pain; $M = 11.63$, $SD = 3.09$ for physical pain), whereas men who took the pain reliever used a greater percentage of first-person pronouns ($M = 9.74$, $SD = 3.02$ for social pain; $M = 11.31$, $SD = 3.65$ for physical pain) than did those who did not take the drug ($M = 8.86$, $SD = 2.62$ for social pain; $M = 10.70$, $SD = 2.58$ for physical pain). Similarly, women who took the pain reliever used marginally fewer emotion words ($M = 6.18$, $SD = 2.37$ for social pain; $M = 6.50$, $SD = 2.29$ for physical pain) than did their female counterparts who did not take the drug ($M = 6.79$, $SD = 2.49$ for social pain; $M = 6.65$, $SD = 2.66$ for physical pain), while men who took ibuprofen employed a marginally greater percentage of emotion words ($M = 6.62$, $SD = 2.85$ for social pain; $M = 6.54$, $SD = 2.71$ for physical pain) than did those who took the placebo ($M = 6.17$, $SD = 2.62$ for social pain; $M = 5.64$, $SD = 2.30$ for physical pain). See Figures 3 and 4, respectively.
Figure 2. Interaction between treatment and sex for relived social pain.

Discussion

This study was conducted to examine whether the effects of taking a physical pain reliever on social pain vary based on biological sex. Our findings suggest there are sex differences in the influence of a physical pain reliever on people’s acute responses to social pain, their responses to relived social pain, and their verbal descriptions of social and physical pain.

In line with pain overlap theory (Eisenberger & Lieberman, 2004), we found that taking a common physical pain reliever affected social pain. While our results are consistent with existing research, they extend it in two important ways. First, they indicate there are sex differences in the aforementioned relationship. Studies suggest that men and women sometimes respond to analgesic drugs in different ways (Giles & Walker, 2000; Tanaka, 1999). Although the findings related to ibuprofen are mixed, there is evidence that ibuprofen has a greater analgesic effect for men than it does for women (e.g., Walker & Carmody, 1998). In the current investigation, women who took ibuprofen noted that they felt less hurt directly after being excluded from a ball-tossing game than did those who took the placebo, but men who took ibuprofen reported feeling more hurt. In other words, women responded as expected and in line with pain overlap theory. Men, however, responded in the opposite fashion. The sex difference evidenced in our findings supports a social cognitive model of pain reduction. More specifically, men who are given a physical pain reliever appear to exhibit a disinhibition effect—it is possible that they report more social pain because they are relatively likely to attribute any reduction in their pain to the pill instead of to themselves or their efforts to constrain their feelings.

Of course, a disinhibition effect is only one possible explanation for our findings. An
alternative explanation is that taking a physical pain reliever enables men to express their social pain. Because men are socialized not to express emotional pain and vulnerability, they likely find it more challenging to express their hurt feelings. Taking a physical pain reliever may influence the dACC in a way that provides men with the cognitive resources they need to articulate their social pain. This explanation is supported by our finding that men who took ibuprofen described their social and physical pain differently—using more first-person pronouns and marginally more emotion words—than did men who took the placebo. Another explanation is that, for men, neural activity associated with social pain and neural activity associated with emotion regulation are linked. Supporting this premise, Eisenberger, Inagaki, Rameson, Mashal, and Irwin (2009) found that men who had increased levels of interleukin-6 (IL-6, a proinflammatory cytokine produced in response to endotoxin), showed some increase in social pain-related neural activity, but also showed increased activity in several regions of the brain involving emotion regulation. By contrast, women who had increased levels of IL-6 showed almost exclusive increases in social pain-related neural activity. These findings suggest the possibility of an association between social pain-related neural activity and emotion regulation neural activity for men.

The second way the results associated with the ball-tossing game extend existing theory and research is that they show that taking a physical pain reliever had an immediate influence on the social pain or hurt individuals reported in response to being excluded. Because prior research used daily diaries to gauge the effect of a physical pain reliever on people’s hurt feelings (DeWall et al., 2010), the immediate or acute effect of the pain reliever on

Figure 3. Interaction between treatment and sex for first-person pronouns.
hurt has been difficult to evaluate. The effect found in prior work could have been a consequence of a reduction in people’s social pain or, alternatively, it could have been a result of individuals reappraising their social pain. The current study evaluated the hurt people felt directly after a painful rejection experience (being excluded from a game) and found that taking a physical pain reliever had an immediate effect on individuals’ social pain.

In addition to examining the social pain people felt immediately after a rejection experience, this study touched on the ongoing or recurring nature of social pain. Research suggests that social pain is more easily reexperienced or relived than physical pain (Chen et al., 2008). Indeed, when people are hurt or rejected, they may think about and relive their feelings years after their initial experience. The current investigation revealed that relived social pain, like concurrent social pain, may share the same neural system as physical pain. We found that women who took ibuprofen felt less hurt or social pain when they relived a painful experience than did those who took the placebo. Men who took ibuprofen, by contrast, reported feeling more hurt when they relived a socially painful experience than did men who took the placebo. This pattern of findings mirrors the pattern found for acute social pain: Taking a physical pain reliever was linked to a reduction in women’s social pain, but an increase in men’s social pain.

Although the aforementioned findings indicate that there are potentially important sex differences in the way the social pain system operates, they do not provide any information about the influence of a physical pain reliever on the way men and women think about and express their social pain. Previous work suggests that the way people think about and describe traumatic experiences such as social pain can...
affect their mental and physical health (Pennebaker, 1993; Pennebaker & Francis, 1996; Pennebaker et al., 1997). Further, individuals’ self-described attitudes about physical pain are associated with the way they experience and respond to pain (Sternbach & Tursky, 1965; Zborowski, 1952). As such, the current study explored the words women and men used to describe their relived social and physical pain. We found that individuals who took ibuprofen described their hurt differently than did those who took the placebo. Further, the sex differences found in men’s and women’s ratings of their social and physical pain were reflected in their descriptions. Women who took ibuprofen used fewer first-person pronouns and marginally fewer emotion words in their descriptions than did women who took the placebo. By contrast, men who took the pain reliever used more first-person pronouns and marginally more emotion words than did men who did not take the pain reliever.

The differences in the frequency of words used by men and women to describe their social pain can be explained by research on the linguistic predictors of well-being. For instance, the frequent use of first-person pronouns has been associated with a focus on the self that is characteristic of sadness and depression (Pennebaker, 1993, 2011). In fact, Rude and colleagues (2004) found that individuals experiencing emotional pain tended to use a relatively high proportion of first-person singular pronouns. People’s tendency to use first-person pronouns in the current study similarly reflected their social pain. Women who took a physical pain reliever used fewer first-person pronouns to describe their social and physical pain and reported feeling less social pain than did those who took the placebo. Men who took the pain reliever, by contrast, used more first-person pronouns in describing their social and physical pain and reported experiencing more social pain than did those who took the placebo.

Similar to the use of first-person pronouns, the frequent use of emotion words has served as an indicator of individuals’ involvement in traumatic situations (Tausczik & Pennebaker, 2010). For example, Holmes and colleagues (2007) found that when women who were coping with intimate partner violence used more emotion words to describe the violence, they felt greater physical pain. These researchers suggested that the women’s use of emotion words demonstrated their immersion in the trauma they had experienced and that this immersion, in turn, led to increased physical pain. A similar case can be made for people’s use of emotion words in this study. Women who took ibuprofen and who reported less social pain used marginally fewer emotion words and were likely less involved in the situations they described; men who took ibuprofen and who reported more social pain used marginally more emotion words and, thus, were likely more involved in the painful situations they described.

When people are highly involved in a painful experience, they may have relatively few cognitive resources at their disposal. Although we did not test whether individuals who reported experiencing more social pain (women who took the placebo and men who took ibuprofen) also expended more cognitive resources than those experiencing less social pain, prior research suggests that this may very well be the case. Chen and colleagues (2008) found that when people relived their social pain, they performed relatively poorly on demanding cognitive tasks. While these findings suggest that people have fewer cognitive resources available when they feel hurt, they do not indicate the extent to which those resources are tied to the physical pain system. One way to advance theory concerning the overlap between social and physical pain would be to measure the cognitive load of people experiencing social pain and to test whether taking a physical pain reliever increases the cognitive resources available to those individuals. Differences in people’s ability to describe their social pain might be explained by changes in their cognitive resources.

Another way to advance existing work and address this study’s limitations would be to further test the explanation posited for the sex differences that were found. Although it is possible that, as suggested by the model, the distinction between men and women was
due to a disinhibition effect, our data do not directly test the effect. Research on the reverse placebo effect (Storms & Nisbett, 1970) offers some guidance as to how the disinhibition effect might be tested. Studies suggest that the reverse placebo effect is stronger for individuals who have high private body consciousness (who are particularly attentive to their internal body processes) and that there is an inverse association between body consciousness and the size of the placebo effect for those with low self-esteem (Brockner & Swap, 1983; also see Duncan & Laird, 1980). Studies also show that men tend to make greater use of internal, physiological information than do women (Roberts & Pennebaker, 1995). Assessing men’s and women’s body consciousness and their self-esteem would provide a more thorough test of the social cognitive model.

The current study also was limited in the extent to which it measured individuals’ ability to sense, as opposed to express, their social pain. It may be that taking a physical pain reliever increases men’s ability to sense their social pain or, alternatively, that taking a physical pain reliever increases men’s ability to express their social pain. Given recent evidence that the severity of a social injury affects the extent to which people experience pain (Bernstein & Claypool, 2012), it is also possible that the severity of the injury will complicate any association between experienced and expressed social pain. Testing which of these two alternatives best explains the sex differences, and under what circumstances each operates, would be fruitful.

Yet another noteworthy limitation of the current study’s data is that they do not provide a direct comparison of social and physical pain. Future research should examine whether there are sex differences in the degree to which ibuprofen reduces individuals’ physical pain and, if so, whether those differences, in turn, influence men’s and women’s social pain. Also, because it is easier to relive social than physical pain (Chen et al., 2008), any differences in the way people describe the two types of pain should be more apparent in relived than in immediately experienced pain. Studying issues such as these will provide further insight into the ways people experience social and physical pain and may help generate new ideas about how the two types of pain can be controlled or alleviated.

References
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Reducing social pain


