Pain and Consumption:
The Influence of Social Pain on Consumer Decision-Making

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Abstract

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Prior research has found that there are overlapping regions in the brain that support the affective processes of both social and physical pain. Furthermore, factors that influence the experience of social pain have been found to affect the experience of physical pain, and vice versa. However, researchers have yet to explore whether social pain has an influence on consumer decision-making. This thesis explored whether social pain had an influence on consumer evaluations and preferences for products for reducing physical pain. In addition, the embodiment of romantic pain and its influence on product preferences were examined. It was found that writing about a past relationship injury increased the evaluation and purchase intent for a pain relief product. However, support was not found for the embodiment of romantic pain. Limitations and recommendations are discussed.
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1.0 Introduction

Social pain has been defined as the distressing experience from an actual or potential loss of a social connection (Eisenberger & Lieberman, 2004; MacDonald & Leary, 2005). When going through one of these experiences, such as a breakup or being ignored in a social situation, a person may describe feelings of being *heartbroken, slapped in the face, scarred or hurt*. Linguistic expressions that use physical injuries to convey social pain are used by not only English speakers but also people of other cultures around the world (MacDonald & Leary, 2005). In fact the English language only uses physical pain words to communicate social pain (Leary & Springer, 2001). Findings from scientific research suggest that there may be some biological underpinning for why physical pain and social pain share many of the same vocabularies.

More than a decade ago, neuroscientists found that the regions in the brain that respond to the distress of physical pain also respond to social pain (Eisenberger, Lieberman, & Williams, 2003). Subsequent work has found that sensitivity to one kind of pain is related to sensitivity to the other kind of pain (e.g., DeWall & Baumeister, 2006; Ehnvall, Mitchell, Hadzi-Pavlovic, Malhi, & Parker, 2009; Eisenberger, Jarcho, Lieberman, & Naliboff, 2006;). Moreover, taking Tylenol, an over-the-counter painkiller commonly taken for body aches, reduces social pain as well (DeWall et al., 2010). These findings suggest that a broken heart *hurts* in some similar ways as a broken arm. However, as people take Tylenol for physical pain relief, do people seek pain relief when they are in social pain?
While some current evidence suggests that altering the experience of social pain changes the experience of physical pain, and vice versa (e.g., DeWall et al., 2010; Eisenberger, Master, et al., 2011; Eisenberger, Jarcho, Lieberman, & Naliboff, 2006; Master et al., 2009; Way et al., 2009), researchers have yet to explore whether people would seek pain relief products when under social distress.

The objective of the present research is to investigate whether the experience of suffering from social injuries affects the preference for products for bodily aches. While there are different causes of social pain (Leary & Springer, 2001; Leary, Springer, Negel, Ansell, & Evans, 1998; MacDonald, 2009; MacDonald & Leary, 2005; Vangelisti, 2005), the present investigation has focused on the experience of threats to or loss of a close social bond. In addition, this research further explored whether the metaphors of heartache reveals the location in which romantic pain is felt. Given that the metaphors make specific reference to the heart, I predicted that people who experience heartbreak would prefer products that care for the heart more than products that care for other parts of the body.

In this thesis, I first review the theories of embodiment (Barsalou, 1999, 2003, 2008) and conceptual metaphor (Lakoff & Johnson, 1980, 1999; Landau, Meier, & Keefer, 2010), the body of work in which I situate the present research. I then review the work that has found the overlapping brain regions that respond to both physical and social pain (Eisenberger et al., 2003), and some of the psychological consequences of the overlap. Given the evidence that supports the shared affective system of physical and social pain, I posited that social injuries may increase the appeal of painkillers such as Tylenol.
The final section of the literature review summarizes the theoretical grounding of the second research hypothesis on the embodiment of heartache. I outline some recent findings that some sensorimotor activity may be accurately predicted by conceptual metaphors to a surprising extent. Moreover, in some instances social pain has been shown manifestations beyond emotional distress. Based on these findings, I predicted that heartbreak may lead to a motivation to care for the heart more than for other parts of the body.
2.0 Literature Review

2.1 Grounded Cognition

The traditional theories of cognition that emerged out of the cognitive revolution in psychology assume an amodal information processing system of the mind analogous to a computer, where information is represented and manipulated as abstract symbols (Block, 1995). Although the body's sensory and perceptual systems serve to deliver modality-rich input from the environment to the mind, the input becomes transformed into language-like, abstract symbols stripped-off its modality-specific information (Fodor, 1975). Mental operations on these amodal symbols constitute higher-level cognition, a process assumed to be largely free from sensory and motor interference.

However, recent work in a developing paradigm that is built upon the embodiment and conceptual metaphor theories has been uncovering phenomena that cannot be adequately accounted for by the amodal theories of cognition. For example, compared with posing in contractive postures (e.g., closed limbs), posing in expansive postures (e.g., open limbs) increases risk-taking tendencies and feelings of power (Carney, Cuddy, & Yap, 2010). Experiencing physical disgust (e.g., being in a malodorous room) increases the severity of moral judgments (Schnall, Haidt, Clore, & Jordan, 2008). These findings suggest that at least some types of information processing are grounded in or influenced by sensorimotor and perceptual input.

One prominent perspective of grounded cognition is the perceptual symbol systems theory (Barsalou, 1999). Barsalou has argued that bodily experiences and the simulations
of these experiences are integral to cognitions (Barsalou, 1999, 2003, 2008). According to this perspective, a concept is stored in the mind as a modality-rich experience that entails the perceptual, sensory and affective information that coincided with the learning of the concept; thinking about the concept brings forth the associated bodily and introspective states registered with the concept. For instance, being primed with senile concepts (e.g., wrinkles, stubborn) decreases young people's walking speed (Bargh, Chen, & Burrows, 1996).

Conversely, influences on the bodily states can bias cognitions and affective states. For example, listening to a radio broadcast while nodding the head leads to increased agreement with the broadcast’s content compared with when shaking the head (Wells & Petty, 1980). Simulating a smile by holding a pencil with the teeth increases perceived humour of cartoons compared with when smiling is inhibited by holding the pencil with the lips (Strack, Martin, and Stepper, 1988). In the similar vein, Botox treatment, which causes facial musculature paralysis, interferes with judgments of facial emotions as portrayed in photographs (Neal & Chartrand, 2011), presumably due to an inability to simulate the emotions in the photographs. These and many other findings support the modality-dependent framework of cognition (for review, see Barsalou, 2008; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005).

The conceptual metaphor theories are another prominent perspective of grounded cognition. (Lakoff & Johnson, 1980, 1999; Landau et al., 2010). Some of these theorists propose that the concrete concepts of the physical world acquired early in a person’s development are the building blocks for the abstract knowledge that form later. This
hypothesis is exemplified in the metaphors of concrete domains that people use to refer to abstract ideas such as friendliness (e.g., a warm welcome), sin (e.g., blood on the hands), and social pain (e.g., a heartache). Lakoff and Johnson have argued that more than conventions and embellishments, linguistic expressions of metaphors may expose the ways people think about a concept. Much empirical evidence on the metaphorical nature of many abstract concepts has supported the claim. For example, analyses of the metaphors for positive and negative valence concepts show that high and low vertical positions are often referenced, respectively (e.g., high spirit, the bottom of the company; Lakeoff & Johnson, 1980; Landau et al., 2010). Crawford, Margolies, Drake, and Murphy (2006) found that participants showed better recall of positive items when the items were positioned high (vs. low). Keefer and colleagues found that college freshmen who were made to feel uncertain about their decision for enrolling in college were more satisfied with their decision when they listed their reasons for going to college from bottom up than from top down, a pattern of results that again corresponded with the metaphors that up is good, and down is bad (Keefer, Landau, Sullivan, & Rothschild, 2011). Furthermore, the social power of a group is identified faster when the group is positioned in the way consistent with the verticality understanding of valence concepts (e.g., powerful groups are identified faster when presented in a vertically high (vs. low) position; Schubert, 2005).

To review some examples in the domain of the present research, researchers have found that the use of temperature-related metaphors for conveying feelings of social connectedness may reflect the bodily sensations that occur with social interactions. Holding a warm beverage in the hands increases the perceived warmness of another
individual's personality (Williams & Bargh, 2008) and the extent of intimacy with friends and families (Ijzerman & Semin, 2009). For individuals who had low amount of social support from their families, drinking cold water (vs. warm or no water) decreased their sense of belongingness (Chen, Poon, & DeWall, 2015). Feeling socially excluded can lead to perceived colder room temperatures than when not feeling excluded (Zhong & Leonardelli, 2008). These findings support the notion that the language for communicating concepts may reveal the nature of how people think, feel and understand the concept (Lakoff & Johnson, 1980).

Both the perceptual symbol systems and the conceptual metaphor approaches to grounded cognition represent a challenge to the purely amodal theories of cognition and constitute a collective effort of connecting the physical and bodily experiences with psychological and behavioral outcomes (Barsalou, 2008). Some researchers have proposed that the embodiment of abstract, higher order cognition may reflect the reuses of older neural adaptations that had primarily action-oriented functions for responding to the environment (Anderson, 2010). Through the course of evolution, these neural circuits have acquired new uses while retaining their original functions. Consistent with this theory, research on the neural circuitry of the emotional distress from social rejection has found the overlapping regions in the brain that respond to both physical and social pain (Eisenberger et al., 2003). Furthermore, there are observable psychological consequences that may be attributed to the neural overlap, and they are reviewed in the following section of this thesis.
2.2. Social Pain and Physical Pain

2.2.1 The Neural Overlap

The distress from a loss of or threats to one’s social relation is referred to as social pain (Eisenberger & Lieberman, 2004; MacDonald & Leary, 2005). Situations that induce social pain may include social exclusion or rejection (e.g., being prevented from participating in a game; unrequited love), social evaluation (e.g., a high stake interview), and inevitable losses of relationships (e.g., death of a family member; moving away from one’s hometown) (Eisenberger & Lieberman, 2004; Leary & Springer, 2001; Leary et al., 1998; MacDonald, 2009; MacDonald & Leary, 2005). In the course of evolution, individuals with the ability to form strong connections with others were more likely to enjoy some advantages that increased the chances of survival and reproduction (Panksepp, 1998), as families and allies could share resources and look out for one another’s interests (Baumeister and Leary, 1995). Belongingness has been argued to be a fundamental need, almost as human’s need for food (Baumeister & Leary, 1995). Given the importance of cooperating with others and living in a group, Panksepp (1998) has proposed that over time the neural systems that respond to losses of social bonds may have begun to use some of the same systems that process physical pain. Physical pain may signal a threat to the body, and social pain may signal a threat to an important relationship. As both kinds of threats are risks to one’s safety and wellbeing, some of the neural mechanisms that process physical pain may have undergone a neural reuse, as Anderson (2010) would put it, and respond to the distress from social threats as well (Eisenberger & Liberman, 2004; Panksepp, 1998; MacDonald and Leary, 2005).
Indeed, neuroscientists have found some overlaps in the brain regions that process both physical and social pain. In the first neuroimaging study on the brain’s responses to social pain (Eisenberger et al., 2003), participants played the Cyberball game (Williams, Cheung, & Choi, 2000) while their brains were scanned. Cyberball is an online game of ball-passing with two other virtual players disguised as naïve participants. Feelings of affiliation were manipulated in the study by putting the real participant through three phases in the game. In the implicit exclusion phase, the participant could only watch the other two players play the game due to some technical difficulties. In the inclusion phase, the participant played the game with the other two players. Finally, in the explicit exclusion phase, the participant stopped being passed the ball from the other two players after a few passes. The imaging data from the study found that compared to the inclusion phase of the game, a region in the brain, the dorsal anterior cingulate cortex (dACC), was more active in both of the exclusion phases. Moreover, the amount of dACC activity positively correlated with self-reported distress. As prior work found that the dACC becomes activated in response to physical pain (e.g., Price, 2000; Rainville, Duncan, Price, Carrier, & Bushnell, 1997; Sawamoto et al., 2000), the results of Eisenberger’s study led to the hypothesis that the distress from negative social experiences falls under the category of pain experiences (Eisenberger & Lieberman, 2004).

Specifically, the proponents of the hypothesis argue that social pain and physical pain share the same affective processes (Eisenberger & Lieberman, 2004; MacDonald & Leary, 2005). Pain affect is the emotional aspect of pain. It motivates people to seek pain relief, and it is one of two dimensions of pain (Price, 2000). The other dimension of pain is
its sensory experience on the body (Price, 2000). While a physical injury typically involves both the sensory and the affective dimensions of pain, Eisenberger (2012a, 2012b) has argued that pain does not always have to involve both dimensions. The emotional turmoil from an injury to one’s interpersonal relationship may involve only pain affect but is nevertheless painful.

The argument that people may experience pain without bodily sensations is further supported by the findings that the two dimensions of pain are processed by different regions in the brain. The main regions that process pain affect are the dorsal anterior cingulate cortex (dACC) and the anterior insula (AI) (Price, 2000; Treede, Kenshalo, Gracely, & Jones, 1999; Eisenberger and Lieberman, 2004). The sensory dimension is processed mainly by the somatosensory cortices and the posterior insula (Apkarian, Bushnell, Treede, & Zubieta, 2005; Bushnell et al., 1999; Schnitzler & Ploner, 2000). Some evidence from lesion and case studies suggests that the two dimensions of pain are related but distinguishable. Patients with lesions to the dACC can perceive pain stimuli but are not bothered or upset by the sensation (Foltz & White, 1962). On the other hand, individuals with impaired somatosensory cortices can still be emotionally bothered by pain stimuli (Ploner, Freund, & Schnitzler, 1999) and report social loss as painful (Danziger & Willer, 2005). These findings support the thesis that pain is not limited within somatosensory experiences (Eisenberger, 2012a, 2012b).

Since Eisenberger and colleagues’ study (2003), additional findings have supported the association between activity in the dACC and AI and social pain. For example, individuals who are high on anxious attachment style characterized by a high concern for
acceptance and high rejection sensitivity display heightened activity in the dACC and AI in response to social exclusion (DeWall, Masten, et al., 2011). Furthermore, researchers have found that for those with a low self-esteem, evaluative circumstances that entail the risk of being shunned or rejected by others also trigger activity in the brain’s pain affect regions (Eisenberger, Inagaki, Muscatell, Haltom, & Leary, 2011). In that study, participants recorded an interview and received arbitrary feedback on the interview from a confederate. The results showed that participants whose state self-worth decreased from receiving negative feedback showed greater neural activity in the dACC and AI than did participants whose self-esteem was not injured by the negative feedback. Feeling envious from comparing oneself to a higher status peer also resulted in greater neural activities in the same regions (Takahashi et al., 2009). Seeing rejecting facial expressions (Burklund, Eisenberger, & Lieberman, 2007) or paintings of rejection themes (Kross, Ochsner, Hirsch, & Downey, 2007) also triggered greater activities in the dACC compared with seeing other negative facial expressions or paintings of acceptance themes. These findings have converged to support that activity in the dACC and AI is associated with the distress from social connection threats.

As social injuries trigger activity in the pain affect circuitry, increasing feelings of affiliation through social support has been shown to attenuate activity in the circuitry. Eisenberger et al. (2007) had participants played the Cyberball game and measured their dACC activity. The results showed that individuals who received high levels of social support in their daily lives showed less activation in the dACC from playing Cyberball than did individuals who had low support. In another study, Masten et al. (2010) had teenage
participants record the amount of time spent with friends outside of school before playing the Cyberball game two years later. The fMRI scans showed that time spent with friends was negatively associated with the amount of activity in the dACC and AI from being ostracised in Cyberball. Using the same social exclusion paradigm, Onoda et al. (2009) found that receiving sympathetic messages when being ostracised reduced the amount of experienced pain and activation in the ACC region. In summary, there is much empirical support that the pain affect circuitry is central to the experience of social pain.

2.2.2 Bidirectional Influences: From Social to Physical

In light of the evidence of the shared affective system in the brain that responds to both physically and socially painful stimuli, factors that modulate social experiences have been shown to modulate the experiences of physical pain as well. For instance introversion is associated with a high sensitivity of relationship threats, and compared to extraverts, introverts are more sensitive to physical pain (Phillips & Gatchel, 2000). Interpersonal factors have also been found to influence physical pain experience. In one study that subjected participants to pain, participants were randomly assigned to experience intentional or unintentional electric shocks (Gray & Wegner, 2008). In the social context, intentionality of harm often communicates the degree of malice the transgressor has against the victim. The outcomes of the study revealed that participants in the intentional pain condition rated the shocks as more painful compared to participants in the unintentional condition. In the latter condition, these participants exhibited the typical habituation response (Greffrath, Baumgärtner, & Treede, 2007) and reported less amount
of pain from additional unintended shocks. In contrast, participants in the intentional condition never became habituated to the shocks and reported the additional shocks as being as painful as the initial shocks. The findings support the argument that pain is not only a negative somatosensory experience but is also under the influence of social-psychological factors.

Social support, which has been argued to buffer social pain (e.g., Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007; Leary, Koch, & Hechenbleikner, 2001; Masten, Telzer, Fuligni, Lieberman, & Eisenberger, 2010; Onoda et al., 2009), has been found to buffer against the discomfort of physical pain. In a cold pressor study (Brown, Sheffield, Leary, & Robinson, 2003), participants immersed their hands in ice water while they were randomly assigned to one of four conditions. In the active support condition, the participant received verbal encouragement from a supporter. In the passive support condition, the supporter provided non-communicative support to the participant. In the mere interaction condition, a bystander interacted with the participant in a non-supportive manner. Finally in the alone condition, the participant underwent the cold pressor task alone. The results showed that participants who received the active or the passive social support reported the cold pressor experience as less painful than did participants in the no support or in the interaction conditions.

Similar results have been found in another experiment on social support and physical pain (Master et al., 2009). Female participants underwent a painful thermal stimulation on their arms under one of three conditions. In the social support condition, participants held their romantic partners' hands or viewed pictures of their partners. In the
stranger support condition, the hands were those of a stranger, as were the pictures. In the object condition, participants held a squeeze-ball or viewed an image of an object. The authors found that the pain ratings from the heat stimuli were lower from participants in the social support condition than from participants in the other two conditions. In an fMRI follow-up study with a similar design (viewing a picture of a partner, a stranger, or an object while undergoing pain stimulation) (Eisenberger, Master, et al., 2011), viewing their partners’ pictures led to participants experiencing less pain and a reduced activation in the dACC and the AI. Thus, social support appears to have an influence on how pain on the body is experienced.

2.2.3 Bidirectional Influences: From Physical to Social

Correspondingly, the experience of physical pain can influence how people interact with others and react to social pain. Patients with a chronic pain condition often become fearful of and anxious about social interactions (Asmundson, Norton, & Jacobson, 1996). In another study that used the Cyberball manipulation, participants with a lower pain threshold felt more distress from being excluded in the game than did participants with a higher pain threshold (Eisenberger et al., 2006). The same study also found that greater distress from playing Cyberball predicted greater reported pain from heat stimuli delivered after the game. This finding suggested a bidirectional influence between the two kinds of pain.

Another Cyberball game study found that participants with a greater sensitivity to pain due to a variation in an opioid receptor gene had a greater sensitivity to rejection and
showed greater activity in the dACC and the AI in response to social exclusion (Way et al., 2009). When sensitivity to physical pain was artificially enhanced by inducing an inflammatory response, it corresponded with increased feelings of disconnection and hurt (Eisenberger, Inagaki, Mashal, & Irwin, 2010). Finally, Riva, Wirth and Williams (2011) compared the amount of social distress reported by participants in a Cyberball exclusion condition with that reported by participants in a cold pressor condition. The authors found that participants in both conditions reported similar levels of feeling ignored and rejected. In sum, just as the degree of social connection influences the amount of experienced pain on the body, bodily pain has substantial manifestations in people's social lives.

### 2.2.4 Social pain and Painkillers

Do pain medications for physical pain numb social pain? Acetaminophen, widely known by its trade name Tylenol, is commonly taken to relieve body aches. In a novel exploration on the effects of acetaminophen on social pain (DeWall et al., 2010), participants in the study took either Tylenol or placebo pills for three weeks and recorded their hurt feelings on a daily basis. Starting from day nine to the end of the study period, participants who had been taking Tylenol reported lower levels of hurt feelings compared to participants who had been taking placebo pills. In a follow-up study with the Cyberball game paradigm, participants who had been taking acetaminophen reported less distress and showed less dACC and AI activation in response to exclusion compared with participants who had been taking placebo pills. More recently, Deckman, DeWall, Way, Gilman, and Richman (2014) found correlational evidence that smoking marijuana reduces
social pain. In their research, frequent marijuana users reported higher self-worth, and the relationships between loneliness and depressive symptoms were weaker compared with those of infrequent marijuana users. Frequent users also experienced less distress from the Cyberball exclusion paradigm than infrequent users.

The present research aimed to further the inquiry on the experiential overlap of physical and social pain. On the one hand, Tylenol has been found to reduce hurt feelings and dACC activation (DeWall et al., 2010). On the other hand, it cannot be assumed that because Tylenol relieves social pain, a person in a socially painful state is more likely to find Tylenol appealing than when in a pain-free state. Given the accumulating evidence from both neural imaging and social-behavioral studies that support the hypothesis of a shared affective mechanism of physical and social pain, I predicted that suffering a painful relationship injury may increase the appeal of Tylenol.

H1a: Threats to or a loss of a close interpersonal relationship (relationship pain) increases the desirability of Tylenol.

H2b: Threats to or a loss of a close interpersonal relationship increases the purchase intent for Tylenol.
2.2.5 Gender and Interpersonal Stress

The present research has focused on females’ experiences of relationship pain. Although the need to belong has been proposed to be a universal, fundamental need (Baumeister & Leary, 1995), there is a difference between the extent to which men and women see themselves in relation to others (Cross & Madson, 1997). Specifically, women tend to have an interdependent construal of the self and have a greater concern for harmony in their social relationships, whereas men have a relatively independent construal of the self and have a greater interest in standing out in their social network. Compared to men whose personality traits are higher on assertiveness, women tend to have more nurturing personality traits (Feingold, 1994). These gender differences may reflect the social environment from which boys and girls are brought up. Girls are socialized to maintain harmony in their close relationships, while boys are encouraged to be competitive and dominant within their social groups (Maccoby, 1990). Girls are also taught to be sensitive to others’ feelings (Kuebli & Fivush, 1992), and this relational focus orientation goes on to become part of a woman’s self-construal (Cross & Madson, 1997; Thoits, 1992).

Women’s focus on their relations with others may contribute to their greater sensitivity to threats to their sense of affiliations (Benenson & Christakos, 2003; Nolen-Hoeksema, 2001). On average, women tend to experience greater interpersonal stress, and they are also more negatively affected by interpersonal stress than are men (Cyranowski, Frank, Young, & Shear, 2000; Rudolph & Hammen, 1999). Whereas men showed greater physiological stress responses when faced with achievement challenges, such as a verbal or a math test, women showed greater stress responses when being socially rejected (Stroud,
Females become more distressed from threats to their close friendships (Benenson & Christakos, 2003) and more jealous when their close friends develop new friendships than do males (Parker, Low, Walker, & Gamm, 2005). Interpersonal problems are more likely to lead to depressive symptoms for females than for males (Acitelli, Cambron, Verratti, & Knee, 2006; Cyranowski et al., 2000; Rudolph & Hammen, 1999). Furthermore, inflammation-induced social pain led to depressive symptoms only for women but not for men (Eisenberger et al., 2010; Moieni et al., 2015).

Given the gender differential emphasis on close-affiliations and females’ greater reactivity to social threats, I recruited only female participants to test my hypothesis. This decision was consistent with the procedure of a prior study that used a similar operational definition for social pain (Kross, Berman, Mischel, Smith, & Wager, 2011).

In addition to H1, I further predicted that linguistic metaphors for the social pain from a broken romantic relationship might reveal the embodied association of the pain. Specifically, heartache might be most relevant to the heart than to other parts of the body.

In the following section of the review, I summarize evidence that suggests that modal information in language use may have originated from sensorimotor activity. Furthermore, under certain circumstances social pain may entail changes somatosensory experiences. The present research explored whether there was a meaningful link between the heartache metaphors and the heart.
2.3. Embodiment of a Broken Heart

Is it a mere coincidence that people use metaphors associated with the heart, such as *heartache*, *heartbroken* and *bleeding heart* to convey the pain from being hurt in a romantic relationship, or do these metaphors reveal *where* on the body the pain may be embodied? The central thesis of the conceptual metaphor theory (Lakoff and Johnson, 1980) is that abstract thoughts are grounded in concrete, physical experiences in such a way that one can only have an understanding of an abstract idea by having been through the physical, bodily experiences that often co-occur with the activation of the idea. Since there are systematicity in the metaphors used to comprehend a concept, there are regularity and limitations to the linguistic expressions that can be used to convey the concept. Therefore, studying the pattern of how the concept is communicated in words should reveal how the concept is structured in terms of concrete, embodied experiences. Since referencing injuries in the heart is commonly understood as suffering from romantic pain, it stands to reason that romantic pain might concern the heart more than other parts of the body.

2.3.1 Conceptual Metaphor and Embodiment

Indeed, paying attention to the linguistic detail of how an abstract concept, such as an emotion, is communicated can reveal the extent to which neuromuscular simulation is involved in the process of understanding the concept. For instance, Foroni and Semin (2009) have found that reading a word describing an emotion increased the activity in particular sets of facial muscles associated with the emotion (the zygomatic major muscle
with positive emotion words; the corrugator supercilii muscle with negative emotion words), and that verbs of an emotion (e.g., to smile, to frown) led to more intense musculature activity than the adjectives of the same emotion (e.g., funny, angry). In a follow-up study, the researchers primed participants with emotion words that were either verbs or adjectives before participants made judgments on some cartoons. In addition, some participants had their facial musculature restricted by holding a pen with their lips (Strack et al., 1988). The results showed that among participants whose facial musculatures were not restricted, participants primed with positive emotion verbs rated the cartoons funnier than did participants primed with negative emotion verbs. However, priming with positive or with negative emotion adjectives did not lead to differential funniness ratings on the cartoons. Furthermore, the effect of positive verbs on cartoon ratings was not observed among participants who were holding a pen between their lips.

The findings complement other work that found that comprehending a verb entails the activation of the motor region in the brain associated with executing the action in the verb (e.g., Hauk, Johnsrude, & Pulvermüller, 2004; Tettamanti et al., 2005). They also corroborate the idea that the nuances of how a concept is conveyed in words can shed light on how the concept is embodied.

That features of a metaphor can inform the selectivity with which a concept is embodied is well-exemplified in Lee and Schwarz’s work (2012) on the embodiment of the metaphor *something smells fishy*. People often use the expression to describe situations that provoke suspicion. In their study, participants who smelled fish oil became more suspicious than did participants who smelled other scents. Remarkably, suspicion led to
increased sensitivity to and accuracy in identifying fishy smells but not other types of scents. The findings suggest the particularity of sensorimotor simulation of an embodied concept is often congruent with its metaphorical linguistic expressions.

Studying the modalities referenced in some conceptual metaphors can have implications in consumer decision-making. In the domain of moral psychology, researchers have found that committing or reading about moral transgressions leads to mental feelings of impurity that can be attenuated by cleansing the body (e.g., Schnall, Benton, & Harvey, 2008; Zhong & Liljenquist, 2006). The findings are consistent with the metaphors related to morality (e.g., dirty crime, clean conscience). Lee and Schwarz (2010) reanalyzed the data from some of these studies and found that cleansing the hands had greater effects in reducing the impact of the impurity feelings when the transgressions involved the hands than when they involved other parts of the body. They argued that as metaphors of morality often entail specific body parts (e.g., dirty hand, dirty mouth), when a transgression is committed through the hands, the perpetrator should be more motivated to clean the hands than to clean other parts of the body. In their study, participants either told a lie through their mouths or typed a deceptive email with their hands. The results showed that telling a lie led to more positive evaluations of a mouthwash compared to typing a deceptive email. In contrast, typing a deceptive email led to more positive evaluations of a hand sanitizer than telling a lie. Therefore, it may be important for researchers of embodiment and conceptual metaphors to pay close attention to which body parts are involved in the embodiment of a concept.
2.3.2 The Neural Perspective of Metaphorical Embodiment

Beyond these intriguing findings remains a critical question: what are the neurophysiological mechanisms for the embodiment of abstract concepts? In the recent development of the conceptual metaphor theory, Lakoff (2009, 2014) invokes findings from neuroscience to suggest that the embodied nature of conceptual metaphors can be attributed to the links in the brain between the circuitries for processing abstract concepts with the circuitries for processing sensorimotor information from the body. The links were developed through the concurrent firing of both types of circuitries. Once the links are in place, the activation of the circuitry for a bodily experience will trigger the firing of the linked circuitry that processes the abstract concept associated with the bodily experience.

Lakoff’s thesis is consistent with the research findings that different bodily postures activate neural correlates of psychological states in metaphorically consistent ways. For example in every day speech, people say *they look forward to* doing something when they are trying to get to a desirable end-state. Harmon-Jones, Gable, and Price (2011) studied whether a forward-leaning posture would activate neural network in the brain associated with desire motivation, that is a motivation to approach a rewarding goal. Participants either leaned forward or reclined on their chair while being shown photographs of desserts (appetitive stimuli) or rocks (control stimuli). The authors found that amongst the forward-leaning participants, their left frontal cortical activation, which is associated with approach motivation, was greater from seeing the dessert photographs than from seeing the rocks. However, amongst participants who were in a reclining posture, seeing the dessert photographs did not produce differential left frontal cortical activation from that
from seeing the control photographs. The results suggest that the words for describing approach motivation are not artificial inventions. Rather they allude to the physiological entailments that often correlate with the concept of striving towards a desirable end state.

In the domain of social pain, some studies have found that social exclusion produces physiological changes and neural activity in the brain in ways that would explain why people often use temperature-related metaphors to illustrate the concept of social closeness. As discussed previously, researchers have found that social distance influences people’s temperature perception (Zhong & Leonardelli, 2008), which according to a later investigation suggests a physiological basis for the finding (IJzerman et al., 2012).

Participants in the study played the Cyberball game while their body temperature from their index fingers was monitored. Participants who were excluded showed a drop in their finger temperature compared with participants who were included in the game. Moreover, holding a warm beverage alleviates the negative affect from being socially excluded.

Inagaki and Eisenberger (2013) have discovered some common neural processes that underlie both social and physical warmth. They have found that reading socially warm passage or holding a warm pack (vs. reading a neutral passage or holding a ball) activate some of the same regions in the brain (the ventral striatum and middle insula). However, non-warm but physically pleasant touch did not share the same neural correlates in the brain as social warmth. These recent findings have provided support that the metaphors for social closeness (e.g., a warm personality, cold and aloof) may have originated from physical warmth, which shares some common neural circuitries with those that process social warmth.
2.3.3 Social Pain and Sensorimotor Processing

In summary, many studies have found that the metaphors that people use to think about abstract concepts influence sensorimotor processing in predictable ways that are consistent with the modality details in the metaphors. Moreover, emerging evidence from neuroscience suggests that the basis of embodiment for some concepts may be due to overlaps in the neural systems that process the concepts and the sensorimotor experiences that co-occur with the concept. The present research explored whether a similar prediction could be made about the body part most relevant to the embodiment of romantic social pain. More specifically, this research aimed to address the following question: is heartache embodied in the heart?

Although researchers of social pain have found that this pain activates mainly the areas in the brain that support pain affect (Eisenberger & Lieberman, 2004; MacDonald & Leary, 2005), an imaging study found that a hurtful episode of sufficient intensity can trigger activities in the brain areas that support the sensory dimension of physical pain (Kross et al., 2011). In the study, female participants who had had an unwanted breakup of a romantic relationship underwent a rejection recall task and a physical pain task. In the recall task, participants thought about their breakups while viewing photographs of their ex-partners. In the physical pain task, participants had painful heat stimulations on their arms. The imaging data from both tasks showed increased activities in the regions that support the sensory experiences of physical pain. Furthermore, the patterns of activations in these regions from the rejection recall task were highly similar to those from physical
pain of other studies. Thus, a strongly felt social distress appears to produce neural activities that resemble a somatosensory experience.

One study has even found that receiving an unexpected social rejection alters cardiac activity (Moor, Crone, & van der Molen, 2010). Participants were shown pictures of strangers and were asked to judge whether they liked the strangers. They were then given mock feedback about whether the strangers liked them. Participants’ cardiac activities revealed that their heart rates slowed down temporarily when they encountered an unexpected social rejection (they liked a stranger, but the stranger did not like them) than when they received an expected rejection (they did not like a stranger, and the stranger did not like them). However, as there were no self-report psychological measures administered in the study, the authors were unable to conclude whether the cardiac slow-down had some cognitive or affective manifestations in participants.

The present research has examined whether the embodiment of romantic pain is particularly relevant to the heart, as explicit in the metaphor heartbroken. I predicted that when experiencing romantic pain, people become concerned for their heart and find products that care for the heart more appealing than products that care for other parts of the body. Stated formally:

H2a: Romantic pain increases the concern for heart health but not for other parts of the body.

H2b: Romantic pain increases the preference for health products for the heart but not for other parts of the body.
3.0 Present Studies

In study 1, I investigated whether recalling an incidence of relationship pain would lead to an increased preference for Tylenol. I compared participants’ preferences for Tylenol with their preferences for non-pain related products. In study 2, I explored whether romantic pain would lead to an increased concern for the heart and preference for a heart health product.

3.1 Study 1

3.1.1 Pretest

Study 1 examined whether reliving a socially painful experience increases the evaluation and purchase intent for Tylenol. Social pain was manipulated by asking participants to recall and write about being the victim of a relationship injury. To rule out general mood changes as an alternative explanation, a pretest was conducted to compare the affective states from writing about the relationship pain topic with those from writing about a topic on losing an object. Participants in the relationship pain condition received the following instructions: “Think of a time when you were going through an unwanted breakup of a romantic relationship or of a friendship. If you have not had such an experience, then think about a time when a relationship that you had with someone close to you almost came to an end. Describe the experience in as much detail as possible, including your thoughts and feelings about the experience.” Participants assigned to the object loss condition were instructed to “Think of a time when you lost an object that you
had previously owned. Describe the experience in as much detail as possible, including your thoughts and feelings about the experience.”

In both conditions, mood valence and mood arousal were measured with the Brief Mood Introspection Scale (BMIS; Mayer & Gaschke, 1988). The results from the pretest showed that the difference in mood valence between the relation threat ($M = 38.86, SD = 6.51$) and the object loss conditions ($M = 41.25, SD = 5.40$) did not reach statistical significance, $t(54) = 1.50, p = .14$. The mood arousal subscale score in the relationship pain condition ($M = 27.42, SD = 3.60$) also did not differ significantly from that in the object loss condition ($M = 26.75, SD = 3.79; t(54) = .69, p = .50$). The results were consistent with some of the prior studies that found that social pain may lead to emotional numbing, such that mood ratings did not differ from control conditions (e.g., DeWall et al., 2011; DeWall & Baumeister, 2006).

However, the two groups differed significantly on hurt feelings (“My feelings got hurt from the event”) and on event painfulness (“How painful was the experience?”; both items were measured on a 1 to 9 scale, $1 = not at all, 9 = extremely$). Participants in the relationship pain condition reported greater amount of hurt feelings ($M = 7.82, SD = 2.04$) than did participants in the object loss condition ($M = 4.57, SD = 2.70; t(54) = 5.08, p < .001$). Similarly, the written event was rated more painful in the relationship pain condition ($M = 7.71, SD = 1.30$) than in the object loss condition ($M = 4.36, SD = 2.00; t(54) = 7.44, p < .001$). The results show that losing a relationship is a more painful experience than is losing an object, consistent with the argument that hurtful episodes are typically interpersonal in nature and often involved a close other (Leary & Springer, 2001; Leary et al., 1998). Based
on these results, I included the object loss condition in the main study as one of the comparison conditions.

In the main study, participants were randomly assigned to write on one of three topics. Two of the three topics, the relationship pain and object loss experiences, were the same as in the pretest. To match the social aspect of the relationship pain topic, a third topic about social interaction with a friend or family member was included as an additional comparison condition. After the writing task, participants rated their evaluation and purchase intent for Tylenol and for other non-pain related products. I predicted that participants in the relationship pain condition would rate Tylenol as more desirable and would express a greater intent to purchase it than would participants in the other two conditions.

3.1.2 Main Study: Method and Procedure

The study received ethic’s approval from the University of Guelph. Female undergraduate participants were recruited from the university in exchange for course credits. To mask the study’s hypothesis, the study was framed as two independent studies: a writing study and a consumer product survey. Participants first complete the writing study that was framed as a pretest for a project by another graduate student. After completing the writing task, participants completed the consumer product survey that was framed as an investigation for understanding students’ preferences for some everyday products based on their lifestyles.
In the writing study, participants were randomly assigned to one of three conditions. In the relationship pain and in the object loss conditions, participants were instructed to write about a threat to or loss of a close relationship, or about losing an object, respectively (the same instructions as in the pretest). In the social interaction condition, participants were to “Think of an activity that you have done with a friend or a family member. Describe the experience in as much detail as possible, including your thoughts and feelings about the experience.” To prevent self-presentational motives, participants were assured that they would not be submitting the writing, and the writing would not be read by anyone else. Instead, participants were led to believe that they would answer questions about the experience they had written later in the study. The writing task lasted for ten minutes.

Following the writing task, participants completed the Brief Mood Introspection Scale (Mayer & Gaschke, 1988), and ten mundane items about their life habits as fillers (e.g., “how many hours do you spend watching the television?”; Mikulincer et al., 2001). Participants were then introduced to the consumer product survey. The products were presented in random order, and they were Tylenol, Centrum Multivitamins, Head & Shoulders Shampoo, and Band-Aid bandages. Participants rated the desirability (1 = completely undesirable, 9 = completely desirable) and their purchase intent for each item (“how likely would you purchase the product”, 1 = very unlikely, 9 = very likely). Finally, the study concluded with participants completing a demographic questionnaire, and after which they were thoroughly debriefed.
3.1.3 Main Study: Results

Ninety-six participants completed the study. Two participants were excluded from the analysis for failing to respond correctly on an attention-check item ("select response 2 to indicate that you have been paying attention"), and two participants were excluded for having guessed the hypothesis. A total of 92 participants were included in the final analysis. A one-way Analysis of Variance (ANOVA) revealed no significant variations in the mood valence \(F(2, 89) = 1.71, p = .19\) or the mood arousal scores across conditions \(F(2, 89) = .49, p = .61\).

For the main analysis, a one-way ANOVA found the writing conditions to have a significant role on the desirability \(F(2, 89) = 5.71, p < .01, \eta^2 = .11\) and purchase intent \(F(2, 89) = 4.87, p = .010, \eta^2 = .09\) for Tylenol. Descriptive statistics for Tylenol desirability and purchase intent are presented in Table 1. Multiple comparisons with Bonferroni correction (Table 2) revealed that the desire for Tylenol was greater in the relationship pain condition \((M = 6.68, SD = 1.51)\) than that in the social interaction \((M = 5.21, SD = 1.81; p < .01\) \) or in the object loss condition \((M = 5.50, SD = 2.15; p = .036)\). The latter two conditions did not differ significantly in Tylenol desirability. Similarly, purchase intent for Tylenol was greater in the relationship pain condition \((M = 6.76, SD = 1.81; p = .03)\) than that in either the interaction \((M = 5.36, SD = 2.04)\) or the object loss condition \((M = 5.33, SD = 2.45; p = .02)\). Once again, the latter two conditions did not differ significantly on the purchase intent for Tylenol. Furthermore, the writing conditions did not have significant influences on the desirability or purchase intent for the other products \((F < 1; \text{see Figure 1})\). Overall, the findings from study 1 support the hypothesis that social pain from relationship...
injuries increases the evaluation and purchase intent for Tylenol but not for non-pain related products.

a. Desirability Ratings

<table>
<thead>
<tr>
<th>Writing Topics</th>
<th>Means</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social interaction (n = 28)</td>
<td>5.21</td>
<td>1.81</td>
</tr>
<tr>
<td>Object loss (n = 30)</td>
<td>5.50</td>
<td>2.15</td>
</tr>
<tr>
<td>Relationship pain (n = 34)</td>
<td>6.68</td>
<td>1.51</td>
</tr>
</tbody>
</table>

b. Purchase Intent

<table>
<thead>
<tr>
<th>Writing Topics</th>
<th>Means</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social interaction (n = 28)</td>
<td>5.36</td>
<td>2.04</td>
</tr>
<tr>
<td>Object loss (n = 30)</td>
<td>5.31</td>
<td>2.46</td>
</tr>
<tr>
<td>Relationship pain (n = 34)</td>
<td>6.76</td>
<td>1.83</td>
</tr>
</tbody>
</table>

Table 1. Descriptive statistics of the desirability (a) and purchase intent (b) for Tylenol between experimental conditions.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Writing Topic (I)</th>
<th>Writing Topic (J)</th>
<th>Mean difference (I – J)</th>
<th>S.E.</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tylenol: Desirability</td>
<td>Relation Injury</td>
<td>Object loss</td>
<td>1.18</td>
<td>.46</td>
<td>.036</td>
</tr>
<tr>
<td></td>
<td>Relation Injury</td>
<td>Control</td>
<td>1.46</td>
<td>.47</td>
<td>.007</td>
</tr>
<tr>
<td></td>
<td>Object loss</td>
<td>Control</td>
<td>.29</td>
<td>.48</td>
<td>n.s.</td>
</tr>
<tr>
<td>Tylenol: Purchase Intent</td>
<td>Relation Injury</td>
<td>Object loss</td>
<td>1.43</td>
<td>.52</td>
<td>.024</td>
</tr>
<tr>
<td></td>
<td>Relation Injury</td>
<td>Control</td>
<td>1.40</td>
<td>.54</td>
<td>.031</td>
</tr>
<tr>
<td></td>
<td>Object loss</td>
<td>Control</td>
<td>-.024</td>
<td>.55</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

Table 2. Pairwise comparisons on the desirability and purchase intent for Tylenol between experimental conditions.
Figure 1. Mean product desirability (a) and purchase intent (b) for Tylenol, Centrum, Head & Shoulder shampoo, and Band-Aid. Error bars are standard errors of the mean.
3.2 Study 2

The findings from study 1 suggest that recalling a socially painful experience can increase the preference for Tylenol. Study 2 examined whether a romantic pain is an embodied concept. Participants were randomly assigned to a romantic pain, an academic threat, or a control condition. In the romantic pain condition, participants wrote a letter that their romantic partners would write to them if they were breaking up. In the academic threat condition, participants completed a short test similar to the Graduate Record Examinations and received a mock feedback indicating that the score was below the 50th percentile. Although both relationship threats and academic threats have been found to produce anxiety and arousal (e.g., McGregor, Nash, Mann, & Phillips, 2010; Nash, McGregor, & Prentice, 2011), as the metaphor heartbroken is most often used on the context of relationship dissolution, I predicted that only participants in the romantic pain but not the academic threat condition would become motivated to care for their heart and to prefer heart caring products.

3.2.1 Method and Procedure

Study sessions took place at a lab at the University of Guelph. Female students who had been in a romantic relationship were recruited for participation. The study was framed as two independent studies to mask the study’s hypotheses. In the first study, participants were randomly assigned to one of three conditions. The romantic pain and the control manipulations were a writing task, while the academic threat manipulation was a mock aptitude test. In the romantic pain condition, participants were told that they would help
the researchers build a bank of vignettes that could be used for mood induction for future studies. Specifically, participants were told to “imagine that your relationship with your current partner is coming to an end. Think about why this would happen, and type a letter that your partner would write to breakup with you.” In the control condition, participants were asked to write about their schedule and routine for a typical Wednesday. In both conditions, participants were given ten minutes to complete the writing task, after which they took a one-minute break before proceeding to the second part of the study.

In the academic threat condition, participants were told that the researchers were collecting data to validate a new standardized exam for college admission. The questions consisted of ten quantitative questions and ten reading comprehension questions similar to those from the Graduate Record Exam. As the exam questions were difficult, participants were expected to feel challenged by the questions. Ten minutes were given to complete the test, after which participants received a mock-feedback indicating that their scores were below the 50th percentile of the individuals who had taken the same test and had a similar background as did participants. After a minute break, participants proceeded to the second part of the study.

The second study was framed as an investigation on the areas of health that college students were most concerned about. Participants first completed the Positive and Negative Affect Schedule (PANAS) for mood (Watson, Clark, & Tellegen, 1988) followed by a ten-item life habits questionnaire as fillers as in study 1. The main dependent variables of interest were an item on health concerns and an item on product preference. The former asked participants to rate how concerned they were about each of the following areas of
health: the heart, brain, digestion, bone, liver, kidney, lung and vision on a scale of 1 to 9 (1 = Not at all concerned, 9 = Extremely concerned). The second item asked, “If you could receive a supplement that prevents diseases in an area of health, which area of health would you want the supplement to target?” Participants had to choose one of the areas from the areas of health concern item.

Lastly, participants answered some questions regarding their study participation experience. Specifically, participants recalled the earlier time in the study when they were completing the writing task or the academic test and rate how the experience made them feel according to four adjectives associated with social pain ("heartbroken", “painful”, “hurtful”, “lonely”; all responses along a 1 to 5 scale, 1 = Not at all, 5 = Extremely). I predicted that writing a breakup letter would induce greater pain-related feelings than the other two experimental manipulations. All participants were thoroughly debriefed before leaving from the study.

3.2.2. Results

Study Participation Experience

One hundred and four female participants, none of whom was suspicious of the study's hypotheses, completed the study. One-way ANOVA's that compared the mean scores concerning the study participation experience found significant differences for all the items (see Table 3). Multiple comparisons (Table 4) showed that participants in the romantic pain condition felt significantly more social and romantic pain ("Lonely", “Heartbroken”, “Painful”, “Hurtful”) than did participants in the academic or in the control
writing condition \((p < .05)\). The scores on these items did not differ between the academic and the control conditions. Moreover, with regards to mood items, the positive and negative mood items from the PANAS were not significantly different across conditions \((F < 1)\). In summary, writing the breakup letter appeared to have the intended effect of inducing romantic pain while the mood states were comparable across conditions.

<table>
<thead>
<tr>
<th>Participation Experience</th>
<th>(F(2, 101))</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lonely</td>
<td>17.29</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Heartbroken</td>
<td>49.11</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Painful</td>
<td>28.86</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Hurtful</td>
<td>32.73</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

*Table 3. ANOVA of Study Participation Experience.*

<table>
<thead>
<tr>
<th>Participation Experience</th>
<th>Condition (I)</th>
<th>Condition (J)</th>
<th>Mean Diff. (I - J)</th>
<th>Std. Error</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lonely</td>
<td>Romantic Pain (n = 37)</td>
<td>Control (n = 32)</td>
<td>1.13</td>
<td>.32</td>
<td>&lt; .01</td>
</tr>
<tr>
<td></td>
<td>Academic Threat (n = 35)</td>
<td>Control</td>
<td>1.26</td>
<td>.31</td>
<td>&lt; .01</td>
</tr>
<tr>
<td></td>
<td>Academic Threat</td>
<td>Control</td>
<td>-.12</td>
<td>.32</td>
<td>n.s.</td>
</tr>
<tr>
<td>Heartbroken</td>
<td>Romantic Pain</td>
<td>Control</td>
<td>2.11</td>
<td>.25</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Academic Threat (n = 35)</td>
<td>Control</td>
<td>1.95</td>
<td>.24</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Academic Threat</td>
<td>Control</td>
<td>.153</td>
<td>.25</td>
<td>n.s.</td>
</tr>
<tr>
<td>Painful</td>
<td>Romantic Pain</td>
<td>Control</td>
<td>1.80</td>
<td>.29</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Academic Threat (n = 35)</td>
<td>Control</td>
<td>1.14</td>
<td>.29</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Academic Threat</td>
<td>Control</td>
<td>.66</td>
<td>.30</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hurtful</td>
<td>Romantic Pain</td>
<td>Control</td>
<td>1.82</td>
<td>.26</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Academic Threat (n = 35)</td>
<td>Control</td>
<td>1.46</td>
<td>.25</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Academic Threat</td>
<td>Control</td>
<td>.36</td>
<td>.26</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

*Table 4. Pairwise comparisons with Bonferroni correction between experimental conditions on study participation experience.*
**Main Analyses**

The main variables of interest were whether writing about a break-up letter would lead to an increased concern for the heart and to increased likelihood of choosing a heart supplement product. The means for areas of health concern are presented in Table 5. A one-way ANOVA revealed that there were no significant differences between conditions in the extent to which participants were concerned about their heart health \(F(2, 101) = .99, p = .376\). Concerns for the other parts of the body (e.g., brain health, vision health) also did not differ significantly across conditions \(F < 1\).

<table>
<thead>
<tr>
<th>Areas of Health Concern</th>
<th>Conditions</th>
<th>Means</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (n = 32)</td>
<td>4.69</td>
<td>2.87</td>
<td>.51</td>
</tr>
<tr>
<td></td>
<td>Academic Threat (n = 35)</td>
<td>5.11</td>
<td>2.90</td>
<td>.49</td>
</tr>
<tr>
<td></td>
<td>Romantic Pain (n = 37)</td>
<td>5.62</td>
<td>2.53</td>
<td>.42</td>
</tr>
<tr>
<td>Heart</td>
<td>Control</td>
<td>4.78</td>
<td>2.89</td>
<td>.51</td>
</tr>
<tr>
<td></td>
<td>Academic Threat</td>
<td>4.09</td>
<td>2.65</td>
<td>.45</td>
</tr>
<tr>
<td></td>
<td>Romantic Pain</td>
<td>4.41</td>
<td>2.89</td>
<td>.48</td>
</tr>
<tr>
<td>Brain</td>
<td>Control</td>
<td>4.25</td>
<td>2.55</td>
<td>.45</td>
</tr>
<tr>
<td></td>
<td>Academic Threat</td>
<td>4.11</td>
<td>2.47</td>
<td>.42</td>
</tr>
<tr>
<td></td>
<td>Romantic Pain</td>
<td>4.35</td>
<td>2.80</td>
<td>.46</td>
</tr>
<tr>
<td>Digestion</td>
<td>Control</td>
<td>3.19</td>
<td>2.63</td>
<td>.47</td>
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<td></td>
<td>Academic Threat</td>
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<td>2.34</td>
<td>.40</td>
</tr>
<tr>
<td></td>
<td>Romantic Pain</td>
<td>4.92</td>
<td>2.77</td>
<td>.46</td>
</tr>
</tbody>
</table>

*Table 5.* Descriptive statistics of mean levels of health concerns across body areas.
For the analysis on the between-condition differences in the proportion of participants choosing a heart health supplement and the proportions of participants choosing a supplement for other parts of the body, since there were only few individuals who had indicated that they would prefer a supplement for an area of health other than the brain or the heart, I collapsed these categories under a single “others” category. Therefore, the three final categories of health supplement are for the heart, the brain, and others. The proportions of participants who had chosen each of the health supplement categories from each of the study's conditions have been summarized in Table 6.

<table>
<thead>
<tr>
<th>Health Supplements</th>
<th>Control (n = 32)</th>
<th>Academic Threat (n = 35)</th>
<th>Romantic Pain (n = 37)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>.43</td>
<td>.40</td>
<td>.49</td>
</tr>
<tr>
<td>Brain</td>
<td>.25</td>
<td>.23</td>
<td>.19</td>
</tr>
<tr>
<td>Others</td>
<td>.31</td>
<td>.37</td>
<td>.32</td>
</tr>
</tbody>
</table>

*Table 6. Proportions of participants in each experimental conditions who chose supplements for per health area.*

A binary logistic regression analysis was performed. The choice of supplement per health area was dummy coded as follows: “Heart supplement” was coded as 1, and “Brain” and “Others” were both coded as 0. Although the main effect of experimental conditions on the choice of supplement per health area was not statistically significant (*Wald* $\chi^2 = .584, df = 2, p = .760$), writing about the romantic pain topic had a small effect on choosing the heart health supplement over the brain and other supplements ($b = .197, S.E. = .48, r = .04$).
4.0 Discussion

This research had set out to investigate whether the neuroscientific findings of the overlap between social and physical pain would have implications in the context of consumer behavior. Since prior work found reciprocal influences between the two kinds of pain, I predicted that experiencing social pain from suffering a relationship injury would lead to an increased evaluation and purchase intent for Tylenol, a commonly taken pain-relief medication. The results from the first study supported the hypothesis: participants who had been asked to recall a past experience of being the victim of social harm found Tylenol more desirable and reported greater intent to purchase it than did participants who had recalled a negative experience of losing an object, and participants who had recalled a social interaction experience.

Using the theories of conceptual metaphor and embodied cognition (Barsalou, 1999; Lakoff and Johnson, 1980), I further explored in a second study whether a particular type of social distress, romantic relationship dissolution, is embodied in the heart as the metaphors for romantic pain such as heartbreaking seem to suggest. However, the results from the study fail to support the hypothesis that imagining a heartbreaking experience would raise people’s concerns about the health of the heart, and the hypothesis that romantic pain would increase the preference for a heart-health product. The following is a discussion and interpretation of the study results.
4.1. Study 1

Firstly, the finding from the first study that recalling an experience of being socially harmed led to an increased preference for Tylenol was not likely the consequence of participants’ rational decision-making. In a follow-up study, a separate group of 45 participants from the same sample frame were recruited to investigate whether people thought Tylenol could provide non-physical pain relief. In this within-subject design study, participants’ perceptions of the efficacy of Tylenol in attenuating physical and emotional pain were compared with their perceptions on the efficacy of Centrum multivitamins in relieving physical and emotional pain (e.g., *When your feelings get hurt, Tylenol (Centrum) can make you feel better, When your body is bruised, Tylenol (Centrum) can make you feel better*; items were measured on a 1 to 7 scale, 1 = *Strongly Disagree*, 7 = *Strongly Agree*). All participants answered the efficacy questions about emotional and physical pain for both Tylenol and Centrum. A product type (Tylenol Vs. Centrum) by pain type (Physical Vs. Social) repeated ANOVA found a significant two-way interaction effect ($F(1, 44) = 89.14$, $p < .001$). Contrasts showed that Tylenol was perceived to be more effective at relieving bodily pain than was Centrum ($M_{\text{diff}} = 1.53$, $p < .001$), but Tylenol was also perceived to be less effective than Centrum at attenuating social pain ($M_{\text{diff}} = .78$, $p < .001$). The results suggest that at least compared with Centrum Multivitamins, people associated Tylenol with even less efficacy at relieving non-physical pain. Therefore, the findings from the first study did not likely reflect participants’ expectancy that Tylenol would relieve their emotional pain. What may be the mediator for the observed effect on product preference from writing about a past relationship injury remains to be investigated.
4.2. Study 2

As for the lack of significant findings from the second study, I suspect that there could have been a ceiling effect from the dependent measures used in the study. The general widespread concern over cardiovascular diseases in the North American society may have biased participants’ health concerns regardless of the experimental conditions to which they were assigned. According to Statistics Canada (2014), heart disease has been consistently placed second following cancer in the top ten causes of death in the country. Compared to the health of the brain, which is also a vital organ, the wellbeing of the heart seems to top consumer’s mind when it comes to health concerns. A recent survey conducted by Reader’s Digest and the Alzheimer’s Association with 1600 participants found that about 60% of respondents reported the heart to be the most important organ, while only about a third mentioned the brain as the most important (Gelman, 2015). Furthermore, 84% of respondents felt that they could do something to maintain the health of their heart, but the same statistic fell to 72% when asked about whether there were things they could do to keep a healthy brain.

Marketers have leveraged this concern for heart health by providing consumers a variety of options that claim or suggest to contribute to a healthy heart. The United States alone represents two thirds of the world’s market for functional foods for cardiovascular health, with some of the most common food items in this category including cereals, bakery, fruit juices and other types of beverages (MarketResearch, 2012). In Canada, a report from Ipsos Reid and TrojanOne ranked the Heart and Stroke Foundation to be one of the most valuable organizations in the country in terms of the emotional connection it establishes.
with Canadian consumers and the business value it brings to its sponsors (Ipsos Reid, 2014). In contrast, the aforementioned survey from Reader’s Digest found that only 21% of its respondents would make lifestyle choices in service of their brain as the area of health concern, and only about five percent made dietary choices intended for brain health. These data suggest that consumers in North America are aware of their risks for heart disease, and that there is a great demand for products that keep the heart healthy. In the context of the present research, the preoccupation with heart health might have masked the potential experimental influence from writing a breakup letter on the dependent measures of heart health. In addition, the nutritional supplements in the second study did not suggest pain-relief, perhaps further attenuating potential effects from the romantic pain manipulation.

4.3. Directionality of Metaphoric Effects

Another issue is whether social pain, a less concrete experience compared with physical pain, leads to changes in perceptions about one’s body state. Lakoff and Johnson’s conceptual metaphor theory (1980) states that concepts from the “source” domain, which are more concrete and derived from the physical experiences with the real world, are used to structure concepts in the “target” domain that is relatively abstract. This perspective could explain why people talk about morality in terms of physical cleanliness (e.g., dirty crime) but do not talk about physical filth with the vocabularies of immorality.

However, the literature of embodied cognition has documented embodied effects in which the activation of certain abstract thoughts trigger changes in the thinking or feeling
about relatively concrete concepts or experiences. As summarized in my literature review, thinking about senile concepts decreases walking speed (Bargh, Chen, & Burrow, 1996), ostracisation lowers perceived room temperature (Zhong & Leonardelli, 2008), immorality raises the preference for cleansing products (Lee and Schwarz, 2010), intentionality of abuse increases perceived physical pain (Gray & Wegner, 2008), and social support enhances physical pain tolerance (Brown, Sheffield, Leary & Robinson, 2003; Master et al., 2009; Eisenberger, Master et al., 2011). In some instances, concepts from the abstract domain have been shown to bring about discernable physiological changes, such as decreased heart rates from an unexpected social rejection (Moor, Crone, & van der Molen, 2010), and lower temperature on the index finger from being socially excluded (Ijzerman et al., 2011). These findings suggest that at least for some of the conceptual metaphors, the relatively abstract conceptual domain may be the place of initiation for the metaphors’ embodied effects.

Lee and Schwarz (2012) have argued that although the people often communicate abstract concepts in terms of concrete concepts, it cannot be assumed that the psychological effects from the metaphoric links between concepts are constrained by the same asymmetry. They argue that it is possible that the psychological manifestations other than language expressions follows a bidirectionality, in which the activation of the neural network for an abstract concept can also trigger the activation of its linked networks for bodily experiences. Furthermore, if thinking and knowledge are grounded in bodily experiences, as argued by the proponents of embodied cognition, naturally abstract thoughts and feelings should manifest in sensorimotor changes in the body.
In a recent discussion on the development of the neural theory of metaphor, Lakoff (2014) has added his perspective on the issue of directionality of metaphorical effects. Drawing on Narayanan’s theory, Lakoff points out that with regards to the neural links between the concrete and the abstract domains, an increase in the strength of synaptic association in one direction simultaneously reduces the strength of synaptic association in the opposite direction. One consequence is an asymmetric influence where the direction of neural activation always follows from the concrete to the abstract domain. The chain of neural activation in the opposite direction is possible but comparatively much weaker in strength. In addition, certain concepts may prime linguistic expressions, the semantics of which may add to the weak neural activity that follow from the abstract to the concrete domain to produce observable psychological phenomena documented in the literature. In any case, Lakoff has recommended further investigation to illuminate the debate on the directionality of metaphorical influences.

The findings from study one of the present research seem to support the view that relatively concrete psychological experiences can be triggered by abstract cognition in the upstream. The results suggest that thinking about a social pain experience increases the evaluation and purchase intent for Tylenol, a product for reducing physical pain. However, it cannot be concluded from the results that the driving force behind the observed effects is pain. The data from the pretest showed that a relationship injury was more painful and hurtful than losing an object, but participants in the main study were not inquired about their current feelings of pain at the time of participating in the study. Since no physiological or neurological measures on pain were taken during the study, the mediator of the
observed product ratings remained unexamined. Accordingly, this limitation left room for alternative interpretations for the results, one of which may be the effect of semantic priming as pointed out by Lakoff (2014).

Specifically, thinking about being socially harmed primes the linguistic expressions for pain that may or may not have been from the psychological experience of pain. Through its semantic associations, the primed linguistic expressions in turn prime Tylenol. As a result, the increased accessibility of the semantic associations of pain could then lead to a greater evaluation and purchase intent for Tylenol.

In the context of the present research, semantic priming is a challenging issue to address, as there is no other way of communicating social pain without making references to physical injuries (Leary and Springer, 2001). This makes it difficult to discern whether changes in bodily experiences from social pain are the result of semantic association, embodiment, or both. The results from study two also fail to support the hypothesis that romantic pain is embodied in the heart, even though there are limitations to the study’s procedure. Future research effort can be directed at disentangling the metaphorical effects of social pain from the semantics effects.
5.0 Contribution and Limitation

To the best of my knowledge, the present research is the first attempt at exploring the psychological manifestations of social-physical pain overlap in the context of consumer decision-making. In addition, the manipulation of asking participants who were in a romantic relationship to write a letter that the partner would write to terminate the relationship was a novel procedure for exploring the effects of social pain. If the finding that social pain leads to an increased evaluation and purchase intent for products concerning pain-relief is robust, it will be worthwhile to understand what the implications might be with regards to consumer wellbeing. Ultimately the need for belongingness is fulfilled when one is integrated and connected to the fabric of social relationships, the support from which are not replaceable by means of consumption that do not form new relationships or strengthen existing social bonds. A broken heart may hurt, but having access to a heart-warming network of beloved friends and family may be the only long-term solution to healing it.

However, the attempt at contributing to the literature was limited by the shortcomings of the procedures used in the studies. As discussed previously, the procedures from both of the studies did not include neurological or physiological measures for pain. Consequently, there was little confidence on whether participants who underwent the social pain manipulations experienced pain. Future research on the metaphorical effects of social pain would benefit from the technology used in neuroscience that measures the activity in the dACC and AI to gain better confidence that the experimental manipulation for social pain produce the intended effects.
In addition, Tylenol was chosen as the pain-relief product included in the first study for its widely known analgesic effect. However, there may be other properties about Tylenol other than pain-relief that may have led to its increased preference among participants in the social pain condition. Furthermore, the present investigation did not include behavioral measures that could corroborate with the findings on product preferences. Therefore, in addition to including other commonly known pain-relief products or other brands of analgesics to rule out the potential idiosyncratic effect of Tylenol, future investigations could include behavioral measures such as transactions from real purchases that would illuminate the extent to which social pain has an influence on consumer behavior.

For the procedure of study two, limiting was the fact that there was no procedural equivalence between the romantic pain and the academic threat manipulation. In the romantic pain condition, participants were asked to write a fictitious letter that their partners would write to break up with them. In the academic threat condition, participants attempted a difficult academic aptitude test that includes both quantitative and verbal reasoning questions in multiple-choice format. The academic test was chosen as a way to match the other aspects of romantic pain that may not be directly associated with pain, such as the feelings of uncertainty and the negative valence of the experience. Prior research has found that achievement and relationship threats both lead to cognitive and behavioral consequences related to psychological threat (e.g., Nash et al., 2011). I did not ask participants to write an essay for academic evaluation, because people may easily overlook having gotten a bad score on an essay about a topic that they have not prepared.
for. Furthermore, for individuals who are confident and certain about their writing ability, the mock feedback that they have scored poorly on the test would make them suspicious of the validity of the feedback. If participants excused themselves for scoring low on the test, this would reduce the threatening aspect about the test that I tried to match with the manipulation of romantic pain. Nonetheless, to enhance the internal validity of the experimental procedure, future investigation should include a comparable manipulation that matches as many aspects of a heartbreaking experience as possible while not having the same metaphorical association as romantic pain.

In addition, participants in the romantic pain condition wrote a fictitious letter based on an imaginary breakup scenario with their current partners. Although the manipulation-check items confirmed that participants in this condition felt lonely, painful, hurtful, and heartbroken when writing the letter, the experience may not have been as deeply felt as a breakup that one has actually gone through. I chose the manipulation of romantic pain as I did, because I believed this procedure offered relatively more control. Real breakups could be due to many different reasons, and people may or may not have been healed since the experience. Furthermore, how long ago the breakup took place could have affected how vividly participants could re-experience the breakup. Perhaps a better procedure would be to recruit only participants who have gone through a breakup recently and ask them to recall the experience, as did Kross et al (2011) who found that the manipulation resulted in increased activity in the somatosensory regions in the brain that suggest physical pain.
One possible future direction can be jointly modeling consumer preferences due to different types of pain (e.g., social and physical as discussed in this research). A number of modeling approaches can be used such as bivariate logit/probit, copulas (see Meade & Islam, 2003, 2010). In this research, the main dependent variables were desirability and purchase intent, but preferences can be elicited to shed insights about time dimensions (i.e., purchase times; see Islam, 2014; Islam & Meade, 2011, 2013).
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