

Social Anxiety and the Nature and Function of Social Pain

by

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Statement of Contributions

Taylor Hudd was the sole author for the General Introduction, bridging sections, and the General Discussion, which were written under the supervision of Dr. David Moscovitch and were not written for publication.

This thesis consists in part of three manuscripts written for publication. Each manuscript was based on originally collected data. As lead author of these studies, Taylor Hudd was responsible for conceptualizing study designs, data analytic planning, carrying out data analyses, and drafting and submitting manuscripts. As co-author and supervisor, Dr. David Moscovitch contributed intellectual input on study design and analyses and provided feedback and editing for each manuscript.

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Abstract

Humans have a fundamental need to belong that drives many of our present-day emotions and behaviours. When the need to belong becomes threatened, people experience “social pain,” which has been conceptualized as an adaptive alarm signal that can motivate people to restore their sense of security within their social community. The current dissertation examines the impact of social pain on individuals with high trait social anxiety (HSA). Past research has shown that HSAs are less likely to engage in increased affiliative efforts following painful exclusion, and more often exhibit signs of withdrawal or aggression, which may disrupt their ability to effectively restore belongingness. However, little is known about the psychological mechanisms that may link the experience of social pain with negative emotional and behavioural outcomes for HSAs. A series of studies were conducted to investigate whether over-sensitivity to social pain and/or maladaptive appraisals about social threat and reward might impact HSAs’ motivation to initiate or benefit from affiliative repair. Study 1 found that HSAs’ social pain sensitivity was pervasive and not limited to contexts in which they experienced an explicit, relational rupture, suggesting HSAs’ threat biases may inhibit their ability to recognize and act upon social opportunities to reconnect after facing a painful exclusion. Consistent with this interpretation, Study 2 found that HSAs experienced down-regulated affiliative desire in the face of social pain. Results suggested that social opportunities that are pursued in the aftermath of heightened social pain may be attractive because they introduce emotional rewards such as heightened positive affect; however, only those individuals with low, but not high trait SA appeared motivated to pursue such rewards following a painful exclusion. This idea was further tested in Study 3, which replicated Study 2 data showing that participants responded to the pain of exclusion with heightened desire to affiliate and greater downstream positive affect, and

extended Study 2 by revealing that this process was driven by increased curiosity and attention to social rewards. HSA participants in Study 3 reported lower curiosity, reward sensitivity, desire for affiliation, and positive affect, irrespective of their reported levels of social pain.

Furthermore, diminished reward sensitivity accounted for HSAs' low desire for affiliation, whereas heightened threat sensitivity did not. These data align with current theories that suggest low reward sensitivity is a distinct symptom-maintaining feature of social anxiety disorder (SAD) that interferes with approach motivation. Implications are discussed from the perspective of learning and memory models that inform SAD symptom maintenance and treatment.

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Table of Contents

List of Figures	x
List of Tables	xi
1. General Introduction.....	1
Threats to Belongingness and Social Pain.....	1
Pro-Sociality and Affiliation.....	2
Hostility and Aggression.....	3
Withdrawal.....	4
The Effects of Social Anxiety on Social Pain.....	6
Social Anxiety and Heightened Threat Sensitivity.....	6
Affiliative Repair Driven by Pursuit of Social Goals and Rewards.....	8
Social Anxiety and Dampened Reward Sensitivity.....	10
Social Pain and the Potential for Long-Term and Widespread Impact on Social Anxiety.....	11
2. Overarching Dissertation Goals.....	14
How Does SA Disrupt Affiliative Repair Processes, and What are the Costs?.....	14
How Should Social Pain Be Measured?.....	16
3. Objectives for Studies 1, 2 and 3.....	18
4. Study 1: Social Pain and the Role of Imagined Social Consequences: Why Personal Adverse Experiences Elicit Social Pain, With or Without Explicit Relational Devaluation.....	20
Introduction	22
Methods.....	29
Results.....	41
Discussion	50
Additional (Unpublished) Analyses: Social Pain and Social Anxiety.....	56

Results.....	58
Discussion	61
5. Study 2: Coping with Social Wounds: How Social Pain and Social Anxiety Influence Access to Social Rewards.....	63
Introduction	65
Methods.....	72
Results.....	77
Discussion	83
6. Study 3: Reconnecting in the Face of Exclusion: Individuals with High Social Anxiety May Feel the Push of Social Pain, But Not the Pull of Social Rewards.....	89
Introduction.....	91
Methods.....	99
Results.....	110
Discussion	118
7. General Discussion.....	128
Summary of Findings.....	128
The Role of <i>Perceived</i> Threats to Belongingness in Evoking Social Pain.....	129
Social Pain and Goal Pursuit in Affiliative Repair Processes.....	130
How does Social Anxiety Inhibit Affiliative Repair Processes?.....	132
Emotional Benefits of Affiliative Repair and Negative Implications for HSAs.....	134
Limitations.....	139
Clinical Implications.....	143
Conclusion.....	146
References.....	148

Appendices.....178

List of Figures

Figure 1. *Visual Representation of Study Flow and Procedures*.....

Figure 2. *Relationship Between Social Pain and Approach Motivation at Low, Average, and High Levels of Social Anxiety*.....

Figure 3. *Relationship Between Social Pain and Positive Affect at Low, Average, and High Levels of Social Approach Motivation, Controlling for Levels of Trait Social Anxiety*.....

Figure 4. *Visual Representation of Study Procedures*.....

Figure 5. *Direct Effects in the Primary Analysis*.....

Figure 6. *Direct Effects in Exploratory Model 1*.....

Figure 7. *Direct Effects in Exploratory Model 2*.....

List of Tables

Table 1. *Bivariate Correlations Between Outcome Variables Collapsed Across Tasks and Conditions*.....

Table 2. *Descriptive Statistics [M (SD)] for Outcome Measures in Each Condition and Task*.....

Table 3. *MANOVA Main Effects of Condition Within Each Task Across Outcome Measures*.....

Table 4. *Tukey Post-hoc Comparisons Between Conditions During Past Memory Recall*.....

Table 5. *Tukey Post-hoc Comparisons Between Conditions During Online Games*.....

Table 6. *Tukey Post-hoc Comparisons Between Conditions During Future Projection*.....

Table 7. *Descriptive Statistics for the Overall Sample and Each Condition Separately*.....

General Introduction

Threats to Belongingness and Social Pain

Social sense of belonging is a fundamental human need. It is generally accepted that this need evolved over time because social bonds conferred adaptive benefits for our survival and reproduction (MacDonald & Leary, 2005). Accordingly, humans have become highly attuned to scenarios in which their belongingness may have been compromised, such as social rejection, exclusion, or criticism (Zadro et al., 2004). Social exclusion has been shown to produce a consistent neural response pattern within the dorsolateral Anterior Cingulate Cortex (dACC) and Anterior Insula (AI) (Eisenberger, 2012). Researchers often refer to this neural response as “social pain” (Eisenberger, 2012; MacDonald & Leary, 2005) because a similar neurological response pattern becomes activated when people experience physical pain (Eisenberger, 2012; MacDonald & Leary, 2005). Social and physical pain similarly disrupt mood and psychological needs satisfaction, including self-esteem and a sense of social belongingness and control (Riva et al., 2011). Moreover, people tend to display a shared sensitivity to both physical and social pain (Eisenberger et al., 2006), and provoking or relieving one source of pain appears to cause analogous effects on the other type of pain (Vangelisti et al., 2014). These data led researchers to theorize that at some point in our evolutionary history, our physical pain signals may have been co-opted to signal social injury (Eisenberger, 2012).

Like physical pain, social pain has been characterized as an adaptive response signal that promotes survival by directing attention and efforts toward managing threat and injury (Bolles & Fanselow, 1980; Ferris et al., 2019; Smart Richman & Leary, 2009). From this perspective, social pain should promote motivations or behaviours that serve to mend and protect an individual’s social network. To this end, researchers who study social pain have discovered that

SOCIAL ANXIETY AND SOCIAL PAIN

people generally respond to situations that threaten belongingness with increased pro-sociality and affiliation, hostility and aggression, and/or withdrawal (Smart Richman & Leary, 2009). Each type of response plays a role in the process of mending and protecting relationships, as described below.

Pro-Sociality and Affiliation

Numerous studies have shown that socially painful exclusion can increase pro-social or affiliative motivations, attitudes, and behaviours. For instance, in response to social pain, Chester et al. (2016) discovered that participants made attempts to increase their proximity to others. Other studies have found that excluded participants demonstrated greater generosity to others (Mallott et al., 2009), reported a greater desire to interact with others (Maner et al., 2007) and were more willing to sacrifice their self-interests in favour of becoming more connected to a group (Mead et al., 2011). Affiliative responses appear to be more likely within contexts where rejection or exclusion disrupt belongingness or a valued aspect of one's identity, or where feasible opportunities to exercise pro-social and affiliative motivations are made available (Balliet & Ferris, 2013; Maner et al., 2007). Affiliative responses could be reasonably predicted to mend social ties; indeed, within close and intimate relationships, feeling and expressing "hurt" after a social rupture has been linked to positive relationship functioning, constructive behaviours, and a greater likelihood of prompting the hurtful perpetrator to engage in efforts to repair the relationship (Lemay et al., 2012; Sanford & Rowatt, 2004). Affiliative desire and motivation could also promote social support seeking and buffer against depressive symptoms after facing a socially painful event (Noh & Kaspar, 2003).

SOCIAL ANXIETY AND SOCIAL PAIN

Hostility and Aggression

Several studies have also found that social rejection can promote anti-social responses. For instance, in Twenge et al. (2001), social rejection led participants to deliver loud and uncomfortable noise blasts, and more critical performance evaluations to fellow participants. Similarly, Wesselmann et al. (2010) demonstrated that rejected participants allocated more hot sauce to fellow participants' meals. Anti-social behaviours can damage instead of repair or extend social bonds, and they are often linked with poorer relationship functioning (Lemay et al., 2012; Sanford & Rowatt, 2004). These findings run contrary to the assumption that social pain initiates downstream motivations or behaviours that seek to re-fulfill social connectedness. However, socially painful events such as rejection or exclusion provoke more than just threats to belongingness and social pain. These relational ruptures can also threaten an individual's sense of control (Ren et al., 2018) which may stimulate anger and frustration alongside social pain. Indeed, participants who described moments of feeling hurt also reported feeling angry (Leary et al., 1998), and Chow et al. (2008) found that anger motivated participants to behave aggressively in response to rejection. Anger often implies that an individual feels they have been treated unjustly, and thus, exercising agency and control or restoring justice by behaving aggressively may deliver short-term satisfaction and pleasure (Ramírez et al., 2005), even if it does not necessarily restore belongingness.

Thus, threats to belongingness may introduce competition between compromised needs and motivations, wherein some choose to respond to their anger and sense of injustice—perhaps leading to a greater sense of control—while others may suppress their anger and desire to aggress in favour of responding to their social pain with pro-social behaviours that fulfill their need to belong. Indeed, Shelton et al. (2005) and Sommer & Bernieri (2015) discovered that

SOCIAL ANXIETY AND SOCIAL PAIN

rejected participants held more hostile attitudes toward others, but instead of behaving aggressively, they exhibited an increase in pro-social behaviours. As well, in Maner et al. (2007), rejected participants were more likely to become hostile toward their “rejectors” but not novel social partners, suggesting these participants responded to their social pain in a strategic manner that could serve to optimize their needs fulfillment. Alternately, if a rejected individual does not perceive a feasible opportunity to reconnect, they may become more inclined to act in accordance with their anger. For instance, in DeBono & Muraven, (2014) participants were more likely to aggress if they perceived their rejection as a sign of disrespect versus being disliked, possibly due to their expectation that the disrespectful rejectors were not capable of, or worth persuading to form a connection.

Withdrawal

Researchers have also observed that people often withdraw from further social interaction after a socially painful event. Ren et al. (2021) discovered that if given the option, many excluded individuals exhibit a preference for solitude. Retreat could be motivated by a desire to protect against further ostracism (Smart Richman & Leary, 2009) or to communicate recognition, regret, and penance for a social blunder—indeed, such a response may be appropriate when rejection or exclusion are used by a social group as a form of deliberate, corrective feedback (Hales et al., 2017). However, it is reasonable to presume that removing oneself from social interactions is unlikely to result in immediate social feedback that could re-fulfill one’s sense of belongingness. In fact, depressive-like withdrawal behaviours that follow painful and unresolved social rejection can promote social isolation and loneliness over time (Buckley et al., 2004; Slavich, O’Donovan, et al., 2010; Slavich, Way, et al., 2010).

SOCIAL ANXIETY AND SOCIAL PAIN

In the short-term, retreat may facilitate access to compromised needs by providing an opportunity for intrapersonal emotion regulation. Excluded individuals tend to experience a state of vulnerability (Vangelisti et al., 2005) and may find it beneficial to manage their pain before approaching a new social interaction. In this case, withdrawal may fulfill one's need for safety and control by affording personal space to self-soothe or re-frame the meaning and importance of the socially painful event such that it becomes less painful. Accordingly, [Kawamoto et al. \(2013\)](#) discovered that as participants' negative affect increased over the course of a prolonged social exclusion, so did their desire to withdraw, suggesting participants may have felt the need to retreat and manage their amplified distress. Such efforts may be effective, as excluded participants are able to recover their compromised needs through the passing of time, without external, targeted interventions (Zadro et al., 2006).

In summary, people respond to social pain in a variety of ways that may have different effects on needs fulfillment. Pro-social and affiliative responses may be more direct and effective means of mending or protecting against threats to the individual's sense of belongingness. Conversely, anti-social and withdrawal responses may temporarily fulfill a need for control or heighten state self-esteem (Ramírez et al., 2005; Ren et al., 2021), but each of these responses are less likely to provide fulfillment for belongingness needs, and if anything, may further threaten the integrity of one's social network (Buckley et al., 2004; Slavich, O'Donovan, et al., 2010; Slavich, Way, et al., 2010). Thus, it is worthwhile to consider whether individuals who struggle with feeling socially disconnected tend to respond disproportionately to social pain with aggression or withdrawal, and whether this process could play a role in maintaining their felt sense of disconnection. For instance, individuals who experience high levels of social anxiety (HSA) exhibit clear challenges with feeling connected: They tend to report more chronic

SOCIAL ANXIETY AND SOCIAL PAIN

loneliness (Lim et al., 2016) and they have relatively smaller social networks (Falk Dahl & Dahl, 2010), both of which are linked with the mental and physical health impairments (e.g., depression, substance use, and heart disease) commonly observed in people who feel disconnected from a social network (Beller & Wagner, 2018; Falk Dahl & Dahl, 2010; Lim et al., 2016).

The Effects of Social Anxiety on Responses to Social Pain

Consistent with the conceptualization that certain traits may make people prone to responding to social disconnection with aggression or withdrawal, studies have shown that people with HSA are less likely than those with low trait SA (LSA) to display signs of increased affiliation in response to exclusion (Maner et al., 2007), even after controlling for depressive symptoms (Mallott et al., 2009). Individuals with higher rejection sensitivity—a feature that is often characteristic of those with HSA (Harb et al., 2002)—demonstrated a tendency to engage in more anti-social responses to exclusion (Ayduk et al., 2008). Notably, Romero-Canyas et al. (2010) revealed an exception to this pattern of data: They discovered that among highly rejection-sensitive individuals, harsh rejection that negatively impacted their self-definition led to an increase in pro-social behaviours. However, when DeWall et al. (2010) measured pro-social behaviours and accompanied attitudes, they discovered that although HSA individuals behaved more pro-socially, their attitudes remained anti-social and hostile.

Social Anxiety and Heightened Threat Sensitivity

Researchers have speculated that HSAs' heightened social threat sensitivity might explain why they exhibit a distinct response pattern to their social pain, relative to those with LSA (DeWall et al., 2010; Mallott et al., 2009; Maner et al., 2007). Several prominent theories of SA symptom development and maintenance emphasize the role of fear-based social cognitions,

SOCIAL ANXIETY AND SOCIAL PAIN

and behaviours that serve to mitigate—but inadvertently uphold—anticipated and perceived social threats. For instance, cognitive models of SA, including those by both Clark and Wells (1995) and Moscovitch (2009), suggest that individuals with SAD hold broad-based, negative assumptions about their self-worth. As well, Clark and Wells (1995) and Hofmann (2007) agree that when HSA individuals enter social situations, their perception of low social worth becomes readily activated because they tend to focus their attention inwards, evaluating themselves as a social object, rather than directing their attention outwards toward their interaction partners. This, along with deliberate efforts to conceal perceived flaws, inhibits their ability to gather disconfirming evidence that could begin to undermine negatively biased beliefs about their self-worth, resulting in a symptom-maintenance cycle (Hofmann, 2007). Moreover, interpersonal symptom-maintenance cycles can further promote social threat-hypervigilance, as outlined in Alden and Taylor's (2004) interpersonal model of SAD. They suggest early experiences with attachment figures and peers can ignite negatively biased beliefs about the self and others, causing HSA individuals to cope in ways that elicit negative reactions from others, lending support to their original threat-biased assumptions. Heimberg and colleagues' model emphasizes how threat appraisals in SAD become amplified through the processes of post-event processing, negative self-imagery, difficulties with emotion regulation, and fears associated with positive evaluation (Heimberg et al., 2010).

Consistent across each of these models is their emphasis on threat-biased appraisals related to expectations of the self, and the self as it relates to others. Such appraisals could be reasonably expected to influence how HSAs respond to perceived belongingness threats and the experience of social pain. First, HSAs may be more likely to draw negative conclusions about the meaning or impact of a socially painful event and experience greater accompanied social

SOCIAL ANXIETY AND SOCIAL PAIN

pain. Indeed, evidence suggests that compared with low SA individuals (LSAs), HSAs experience more worry and hurt feelings after facing interpersonal rejection (Harb et al., 2002) and rate social blunders as more costly (Moscovitch et al., 2012). Thus, HSAs may experience stronger pain due to threat appraisals, which may increase their motivation to withdraw and devote the necessary cognitive and emotional resources toward regulating their intensified social pain (Smart Richman & Leary, 2009). Heightened pain and pessimism could also produce a defensive reaction that promotes hostility or aggression, especially for HSAs who are more likely to search for cues in subsequent encounters that suggest others are threatening and hostile (Bantín et al., 2016). To this end, SA has been linked to higher levels of anger and anger suppression following social rejection (Breen & Kashdan, 2011), which may increase their likelihood of engaging in anti-social or aggressive behaviours and exhaust cognitive resources that may otherwise be directed towards mending their social connections (2011).

Moreover, HSAs' threat appraisals may lead to dampened desire and efforts to reconnect, even with safer and more familiar interaction partners, perhaps due to pervasive fears that failure to connect with others would diminish their already tenuous social standing and increase the likelihood of incurring catastrophic social consequences such as ostracism (Rodebaugh, 2009). Finally, HSAs also fear receiving compassion from others (Ho et al., 2021; Merritt & Purdon, 2020), which could deter them from relying on the support of others to implement effective interpersonal emotion regulation strategies that, in turn, could increase their compromised need for belongingness.

Affiliative Repair Driven by Pursuit of Social Goals and Rewards

While it seems likely that HSAs' amplified threat sensitivity could deter them from approaching others, their perception of current or future threats may not be the only factor that

SOCIAL ANXIETY AND SOCIAL PAIN

inhibits affiliative efforts after facing a painful rejection or exclusion. The perceived presence (or absence) of social rewards could also explain why some individuals pursue social reconnection despite feeling hurt, angry, and hostile following the initial threat of exclusion (Maner et al., 2007; Sommer & Bernieri, 2015).

First, there is evidence to suggest that people in general tend to become more attentive to social reward signals at early stages of cognitive processing after having been socially excluded. For example, DeWall et al. (2009) found that excluded participants were faster at recognizing smiling faces and less likely to disengage their attention from these social reward cues. Recognizing social rewards could elicit heightened approach motivation, building optimism about prospective opportunities to reconnect, ultimately enhancing desire to affiliate (Anderson & Berdahl, 2002; Kunstman & Maner, 2011; Min & Kim, 2013). Indeed, Narayanan et al. (2013) discovered that individuals primed to become approach-oriented were more likely to increase their affiliative behaviours after experiencing a social rejection. These participants may have felt motivated to engage in affiliative repair because their approach orientation directed their attention toward social reward cues (see also Anderson & Berdahl, 2002; Kunstman & Maner, 2011).

Furthermore, social pain and the desire to access social rewards may work hand-in-hand to promote affiliative motivations and behaviours through increases in curiosity. Curiosity is a state-level psychological experience that describes feelings of surprise, intrigue, and desire to pursue more information or clarification (Naylor, 1981). Social exclusion is painful because it is unexpected. People tend to hold expectations about their relational value based on their potential to develop meaningful interpersonal connections with others and on others' reciprocal desire for relational closeness with them (Leary et al., 1998; Leary & Springer, 2000, p. 200; Wesselmann

SOCIAL ANXIETY AND SOCIAL PAIN

et al., 2017). When someone behaves in a manner that violates these expectations, people become alerted to a discrepancy between their expectations and reality, otherwise known as a *prediction error*. This prediction error could activate curiosity and direct the individual's attention and efforts toward resolving the discrepancy, ultimately guiding them to approach social rewards and fulfill their need for social connection (Gruber & Ranganath, 2019).

Social Anxiety and Dampened Reward Sensitivity

A growing body of research suggests SA symptomatology is characterized by a diminished sensitivity and responsiveness toward social reward cues (Blay et al., 2021; Weisman et al., 2011). Thus, to the extent that goal and reward pursuit motivate affiliative repair processes, HSAs' decreased appreciation and desire for social rewards could play a central role for inhibiting affiliative repair processes. Studies have found that participants with high trait SA exhibit reduced neural activation in anticipation of social rewards compared to non-social (monetary) rewards (Cremers et al., 2015; Richey et al., 2014), even during resting states (Manning et al., 2015). Moreover, HSAs display similar elevations in positive affect (PA) when they spend time with others vs. alone, but even so, their overall PA (in social and non-social situations) is diminished relative to LSAs (Goodman et al., 2021). HSAs are also less likely to recall positive, socially rewarding information within their autobiographical memories (Glazier & Alden, 2019; Romano, Tran, et al., 2020). These data suggest that higher trait SA may be associated with a reduced capacity to notice, encode, and/or emotionally respond to social rewards.

As well, HSAs' excessive social pain and biased threat appraisals could disrupt what may be an already diminished capacity for recognizing and responding to social reward cues.

Curiosity tends to promote exploration when the cause of the prediction error is appraised to be

SOCIAL ANXIETY AND SOCIAL PAIN

manageable (Gruber & Ranganath, 2019) but as previously noted, HSAs are more likely to appraise a social rejection or exclusion as insurmountable because they exaggerate the cost and likelihood of committing a social blunder, perceive themselves as having low social competency, and view others as being judgemental and unforgiving (see Moscovitch, 2009; Rodebaugh, 2009). Consequently, HSAs' amplified social pain may dampen rather than heighten their curiosity and affiliative motivations and behaviours. For instance, Maner et al. (2012) discovered that anxiety inhibited reward recognition, resulting in lower approach motivated goal-pursuits. Similarly, Becker et al. (2017) discovered that those with SAD were less emotionally responsive to positive social feedback while they were under scrutiny, suggesting the looming threat of social evaluation disrupted their social reward sensitivity. In summary, in the face of a threatening social exclusion, those with higher SA may be less likely to shift into a state of curiosity-driven appetitive goal pursuit, recognize social reward potential, and experience a heightened desire to affiliate.

Social Pain and the Potential for Long-Term and Widespread Impact on Social Anxiety

How individuals respond to painful events in the short-term can contribute to longer-term consequences and shed light on symptom maintenance processes in SAD. Socially painful events have been suggested to play a formative role in SAD symptom development, wherein autobiographical memories inform future anxiety and avoidance behaviours (Hackmann et al., 2000). One study (Fung & Alden, 2016) showed that the degree of social pain following a social exclusion mediated anxiety in anticipation of a subsequent social interaction, suggesting the effects of social pain may be carried forward with individuals into future social encounters. Over time, social anxiety symptoms, loneliness, and depression interact with one another and

SOCIAL ANXIETY AND SOCIAL PAIN

proliferate (Lim et al., 2016), contributing to social isolation and poorer physical health and mortality outcomes (Beller & Wagner, 2018).

Given the potential long-term consequences of repetitively engaging in maladaptive responding to social pain over time and across situations, it is worthwhile to consider the breadth of contexts in which HSAs experience social pain sensitivity. As reviewed above, there is evidence to suggest HSAs display greater pain sensitivity in response to explicit, relational ruptures such as rejection, exclusion, or direct criticism (Harb et al., 2002; Zimmer-Gembeck et al., 2021). Researchers theorize that social pain and social pain sensitivity may also emerge in less explicitly relational contexts; might HSAs display similar sensitivity within these contexts as well?

As previously noted, social pain—sometimes also referred to as “hurt feelings”¹—is expected to occur following perceived damage to one’s social network. Leary et al. (1998) found that participants asked to describe scenarios that caused hurt feelings tended to describe acts of rejection, exclusion, betrayal or criticism. Leary and Springer (2000) argued that these events are painful because they involve “relational devaluation”—a process whereby one individual perceives that another person or group has shown they no longer value their relationship with that individual. However, other researchers suggest any circumstances involving a loss of

¹Some researchers use the term “hurt feelings” interchangeably with social pain, while others suggest hurt feelings occur within a specific subset of socially painful experiences—namely, those that involve explicit relational devaluation (e.g., rejection or exclusion). Those who draw this distinction believe social losses that do not involve relational devaluation are painful, but do not cause hurt feelings. For example, they would suggest social pain, but not hurt feelings, would emerge in scenarios in which a social loss occurs without relational devaluation (for example, when a person’s best friend is forced to move to a new city and this results in a social loss, but not because they did not value the person and their friendship). Thus, social pain may be best conceptualized as a “higher order” negative emotional experience, with hurt feelings a distinct subtype that occurs only within relational contexts in which a person feels devalued. Although this conceptual distinction between social pain and hurt feelings appears logical, for the sake of this dissertation I use the terms synonymously, in part because social pain as well as hurt feelings may arise even in non-explicitly relational contexts that negatively impact self-esteem and imagined social worth, as described in greater detail below and demonstrated in Study 1.

SOCIAL ANXIETY AND SOCIAL PAIN

personal value or currency—in other words, self-esteem—may elicit a similar emotional response (Feeney, 2005). Self-esteem captures an individual’s self-perceived value and worthiness, which is closely, if not directly, linked to an individual’s perceived social value because their “worth” can be conceptualized as social currency that can sustain and attract ongoing and new relationships. Thus, because self-esteem functions as a metric of perceived social value, it can affect whether we believe our social networks are safe and secure, or under threat (Eisenberger et al., 2011; Leary et al., 1995). From this perspective, even private failure experiences (e.g., failing an exam) that do not involve explicit relational devaluation may have the capacity to produce hurt feelings by virtue of threatening an individual’s self-esteem.

Surveying the social pain and social anxiety literature, at least two fundamental issues remain unclear: 1) Whether social pain indicators become similarly elevated in contexts that threaten self-esteem, even in the absence of explicit relational devaluation, and 2) whether HSAs exhibit greater sensitivity to social pain within these contexts. Examining broader contexts in which HSAs may experience social pain sensitivity could reveal the pervasiveness of factors that heighten their social pain—such as threat and reward interpretation biases—and inform our understanding of SAD etiology and symptom maintenance, while also improving our conceptualization of social pain as a measurable construct.

Overarching Dissertation Goals

How Does SA Disrupt Affiliative Repair Processes, and What are the Costs?

Researchers have speculated about, but not directly tested, how pain, threat, and reward sensitivity might interact in ways that disrupt affiliative repair processes for those with higher levels of social anxiety within explicitly relational as well as nonrelational contexts. There are multiple points of interference worth investigating. For example, a fundamental aspect of engaging in affiliative repair processes when one experiences social pain might involve determining the likelihood that affiliation would enable one to access social rewards and boost positive affect. It is possible that HSAs' affiliative motivations within such contexts are inhibited because they may be less likely to anticipate or recognize social reward potential (i.e., social pleasure or enjoyment) when faced with social opportunities that could restore their sense of belongingness. Indeed, a sizable literature has emerged in recent years documenting "positivity deficits" in people with higher levels of social anxiety, including the failure to derive emotional benefits (e.g., increases in positive affect) within typically pleasurable interpersonal contexts (Kashdan et al., 2011). Moreover, heightened social pain sensitivity in social anxiety – i.e., the tendency for HSAs to experience greater social pain in response to a standardized context compared to LSAs – could capture HSAs' attention and associated cognitive resources and make it more challenging for them to redirect their attention and expectations away from social threat cues and toward social reward potential. Establishing whether there is an interactive role between social pain and social reward sensitivity for people with higher social anxiety could have meaningful implications for treatment of SAD, as it would suggest threat-avoidance and appetitive-approach motivational systems interact with one another such that symptoms of

SOCIAL ANXIETY AND SOCIAL PAIN

anxiety related to perceived social threats must be reduced before social rewards can be recognized and appreciated.

Furthermore, the emotional impact of affiliative repair remains unknown. Specifically, it is unclear how individuals feel *after* responding to social pain by increasing their affiliative motives and behaviours. If we predict that affiliative repair is driven by anticipation and recognition of social reward potential, we might assume that people who exhibit signs of heightened affiliative motivation and behaviour in the face of social pain may be more likely to experience increased PA within subsequent affiliative contexts. Establishing the affective outcomes associated with affiliative repair can provide information about what HSAs stand to lose by disengaging from this social repair process. For instance, while LSAs' engagement in social repair may enable them to experience reward cues and positive emotions that compete with the original source of social pain, HSAs may be at risk of carrying un-mended social wounds that serve to heighten anxiety as well as maintain and prolong social pain sensitivity in anticipation of subsequent social interactions (Fung & Alden, 2016).

Thus, it is currently unknown whether SA moderates the effects of social pain on affiliative motives and behaviours within relevant contexts, and how such effects might impact downstream PA. One study revealed that even when HSAs exhibit an increase in pro-social behaviours following threats to their belongingness, their attitudes toward others remain more hostile and pessimistic compared to LSAs (DeWall et al., 2010). Thus, even when HSAs actively seek affiliation and behave in pro-social ways to foster a positive social interaction, they may not experience the same emotional benefits as their LSA counterparts. Accordingly, early work by Segrin and Kinney (1995) revealed that HSAs were no more likely than LSAs to receive rejection signals from their interaction partners, yet still felt lonelier after the interaction.

SOCIAL ANXIETY AND SOCIAL PAIN

Consequently, additional research is needed to determine whether heightened affiliative motivation or *desire* (rather than prosocial behaviours per se) may be a more reliable estimate of whether HSAs will experience mood benefits from affiliative repair processes.

How Should Social Pain Be Measured?

An additional knowledge gap that exists within the social pain literature is the lack of clarity and consensus on how social pain should be measured. Addressing this issue is not a focal point for this program of research, but it requires attention as this issue necessarily lies at the heart of any study seeking to gain new insights about social pain and its downstream effects.

Many researchers suggest that social pain manifests as a general state of distress or discomfort that involves a combination of anxiety and sadness. People have described their subjective experiences of “hurt feelings” as a diffuse state of physical and emotional discomfort (Leary et al., 1998). Phenomenological data suggest that social pain involves a cluster of discrete emotions, including *grief* or *sadness* of social loss, and the *fear* or *anxiety* that future social connections may also become compromised (Vangelisti, 2001). Shaver et al.'s (1987) cluster analysis revealed that “hurt feelings” fell within a cluster of emotion terms related to sadness. As well, neural markers suggest social pain involves a fear-threat response, represented by heightened activity in the dACC and AI (Eisenberger 2015).

Researchers have used a wide variety of self-report measures to capture these proposed features of social pain. For example, the Needs-Threat Scale (NTS; Williams et al., 2000) is a measure of social pain that is based on the theoretically-derived and tested assumption that when social bonds are damaged, a specific set of psychological needs become compromised, including belongingness, self-esteem, control, and meaningful existence (Chester et al., 2014, 2016; Dewall et al., 2010; Williams, 1997). However, critics have argued that the NTS captures a

SOCIAL ANXIETY AND SOCIAL PAIN

general threat response rather than a distinctive social pain signal per se (Gerber et al., 2017). The same is true of scales assessing subjective physical pain or general affect that researchers have used in prior studies to assess social pain, such as the “faces pain scale” or “pain slide,” which asks participants to view faces expressing varying degrees of pain and choose the one that best reflects how they feel (e.g., Chen et al., 2008; Klages & Wirth, 2014; Nordgren et al., 2011). Other researchers have employed the McGill Pain Questionnaire (MPQ; (Lovejoy et al., 2012) to measure social pain (e.g., Chen et al., 2008; Chen & Williams, 2012; Chester et al., 2016), even though the MPQ was originally intended as a self-report measure of physical pain. Studies on social pain have also used single or multi-item measures that ask participants to rate their experience of “hurt feelings” (e.g., Freedman et al., 2017; Fung & Alden, 2016; Gilbert et al., 2015; Lemay et al., 2012; Riva et al., 2015). Various studies in this area of research (e.g., Auyeung & Alden, 2016) have also relied on the Positive and Negative Affect Schedule (PANAS; Crawford & Henry, 2004) which measures positive (e.g., “interested”, “enthusiastic”) and negative (e.g., “distressed”, “irritated”) mood state across 10 items on each subscale. The PANAS and other mood inventories have also been used in conjunction with other indicators of social pain, such as rejection or exclusion appraisals (e.g., Chen & Williams, 2012; Hermann et al., 2014). Clearly, social pain researchers have yet to establish a consensus around the optimal measurement of social pain. Thus, researchers who wish to study the downstream effects of social pain and social pain sensitivity—as in the current program of research—could benefit from an improved understanding of how these different measures compare to one another across theorized socially painful contexts.

Objectives for Studies 1, 2 and 3

The following dissertation seeks to inform our understanding of the factors that drive affiliative repair processes, when and how this process may become disrupted for those with higher levels of social anxiety, and the nature of the social and emotional consequences this might hold for such individuals.

In Study 1, a large sample of undergraduates were recruited to participate in an online study to investigate the types of contexts in which social pain might occur and whether HSAs exhibit heightened social pain sensitivity across these contexts. We assigned participants to various experimental contexts and tasks to analyze the extent to which explicit relational devaluation was necessary for eliciting social pain. Additional exploratory analyses also examined whether these effects depended on participants' levels of trait SA. Furthermore, we used Study 1 as an opportunity to examine the effects of experimental contexts and tasks on several commonly used measures of social pain in order to gather descriptive information about the performance and reliability of each measure as a potential indicator of social pain and increase our confidence in the validity of the social pain measures used in Studies 2 and 3.

Subsequently, Study 2 consisted of an in-person experiment on a modest sample of undergraduate participants that aimed to replicate and extend previous research by showing that higher levels of SA would inhibit affiliative efforts in the face of social pain. Moreover, Study 2 was designed to investigate whether and how SA might moderate relations between social pain and both affiliative motivation and pro-social behaviour. Study 2 also built on previous research by investigating whether heightened affiliation in the face of social pain would lead to higher levels of downstream positive affect, providing preliminary evidence to suggest that reward recognition may be an integral component of affiliative repair processes.

SOCIAL ANXIETY AND SOCIAL PAIN

Finally, Study 3 sought to corroborate and extend findings from Study 2 by recruiting a large community sample to participate in an online experiment, which bolstered statistical power and allowed us to employ a more sophisticated data analytic strategy. Moreover, Study 3 investigated the roles of curiosity, reward, and threat sensitivity as potential mechanisms driving the relationship between social pain and social approach motivation for individuals reporting varying levels of trait SA.

Study One

Social Pain and the Role of Imagined Social Consequences:

**Why Personal Adverse Experiences Elicit Social Pain, With or Without Explicit Relational
Devaluation²**

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Abstract

When we experience damage to a social connection—in particular, perceiving that others have devalued our relationship with them—we experience “social pain.” Prior studies have typically examined social pain by creating explicit contexts to elicit experiences of relational devaluation. However, there may be other antecedents of social pain that do not involve direct threats to social belongingness. For example, personal failures, mistakes, or accidents that do not involve overt relational devaluation may also be socially painful because they can damage self-esteem—a marker of the self-perceived value we bring to all of our relationships. In the present study, 739 online participants were randomly assigned to imagine or experience events in one of three conditions: social inclusion, personal adversity with explicit relational devaluation (e.g., social rejection), or personal adversity without explicit relational devaluation (e.g., failing an exam). Participants were exposed to these experiences in one of three possible ways: by writing about a past memory, participating in an online game, or writing about an imagined future scenario.

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SOCIAL ANXIETY AND SOCIAL PAIN

Well-established self-reported measures of social pain were administered following the assigned task. Results demonstrated that the personal adversity conditions, both with and without explicit relational devaluation, evoked consistently more social pain across measures than inclusion but generally did not differ from one another. These findings suggest that even when it has not been made explicit, relational devaluation may be socially painful by virtue of threatening self-esteem, supporting the notion that many of our life experiences, independent or relational, are imbued with social significance.

Introduction

Social sense of belonging is a fundamental human need that confers adaptive benefits (MacDonald & Leary, 2005). When valuable social bonds become compromised, people experience a powerful distress signal that occupies distinctive space in long-term memory and can be cued to re-emerge with substantial emotional vigour (Chen et al., 2008; Vangelisti et al., 2005). Researchers commonly refer to this signal as “social pain.”

What is Social Pain?

Social pain has been conceptualized as an adaptive neurobiological signal that alerts people to loss or damage in their social networks. Neuroimaging studies have shown that experiences such as exclusion or rejection activate similar brain areas as physically painful experiences (Lelieveld et al., 2013; Onoda et al., 2010; see Eisenberger, 2012 for review). Researchers believe that during our evolutionary history, physical pain signals may have become co-opted to signal social injury and motivate individuals to repair social ruptures (Eisenberger, 2012; MacDonald & Leary, 2005).

Studies on the nature and consequences of social pain have proliferated in the literature. Yet, there is no established, agreed-upon gold-standard measure of social pain. One common approach to measuring social pain involves use of the “faces pain scale” or “pain slide,” in which participants view a series of animated faces expressing varying degrees of pain and select the one that best reflects how they feel (e.g., Chen et al., 2008; Klages & Wirth, 2014; Nordgren et al., 2011). Other self-report measures that are commonly used to capture the experience of social pain include the McGill Pain Questionnaire (e.g., Chen et al., 2008; Chen & Williams, 2012; Chester et al., 2016), the negative affect subscale of the Positive and Negative Affect Schedule (Auyeung & Alden, 2016; Chen & Williams, 2012; Hermann et al., 2014; Hudd & Moscovitch,

SOCIAL ANXIETY AND SOCIAL PAIN

2020), and similar well-validated self-report measures of anxiety and distress. Single-item ratings of “hurt feelings” are also used frequently, with some authors claiming that such ratings may help to capture unique variance in emotional experiences associated with social pain and not with other types of distress (Leary et al., 1998). Indeed, Leary et al. (1998) observed that participants tended to distinguish the experience of “pain” and “hurt” from other negative emotions when describing their reactions to relational devaluation events. Similarly, single-item indicators such as “I felt excluded” and “I felt rejected” (e.g., Chen & Williams, 2012; Fung & Alden, 2016; Hermann et al., 2014) are often used to measure participants’ appraisals or interpretations of socially painful contexts (i.e., rejection and exclusion), even though these items do not directly assess the emotional features of the experience itself. Finally, social pain is frequently measured with use of the Needs-Threat Scale (Williams et al., 2000), which assesses the types of psychological needs that may be compromised by socially painful experiences (e.g., Chester et al., 2016; Eisenberger et al., 2006), including belongingness, self-esteem, control, and meaningful existence (Williams, 1997).

These varied approaches to the measurement of a single construct illustrate the multifaceted nature of contemporary conceptualizations of social pain, encompassing physical, psychological, and emotional elements. It is likely that some of the current methods used to assess social pain may capture the discriminant features of social pain more effectively than others, though prior research has not tested this hypothesis directly.

Which Contexts Elicit Social Pain?

Theoretical models contend that social pain is elicited by social and relational contexts in which social loss or disruption has occurred and, in the case of “hurt feelings” specifically, when this loss or disruption is due to another person devaluing the relationship (Leary & Springer,

SOCIAL ANXIETY AND SOCIAL PAIN

2000). As such, researchers have commonly induced social pain by designing experimental contexts in which participants experience explicit relational devaluation (e.g., rejection or criticism) through direct feedback and exchanges with experimenters or fellow participants. One commonly used task is Cyberball (Williams et al., 2000), a virtual ball-tossing game in which participants are either included or excluded based on the number of ball tosses they receive from other ostensible participants within an online context. Other popular social pain-eliciting tasks include autobiographical writing exercises that prompt participants to recall past personal experiences of social exclusion (e.g., DeWall, 2006), partner preference tasks where participants are rejected as a partner for an upcoming task (e.g., Maner et al., 2007; Narayanan et al., 2013), and critical feedback tasks in which participants receive negative evaluative feedback about their personal attributes (e.g., DeBono & Muraven, 2014; Romero-Canyas et al., 2010).

In contrast to the notion that social pain is elicited exclusively within contexts in which participants explicitly and directly experience relational devaluation, some authors have suggested that social pain may be elicited whenever people experience a threat to self-esteem, even when relational devaluation is not explicit (Feeney, 2005). Self-esteem is often conceptualized as the output of a “sociometer,” an internal barometer of one’s perceived social value, which evolved to be highly sensitive to cues that signal potential threat or loss of value within one’s social networks (e.g., Leary et al., 1995). When one believes that an event reflects poorly on one’s perceived social currency, one’s perceived self-worth diminishes (Eisenberger et al., 2011). Examining relations between trait self-esteem and social pain, Onoda et al. (2010) discovered that individuals with low self-esteem are more sensitive to social rejection and thus, report higher levels of social pain. However, this study, like most others in the social pain literature, only examined social pain in response to an explicit relational devaluation event. It is

SOCIAL ANXIETY AND SOCIAL PAIN

possible, as previously noted, that damage to self-esteem that occurs outside the context of explicit relational devaluation may also elicit social pain and hurt feelings because people might imagine that the precipitating event would have negative social or relational consequences and reflect poorly on their social standing. For instance, personal failures, such as failing an exam or experiencing difficulty learning a new concept, could evoke social pain because people might imagine that such failures indicate they are, for instance, incompetent and thus, an unworthy investment for present and future companions. Indeed, the sociometer theory suggests that any loss of self-worth is akin to a loss of social worth. Thus, personal failures even outside contexts in which explicit relational devaluation occurs may lead people to imagine that others will be more likely to devalue them, thereby activating hurt feelings.

Some prior studies have sought to examine the relative effects of conditions in which threats to social belongingness are made more or less explicit. For instance, in the Future Life task, participants are provided with false feedback on personality questionnaire data indicating that, in the future, they will be a) without relationships (social exclusion condition designed to threaten social belongingness explicitly), b) with many thriving relationships (social inclusion), or c) accident or injury-prone (a threat condition without explicit relational devaluation). Studies have shown that the social exclusion condition leads to heightened desire to affiliate or aggress relative to the accident/injury and inclusion conditions (DeWall et al., 2009; Narayanan et al., 2013; Twenge et al., 2001); however, methodological issues and differences across these studies have prevented researchers from drawing definitive conclusions about the relative emotional impact of these conditions that would provide insights relevant to our understanding of social pain per se. Indeed, many of the studies which have employed the Future Life paradigm have not measured social pain directly or considered its potential role as a mediator in their models.

SOCIAL ANXIETY AND SOCIAL PAIN

Bernstein and Claypool (2012) attempted to address this gap by using the Future Life task to examine the impact of condition on social pain (as measured by the Needs-Threat Scale and negative affect questionnaires). However, they did not include the accident/injury condition in their design, thus preventing conclusions about whether direct threats to social belongingness such as exclusion might uniquely promote elevated levels of social pain, or whether elevations in social pain may also be elicited by unpleasant experiences that do not explicitly elicit threats to belongingness, such as personal failures, accidents or injuries. Moreover, in their study, the social exclusion condition failed to elicit more social pain than the inclusion condition, resulting in the authors' conclusion that the social exclusion condition may have been so painful that it led to a protective "numbing response." (p. 115, Bernstein & Claypool, 2012). Another consideration is that the social exclusion condition in the Future Life manipulation was devised to serve as a threat manipulation, not a social pain manipulation per se, and thus we should not expect such a manipulation to reliably translate to detectable elevations in social pain. Thus, critical gaps remain in our understanding of social pain and the contexts that reliably elicit it.

Current Study

The primary goal of the present study was to examine the prevailing assumption that relative to social inclusion, explicit relational devaluation events would more strongly, if not uniquely, cause elevated social pain than other personal adverse events that do not directly prime relational devaluation but could be imagined to hold relational devaluation potential. Participants were randomly assigned to one of three conditions in which they were exposed to: 1) a personal adverse event *with* explicit relational devaluation ("explicit relational devaluation"), 2) a personal adverse event *without* explicit relational devaluation ("without explicit relational devaluation"), or 3) social inclusion. Only those who experienced an explicit relational

SOCIAL ANXIETY AND SOCIAL PAIN

devaluation were primed to imagine or experience social exchanges in which the individual's relationship with another person or people was directly and explicitly threatened or devalued by the other person(s) (e.g., via rejection, exclusion, betrayal, etc.). In contrast, participants who experienced a personal adverse event without explicit relational devaluation were primed to reflect on personal adverse events that did not include an explicit or direct relational exchange with others. Finally, participants who experienced "social inclusion" were primed to imagine or experience social exchanges in which they were included or accepted by others. Since the inclusion condition was not expected to threaten belongingness (and therefore not elicit elevations in social pain), it served as a useful comparison condition or "measuring stick" against which the magnitude of evoked social pain experiences could be assessed across the two adversity conditions.

Our study design also varied the nature of the task demands within each of these conditions; namely, participants within each condition were further assigned to one of three tasks: a) recalling a past memory, b) experiencing a real-time, in-situ event within an online game, or c) imagining a future scenario. Thus, our study used a 3x3 fully between-subjects design, in which we examined the effects of condition within each of these three tasks. We reasoned that examining the effects of social inclusion or personal adversity with or without explicit relational devaluation across different task demands would yield a more robust test of our research hypothesis by establishing that the anticipated effects occurred regardless of variability in task features. The specific tasks we used (past memory recall, online game, and future projection) were selected because they varied sufficiently in their task features and reflected validated methods of eliciting social pain in prior research (e.g., Chen et al., 2008 for

SOCIAL ANXIETY AND SOCIAL PAIN

use of past memory recall; Williams et al., 2000 for use of an online game; Chen & Williams, 2012 for use of future projection).³

A final important feature of our study design was our inclusion of multiple well-established measures of social pain that were presented in randomized order following participants' engagement in their assigned tasks across conditions. We reasoned that a multi-method, multi-measure experimental approach would facilitate a more rigorous test of hypotheses and enable us to make more substantive claims about the generalizability of our data than a more selective methodological approach that would inevitably limit the conclusions that can be drawn.

We predicted, first, that personal adverse events both with and without explicit relational devaluation would provoke elevated social pain relative to social inclusion, as each type of event would likely have the potential to threaten belongingness by provoking negative imagined consequences for one's social currency. Second, we hypothesized that our expected pattern of results would emerge consistently across tasks and measures. In other words, we expected that results would reflect a consistent and robust main effect of condition in which the two adversity conditions would elicit greater pain than the inclusion condition regardless of the specific task paradigm or social pain outcome measure examined.

³Our future projection task was not intended to mimic the Future Life task. Though the future-oriented focus is similar across the two tasks, the two tasks contain features that are quite distinct from one another. The main reason we included the future projection task was to increase variability across task demands, so that one task relied on recalling a past experience, one relied on a present-moment experience, and one relied on imagining the future.

Method

In the following section, we report how we determined our sample size, all data exclusions, all manipulations, and all measures collected in the study.

Participants

Undergraduate students were recruited for an online study from the research participation pool of a large Canadian university. Data were originally collected on $N = 820$ participants. Participants were removed from the sample if they met the following exclusion criteria: (a) at the end of the study, self-reporting low scores on their levels of attention and honesty throughout the study (i.e., those who said they were only “a little” or “less than a little” honest or engaged; $n = 11$); (b) failing to comply with necessary study procedures to provide their identification number so their survey data could be merged from distinct parts of the study ($n = 22$), or (c) not providing/declining consent to allow researchers to use their study data following re-consent procedures at the conclusion of the study ($n = 48$). Participants also completed two attention checks embedded within the study, in which they were asked to respond “true” to a true or false question that would typically be answered as “false” (e.g., “I own a pet tiger”). Participants were flagged for further examination of data quality if they failed either attention check. Within the sample of $N = 739$ participants, 85% passed both attention checks ($N = 624$) and 6% passed only one attention check ($N = 45$). For those who passed neither attention check (8%, $N = 62$), we visually inspected descriptive statistics for their outcome measures to determine whether their responses deviated significantly from the remainder of the sample, and this was not the case. As such, participants were not excluded if they failed the embedded attention checks.⁴

⁴Rates of participant exclusion did not differ by condition or task.

SOCIAL ANXIETY AND SOCIAL PAIN

These exclusions resulted in a final sample of $N = 739$. Participants were, on average, 20.15 years old ($SD = 3.21$), with 75.5% identifying as female, 23% as male, 0.4% as transgender, and 0.7% as other (where all participants who selected “other” specified their gender identity as “nonbinary”). Data were missing for the remaining 0.4% of participants. Participants identified their cultural/ethnic background as follows: 40.6% Caucasian, 21.2% South Asian, 18% East Asian, 4.9% Middle Eastern, 4.9% Black, 3.7% South-East Asian, 2.7% Hispanic, 0.1% Indigenous, and 3.2% specified other while 0.7% declined to answer.

Study Procedures

The study was conducted entirely online using Qualtrics™ (Qualtrics, Provo, UT). Participants were informed that they were participating in a study that aimed to examine how people feel in online environments. They were led to believe that the study was being run in partnership with other nearby universities and that participants would complete solitary activities and/or interact online with other student participants. These were deceptions, as study participants were exclusively students at the authors’ institution and all “other participants” were actually pre-programmed avatars. At the outset of the study, participants completed demographic questionnaires and were randomly assigned by Qualtrics (using the “fully random assignment” function) to one of the nine possible conditions in which they experienced or imagined experiencing a personal adverse event with or without explicit relational devaluation, or social inclusion by recalling a past memory, playing an online game, or imagining a future scenario. They were directed to complete their assigned task following standardized instructions dictated by their assigned condition. Following task completion, the social pain outcome measures (described below) were presented in fully randomized order.

SOCIAL ANXIETY AND SOCIAL PAIN

After collecting the social pain outcome measures, participants completed “part 2” of the study, which tested research questions that were not a part of the current paper’s aims and is, therefore, not reported here. Additional measures were collected in relation to a follow-up social tasks presented in part 2, which included measures of social approach motivation, reward and threat responsiveness, and positive affect. The entire study took approximately 30 minutes to complete, and participants were remunerated with partial course credit.

Tasks and Conditions

Online games. In this paradigm, participants were guided through a real-time, online experience. Each condition involved some form of deception (described below).

Condition 1: Personal adverse event with explicit relational devaluation. Participants played a game of online catch (Cyberball) with three pre-programmed computer avatars. They were led to believe the avatars were other participants. Cyberball was programmed in the manner commonly reported within the literature to elicit rejection; that is, participants received three throws at the beginning of the game and then zero throws for the remainder of the game, which consisted of 36 total trials. To enhance deception, we instructed participants to share their favourite book or movie with the other players by sending a message to them through a simple chat interface at the beginning of the game. They were led to believe the other players received the same prompt and the avatars were programmed to also send a message introducing themselves and their favourite book or movie. Participants read the following prompt before beginning the game of Cyberball: *To get things started, the first online task will be a straightforward game of catch. The purpose of this game is for participants to mentally visualize their interaction partners (what they might look like, how they sound, what their personalities*

SOCIAL ANXIETY AND SOCIAL PAIN

might be like, and so on). We want to know whether the way players perceive each other affects how they engage with others during the game.

Condition 2: Personal adverse event without explicit relational devaluation.

Participants in this condition attempted to complete an unsolvable set of anagrams. They were introduced to the task as follows: *The first activity we would like you to complete is a simple introductory exercise. The purpose of this exercise is to help participants get used to completing an online activity and responding with how they feel.* They were guided through two example anagrams in order to acquaint them with the task and then led to believe the remaining seven anagrams were solvable in a relatively straightforward manner, when in fact the remaining items were impossible to solve. Specifically, participants were told, *“This task is straightforward and most people find it relatively easy.”* Participants had 10 seconds to enter their response for each trial before the survey auto-advanced to the next item. Like Cyberball, the task was similar in length and has been used in previous research as a mild threat induction (e.g., Starcke et al., 2017). Unlike Cyberball, where participants interacted with others who subsequently ignored them during the game of catch, participants did not interact with others, nor were they provided with any social cues during the anagram task (i.e., they were not given any explicit social or performance feedback, nor were they given any indication that the experimenters would comment on, collect, or otherwise use the data from this activity). In this sense, there were no overt indications of social threat.

Condition 3: Social inclusion. Participants in this condition played an online game of Cyberball and received identical prompts and instructions as those in the explicit relational devaluation condition. However, participants in this condition received an equal number of throws relative to other players (one out of every four throws, on average).

SOCIAL ANXIETY AND SOCIAL PAIN

Manipulation checks for online games. Participants who played Cyberball responded to a two-item manipulation check to ensure they recognized that they were thrown the ball equally or far fewer times relative to the other players. This manipulation check was validated in a previous study (Hudd & Moscovitch, 2020). Those who completed an unsolvable anagram task responded to a manipulation check to ensure they recognized their poor task performance, despite not having received explicit feedback; to this end, participants rated their agreement with the following items on a 5-point scale: *I understood the rules of this task; I answered most of the anagrams correctly; I answered very few of the anagrams correctly; and I think I performed well on this task.* (*reverse-coded). This manipulation check was devised for this study and not previously validated.

Recalling a past memory. In this task, participants were asked to recall a time in their lives when they personally experienced an explicit relational devaluation, a personal adverse event without explicit relational devaluation, or social inclusion. After identifying and bringing to mind a relevant experience, participants were guided through follow-up questions to enhance their immersion in the memory; specifically, participants were asked what they thought, how they felt, and to whom their emotions were directed at the time of the event. For ethical reasons aligned with the value of protecting participants from possible harm, participants were prohibited from selecting any memory that involved criminal activity, physical or sexual abuse, trauma or neglect.

Condition 1: Personal adverse event with explicit relational devaluation. Participants in this condition read the following prompt: *Right now, we would like you to think about a time in the past when a friend, coworker, family member or significant other excluded you. Some examples of this might be forgetting to invite you somewhere, deliberately excluding you from*

SOCIAL ANXIETY AND SOCIAL PAIN

plans or activities, or by sharing information or inside jokes with others and not with you. Please write a few sentences to capture the details of the event you recalled.

Condition 2: Personal adverse event without explicit relational devaluation.

Participants in this condition read the following prompt: *Right now, we would like you to think about a time in the past when you experienced a negative event that primarily affected YOU, and NOT other people or your personal relationships. This could be a personal failure, accident or unfortunate mishap (e.g. doing poorly on a test, getting into a minor car accident, undergoing an unpleasant dental procedure, etc.). Please write a few sentences to capture the details of the event you recalled.*

Condition 3: Social inclusion. Participants in this condition read the following prompt: *Right now, please think about a time in the past when you experienced being included and accepted by a friend, coworker, family member or significant other (e.g., during a gathering with friends or family, or during one-on-one time spent with a friend, family member or significant other, etc.). Please write a few sentences to capture the details of the event you recalled.*

Manipulation check for past writing exercises. Participants' responses in the past writing tasks were coded within each condition to ensure that the themes and content aligned with expectations for each condition. The coding procedure used in this study was developed ad-hoc and was not previously validated. Events were coded by the first author using a binary system where each event was coded as a "yes" (1) or "no" (0) across 10 indicators. These indicators captured common forms of relational devaluation or social inclusion (Leary et al., 1998), including instances in which people with whom the participant shared a relationship included/accepted them, rejected/ignored them, criticized/teased them, or betrayed them (i.e., a partner committing infidelity or lying to them). Additionally, we included an indicator to capture

SOCIAL ANXIETY AND SOCIAL PAIN

circumstances where a loss of relationship occurred, whether that was due to a death, friend moving away, or in conjunction with a relational devaluation event (e.g., rejection and then romantic breakup, which was coded as both exclusion/rejection and loss of relationship). Events were also coded to capture whether the participant described the event as having a real or anticipated negative or positive impact on their personal relationships. Finally, indicators captured sources of distress that previous researchers have identified as being more closely aligned with “independent” (as opposed to “interdependent”) events (Jaremka et al., 2011): these included personal failures, physically painful events or injuries, or misfortunes that were not anyone’s fault (e.g., illnesses or random accidents).

Imagining a future scenario. In this task, instructions were similar to the past recall conditions. However, instead of recalling a past event, participants were asked to imagine a moment in the future during which they experience a personal adverse event with explicit relational devaluation, a personal adverse event without explicit relational devaluation, or social inclusion. They were guided through follow-up questions to enhance their engagement with the imagined event; specifically, participants were asked what they would think, feel, and to whom their emotions would be directed if this event were to take place. Participants were prohibited from imagining scenarios that involved criminal activity, physical or sexual abuse, trauma or neglect.

Condition 1: Personal adverse event with explicit relational devaluation. Participants in this condition read the following prompt: *Right now, please imagine a scenario that is set in the distant future where a friend, coworker, family member or significant other excludes you (e.g. by forgetting to invite you somewhere, deliberately excluding you from plans or activities, or by*

SOCIAL ANXIETY AND SOCIAL PAIN

sharing information or inside jokes with others and not with you). Please write a few sentences to capture the details of the event you imagined.

Condition 2: Personal adverse event without explicit relational devaluation.

Participants in this condition read the following prompt: *Right now, please imagine a scenario that is set in the distant future where you experience a negative event that primarily affects YOU, and NOT other people or your personal relationships. This could be a personal failure, accident or unfortunate mishap (e.g. doing poorly on a test, getting into a minor car accident, undergoing an unpleasant dental procedure, etc.). Please write a few sentences to capture the details of the event you imagined.*

Condition 3: Social inclusion. Participants in this condition read the following prompt: *Right now, please imagine a scenario set in the distant future where you experience a moment of being included and accepted by a friend, coworker, family member or significant other (e.g., a gathering with friends or family, or during one-on-one time spent with a friend, family member or significant other, etc.). Try to imagine the scenario as realistically as possible. Please write a few sentences to capture the details of the event you imagined.*

Manipulation checks for future writing exercises. Participant responses in the future writing tasks were coded within each condition in the same manner as responses to past writing tasks (described above).

Measures of Social Pain

The following measures were presented in a randomized, counterbalanced order immediately following each task. For each measure, participants were asked to report how they felt “just now, while completing the activity.”

SOCIAL ANXIETY AND SOCIAL PAIN

Hurt feelings. Participants rated their agreement with the statement “My feelings were hurt” on a scale from 1 (very slightly or not at all) to 5 (extremely).

Feeling rejected and excluded. Participants rated their agreement with the statements “I felt rejected” and “I felt excluded” on scales from 1 (very slightly or not at all) to 5 (extremely). The items were combined to form a composite measure, which had good internal consistency, $\alpha = .85$.

Short-Form McGill Pain Questionnaire (SF-MPQ; Melzack, 1987). The SF-MPQ is a 15-item scale that captures sensory and affective components of pain. The sensory subscale includes items such as “throbbing”, “cramping” and “gnawing,” and the affective subscale includes items such as “tiring-exhausting” and “punishing-cruel.” This measure has been used to gauge pain across a number of studies examining social exclusion (Chen et al., 2008; Chester et al., 2016; Riva et al., 2011) and has strong psychometric properties (Lovejoy et al., 2012). The SF-MPQ showed strong internal consistency in the present study, $\alpha = .91$.

Needs-Threat Scale (NTS; Williams et al., 2000). The NTS captures the degree to which four needs are threatened in the aftermath of social exclusion, including self-esteem, power/control, need to belong, and meaningful existence. This scale includes items such as, “I felt poorly accepted by the other participants,” “I felt somewhat inadequate during the game,” and “I felt as though my existence was meaningless during the game.” The subscales of the Needs-Threat measure have demonstrated adequate reliability in previous research (α 's ranging between 0.71 to 0.79; Gerber et al., 2017), and showed good internal consistency in the present study, $\alpha = .84$.

State-Trait Inventory for Cognitive and Somatic Anxiety - State Subscale (STICSA-S; Ree et al., 2008). The STICSA is a validated, 21-item measure of how anxious a person feels

SOCIAL ANXIETY AND SOCIAL PAIN

in the present moment, including items such as “my heart beats fast” and “my muscles are tense.” This scale has demonstrated excellent internal consistency ($\alpha > .92$), convergent validity with other established measures of anxiety and good divergent validity from depressive affect and other measures of affect (Roberts et al., 2016). The STICSA-S showed good internal consistency in the present study, $\alpha = .93$.

Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). The PANAS consists of two subscales measuring emotion adjectives based on how the individual feels “right now, at this moment.” Only the negative affect subscale was used in this study, which includes 10 emotion adjectives rated on a 5-point Likert scale, such as “ashamed,” “distressed,” and “upset.” It has demonstrated good reliability in prior research (e.g., $\alpha = .85$ for negative affect in Crawford & Henry, 2004) and showed good internal consistency in the present study, $\alpha = .90$.

Data Analysis Plan and Sample Size Calculations

We conducted three separate MANOVAs to test the effect of condition on the social pain outcome measures for each task separately. Conditions were coded as 1) personal adverse event with explicit relational devaluation, 2) personal adverse event without explicit relational devaluation, and 3) social inclusion. Main effects of condition were followed up with post-hoc *t*-tests, which were adjusted for multiple comparisons with Tukey correction. Reported confidence intervals were bias-corrected and based on 5000 bootstrap samples.

We estimated our required sample size a priori using GPower (Faul et al., 2009). Prior studies with Cyberball have shown large effects of ostracism vs. inclusion on threatened needs (e.g., Hartgerink et al., 2015). Though we expected to replicate the large effect associated with Cyberball, we thought the effect could be small to medium for other tasks or measures that are not as well established in the literature. Sample size calculations revealed that to observe a

SOCIAL ANXIETY AND SOCIAL PAIN

significant main effect of condition with an effect size of Cohen's $f = 0.15$, we would require a minimum sample size of $N = 536$. To observe small-to-medium-sized differences for post-hoc independent t-tests (Cohen's $d = .5$), each condition required a minimum sample size of $N = 64$, bringing our required minimum total sample size to $64 * 9$ conditions = 576. We oversampled to account for the likelihood that some data would be deemed unreliable and require exclusion. Thus, our analyses had 80% power to detect an effect size of Cohen's $f = 0.15$ or similar.

Missing Data and Outlier Analyses

Most measures had very little missing data, with a maximum of 3.7% missing data per item. The SF-MPQ was the only measure with greater than 5% missing data per item, ranging from 4.2-6.6% missing data per item. For the PANAS-N and NTS, missing data were MCAR as determined by non-significant Little's MCAR tests (Little, 1988). The other measures could not be confirmed as MCAR due to significant Little's MCAR tests (Little, 1998). As we held no theoretical reasons to believe data from the other measures were missing not at random (MNAR), we concluded that data for these measures were likely missing at random (MAR). In accordance with suggested approaches for dealing with MCAR and MAR data (Dong & Peng, 2013), and to retain as much of the sample as possible, missing data were imputed using the expectation-maximization approach whenever the majority of items were completed for a particular scale. Data points were deleted listwise from analyses in instances when the majority of items for a particular scale were missing. Data were visually scanned for outliers using boxplots and descriptive analyses. No data points were excluded as outliers. Apart from the SF-MPQ, all measures were normally distributed, with acceptable skewness and kurtosis; Gravetter and Wallnau (2014). The SF-MPQ was kurtotic, likely because SF-MPQ items describe severe

SOCIAL ANXIETY AND SOCIAL PAIN

types of physical pain that were unlikely to be elicited by the activities in this online study (e.g., *I felt stabbing or sickening pain*).

Results

Manipulation Checks

Online games. Results indicated that participants understood and interpreted the online game manipulations in accordance with our expectations. Relative to those in the social inclusion Cyberball task, participants in the explicit relational devaluation condition were more likely to respond that the ball was thrown to them “*much less frequently than it was to other participants,*” $t(166) = 10.672, p < .001, CI [1.57, 2.28], d = 1.53$. and less likely to respond that the ball was thrown to them “*about as frequently as it was to other participants,*” $t(166) = -12.233, p < .001, CI [-2.30, -1.66], d = 1.81$.

On the manipulation check for the unsolvable anagram task, out of a total possible score of 20, most participants (80% or higher) scored at least 16/20, suggesting that on average participants understood the rules of the task and the manipulation successfully created a personal failure context.

Past and future writing exercises. Results from the coding procedure suggested that participants recalled or imagined events in accordance with condition instructions. Of those who were asked to recall or imagine explicit relational devaluation in the past and future writing tasks, most participants described at least one form of relational devaluation, with 95.4-97.3% endorsing that they were rejected/ignored and relatively fewer describing an instance of being criticized or teased (1.5-2.7%), being betrayed or lied to (5.3-18.5%), or experiencing a loss of relationship (2.7-9.2%). In these conditions, the majority (90.8-94.7%) of participants also referenced a negative impact on their relationship(s) and very few (0-1.5%) described being included/accepted or referenced a positive impact on their personal relationship(s). Within the

SOCIAL ANXIETY AND SOCIAL PAIN

explicit relational devaluation conditions, very few participants wrote about personal failures (0-1.5%) and none wrote about accidents/misfortunes or physical injuries/painful events.

Participants assigned to imagine personal adversity without explicit relational devaluation primarily wrote about personal failures across both the past and future writing tasks (83.0-87.0%). A smaller proportion wrote about accidents or misfortunes (6.8-10.3%) or physical injuries/painful events (8.0-11.6%). Events were predominantly related to poor performance on exams or coursework, but some also involved car accidents or personal injuries for which the participant was at fault. Many participants suggested that the event described could or did have a negative impact on their relationship(s) (24.6-46.6%), with only 1.1-1.4% citing a positive impact. For instance, several participants described their personal failure as humiliating and something that they imagined could be disappointing to their loved ones. A small minority of participants wrote about being rejected/ignored (5.7-5.9%), criticized or teased (4.3-6.8%), betrayed or lied to (0-6.8%) or a loss of a relationship (1.4-5.7%) despite instructions to the contrary.

Finally, the majority of those who were assigned to the social inclusion conditions across the past and future writing tasks wrote about a social inclusion or acceptance event (98.8%) and indicated that this had/would have a positive impact on their relationship(s) (92.4-97.7%). Most of the events described were related to meeting new people who expressed interest in the participant, or family/friend gatherings where they felt a sense of love and community. Very few participants in this condition described forms of relational devaluation, such as being rejected/ignored (0-2.3%), criticized or teased (0-2.5%), betrayed or lied to (0-2.5%) or a loss of a relationship (0-4.7%). Additionally, very few wrote about personal failures (0-2.3%) and none wrote about accidents/misfortunes or physical injuries/painful events.

SOCIAL ANXIETY AND SOCIAL PAIN

Primary Analyses

Bivariate correlations between outcome measures overall (i.e., collapsed across conditions and tasks) are presented in Table 1⁵. Descriptive statistics for outcome measures in each condition and task are presented in Table 2.

Table 1.

Bivariate Correlations Between Outcome Variables Collapsed Across Tasks and Conditions.

	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.70**	1	-	-	-	-
3	.37**	.37**	1	-	-	-
4	.56**	.52**	.37**	1	-	-
5	.50**	.56**	.54**	.56**	1	-
6	.43**	.46**	.60**	.51**	.74**	1

Note.

** $p < .001$, * $p < .05$.

SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

Results of the three MANOVAs testing the effects of each condition on outcomes for each task separately are detailed in Table 3, along with effect sizes for each outcome variable (η_p^2). Results largely supported hypotheses, such that the effects of condition within each task were significant across most outcome measures. There were only two exceptions: there was no significant effect of condition for the STICSA-S within the past recall task, and there was no significant effect of condition for the SF-MPQ within the online games task.

Table 2.

Descriptive Statistics [M (SD)] for Outcome Measures in Each Condition and Task

⁵Bivariate correlations between measures during each task for each condition separately are provided in Supplementary Materials.

SOCIAL ANXIETY AND SOCIAL PAIN

	Adverse event with explicit relational devaluation <i>M</i> (SD)	Adverse event without explicit relational devaluation <i>M</i> (SD)	Social inclusion <i>M</i> (SD)
Past Memory Recall			
Outcome Measures			
Rejection-Exclusion	3.54 (1.83) ^a	3.02 (1.97) ^a	2.19 (.85) ^b
Hurt Feelings	1.42 (.66) ^a	1.60 (1.00) ^a	1.13 (.41) ^b
SF-MPQ	18.29 (4.55) ^{ab}	20.10 (7.11) ^a	17.33 (3.83) ^b
NTS	40.18 (15.15) ^a	38.94 (14.57) ^a	28.87 (12.65) ^b
PANAS-N	17.48 (7.10) ^a	21.21 (8.67) ^b	15.69 (5.53) ^a
STICSA-S	28.52 (8.53) ^a	30.83 (9.69) ^a	28.60 (10.03) ^a
Online Games			
Outcome Measures			
Rejection-Exclusion	4.35 (2.15) ^a	2.69 (1.35) ^b	2.64 (1.15) ^b
Hurt Feelings	1.67 (.98) ^a	1.64 (.99) ^a	1.15 (.40) ^b
SF-MPQ	17.63 (5.22) ^a	18.36 (6.10) ^a	16.82 (3.63) ^a
NTS	40.53 (14.57) ^a	42.61 (13.68) ^a	31.91 (11.87) ^b
PANAS-N	17.20 (6.71) ^a	21.40 (8.37) ^b	15.24 (4.46) ^a
STICSA-S	26.16 (6.16) ^a	30.48 (10.24) ^b	25.10 (5.69) ^a
Future Projection			
Outcome Measures			
Rejection-Exclusion	4.59 (2.46) ^a	2.92 (1.61) ^b	2.65 (1.66) ^b
Hurt Feelings	1.81 (1.02) ^a	1.46 (.76) ^b	1.23 (.63) ^b
SF-MPQ	19.17 (5.09) ^{ab}	20.52 (7.15) ^a	17.76 (5.03) ^b
NTS	43.47 (15.87) ^a	40.38 (14.84) ^a	27.02 (13.17) ^b
PANAS-N	20.36 (8.45) ^a	20.78 (8.64) ^a	15.85 (5.52) ^b
STICSA-S	32.13 (10.24) ^a	32.68 (11.69) ^a	27.11 (8.65) ^b

Note.

SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety. Values with different superscripts differ significantly from one another.

SOCIAL ANXIETY AND SOCIAL PAIN

Table 3.

MANOVA Main Effects of Condition Within Each Task Across Outcome Measures.

Task	Outcome Measure	F-Statistic	P-value	Effect Size (η_p^2)
Past Memory Recall	Rejection-Exclusion	13.337	.000	.11
	Hurt Feelings	8.673	.000	.07
	SF-MPQ	5.553	.004	.05
	NTS	15.226	.000	.12
	PANAS-N	12.443	.000	.10
	STICSA-S	1.481	.230	.01
Online Games	Rejection-Exclusion	29.392	.000	.20
	Hurt Feelings	9.606	.000	.07
	SF-MPQ	1.836	.162	.02
	NTS	14.353	.000	.11
	PANAS-N	17.888	.000	.13
	STICSA-S	11.204	.000	.09
Future Projection	Rejection-Exclusion	20.296	.000	.17
	Hurt Feelings	9.338	.000	.08
	SF-MPQ	3.934	.021	.04
	NTS	25.822	.000	.20
	PANAS-N	9.270	.000	.08
	STICSA-S	6.488	.002	.06

Note.

Bold values: $p < .05$. SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

Tukey-corrected post-hoc t-tests were conducted to further probe for significant main effects of condition within each task separately. Tables 4-6 summarize the results of these between-condition comparisons for the outcome measures that demonstrated a significant main effect of condition in the initial MANOVAs. These tables contain the p values, 95% CIs and Cohen's d effect sizes for each comparison. Overall, the observed pattern of results supported hypotheses but not uniformly for every measure and task, as described below.

SOCIAL ANXIETY AND SOCIAL PAIN

As shown in Table 4, within the past recall task, four of the five outcome measures (rejection-exclusion, hurt feelings, NTS, and PANAS-N, but not SF-MPQ), were significantly elevated in the adverse events with explicit relational devaluation condition relative to the social inclusion condition. All five outcome measures (rejection-exclusion, hurt feelings, NTS, PANAS-N, and SF-MPQ) were significantly elevated in the adverse events without explicit relational devaluation condition relative to the social inclusion condition. The two adverse event conditions with and without explicit relational devaluation only differed from one another significantly on the PANAS-N measure, where personal adverse events without explicit relational devaluation unexpectedly led to greater distress.

SOCIAL ANXIETY AND SOCIAL PAIN

Table 4.

Tukey Post-hoc Comparisons Between Conditions During Past Memory Recall

Task	Outcome Measure	Condition	Comparison Condition	P-value	95% Confidence Interval		Cohen's <i>d</i>
					Lower	Upper	
Past Memory Recall	Rejection-Exclusion	ERD	Non-ERD	.136	-.12	1.15	0.27
			SI	.000	.72	1.97	0.94
	Hurt Feelings	ERD	Non-ERD	.003	.24	1.42	.55
			SI	.266	-.48	.10	0.22
	SF-MPQ	ERD	Non-ERD	.000	.20	.74	0.62
			SI	.112	-3.92	.31	0.30
			SI	.526	-1.14	3.07	0.23
	NTS	ERD	Non-ERD	.003	.79	4.76	0.49
			SI	.857	-4.29	6.77	0.08
			SI	.000	5.82	16.82	0.81
	PANAS-N	ERD	Non-ERD	.000	4.89	15.26	0.74
			SI	.006	-6.56	-.90	0.47
SI			.293	-1.03	4.61	0.28	
		Non-ERD	.000	2.87	8.18	0.76	

Note.

Negative CI values indicate that the condition is associated with lower scores than the comparison condition.

ERD: Explicit relational devaluation; Non-ERD: Without explicit relational devaluation; SI: Social inclusion.

SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

As shown in Table 5, within the online games, adverse events with explicit relational devaluation produced significantly higher scores than social inclusion on three of the five outcome measures (rejection-exclusion, hurt feelings, and NTS measures, but not PANAS-N or STICSA-S). Adverse events without explicit relational devaluation led to significantly greater hurt feelings and threatened needs (NTS) as well as PANAS-N and STICSA-S scores compared to social inclusion but did not elicit relatively elevated scores on the rejection-exclusion measure. Unexpectedly, the adverse event with explicit relational devaluation led to higher rejection-

SOCIAL ANXIETY AND SOCIAL PAIN

exclusion scores than the adverse event without explicit relational devaluation, while adverse event without explicit relational devaluation led to higher PANAS-N and STICSA-S scores. As expected, however, the two adverse event conditions did not differ in their degree of reported hurt feelings or threatened needs (NTS).

Table 5.

Tukey Post-hoc Comparisons Between Conditions During Online Games

Task	Outcome Measure	Condition	Comparison Condition	P-value	95% Confidence Interval		Cohen's <i>d</i>
					Lower	Upper	
Online Games	Rejection-Exclusion	ERD	Non-ERD	.000	1.07	2.26	0.92
			SI	.000	1.11	2.32	0.99
		Non-ERD	SI	.977	-.54	.65	0.04
	Hurt Feelings	ERD	Non-ERD	.975	-.28	.34	0.03
			SI	.000	.20	.83	0.69
		Non-ERD	SI	.001	.18	.80	0.65
	NTS	ERD	Non-ERD	.585	-7.04	2.88	0.15
			SI	.000	3.58	13.66	0.65
		Non-ERD	SI	.000	5.74	15.67	0.84
	PANAS-N	ERD	Non-ERD	.000	-6.70	-1.71	0.55
			SI	.163	-.57	4.49	0.34
		Non-ERD	SI	.000	3.68	8.66	0.92
STICSA-S	ERD	Non-ERD	.001	-7.16	-1.46	0.51	
		SI	.662	-1.83	3.96	0.18	
	Non-ERD	SI	.000	2.53	8.22	0.65	

Note.

Negative CI values indicate that the condition is associated with lower scores than the comparison condition.

ERD: Explicit relational devaluation; Non-ERD: Without explicit relational devaluation; SI: Social inclusion.

SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

As shown in Table 6, within the future projection task, adverse events with explicit relational devaluation produced significantly higher scores than social inclusion across all outcome measures but one (SF-MPQ). Adverse events without explicit relational devaluation

SOCIAL ANXIETY AND SOCIAL PAIN

produced significantly higher scores than social inclusion on the SF-MPQ, NTS, PANAS-N, and STICSA-S, but not on the rejection-exclusion or hurt feelings measures. Comparing the two adverse event conditions with each other revealed no significant differences between NTS, SF-MPQ, PANAS-N, and STICSA-S scores, as expected. However, explicit relational devaluation unexpectedly led to higher rejection-exclusion and hurt feelings than non-explicit relational devaluation.

Table 6.

Tukey Post-hoc Comparisons Between Conditions During Future Projection

Task	Outcome Measure	Condition	Comparison Condition	P-value	95% Confidence Interval		Cohen's <i>d</i>
					Lower	Upper	
Future Projection	Rejection-Exclusion	ERD	Non-ERD	.000	.87	2.47	0.80
			SI	.000	1.17	2.71	0.92
		Non-ERD	SI	.694	-.52	1.06	0.17
	Hurt Feelings	ERD	Non-ERD	.037	.02	.69	0.39
			SI	.000	.26	.91	0.69
		Non-ERD	SI	.216	-.10	.56	0.34
	SF-MPQ	ERD	Non-ERD	.374	-3.73	1.03	0.22
			SI	.309	-.86	3.69	0.28
		Non-ERD	SI	.015	.43	5.09	0.45
	NTS	ERD	Non-ERD	.448	-2.93	9.10	0.20
			SI	.000	10.69	22.21	1.13
		Non-ERD	SI	.000	7.46	19.26	0.95
PANAS-N	ERD	Non-ERD	.947	-3.54	2.70	0.05	
		SI	.001	1.52	7.50	0.63	
	Non-ERD	SI	.001	1.87	7.99	0.68	
STICSA-S	ERD	Non-ERD	.948	-4.74	3.64	0.05	
		SI	.010	1.01	9.03	0.53	
	Non-ERD	SI	.004	1.46	9.68	0.54	

Note.

Negative CI values indicate that the condition is associated with lower scores than the comparison condition.

ERD: Explicit relational devaluation; Non-ERD: Without explicit relational devaluation; SI: Social inclusion.

SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

Discussion

Social pain has been conceptualized as a specific type of cognitive/emotional response that is elicited uniquely by loss or damage to a social connection, and in particular, when someone else inflicts that loss or damage—otherwise known as relational devaluation (e.g., DeWall et al., 2009; Twenge et al., 2001). Based on the sociometer theory of self-esteem, we hypothesized that personal adverse events that do not involve explicit relational devaluation—but could hold such potential—might have a similar capacity to cause social pain. Any adverse event that undermines an individual’s perception of their broader social worth (i.e., their self-esteem) could be imagined to hold negative consequences across current and future relationships. Data from the present study revealed that within most tasks and across most outcome measures, social pain responses were elevated in response to adverse events, both with and without explicit relational devaluation, in comparison to social inclusion, whereas the magnitude of social pain reported did not generally differ between the two adverse event conditions. This pattern of findings supported our predictions, with some inconsistencies and exceptions worth noting, which we discuss below. Overall, these findings generally support the potential need to expand our conceptualization and study of social pain as a distress signal that is evoked not only by direct ruptures to social relationships but also by personal failures, mistakes or accidents that have the capacity to damage self-esteem, even if the event occurs privately. After all, relational devaluation is an appraisal conjured in the imagination, where both actual and imagined threats to one’s social belongingness can be experienced as one and the same, and equally painful.

We begin by highlighting the social pain indicator that met our predictions most consistently across different task contexts: within each of the three task contexts used in this study, conditions with and without explicit relational devaluation consistently led to higher

SOCIAL ANXIETY AND SOCIAL PAIN

threatened needs (NTS) relative to the social inclusion conditions, with medium to large effect sizes across tasks (Cohen's d ranging from 0.65 to 1.13). This scale was originally developed as a measure of fundamental needs (belongingness, self-esteem, control, and meaningful existence) that become threatened in the face of explicit relational devaluation events, such as social exclusion (via Cyberball; Williams et al., 2000). Yet, consistently across all three task contexts, the NTS measure did not differ between conditions with and without explicit relational devaluation. Similarly, the pattern of data across other social pain indicators revealed that for the most part, across most tasks, they did not significantly differ between conditions with and without explicit relational devaluation. Moreover, some indicators of social pain were elevated in conditions *without* (vs. with) explicit relational devaluation, suggesting that personal failures have the capacity, at times, to evoke even greater social pain than overtly relational devaluation events. It is possible that this may happen if real or imagined personal failure is not constrained to a specific relationship, but instead is construed as a more global deficiency of the self that participants imagine as having the potential to exert a meaningful, negative impact on all of their relationships (see Moscovitch, 2009; Rodebaugh, 2009). Accordingly, the coded data from the writing exercises showed that many of the personal adverse events that did not include explicit relational devaluation were reported as having an imagined potential negative impact on the participants' relationships. It should be emphasized here that these negative effects were not described by participants as having actually taken place, but rather described as *potential* downstream consequences. In accordance with the "social barometer" theory of self-esteem, these participants perceived that personal, private failures would likely have negative relational consequences (Eisenberger et al., 2011; Leary et al., 1995).

SOCIAL ANXIETY AND SOCIAL PAIN

Contrary to the general pattern of results, when comparing conditions with (vs. without) explicit relational devaluation, the condition with explicit relational devaluation led to higher scores on the rejection-exclusion measure in two of the three tasks (online games and future projection; both with large effect sizes), and on the hurt feelings measure in one of the three tasks (future projection; a small effect). The rejection-exclusion measure directly implies that a relational event took place, so it may be unsurprising to discover that this measure was often elevated in the adverse event condition in which a relational event was (vs. was not) explicitly primed. It is also important to note that when administered on its own as a two-item measure, it is unclear whether rejection-exclusion is a meaningful indicator of elevated social pain in an emotional sense. The items “I felt rejected” and “I felt excluded” suggest both an appraisal and an emotional response to the situation. Since higher levels of feeling rejected/excluded in the conditions with (vs. without) explicit relational devaluation did not often coincide with significantly higher reported distress across the other affective measures of social pain, such elevations may have simply reflected this measure’s alignment with people’s appraisals of the event (as many were, indeed, coded as having been rejected or excluded). Indeed, similar rejection-exclusion items as those used in this study have been used as a simple manipulation check and not a social pain outcome measure in prior studies (e.g., Chester et al., 2016). Similarly, as noted in Leary et al. (1998), cultural use of the phrase “hurt feelings” in North America is often applied to relational contexts. As such, some participants may have been hesitant to describe feeling “hurt” outside of an explicitly relational context. Notably, however, this effect was small and inconsistent and therefore must be interpreted with caution.

The current study was limited in a variety of ways. First, ethnicity categories were presented as mutually exclusive choices which limited participants from choosing multiple

SOCIAL ANXIETY AND SOCIAL PAIN

concurrent categories that may have represented their ethnic identity. We intend to adjust the way we ask about ethnic identity information in future studies so that participants may “check all that apply.” Another limitation was that we did not employ a standardized manipulation check that evaluated participants’ perceptions of the degree to which each condition reflected an explicit relational devaluation or held potential social consequences. Future research may address this limitation by employing a standardized manipulation check that serves to capture degree of social salience. Our study was also limited by its failure to include a fourth condition that was both non-threatening and non-explicitly relational, such as an “easy anagrams” task. Moreover, though our ad hoc coding system of written responses enabled us to gather information about how participants responded to instructions when recalling past experiences or imagining future ones, our coding procedures were limited in that we used a single coder and thus did not report inter-rater reliability. Furthermore, we cannot assume that participants’ written responses were accurately representative of what they had in fact imagined in response to the writing prompts. With these limitations in mind, the qualitative data showed that participants assigned to the explicit relational devaluation condition clearly recalled or imagined social exchanges, which enhances our confidence that this condition evoked imagined relational devaluation events; in contrast, very few participants in the condition without explicit relational devaluation reported relational devaluation events, suggesting that this prompt was able to provoke distinct recollected or imagined contexts relative to the explicit relational devaluation condition. Finally, our measurement of social pain relied exclusively on self-report measures of subjective experience. Future studies seeking to replicate and extend our findings should combine subjective assessments of social pain with behavioural and physiological markers.

SOCIAL ANXIETY AND SOCIAL PAIN

These limitations notwithstanding, results of the present study have important implications for research on social pain and suggest fruitful directions for future work in this area. First and foremost, as there is no agreed-upon gold standard measure of social pain, future research is clearly needed to determine the most valid and reliable ways of measuring this multifaceted emotional experience. Indeed, it remains relatively unclear how best to measure the multilayered construct of social pain or even what “social pain” consists of or represents as a unique emotional response. Our multi-measure approach in the present study relied on commonly used indicators from prior studies to capture the experience of social pain; however, our results suggest that many of these indicators may capture general psychological distress that becomes elevated when self-esteem and social relationships are threatened. The social pain literature would benefit from research that aims to assess the factor structure of the various components of social pain on independent samples of participants.

To this end, as noted above, it would also be worthwhile to extend the current findings by investigating whether similar effects emerge with neural measures of social pain. To our knowledge, there are no clear data to suggest that brain regions that are activated during the subjective experience of social pain are unique to social pain per se, as these same regions appear to be activated as well in response to broader signals of threat or novelty (Arioli et al., 2018) and in response to processing self-relevant feedback, whether the feedback is painful or positive (Dagleish et al., 2017; Perini et al., 2018). In contrast, some researchers claim to have identified unique neural activation patterns when participants re-live socially painful in comparison to physically painful events (Meyer et al., 2015). Notably, most of the prior research on the neurobiological correlates of social pain has been conducted within experimental contexts in which participants receive explicit relational devaluation feedback (Eisenberger et al., 2011;

SOCIAL ANXIETY AND SOCIAL PAIN

Kawamichi et al., 2018; Perini et al., 2018), so these experimental contexts should be broadened and diversified in future research in line with the approach we took in the current study. It may also be worthwhile for researchers to investigate whether the same types of prosocial or aggressive behaviours that tend to emerge in explicit relational devaluation contexts (e.g., Chester et al., 2014, 2016) also emerge during personal adverse events in which relational devaluation is less explicit. If similar patterns of social pain-related brain activation and behaviour emerge within both contexts, such findings may perhaps be viewed as further evidence that the social pain signal evolved not merely to enable us to detect actual ruptures in discrete interpersonal relationships but rather to alert us to *potential* or imagined ruptures, which may become activated whenever our self-esteem is threatened. Thus, even when relational devaluation is not experienced overtly, social pain may be generated through the mechanism of imagined social consequences, supporting the notion that many of our life experiences, independent or relational, are imbued with social significance.

Study 1 Additional (Unpublished) Analyses: Social Pain and Social Anxiety

Study 1 assessed whether people in general tend to experience cognitive and emotional responses reminiscent of social pain, even in contexts that do not involve explicit relational devaluation. Findings suggested that social pain indicators were similarly elevated in personally distressing tasks, with or without explicit relational devaluation.

Following up on Study 1, additional exploratory analyses were conducted on Study 1 data to examine how levels of trait SA relate to social pain across different types of socially painful contexts. Because HSAs tend to draw especially negative conclusions about interpersonal conflicts or blunders and their consequences (Harb et al., 2002; Moscovitch et al., 2015), it was expected higher levels of SA to predict greater pain within explicit relational devaluation contexts, relative to those without explicit relational devaluation or social inclusion. However, since individuals with higher SA often struggle with low self-esteem associated with generalized, negative impressions of the social self (Moscovitch, 2009), it is also possible they may experience increased levels of social pain in response to various sources of personal adversity, even without an explicit relational rupture. The following supplementary analyses sought to address this exploratory research question.

Trait SA Measure

Trait SA was measured using the Social Phobia Inventory (SPIN; Connor et al., 2000), which includes 17 items that measure SA symptoms over the past week. The SPIN has demonstrated strong reliability and validity in prior research (Antony, Coons, McCabe, Ashbaugh, & Swinson, 2006; Connor et al., 2000). Internal consistency in the current study was $\alpha = .93$. SPIN scores in the sample ranged from 0 to 66 ($M = 25.34$, $SD = 12.97$).

SOCIAL ANXIETY AND SOCIAL PAIN

Data Analysis Plan

Using Hayes PROCESS, outcome measure data were collapsed across task paradigms and the relative effects of condition (personal adversity with explicit relational devaluation, personal adversity without explicit relational devaluation, and social inclusion) were examined on each of the social pain indicators, with trait social anxiety based on continuous SPIN scores entered as the moderator.

A total of six moderation analyses were conducted (one for each social pain indicator) with social inclusion set as the reference group; thus, between-condition comparisons examined how social inclusion differed from each of the personal adversity conditions (with and without explicit relational devaluation). Each model included condition as the predictor variable (X), one of the six social pain indicators as the outcome variable (Y), and trait SA entered as the moderator (M).

Results

Moderation Model 1: Rejection/Exclusion Measure

Participants who experienced personal adversity with explicit relational devaluation, $b = 1.68, p < .001, CI [1.37, 2.0]$, or without explicit relational devaluation, $b = .35, p = .024, CI [.05, .66]$, reported a greater sense of having been rejected/excluded relative to those who experienced social inclusion. Trait SA was associated with a greater sense of having been rejected/excluded, $b = .03, p < .001, CI [.01, .05]$. However, SA did not moderate relations between condition and feelings of rejection/exclusion for social inclusion relative to personal adversity either with explicit relational devaluation, $b = .02, p = .134, CI [-.01, .04]$, or without explicit relational devaluation, $b = -.01, p = .508, CI [-.03, .02]$.

Moderation Model 2: Hurt Feelings Single Item Measure

Participants who experienced personal adversity with explicit relational devaluation, $b = .45, p < .001, CI [.30, .60]$, and without explicit relational devaluation, $b = .39, p < .001, CI [.24, .53]$, reported greater hurt feelings relative to those who experienced social inclusion. Trait SA was associated with stronger hurt feelings, $b = .01, p = .014, CI [.002, .02]$. However, SA did not moderate the difference between those who experienced social inclusion relative to personal adversity either with explicit relational devaluation, $b = .01, p = .062, CI [-.001, .02]$, or without explicit relational devaluation, $b = .004, p = .523, CI [-.01, .01]$.

Moderation Model 3: McGill Pain Questionnaire- Short Form

Participants who experienced personal adversity with explicit relational devaluation, $b = 1.11, p = .026, CI [.14, 2.08]$, and without explicit relational devaluation, $b = 2.07, p < .001, CI [1.11, 3.02]$, reported greater pain relative to those who experienced social inclusion. Trait SA was associated with stronger pain, $b = .07, p = .008, CI [.02, .12]$. However, SA did not moderate

SOCIAL ANXIETY AND SOCIAL PAIN

the difference between those who experienced social inclusion relative to personal adversity either with explicit relational devaluation, $b = .07, p = .067, CI [-.01, .13]$, or without explicit relational devaluation, $b = .06, p = .123, CI [-.02, .13]$.

Moderation Model 4: Needs-Threat Scale

Participants who experienced personal adversity with explicit relational devaluation, $b = 12.13, p < .001, CI [9.76, 14.49]$, and without explicit relational devaluation, $b = 10.34, p < .001, CI [8.03, 12.66]$, reported greater threatened needs relative to those who experienced social inclusion. Trait SA was associated with greater threatened needs, $b = .35, p < .001, CI [.23, .48]$. However, SA did not moderate the difference between those who experienced social inclusion relative to personal adversity either with explicit relational devaluation, $b = .17, p = .068, CI [-.01, .35]$, or without explicit relational devaluation, $b = -.07, p = .455, CI [-.25, .11]$.

Moderation Model 5: Positive and Negative Affect Scale - Negative Affect Subscale

Participants who experienced personal adversity with explicit relational devaluation, $b = 2.46, p < .001, CI [1.20, 3.73]$, and without explicit relational devaluation, $b = 5.08, p < .001, CI [3.84, 6.32]$, reported greater negative affect relative to those who experienced a form of social inclusion. Trait SA moderated the difference between those who experienced social inclusion vs. those who experienced personal adversity with explicit relational devaluation, $b = .10, p = .044, CI [.003, .198]$, but trait SA did not moderate the difference between social inclusion and personal adversity without explicit relational devaluation, $b = .02, p = .622, CI [-.07, .12]$.

To follow up on this significant interaction effect, differences were examined between the inclusion and explicit relational devaluation conditions at high, average, and low levels of SA. Results revealed that among low SA participants, those who experienced personal adversity without explicit relational devaluation reported higher levels of negative affect than those who

SOCIAL ANXIETY AND SOCIAL PAIN

were assigned to the social inclusion condition, $b = 4.78, p < .001, CI [3.05, 6.52]$, but those who experienced personal adversity with explicit relational devaluation did not differ from those assigned to inclusion, $b = 1.23, p = .152, CI [-.45, 2.91]$. Conversely, those with average levels of SA reported higher levels of negative affect if they experienced personal adversity either with explicit relational devaluation, $b = 2.33, p < .001, CI [1.07, 3.59]$, or without explicit relational devaluation, $b = 5.05, p < .001, CI [3.80, 6.30]$, compared to social inclusion. Similarly, those with high levels of SA reported higher levels of negative affect if they experienced personal adversity either with explicit relational devaluation, $b = 3.84, p < .001, CI [1.94, 5.73]$, or without explicit relational devaluation, $b = 5.41, p < .001, CI [3.64, 7.18]$ compared to social inclusion.

Moderation Model 6: State and Trait Inventory of Cognitive and Somatic Anxiety- State Subscale

Relative to those who experienced social inclusion, state anxiety was greater among participants who experienced personal adversity without explicit relational devaluation, $b = 3.58, p < .001, CI [1.98, 5.18]$, but not among those who experienced personal adversity with explicit relational devaluation, $b = 1.48, p = .075, CI [-.15, 3.12]$. Trait SA was associated with greater state anxiety, $b = .26, p < .001, CI [.17, .34]$, but SA did not moderate the difference between those who experienced social inclusion relative to personal adversity with explicit relational devaluation, $b = .02, p = .711, CI [-.10, .15]$, or without explicit relational devaluation, $b = -.04, p = .497, CI [-.17, .08]$.

Discussion

Results demonstrated a robust relationship between SA and social pain: Higher levels of SA predicted greater social pain across each of the six indicators, regardless of context, suggesting that those with high SA are sensitive to a range of socially painful contexts, including those that involve unpleasant personal failures, mistakes, or unfortunate events that do not involve explicit relational devaluation.

Only one moderation model revealed an interaction between trait SA and condition. SA significantly moderated the effects of condition on negative affect, demonstrating that all forms of personal adversity were more painful than social inclusion for those with higher SA. Conversely, only personal adversity without relational devaluation evoked more negative affect than social inclusion for participants at moderate or low levels of SA. A similar pattern of effects approached significance for the NTS and hurt feelings measures, though the interaction effects for these measures failed to reach the threshold for statistical significance. These data suggest that experiencing, recalling, or imagining relational devaluation was often relatively benign for low SAs, whereas for HSAs, personal adversity both with and without relational devaluation evoked greater distress relative to social inclusion.

Collectively, these findings from additional (unpublished) Study 1 analyses suggest HSAs are more likely to experience social pain across a multitude of contexts, even beyond those that involve explicit social ruptures. Because HSAs are already more inclined to believe they hold low social value, any event that further detracts from their social currency—even if it does not involve a direct relational rupture—may be perceived or imagined as being potentially catastrophic for their current and future potential relationships.

SOCIAL ANXIETY AND SOCIAL PAIN

These results also suggest that HSAs overestimate threats even within social inclusion activities, where no overt threats to belongingness exist. In accordance with these findings, [Park et al. \(2017\)](#) discovered that individuals with a history of relational victimization felt greater distress and threatened needs in response to social contexts that included overt signs of social inclusion. Park et al. (2017) suggested that these individuals may carry generalized, distorted beliefs about their social self which—when activated within socially evaluative contexts—cause them to misinterpret or fail to recognize socially rewarding information that would indicate social acceptance by their peers. Although Park et al. (2017) did not measure levels of trait SA within their peer-victimized participants, their interpretation is consistent with prevailing cognitive models of SAD and applicable to the present study's findings (e.g., [Clark & Wells, 1995](#); [Hofmann, 2007](#); [Moscovitch, 2009](#)).

Thus, broad-based threat interpretation biases may serve to amplify HSAs' social pain sensitivity and disrupt their recognition of reward cues. This process could also impact the likelihood that social pain will promote downstream affiliative repair for HSAs: To the extent that rewarding information propels individuals to cope with their social pain by increasing their affiliative motivation and behaviours, we may expect those with low but not high SA to respond to a subsequent social opportunity with greater affiliative drive that is accompanied by heightened positive affect. Study 2 aimed to investigate this possibility within the context of an experimental design using the standardized Cyberball exclusion and inclusion conditions deployed in Study 1.

Study Two

Coping with Social Wounds: How Social Pain and Social Anxiety Influence Access to Social Rewards⁶

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Abstract

Background and Objectives: Prior studies have shown that people display signs of increased social approach motivation and affiliative behaviour in response to social exclusion. This response is considered an adaptive strategy that serves to repair damage to social networks and increase access to mood-enhancing social rewards. However, heightened trait social anxiety (SA) has been linked to decreased approach motivation and responsiveness to social rewards. In the current preliminary experimental study, we tested whether trait SA inhibits the expected increase in social approach following the pain of exclusion. We then tested whether diminished social approach is associated with reduced positive affect.

Methods: Participants played a game of Cyberball and were randomly assigned to receive significantly fewer passes (exclusion condition) or an equal number of passes (control condition) as other players. Subsequently, participants were given the opportunity to engage in an online social interaction activity with avatars they believed were other participants.

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SOCIAL ANXIETY AND SOCIAL PAIN

Results: Analyses revealed that the exclusion condition led to greater social pain than the control condition. Across conditions, greater social pain was associated with higher levels of approach motivation in anticipation of the social interaction activity, but only for individuals with lower levels of trait SA. Finally, when controlling for levels of trait SA, social pain was associated with positive affect following the social interaction activity, but only for individuals with higher levels of approach motivation.

Limitations: Participants consisted predominantly of female undergraduates, limiting generalizability of these data. As well, hypotheses were supported for the measure of approach motivation but not the measure of approach behaviour. Finally, this study was not powered to enable moderated mediation analyses, which would have provided the most direct test of the hypothesized model.

Conclusions: Heightened approach motivation in the face of social pain may facilitate increased positive affect. However, higher levels of trait SA dampen approach motivation. Future well-powered studies should use moderated mediation analyses to test the hypothesized model more parsimoniously.

Introduction

Social rejection and exclusion are, unfortunately, a part of life. These experiences are emotionally painful and deny people access to valuable social resources and rewards that are essential to human survival and reproduction (Baumeister & Leary, 1995; Brewer, 2004). Individuals who face frequent threats to their social belongingness experience heightened distress and greater risk of mortality (Beller & Wagner, 2018), whereas social support buffers the negative impact of daily stressors on physical health (DeLongis et al., 1988). Social experiences have the capacity to elicit powerful emotional responses (Baumeister & Tice, 1990; Jaremka et al., 2011). In the face of rejection, exclusion, or ostracism, people tend to respond with “hurt feelings,” a type of emotional distress that is akin to social pain. Early research investigating the phenomenology of hurt feelings described the source of this pain as stemming from perceived “relational devaluation,” or experiencing a loss of perceived value within a relationship (Leary et al., 1998), which has been shown to have a lasting impact. Indeed, when people recall socially painful events they tend to re-experience the negative emotions and hurt feelings they felt initially, even if such events occurred decades prior; in contrast, people can also vividly recall distant experiences of physical pain, but such pain tends not to be re-experienced at the time of recall (Chen et al., 2008).

Importantly, emotional pain shares significant neurological overlap with physical pain, suggesting the two types of pain responses may also overlap in their purpose and adaptive functions (Eisenberger, 2012). Numerous studies have shown that similar activation patterns in the dorsolateral anterior cingulate cortex (dACC) and anterior insula (AI) take place during experimental manipulations used to either elicit or attenuate physical and social pain (e.g., Eisenberger, Lieberman, & Williams, 2003; Eisenberger, Jarcho, Lieberman, & Naliboff, 2006;

SOCIAL ANXIETY AND SOCIAL PAIN

Master et al., 2009). Social pain can therefore be understood as serving an adaptive purpose similar to that of physical pain, by signaling that a threatening or damaging event has taken place (MacDonald & Leary, 2005). Much like physical pain encourages us to engage in wound-mending to reduce further harm, social pain may serve a similar function by encouraging us to repair damage to our social networks. To this end, researchers have investigated whether social pain serves a regulating function by promoting mending behaviours, otherwise described as social approach, prosocial, or socially affiliative behaviours.

Studies have shown that healthy participants who are primed to feel rejected or excluded, in comparison to those who are included, demonstrate increased attention to signs of social acceptance (i.e., smiling faces; DeWall, Maner, & Rouby, 2009), elevated desire to increase proximity to others (Chester et al., 2016), enhanced desire to work with and engage pro-socially with others (Maner et al., 2007), and increased goal-oriented behaviours that draw themselves closer to others, even when doing so requires personal sacrifices (Mead et al., 2011). Increases in people's affiliative behaviour in the aftermath of social pain have been observed both toward those who reject them and toward novel others (Balliet & Ferris, 2013; Romero-Canyas et al., 2010).

Theorists propose that these affiliative tendencies serve an ultimate goal, which is to maintain a thriving social network. In this sense, social approach or affiliation are proximal behaviours that collectively build towards the ultimate goal. As described in Tamir and Hughes (2018), people are motivated to engage in such proximal social behaviours not because they lead to an adaptive goal, but because they are immediately rewarding. Presumably, then, social approach following social pain should yield proximal value for the rejected individual, though researchers have not explicitly studied the nature and dynamics of such rewards in relation to

SOCIAL ANXIETY AND SOCIAL PAIN

approach motivation and behaviours. Research from the motivational systems literature supports the possibility that the motivation to approach others, in and of itself, may be rewarding, such that greater approach motivation within social contexts could lead directly to heightened emotional rewards.

McNaughton and Gray's Reinforcement Sensitivity Theory (2000) suggests that human motivations are guided by three primary systems: the Behavioural Inhibition System (BIS), the Behavioural Activation System (BAS), and the Fight, Flight or Freeze System (FFFS). The BAS is activated when a person is in a state of goal pursuit and is associated with attention to reward stimuli, whereas the other motivational systems are activated in response to perceived threat (FFS) and the presence of novelty or simultaneously rewarding and threatening stimuli (BIS) (McNaughton & Gray, 2000). When individuals are in an approach-oriented frame of mind, they are more attuned to potential rewards, including social rewards such as perceived liking (Anderson & Berdahl, 2002) or sexual interest from an interaction partner (Kunstman & Maner, 2011). These approach or goal-oriented systems are activated when perceived threats are low and reward potential is high (see Keltner, Gruenfeld, & Anderson, 2003). Under such conditions, individuals are likely to display heightened positive affect (Bombari et al., 2016) and become more optimistic and more willing to engage in risky behaviour (Anderson & Galinsky, 2006). Thus, after social exclusion, people would be expected to demonstrate a heightened approach response when there is an opportunity for follow-up social interaction that is perceived to carry reward potential (DeWall & Richman, 2011; Maner et al., 2007). To the extent that being excluded thwarts certain fundamental social needs, such as a need to belong (Chester et al., 2016), individuals would be expected to become motivated to replenish these needs and engage in goal-directed behaviours to increase social belongingness. Although numerous studies have

SOCIAL ANXIETY AND SOCIAL PAIN

demonstrated a pattern of heightened social affiliation in the face of social pain, at least one study has failed to replicate this effect (Sunami et al., 2018), warranting further investigation into the contexts or conditions in which such effects may be more or less likely to emerge.

In this vein, Maner et al. (2007) observed that individuals who are fearful of receiving negative evaluation from others—a characteristic feature of high trait SA (Moscovitch, 2009)—do not display increased social approach tendencies in response to social distress. Similar results emerged even when controlling for low mood symptoms (Mallott et al., 2009). These findings reflect the notion that those with HSA may remain attuned to threat potential, leading to activation of the BIS and a ‘watch, wait, and see’ approach, rather than the typical social approach responses that are aligned with activation of the BAS (Keltner et al., 2003; McNaughton & Gray, 2000). Other trait constructs that are associated with heightened awareness of interpersonal threat signals might be expected to reveal similar effects. For example, rejection sensitivity is a construct that has been closely linked to SA (Harb et al., 2002). SA and rejection sensitivity capture individuals’ concerns with social belongingness alongside doubts that they will attain belongingness, suggesting both may result in heightened attention to threat and BIS activation in the face of rejection.

High trait SA individuals’ oversensitivity to perceived threat has been documented in a number of studies (Steinman et al., 2014). For example, people with high trait SA tend to overestimate others’ expected standards of them (Bielak & Moscovitch, 2013) and assume that not meeting those standards would be costly (Moscovitch, Rodebaugh, & Hesch, 2012). Moreover, research has demonstrated that high trait SA is not only characterized by the tendency to perceive greater threat within social contexts but also to experience diminished responsiveness to reward stimuli. Specifically, fMRI studies have shown that relative to controls, those with

SOCIAL ANXIETY AND SOCIAL PAIN

higher levels of SA show reduced activation in neural reward structures (Manning et al., 2015) as well as lower neural reward responsiveness to anticipation of social rewards than in anticipation of social punishment (Cremers et al., 2015) or monetary rewards (Richey et al., 2014). Even under circumstances where there is high reward and limited threat potential, socially anxious individuals do not appear to shift their goal-orientation toward an approach mindset (Maner, Gailliot, Menzel, & Kunstman, 2012). Indeed, Maner et al. (2012) showed that when placed in a position of power, those with lower levels of SA displayed signs of approach-system activation and attention to reward potential (i.e., heightened perceived sexual interest from a confederate), whereas those with higher levels of SA did not. Furthermore, deficits in positive affect have been cited as an exclusive feature of social anxiety disorder compared to other anxiety disorders, over and above the effects of comorbid depressive symptoms (Brown et al., 1998; Kashdan, 2007).

Although it is not yet clear whether the relationship between SA and diminished responsiveness to reward stimuli results from an underactive approach-motivation system, an overactive attention to threatening stimuli, or a combination of the two (Kashdan, 2007), SA researchers are beginning to appreciate the consequences that impoverished reward experiences might have for symptom maintenance. Indeed, Fung and Alden (2016) found that the emotional outcomes of socially painful situations may be transmitted to subsequent interactions, especially for those high in SA. In two separate studies, they reported that the experience of greater social pain mediated the relation between a negative social experience and increased state SA in anticipation of a future social interaction, and that alleviating social pain mitigated its effects on anticipatory SA (Fung & Alden, 2016). Although this study measured the emotional impact of social pain on downstream negative emotions states (i.e., anxiety in anticipation of a future social interaction), researchers have yet to examine whether—post-exclusion—seeking out social

SOCIAL ANXIETY AND SOCIAL PAIN

activity and behaving pro-socially in a follow-up social interaction can promote downstream positive emotion states.

Current Study

We recruited participants across the trait SA spectrum to undergo a novel laboratory-based paradigm. Half of the participants were randomly assigned to experience social exclusion (exclusion condition) while the other half were included (control condition). We then measured participants' social pain, their subsequent approach motivation and behaviour in anticipation of a social task, and finally, their degree of positive affect. Our overarching goals were: (a) to replicate prior studies demonstrating that exclusion during a game of Cyberball generates social pain; (b) to extend past findings (e.g., Mallott et al., 2009; Maner et al., 2007) that suggest high trait SA inhibits social pain-related affiliation; and (c) to investigate whether increased social pain-related affiliation has positive downstream emotional effects. We hypothesized, first, that participants assigned to the exclusion condition would report greater social pain than those assigned to the control condition. Second, we hypothesized that, across conditions, only participants with lower levels of trait SA would show heightened social pain-related affiliation. Third, we hypothesized that only individuals who respond to pain with increased affiliation would report higher levels of positive affect following an opportunity for social engagement. We examined hypothesis 3 both with and without controlling for levels of SA, as research has shown that trait SA is negatively correlated with positive affect (e.g., Kashdan, 2007) and we wished to isolate the effects of affiliation per se as a potential moderator of the relationship between social pain and downstream positive affect without the additional noise that may be introduced if SA was allowed to vary freely. Thus, we hypothesized that with SA held constant, only those who

SOCIAL ANXIETY AND SOCIAL PAIN

respond to social pain with greater social approach will experience more positive affect after the follow-up social engagement activity.

Methods

Participants

Undergraduate students were invited to complete a number of tasks and questionnaires in a research laboratory under the guided instructions of a member of the research team. The study received ethical clearance from the Office of Research Ethics (ORE) at the University of Waterloo (ORE #31403). A statistical power analysis was performed to estimate sample size using Gpower software (Faul et al., 2009). Prior studies examining the interaction between social anxiety and rejection on social approach have reported medium-sized effects (Mallott et al., 2009; Maner et al., 2007). Thus, we deemed it appropriate to conduct an a-priori power analysis to determine the sample size required for a medium-sized effect in our planned regression analysis that involved the most predictors (i.e., hypothesis 3). To detect this effect with $\alpha = .05$ and power = 0.80, the projected sample size needed was $N = 68$. Thus, a total of $N = 71$ participants were recruited. As the study involved deception, one participant was excluded from analyses because of a high degree of skepticism in the study cover story during the debriefing and re-consent process, resulting in a sample size of $N = 70$. An additional outlier was removed (see Supplemental Materials), leaving a final sample of 69 participants consisting of 73.9% females and 26.1% males, with a mean age of 18.8 years. Thirty-six percent of the sample identified as Caucasian, 23% as East Asian, 22% as South Asian, 7% as Black/African, 2.9% as Southeast Asian, 2.9% as Middle Eastern, and 1.4% as West Indian/Caribbean, with 3.4% declining to answer.

Study Procedures and Deception

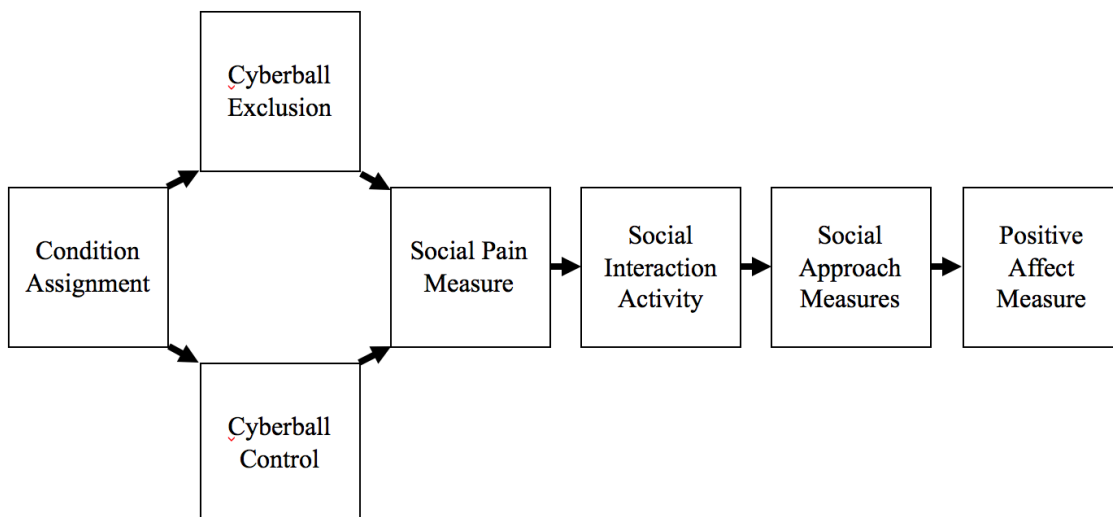
The title of the advertised study was “Building Partnerships in the Online World.” Upon arriving at the laboratory individually, participants were told that they would complete a number

SOCIAL ANXIETY AND SOCIAL PAIN

of activities online with other students from surrounding universities, when in fact they were the only participant involved. All supposed interactions with others were actually with pre-programmed avatars. Each participant was randomly assigned to play a game of Cyberball in either the exclusion or control condition (see details below). Next, they completed a measure of social pain. As outlined below, the experimenter then described the next online activity, which was a social media interaction activity. Immediately following this activity, participants completed the social approach items pertaining to the social media interaction activity and, following this, a measure of state positive affect. Finally, participants completed the trait SA measure. Upon completion, the researcher debriefed participants, informed them of the true nature of the study, and assessed whether the deception was successful. See Figure 1 for a visual representation of study procedures.

Figure 1.

Visual Representation of Study Flow and Procedures



SOCIAL ANXIETY AND SOCIAL PAIN

Social Exclusion and Control Conditions

Cyberball is an online game of catch that is frequently and effectively used in ostracism research to elicit social pain by making participants feel socially excluded (Hartgerink et al., 2015). In the present study, participants were randomly assigned to be either excluded or included by receiving an equal or far fewer number of throws relative to other “players”. Researchers were blind to participants’ condition assignment throughout study participation.

Social Interaction Activity

After responding to the state affect measures, participants anticipated engaging in a social media interaction activity. This activity was designed to provide a social context within which participants could perceive social reward potential and have an opportunity to actualize any social approach motivations. Drawing upon a paradigm originally used by Wolf et al. (2015), we deceived study participants to believe that they would be interacting in an online space with other participants whose profiles they could see (in reality, these were preprogrammed avatars). They were instructed to write their own personal profile and were then exposed to the profiles of 10 other avatars, which were described as university students with diverse backgrounds, hobbies, and interests. We informed participants that in the first part of the task, they were to read and click “like” on as many profiles as they wished. Participants were told that the more profiles they liked, the greater the chance was that they were going to be paired with one of the other participants to complete a subsequent social task.

Measures of Social Approach

We measured both behavioural approach and approach motivation. Behavioural approach was measured by the number of “likes” participants clicked on other avatars’ profiles. Approach motivation was measured immediately after the social interaction task by collecting participants’

SOCIAL ANXIETY AND SOCIAL PAIN

ratings of the degree to which they wanted to work with a partner for a subsequent social task on a 5-point Likert scale ranging from “definitely yes” to “definitely no.”

Measures of Affect

Social Pain. Researchers tend to use a wide variety of social pain measures within the extant literature (e.g., Auyeung & Alden, 2016; Chester et al., 2016; Gerber, Chang, & Reimel, 2017; Nordgren, Banas, & MacDonald, 2011; Zadro, Williams, & Richardson, 2004), none of which have been well-validated as a distinct measure of social pain. In the present study we conceived of social pain as an emotion state comprised of both general negative mood and a specific sense of having been rejected. As such, our measure of social pain combined a well-established questionnaire assessing state negative affect, the *Positive and Negative Affect Schedule* (PANAS; Watson et al., 1988), with two specific items we developed based on previous studies to assess hurt feelings (Fung & Alden, 2016; Park et al., 2017). Others have used a similar approach in prior research examining social pain (e.g., Vangelisti et al., 2014). Specifically, in addition to the PANAS, participants rated on a 5-point Likert Scale the degree to which they agreed with the following items pertaining to their game of Cyberball: “I am bothered by how the activity went” and “I feel bad because I was excluded by others.” Scores on these items were summed with participants’ total scores on the negative affect subscale of the PANAS, which consisted of 10 emotion adjectives rated on a 5-point Likert scale, such as “ashamed,” “distressed,” and “upset,” with instructions directing participants to respond according to how they are feeling “right now” immediately after they completed their game of Cyberball. This composite social pain measure was administered immediately after Cyberball and demonstrated adequate reliability ($\alpha = .74$).

SOCIAL ANXIETY AND SOCIAL PAIN

Positive Affect. Participants also completed the state positive affect subscale of the *Positive and Negative Affect Schedule* (PANAS; Watson et al., 1988), consisting of 10 emotion adjectives rated on a 5-point Likert scale, such as “interested,” “excited,” and “enthusiastic.” The positive affect subscale, which was administered after the social media interaction activity and social approach measures, demonstrated excellent reliability ($\alpha = .90$) in the present study.

Trait Measures

Social Phobia Inventory (SPIN). The Social Phobia Inventory (SPIN; Connor et al., 2000), which served as our measure of trait SA, includes 17 items that measure SA symptoms over the past week. The SPIN demonstrated strong internal consistency in the current study ($\alpha = .93$) and has demonstrated strong reliability and validity in prior research (Antony, Coons, McCabe, Ashbaugh, & Swinson, 2006; Connor et al., 2000).

Data Analysis Strategy

Data were analyzed with the Hayes PROCESS macro developed for SPSS (Hayes, 2013). Each hypothesis was tested with the basic moderation model, which is identical to hierarchical regression. Hypotheses that examined social approach (hypotheses 1 and 2) were run twice—once with the behavioural approach measure, and once with the approach motivation measure. Hayes PROCESS examines both the direct effects and R^2 change values for interaction effects, in addition to providing bias corrected bootstrap confidence intervals based on 5000 bootstrap samples. Continuous predictor variables were centered for the analyses. Significant interaction effects were followed up by probing for simple effects at 1 *SD* at, above, and below the mean of the moderator variable, and by conducting Johnson-Neyman regions of significance analyses.

Results

Integrity of Conditions

There were no significant differences between participants assigned to the exclusion and control conditions in age, $t(67) = 1.18, p = .242$, gender distribution $X^2(3) = 3.89, p = .273$, ethnicity $X^2(7) = 7.68, p = .361$, or trait SA levels, $t(67) = -.90, p = .374$. See Table 7 for descriptive statistics. Correlations between measured variables within and between conditions are presented in Table S4 in the Supplementary Materials.

Table 7.

Descriptive Statistics for the Overall Sample and Each Condition Separately

	Overall ($n = 69$)	Exclusion Condition ($n = 36$)	Control Condition ($n = 33$)
Age	18.80 (1.29)	19.0 (1.34)	18.6 (1.22)
Gender (% Female)	73.90	83.30	63.60
Ethnicity (% Caucasian)	36.20	27.80	45.50
SPIN [M (SD)]	22.17 (14.85)	20.64 (13.22)	23.85 (16.49)
Social Pain [M (SD)]	15.37 (3.83)	17.00 (4.17)	13.61 (2.45)
Positive Affect [M (SD)]	26.94 (8.62)	28.33 (9.76)	25.42 (7.01)
Approach Behaviour [M (SD)]	4.28 (1.06)	4.56 (1.13)	3.97 (0.88)
Approach Motivation [M (SD)]	4.28 (0.91)	4.31 (0.92)	4.24 (.90)

Missing Data, Data Distribution and Outliers

There were no missing data points in the study measures. Data were normally distributed, with all measures demonstrated skewness and kurtosis values < 3 (Kline, 1998). Data were

SOCIAL ANXIETY AND SOCIAL PAIN

visually inspected with histograms to identify outliers. One participant was removed from analysis, as their scores were more than 3 *SDs* outside the grand mean, resulting in a final sample of $N = 69$ for hypothesis testing.

Exclusion Manipulation Check

Compared to those in the control condition, participants in the exclusion condition reported more agreement with the statement that the ball was thrown to them less frequently than other players, $t(67) = 17.422, p < .001, 95\% \text{ CI } [2.69, 3.39]$, and less agreement with the statement that the ball was thrown to them as frequently as the other players, $t(67) = -17.957, p < .001, 95\% \text{ CI } [-3.38, -2.71]$, suggesting the manipulation was effective and participants were aware of whether or not they were being excluded in both conditions.

Hypothesis 1. Does condition predict variability in social pain?

Linear regression analyses were conducted with the dichotomous condition variable entered as the predictor variable and the continuous measure of social pain entered as the outcome variable. Results demonstrated that condition led to significantly greater social pain in the exclusion condition compared to the control condition, $R^2 = .20, F(1, 67) = 16.61, p < .001$.

Hypothesis 2. Does trait SA interact with social pain to predict social approach?

Behavioural Approach Measure. Results illustrated that social pain, SA, and their interaction term did not collectively predict significant variability in participants' social approach behaviour, $R^2 = .09, F(3, 65) = 2.25, p = .091$.

Motivational Approach Measure. Unlike above, social pain, SA, and their interaction term predicted significant variability in participants' social approach motivation, $R^2 = .16, F(3, 65) = 4.21, p = .008$. A marginally significant direct effect emerged between SA and social approach motivation, $b = -.01, SE = .01, p = .053, 95\% \text{ CI } [-.03, .00]$, but there was no significant

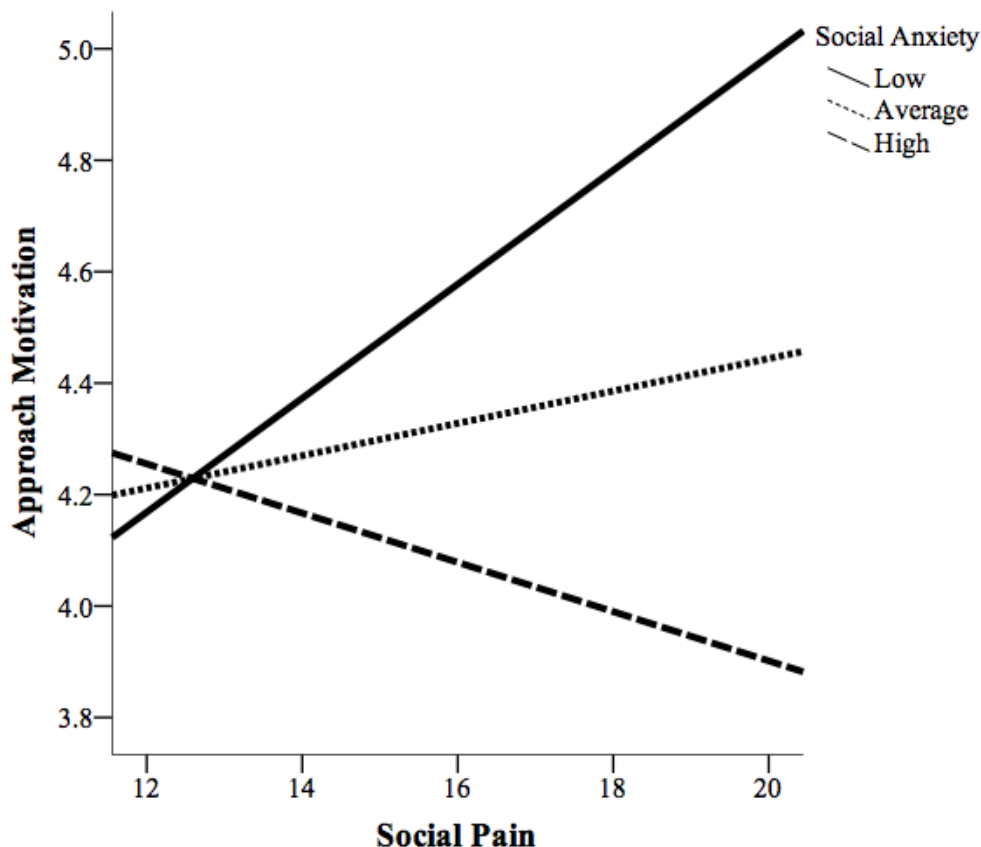
SOCIAL ANXIETY AND SOCIAL PAIN

direct effect between social pain and social approach motivation, $b = .03$, $SE = .03$, $p = .292$, 95% CI [-.03, .08]. The interaction between SA and social pain was significant, $\Delta R^2 = .09$, $F(1, 65) = 6.89$, $p = .011$, 95% CI [-.01, -.001]. Simple slopes follow-up tests revealed that social pain was associated with greater social approach motivation for those with low SA, $b = .10$, $SE = .04$, $p = .006$, 95% CI [.03, .17], but not those with average levels of SA, $b = .03$, $SE = .03$, $p = .292$, 95% CI [-.03, .08], or high levels of SA, $b = -.04$, $SE = .04$, $p = .296$, 95% CI [-.13, .04]. This interaction is illustrated in Figure 2.

The interaction effect was further probed by conducting a Johnson-Neyman significance test within PROCESS to determine the severity of SA symptoms at which social pain was not associated with increased approach motivation. Results indicated that those with a raw score of 18 or higher on the trait SA measure (SPIN; Connor et al., 2000) did not respond to their social pain with greater desire to approach. Connor et al. (2000) found that raw SPIN scores of 19 and above represent clinically significant levels of SA.

Figure 2.

Relationship Between Social Pain and Approach Motivation at Low, Average, and High Levels of Social Anxiety



Hypothesis 3. Within the context of an opportunity for social engagement, does social pain interact with social approach to predict positive affect when trait SA levels are held constant?

Behavioural Approach Measure. Results illustrated that when controlling for trait SA, social pain, behavioural approach, and the pain x approach interaction term collectively predicted significant variability in participants' positive affect after they were given an opportunity for social interaction, $R^2 = .16$, $F(4, 64) = 3.14$, $p = .020$. A significant direct effect was observed between social pain and positive affect, $b = .75$, $SE = .28$, $p = .009$, 95% CI [.20, 1.31]. However, no other direct or interaction effects were observed, (all p 's > .315).

SOCIAL ANXIETY AND SOCIAL PAIN

Motivational Approach Measure. Again, when SA was held constant, social pain, social approach motivation, and their interaction term collectively predicted significant variability in participants' positive affect after they were given an opportunity for social interaction, $R^2 = .35$, $F(4, 64) = 8.44$, $p < .001$. Direct effects were observed between social pain and positive affect, $b = .57$, $SE = .24$, $p = .022$, 95% CI [.09, 1.05], and between social approach motivation and positive affect, $b = 4.23$, $SE = 1.02$, $p < .001$, 95% CI [2.18, 6.27]. Trait SA did not share a significant direct effect with positive affect, $b = .11$, $SE = .07$, $p = .092$, 95% CI [-.02, .24]. Finally, when controlling for SA, a significant interaction emerged between social pain and social approach motivation, $\Delta R^2 = .06$, $F(1, 64) = 5.62$, $p = .021$, 95% CI [.10, 1.17]. As shown in Figure 3, simple slopes follow-up tests revealed that when social approach motivation was low, social pain was not associated with positive affect following the social interaction activity, $b = -.24$, $SE = .47$, $p = .602$, 95% CI [-1.18, .69]. However, social pain significantly predicted positive affect when levels of approach motivation were average, $b = .56$, $SE = .24$, $p = .022$, 95% CI [.08, 1.05], or high, $b = 1.02$, $SE = .27$, $p < .001$, 95% CI [.49, 1.56].

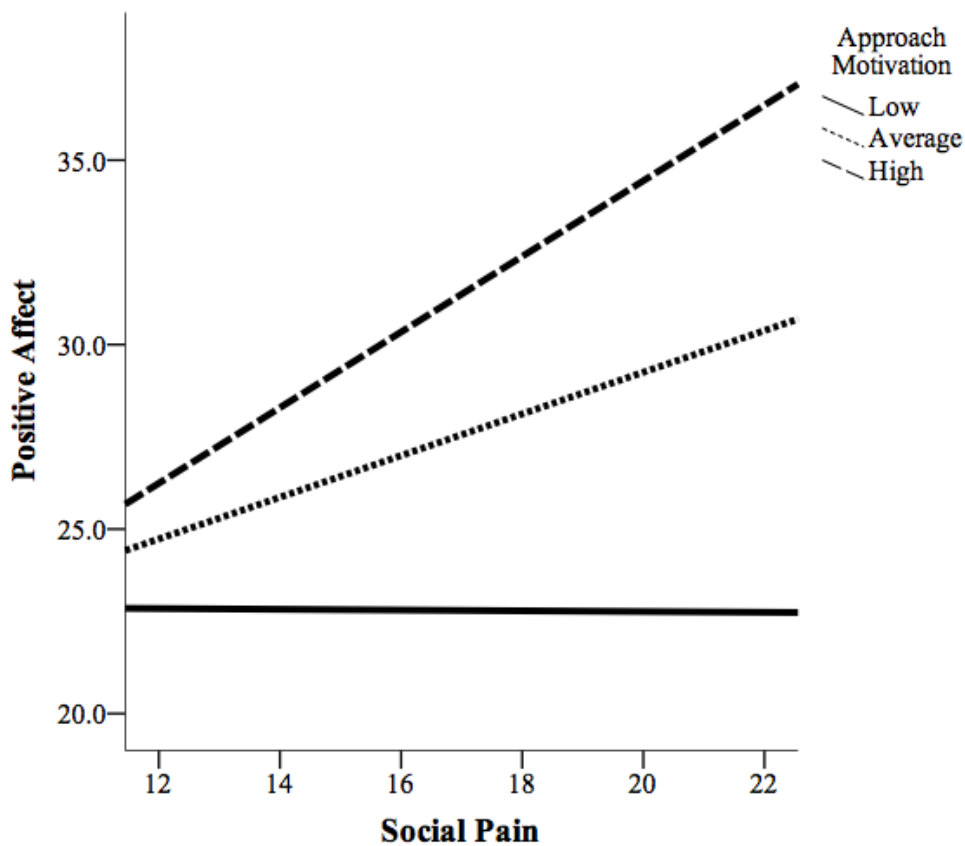
When analyses using the approach motivation measure were repeated without SA as a covariate, results suggested a similar pattern of results but with a marginally non-significant interaction term. Social pain, social approach motivation, and their interaction term collectively predicted significant variability in participants' positive affect, $R^2 = .37$, $F(3, 65) = 9.99$, $p < .001$. Direct effects emerged between social pain and positive affect, $b = .67$, $SE = .24$, $p = .007$, 95% CI [.19, 1.14], and between social approach motivation and positive affect, $b = 3.71$, $SE = .99$, $p < .001$, 95% CI [1.73, 5.70]. Finally, the interaction between social pain and social approach motivation neared significance, $\Delta R^2 = .04$, $F(1, 65) = 3.38$, $p = .07$, 95% CI [-.04, .97]. Simple slopes follow-up tests illustrated that when social approach motivation was low, social

SOCIAL ANXIETY AND SOCIAL PAIN

pain was not associated with positive affect, $b = .07$, $SE = .43$, $p = .602$, 95% CI [-.80, .94], but social pain significantly predicted positive affect when approach motivation was average, $b = 1.0$, $SE = .27$, $p = .022$, 95% CI [.46, 1.54], or high, $b = 1.0$, $SE = .27$, $p < .001$, 95% CI [.46, 1.54].

Figure 3.

Relationship Between Social Pain and Positive Affect at Low, Average, and High Levels of Social Approach Motivation, Controlling for Levels of Trait Social Anxiety



Discussion

Researchers have theorized that the pain of social exclusion motivates individuals to respond in adaptive ways that serve to mitigate its negative effects (Brewer, 2004; Eisenberger, 2012; MacDonald & Leary, 2005). One such response is social approach or social affiliation, which has been understood as an adaptive effort to repair damage to an individual's social network. However, previous research suggested that socially anxious individuals may be less likely to display an increase in approach following a socially painful experience (Mallott et al., 2009; Maner et al., 2007).

Using a novel paradigm, results of the current preliminary study indicated, first, that experimentally induced rejection led to greater social pain than being included, as expected. Second, results demonstrated that greater pain was associated with heightened approach motivation, but only for those with low trait SA and not for individuals with average or high trait SA. However, the same interaction effect was not observed when the approach variable of interest was the behavioural measure of approach (i.e., the number of "likes" participants gave to others during the social media interaction activity). Results from this study also demonstrated, in support of hypothesis 3, that after controlling for trait SA, those who responded to their social pain with greater approach motivation reported higher positive affect following the social media interaction task. Once more, this interaction effect was not significant when the moderator variable was the behavioural measure of approach (number of "likes"). It is possible that the behavioural measure demonstrated a weaker effect across both types of tests because participants were implicitly tethered by how many "likes" others were giving and receiving; in other words, participants may have felt motivated to mirror others' "liking" behaviour irrespective of how motivated they felt to engage, thereby limiting response variability. Indeed, social exclusion has

SOCIAL ANXIETY AND SOCIAL PAIN

also been associated with an increased likelihood of conforming with others (Wasylyshyn et al., 2018).

Taken together, these findings indicate that when exposed to social reward potential, those with lower levels of trait SA responded to their social pain with a stronger desire to socially affiliate. Seeking affiliation, in turn, related to increased positive affect, suggesting there is immediate value to adopting an approach-orientation mindset in the face of social pain— a mindset which appears to help facilitate positive affect in the face of hurt feelings. Thus, those with higher levels of trait SA might fail to move forward from feeling hurt to capitalizing on social approach opportunities and their reward potential (Kashdan et al., 2013).

Research suggests that positive affect leads to more positive interpersonal exchanges, which, in turn, produces more rewarding experiences and positive emotion (Fredrickson, 1998; Keltner & Haidt, 1999). Thus, experiencing positive emotions can lead to a greater desire for social interaction (Whelan & Zelenski, 2012) that may further strengthen one's social relationships.

Because those with high trait SA displayed deficiencies in their approach motivation in response to social pain, they may be less likely to experience mood improvement, which could potentially impede access to the social networking benefits that stem from positive emotional experiences, thus generating a negative feedback loop. Although we did not measure reward perception, it is plausible that higher trait SA was associated with lower perceptions of reward potential in the follow-up social activity. Indeed, studies have linked higher levels of SA with diminished neural and behavioural activation when experiencing or anticipating social rewards (Cremers et al., 2015; Maner et al., 2007; Manning et al., 2015; Richey et al., 2014).

Future research might add to these findings by measuring reward perception and determining whether this factor mediates the relationship between social pain and social

SOCIAL ANXIETY AND SOCIAL PAIN

approach, and whether the effects of reward perception are moderated by levels of trait SA. Moreover, to the extent that results may be generalizable to clinical samples of individuals with social anxiety disorder, applied clinical research might also benefit from investigating ways to re-focus socially anxious individuals on proximal social rewards that serve to motivate them toward broader social goals (Tamir & Hughes, 2018); for instance, by drawing their focus toward basic building blocks that hold immediate value such as a smile from an interaction partner, which could build an intrinsic desire to heighten social approach in a variety of contexts. For example, in the present study, this could involve drawing the individual's attention toward common interests or experiences and signs of positive engagement from other participants during the social media task, and asking them to imagine how these indicators may hold positive downstream consequences for future interactions (e.g., gaining enjoyment or moments of connection during the ostensible one-on-one interaction at the end of the study) and for their self-beliefs (e.g., likeability, relatability).

Activities that allow an individual to feel both challenged and successful (i.e. "flow" states) may be likely to facilitate enjoyment and positive emotion (Csikszentmihalyi & LeFevre, 1989). Although individuals with high trait SA perceive social situations as inherently challenging, they are less likely to feel competent and successful at them, which may preclude them from experiencing positive emotions during social interactions (Blalock et al., 2018). Moreover, attending to potential social rewards may be particularly challenging in the aftermath of social rejection for high SA individuals, who tend to cope with challenging situations by avoiding or suppressing their emotions (Kashdan, 2007; Panayiotou et al., 2014; Spokas et al., 2009). Avoidance of unpleasant internal experiences might stifle their awareness of or level of engagement with social pain, making it even more difficult for them to recognize that their social

SOCIAL ANXIETY AND SOCIAL PAIN

needs have been compromised and, from there, respond with an approach-orientated mindset that guides their attention and behaviour toward fulfilling their need for belongingness and social affiliation.

The present study relied on experimental methods and used behavioural measures to test theory-driven hypotheses. Despite its methodological rigour, this study should be considered preliminary and certain limitations must temper our conclusions. Although our sample size provided enough power to analyze and sequentially link associations between separate variables across time, we were not adequately-powered to test these variables within one holistic moderated-mediation model, beginning with rejection and ending with positive affect as well as incorporating the moderating role of trait SA (see Fritz & Mackinnon, 2007). It would have also been informative to test changes in positive affect and/or social pain over time in order to bolster the idea that an emotional “wound” was being mended or changed as a function of social approach motivation. In the present study, we could not make assertions about wound-mending from observed associations between two separate emotion constructs (i.e., social pain and positive affect) that were each measured at single time points.

Moreover, although we conceptualized social pain as an emotion state consisting of both general negative mood and a specific sense of having been rejected, the way social pain has been conceptualized and measured has differed across studies, with no clear data-driven consensus about the optimal way of measuring it. The current study’s approach to measuring social pain was informed by Leary et al.’s (1998) phenomenological research on the experience of “hurt feelings/social pain”, in which they concluded that the subjective experience of “hurt feelings” is characterized by undifferentiated negative affect, more-so than any specifically distressing emotion (such as anxiety, guilt or hostility alone). Our study also aligns with current approaches

SOCIAL ANXIETY AND SOCIAL PAIN

taken in the social pain literature, whereby researchers often claim to have measured social pain by establishing that negative emotions were prompted by an interpersonally distressing scenario (e.g., Auyeung et al, 2016; Nordgren et al., 2011; Riva et al., 2015). Nonetheless, the social pain literature would benefit from an agreed-upon standardized and well-validated measure of social pain that is both theoretically informed and data-driven. Additional research is also necessary to extend our findings to other populations, as our undergraduate sample consisting primarily of female participants may have had higher intrinsic motivation to engage socially since meeting new people is a commonly valued component of completing the early stages of an undergraduate degree. In addition, the “tend and befriend” theory suggests women may be more likely to respond to threatening contexts with efforts to strengthen social bonds that could maximize their safety and reduce stress (S. E. Taylor et al., 2000). Even so, researchers have demonstrated heightened approach in the face of painful social exclusion in balanced samples of men and women (e.g., (Lee & Shrum, 2012), and in samples consisting entirely of men (e.g., (Narayanan et al., 2013). Therefore, it is unclear whether and how effects observed in the present study would generalize to other samples with varied demographics, including community samples of individuals with a clinical diagnosis of social anxiety disorder.

Finally, low mood is often a comorbid symptom of clinically-impairing SA that could undermine higher trait SA individuals’ abilities to experience approach motivation or positive affect. However, previous studies have reported that SA moderates the relationship between social pain and approach, even while controlling for depressive symptoms (Mallott et al., 2009). Nonetheless, future studies would benefit from addressing this limitation more directly by measuring and controlling for depressive symptoms.

SOCIAL ANXIETY AND SOCIAL PAIN

Notwithstanding these important limitations, the results of the present study help to clarify the role of social approach as a gateway to responding to one's social wounds and promoting positive affect following the pain of exclusion. If social pain serves as an adaptive signal to seek social affiliation in the face of threat to one's social network, then failure to seek such affiliation at crucial moments may be costly, both emotionally and interpersonally. This may be especially true for vulnerable individuals, such as those with higher trait levels of SA, who are already more prone to viewing themselves as having low social currency. As such, clinicians may wish to identify and target factors that inhibit affiliative drive.

Study Three

Reconnecting in the Face of Exclusion: Individuals with High Social Anxiety May Feel the Push of Social Pain, But Not the Pull of Social Rewards⁷

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Abstract

Background: Previous research has shown that high levels of trait social anxiety (SA) disrupt the social repair processes following a painful social exclusion, but the cognitive mechanisms involved in these processes and how trait SA may disrupt them remain unknown.

Methods: We conducted a preregistered study on Prolific participants ($N = 452$) who were assigned to experience either social exclusion or inclusion and were then exposed to follow-up opportunities for social reconnection.

Results: Moderated mediation analyses revealed that irrespective of levels of SA, participants responded to social pain with heightened approach motivation and greater downstream positive affect. Exploratory analyses revealed that heightened desire to affiliate was driven by increased curiosity and attention to social rewards. Moreover, higher SA was associated with lower overall desire to affiliate and this relationship between SA and affiliation was mediated by diminished reward responsiveness.

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SOCIAL ANXIETY AND SOCIAL PAIN

Conclusions: Findings highlight the roles of goal pursuit and social reward responsiveness in social repair and how high levels of trait SA may disrupt these processes.

Study 3 sought to replicate and extend novel findings from Study 2, while also addressing some of its key limitations. First, Study 3 aimed to replicate findings of Study 2 while addressing the prior limitations with sample size and demographics. Thus, Study 3 was conducted on Prolific to collect a larger, more demographically diverse community-based sample that was sufficiently powered for mediation analyses, rather than a series of simple hierarchical regression analyses as conducted in Study 2. Second, in Study 2, we sought to determine whether the social pain signal leads to social approach, but we did not examine how this transition takes place—from feeling the pain and threat of exclusion to feeling the desire to pursue further social connection. Thus, in Study 3 we investigated variables that we hoped would capture how participants transitioned from social pain to desiring social connection and why those with higher levels of SA may have failed to initiate this transition toward affiliative goal pursuit. Specifically, we investigated whether social pain cued increased state curiosity and greater anticipated or perceived rewards when anticipating and engaging in a subsequent social activity. Moreover, this study aimed to assess whether HSAs' diminished curiosity and reward sensitivity could explain why they experience less affiliative desire, and to what extent their reward sensitivity is influenced by heightened social pain and threat sensitivity.

Introduction

When others reject or exclude us, the need to belong becomes thwarted (Zadro et al., 2004), eliciting feelings of *social pain* (Eisenberger, 2015; Eisenberger et al., 2003). Social pain is an emotional distress signal that activates neurological response patterns resembling physical pain, highlighting the importance of forming social bonds for our ancestors' survival and reproduction (Eisenberger, 2012; MacDonald & Leary, 2005).

Of course, signaling that damage to a social network has taken place is only helpful if it motivates a functional or adaptive response. Adaptive behaviours within this context may include those that re-establish or promote new social bonds or protect against further social ostracism. In this vein, researchers have discovered that when there is reasonable opportunity for social connection following exclusion, people often increase their efforts to bond with others by becoming more affiliative (Narayanan, Tai, & Kinias, 2013). Excluded participants also engage in more generous acts toward others and make attempts to increase their proximity to others (Chester et al., 2016; DeWall et al., 2009; Maner et al., 2007; Mead et al., 2011; Romero-Canyas et al., 2010; Sommer & Bernieri, 2015). Moreover, excluded participants increase their affiliative efforts through reciprocal interpersonal behaviours, such as mirroring, even when exclusion has made them less trusting and more critical of others (Derfler-Rozin et al., 2010; Sommer & Bernieri, 2015).

Social Anxiety and Dampened Desire to Reconnect

Notably, certain trait-like tendencies appear to undermine this social repair process. In particular, studies have shown that those with high trait levels of social anxiety (SA) do not heighten their affiliative efforts in response to socially painful events (Hudd & Moscovitch, 2020; Maner et al., 2007), an effect that remains robust even after controlling for depressive

SOCIAL ANXIETY AND SOCIAL PAIN

symptoms (Mallott et al., 2009). These effects could inform pathways through which SA symptoms become elevated and maintained. To this end, Fung and Alden (2016) showed that the intensity of social pain following social exclusion in an initial social encounter mediated levels of anxiety participants experienced in anticipation of a subsequent social interaction, suggesting the negative impact of social pain may be carried forward into future social encounters. Social repair processes may function to alleviate the sustained negative effects of social pain and, in their absence, individuals might carry with them the full weight of a socially painful event.

There are at least two ways that high levels of trait SA may impede individuals from approaching and affiliating with others in the face of painful exclusion. SA has long been characterized as a fear-based problem (D. M. Clark & Wells, 1995), in which symptoms are borne out of beliefs that the self is fundamentally deficient and that such self-flaws be concealed from others to prevent negative evaluation (see Moscovitch, 2009; Rodebaugh, 2009). Entering social interactions with such negative appraisals of the self in relation to others may lower their threshold for perceiving threat cues that signify the possibility of social rejection (Bantini et al., 2016; Harb et al., 2002). Thus, oversensitivity to threat (e.g., excessive attention and responsivity to threat signals) may be one important factor that motivates people with high SA to prevent further damage and “cut their losses” by socially withdrawing in response to social exclusion, rather than heightening their affiliative efforts (see also Bielak & Moscovitch, 2013; Moscovitch et al., 2012, 2015; Steinman et al., 2014).

A second factor that may explain how high SA may impede affiliation following exclusion emerges from a growing body of research suggesting that SA symptomatology is not only driven by an overactive threat-avoidance motivational system, but also an underactive reward-seeking approach system, particularly within interpersonal contexts (see Blay et al.,

SOCIAL ANXIETY AND SOCIAL PAIN

2021; Weisman et al., 2011). From this perspective, high SA may inhibit desire to affiliate, perhaps by dampening goal pursuit and social reward responsiveness in the face of painful exclusion. Indeed, evidence is accumulating in support of the view that those with high SA demonstrate a broad pattern of diminished reward responsiveness (Richey et al., 2019). Individuals with high SA also display reduced neural connectivity in reward centres during resting states (Manning et al., 2015), suggesting that even if rewards are recognized, higher SA individuals may not have the capacity to respond emotionally to the same degree as their low SA counterparts. Studies have also found that participants with high trait SA exhibit reduced neural activation in anticipation of social rewards compared to the levels of activation exhibited in response to social punishments or non-social (monetary) rewards (Cremers, Veer, Spinhoven, Rombouts, & Roelofs, 2015; Richey et al., 2014).

A key component of the social repair process following exclusion appears to be the activation of motivated social goal pursuit, which, if successful, can promote heightened downstream positive affect—especially when a feasible avenue for affiliative reconnection is made available (Hudd & Moscovitch, 2020; Maner et al., 2007). To this end, research has shown that the activation of goal-oriented social approach motivations is associated with greater recognition of social reward potential (Anderson & Berdahl, 2002; Kunstman & Maner, 2011; Min & Kim, 2013) and that excluded participants become more attentive to social reward signals at early stages of cognitive processing (i.e., noticing smiling faces) (DeWall et al., 2009). The pull of rewards could explain why non-anxious individuals who have been excluded tend to experience a heightened desire for social reconnection, even when they are negatively affected by the initial threat of exclusion. In contrast, people with social anxiety disorder (SAD) displayed inhibited reward processing while under scrutiny (Becker et al., 2017), suggesting the looming

SOCIAL ANXIETY AND SOCIAL PAIN

threat of social evaluation may hinder their ability to feel rewarded when receiving positive feedback. Without the “pull” of rewards, people with high SA may fail to engage in this adaptive repair process.

Another factor contributing to differences between people with high versus low SA in responding to social exclusion may be related to whether social exclusion piques feelings of curiosity, which in turn drives the desire for additional information. Supporting this idea is the notion that social exclusion is often painful precisely because it is unexpected (Wesselmann et al., 2017). People tend to hold expectations about their relational value based on their potential to develop meaningful interpersonal connections with others and on others’ reciprocal desire for relational closeness with them; therefore, when someone behaves in a manner that violates these expectations—known as “relational devaluation”—people experience social pain, alerting them to initiate the social repair process (Leary et al., 1998; Leary & Springer, 2000). This powerful emotional signal that alerts a discrepancy between expectations and reality may be conceptualized as a form of *prediction error*, which elevates people’s curiosity and enhances their motivation to resolve the discrepancy by seeking further information, ultimately driving them toward the interpersonal and emotional rewards associated with social reconnection (Gruber & Ranganath, 2019).

One of the current study’s novel aims is to explore the possibility that social exclusion fails to pique high SA individuals’ curiosity to seek additional information through social reconnection because they expect to be rejected or excluded and therefore do not experience prediction error when their expectations are supported. Moreover, research has shown that curiosity only prompts exploration when the cause of the prediction error is appraised to be manageable (Gruber & Ranganath, 2019), and those with high SA may find the problem

SOCIAL ANXIETY AND SOCIAL PAIN

insurmountable due to their perception of themselves as having poor social competency (see Moscovitch, 2009; Rodebaugh, 2009). In summary, in the face of a threatening social exclusion, those with higher SA may be less likely to shift into a state of curiosity-driven appetitive goal pursuit, recognize social reward potential, and experience a heightened desire to affiliate.

Current Study Objectives and Hypotheses

The current study sought to investigate the following novel research questions (a) whether heightened affiliation in the face of painful exclusion promotes heightened downstream positive affect, (b) whether a goal-pursuit mechanism involving curiosity and reward recognition facilitates this process, and (c) whether and how these repair processes may become disrupted for those with higher trait levels of SA. We investigated these research questions by testing one primary model and two exploratory ones, as described below.

We created an online experiment and recruited a sample of community participants in which participants were first randomly assigned to 1 of 2 conditions where they were either rejected or included and then provided with a subsequent opportunity to engage with avatars whom they were led to believe were other online participants. Proposed mechanisms were assessed via self-report measures that were administered in sequential fashion. This study was preregistered on the Open Science Framework website at <https://osf.io/vc9fs/>.

Primary Model

Our primary goal was to test a consecutive mediation model⁸ in which we predicted that exclusion (relative to inclusion) would lead to greater social pain, which would in turn increase

⁸ Consecutive (or serial) mediation represents a causal chain, whereby predictor variable X is hypothesized to have a causal impact on mediator variable 1, which then subsequently causes an impact on mediator variable 2, and finally, mediator 2 impacts outcome variable Y ($X \rightarrow M1 \rightarrow M2 \rightarrow Y$). This process differs from simultaneous (or concurrent) mediation, which implies that predictor variable X has a direct impact on 2 or more mediator variables at once, and subsequently, all mediator variables have a direct impact on outcome variable Y at once ($X \rightarrow M1 \& M2 \rightarrow Y$) (Hayes, 2017).

SOCIAL ANXIETY AND SOCIAL PAIN

social approach motivation, and finally enhance downstream positive affect. The variables and proposed relationships for this model were determined a-priori and outlined in our study pre-registration materials. The theoretical foundation for this model and the basic relationships between its factors were originally examined in Hudd and Moscovitch (2020), and the present study was designed to build upon and extend those preliminary findings.

Hypothesized SA Moderation Effect

We further predicted that this consecutive mediation effect would be moderated by trait SA, such that only those with low but not high levels of SA would respond to the pain of exclusion with increased desire to approach and heightened positive affect. However, doubling the sample size to achieve the necessary power to detect significant moderated mediation effects (as suggested by Simonsohn, 2014) was financially unfeasible if we also wished to give participants a fair wage, which is dictated by Prolific policy as a minimum of \$6.50 USD per hour. Thus, consecutive mediation was conceptualized as the primary research question, for which our study was intentionally powered (see Sample Size and Power Calculations below). Nonetheless, we still pursued exploration of the moderated mediation effect in order to: 1) observe variability in the strength of the consecutive mediation effect across levels of SA at a descriptive level, knowing it was unlikely to meet p -value threshold for significance, and 2) observe the simple moderation effect between SA and social pain for predicting social approach motivation, which we were sufficiently powered to observe and interpret.

Furthermore, we compared this model with and without current depressive symptoms entered as a covariate. We sought to ensure effects pertaining to trait SA would not be explained by concurrent low mood, as SA and dysphoria often present comorbidly (Moitra et al., 2008) and

SOCIAL ANXIETY AND SOCIAL PAIN

low mood could be reasonably expected to affect each variable of interest. Others have taken a similar approach when examining the effects of SA on social affiliation (Mallott et al., 2009).

Exploratory Models

We also aimed to test two exploratory mediation models that investigated the effects of curiosity as well as reward and threat anticipation and perception on social approach motivation. The theoretical foundation for investigating these variables was first discussed in Hudd and Moscovitch (2020), where it was theorized that goal-pursuit and heightened reward perception might explain motivation to affiliate in the face of painful exclusion, and that SA symptoms would likely moderate this effect. However, the roles of curiosity and reward and threat variables were only theorized in Hudd and Moscovitch (2020) and not measured or examined directly.

Exploratory Model 1

Our first exploratory model was that social pain would predict heightened curiosity and, in turn, increased perception of social rewards and heightened approach motivation for subsequent social activities (social pain → curiosity → reward perception → approach motivation). We hypothesized that this effect may be moderated by trait SA in two possible ways: that in response to higher levels of social pain, those with high SA would either (a) experience lower levels of curiosity and/or (b) perceive fewer social rewards.⁹ As in the primary model, we only expected to have sufficient power to detect the consecutive mediation effect, but not the *moderated* consecutive mediation effect. Once again, we included the moderated mediation effects in the model because we intended to observe variability in the strength of consecutive

⁹ It is worth noting that the effects of condition were not accounted for in this model. The focal predictor of this model is social pain, which (in accordance with primary hypothesis 1) is expected to vary as a function of condition. In this analysis we retained all participants across both the inclusion and exclusion conditions to allow for maximum variability in our focal predictor (social pain) by including participants who experienced lower levels of social pain (i.e., those within the inclusion condition), and to retain maximum power for detecting anticipated effects.

SOCIAL ANXIETY AND SOCIAL PAIN

mediation effect across levels of SA at a descriptive level as well as interpreting the sufficiently powered simple moderation effects between social anxiety and social pain for predicting curiosity and social reward perception. We again sought to compare the effects of this model with and without depressive symptoms entered as a covariate to distinguish the effects of trait SA from the potential effects of low mood.

Exploratory Model 2

In the second exploratory model, we aimed to investigate the potential roles of social reward and threat perception in the relationship between SA and dampened approach motivation. Specifically, we sought to investigate the relative strength of anticipated or perceived rewards versus anticipated or perceived threats as simultaneous mediators of the relationship between SA and approach motivation (social anxiety → reward anticipation, reward perception, threat anticipation & threat perception → approach motivation). These effects were also compared with and without depressive symptoms entered as a covariate in the model.

Methods

Participants

The sample consisted of participants recruited from the Prolific research participation pool^{10,11}. We restricted the sample to those residing in the United States or Canada. Participants were removed from the original collected sample of $N = 470$ if they: a) did not properly indicate their consent to participate ($n = 8$), b) entered the study, quit, and then re-entered, as this may have compromised the integrity of their data ($n = 9$), or c) if they did not re-consent after being debriefed about the study's deceptions ($n = 1$). Participants were also removed if they failed to adequately meet self-reported and embedded attention checks. Adequate attention was determined using two methods. First, a summary score was created for participants' self-reported attention and honesty (minimum possible score of 3, maximum possible score of 15). The distribution of scores revealed that most participants scored 10 and above (98.7%). Those who scored <10 on the self-report attention/honesty check ($n = 6$) were flagged for further review. Participants who were flagged for lower scores on the attention/honesty measure ($n = 6$) were examined to see how they performed on the embedded attention checks. Most of these participants passed all embedded attention checks: only one participant failed any of the embedded attention checks, and in this case, they still passed the majority (4 out of 6 checks). In the entire sample, 87% of the participants passed all 6 embedded attention checks. Based on these results, we determined that all participants demonstrated sufficient attention and honest engagement.

¹⁰ Our study pre-registration stated that participants would be recruited from MTurk, but due to concerns about the increasing prevalence of bot data on the MTurk platform, especially during the start of the COVID-19 pandemic when the study was preparing to launch, we opted instead to use the Prolific platform for recruitment. We discovered zero evidence of bot data in our study sample.

¹¹ Prolific is an online platform that allows researchers to connect with potential research participants in exchange for remuneration.

SOCIAL ANXIETY AND SOCIAL PAIN

Exclusions resulted in a final sample of $N = 452$. Participants were, on average, 33.77 years old ($SD = 12.20$), with 52.9% identifying as male, 46.5% identifying as female, and 0.7% identifying as non-binary. The sample primarily consisted of participants residing in the United States (81%), while the remainder were Canadian (19%). Most participants had completed all or part of a professional degree (98.3%), some held a high school diploma (11.3%), while very few had not completed high school (0.4%).

Participants from Canada ($n = 86$) identified their cultural/ethnic background as follows: Asian (38%), European (31.4%), other North American (12.8%), African (7.0%), prefer to self-identify (3.5%), prefer not to answer (3.5%), Caribbean (2.3%), Indigenous (2.3%), and Metis (1.2%). Those who preferred to self-identify ($n = 3$) described themselves as South Asian, North African and Black American. Participants from the United States ($n = 366$) identified their cultural/ethnic background as follows: White or European American (71.9%), Asian (14.2%), Black or African American (8.7%), Hispanic Latinx (7.4%), prefer to self-identify (1.6%), Indigenous or Alaskan Native (1.4%), Non-Hispanic Latinx (0.8%), and prefer not to answer (0.3%). Those who preferred to self-identify ($n = 4$) described themselves as Ashkenazi Jewish, Mixed, Native American, or White/West Asian.

Sample Size and Power Calculations

The target sample size was calculated based on the necessary power required to detect effects within the primary consecutive mediation model. Expected effects ranged from small to large and were estimated based on correlations reported in Hudd & Moscovitch (2020) between very similar (or identical) variables of interest for the present study. Specifically, we estimated the effect of condition on social pain to be medium-large ($r = .45$) while its direct effects on social approach motivation and positive affect were estimated to be small ($r = .04$ and $.17$,

SOCIAL ANXIETY AND SOCIAL PAIN

respectively). We estimated the relationship between social pain and approach motivation (without accounting for trait SA moderation effects) to be small ($r = .14$), and the relationship between social pain and positive affect to be medium ($r = .38$). Finally, we estimated the relationship between approach motivation and positive affect to be large ($r = .42$). These were entered into a Monte Carlo power analysis for indirect effects (Schoemann et al., 2017), which estimated that in order to detect a significant serial mediation effect in the primary analysis with .80 power, we would require a sample size of approximately $N = 433$.

Overview of Study Procedures

The study took place entirely online. At the beginning of the study, participants were told that they would complete several activities online with other Prolific participants, when in fact each participant was the only participant involved and all interactions with others were with pre-programmed avatars. Participants completed trait and demographic questionnaires and then were randomly assigned to one of two conditions in which they experienced social exclusion or social inclusion during a game of Cyberball.

After the Cyberball game, participants completed a measure of social pain and then state curiosity. Then, all participants across conditions were told about two upcoming social interaction activities. They were informed that they would first participate in a social media task (described below) and then later have the chance to interact via instant messaging with one other participant in a final social task. In reality, participants would only participate in the Cyberball and social media task, but not the “instant messaging” task. The instant messaging task was only introduced as a potential upcoming social activity so we could first measure anticipated and perceived rewards and threats within the context of the social media activity and then evaluate

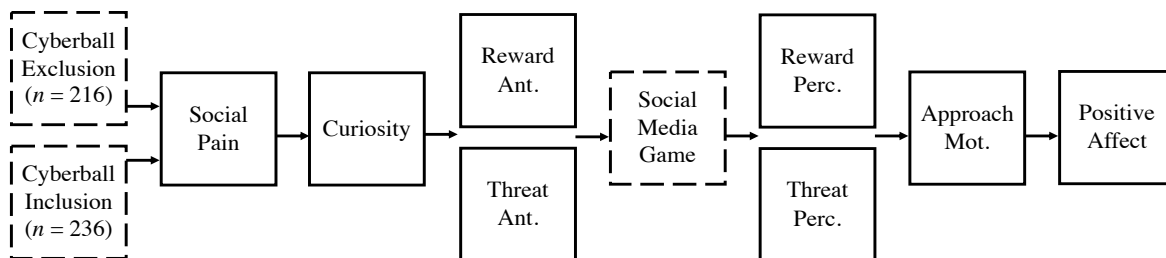
SOCIAL ANXIETY AND SOCIAL PAIN

how this affected the degree to which participants were interested in further affiliating with others.

After Cyberball, participants were informed of the upcoming social media task and asked to rate to what degree they anticipated experiencing social rewards or threats in that task. Participants then completed the social media activity and, immediately afterward, rated their perception of social rewards and threats within the social media task itself. Subsequently, participants were reminded of the final ostensible social interaction task (“instant messaging”) and rated their degree of motivation to engage with others in this activity. Finally, they completed a measure of state positive affect, were debriefed about the study purpose and deceptions, and were given the opportunity to provide confirmation that they consented to our use of their data. The study took approximately 30 minutes to complete. Figure 4 provides a visual representation of study procedures.

Figure 4.

Visual Representation of Study Procedures



Note. Boxes with dotted lines represent the two activities to which participants were exposed during the study. Solid lines represent measures collected from participants.

SOCIAL ANXIETY AND SOCIAL PAIN

Cyberball Procedures

Participants in both the exclusion and inclusion conditions participated in a game of Cyberball with 3 other players for a minimum of 2 minutes (36 total throws). To enhance the believability of the deception and establish a sense of personal identity and connection among the players, all players were asked to send a message to the group at the beginning of the game in which they introduced themselves and their favourite book or movie. Because participants were led to believe the other ostensible players received the same prompt, the avatars were programmed to also send a message introducing themselves and their favourite book or movie. Participants assigned to be excluded received 3 passes at the beginning of the game and then zero passes for the remainder of the game, while those assigned to be included received the same number of passes as the other avatars on screen.

Social Interaction Activity

After responding to the social pain measure, participants anticipated engaging in a social media interaction activity. This activity was designed to provide a social context within which participants could anticipate and perceive social rewards or threats. Drawing upon a paradigm originally used by Wolf et al. (2015), we deceived study participants to believe that they would be interacting in an online space with other participants whose profiles they could see (in reality, these were preprogrammed avatars). They were instructed to write their own personal profile and were then exposed to the profiles of 10 other avatars, who were described as university students with diverse backgrounds, hobbies, and interests. We informed participants that in the first part of the task, they were to read and click “like” on as many profiles as they wished. Participants were pre-programmed to receive 5 total “likes” (out of a possible 10) and the pre-programmed profiles were also programmed to receive between 4-5 “likes”, in addition to whatever the real

SOCIAL ANXIETY AND SOCIAL PAIN

participant chose to give. By keeping the number of “likes” relatively equal between the participant and the other ostensible participants, the context was left neutral and ambiguous (neither overt inclusion nor exclusion).

Manipulation Checks

We used two pre-validated measures to serve as Cyberball condition manipulation checks. First, participants responded to a two-item manipulation check to ensure they recognized that they were thrown the ball equally or far fewer times relative to the other players. They were asked to rate the following items on a 5-point Likert scale ranging from 1 (no, not at all) to 5 (yes, definitely): *I was thrown the ball less frequently than the other players*, and *I received the ball just as frequently as the other players*. This manipulation check was validated in a previous study (Hudd & Moscovitch, 2020). Participants also completed the Needs-Threat Scale (NTS; Williams et al., 2000), which was developed based on theory and data that suggest social exclusion threatens a core set of fundamental human needs. Thus, we used this measure to ensure our exclusion manipulation generated expected psychological “threat” responses across the theorized domains, including needs for belongingness (e.g., *I felt like an outsider during the Cyberball game*), self-esteem (e.g., *During the Cyberball game, I felt good about myself*), control (e.g., *I felt in control during the Cyberball game*), and meaning (e.g., *I felt as though my existence was meaningless during the Cyberball game*). For this measure, participants rated their agreement with items on a 9-point Likert scale ranging from 1 (not at all) to 9 (very much). The Needs-Threat scale items revealed good internal consistency, $\alpha = .90$.

Trait Measures

Social Anxiety Symptoms. The Social Phobia Inventory (SPIN; Connor et al., 2000), which served as our measure of trait SA, includes 17 items that measure SA symptoms over the

SOCIAL ANXIETY AND SOCIAL PAIN

past week. The SPIN has demonstrated strong reliability and validity in prior research (Antony, Coons, McCabe, Ashbaugh, & Swinson, 2006; Connor et al., 2000) and showed good internal consistency in the current study ($\alpha = .94$).

Depressive Symptoms. The Depression Anxiety and Stress Scales (DASS; Lovibond & Lovibond, 1995) is a 21-item questionnaire assessing symptoms of depression, anxiety, and stress over the past week. Only the DASS items pertaining to symptoms of depression, of which there are seven items (e.g., “I felt down-hearted and blue”), were used for this study. This measure has shown good internal consistency, validity and support for its 3-factor structure (Page et al., 2007) and demonstrated good internal consistency in the current study ($\alpha = .93$).

State Measures

Social Pain. Participants responded to this measure immediately after the condition task and were asked to rate items describing how they felt “just now, while completing the activity” on a Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). Researchers have used a wide variety of social pain measures that tend to capture psychological or emotional distress and some form of rejection appraisal (e.g., Auyeung & Alden, 2016; Chester et al., 2016; Gerber, Chang, & Reimel, 2017; Nordgren, Banas, & MacDonald, 2011; Zadro, Williams, & Richardson, 2004). Hudd and Moscovitch (2020) used a composite measure of negative affect and additional items that captured the notion of being rejected or excluded as their measure of social pain. As such, we used the same approach by collecting responses from the *Positive and Negative Affect Schedule* (PANAS; Watson et al., 1988), and responses to following two additional items: “I felt rejected” and “I felt excluded”. The items were combined to form a composite measure with negative affect, which had good internal consistency, $\alpha = .87$.

SOCIAL ANXIETY AND SOCIAL PAIN

Curiosity. Participants responded to the curiosity measure after completing the social pain measure. They were asked to rate 6 items describing how they felt “just now, while completing the game of catch” on a Likert scale ranging from 1 (not at all) to 5 (very much so). We used a shortened, adapted version of the state measure of the State-Trait Curiosity Inventory (Naylor, 1981). This was done an effort to limit response fatigue and potential agitation we anticipated participants might experience if asked to respond to the full 21-item measure. For the present study, the following items were included, which sought to capture participants’ feelings of surprise, intrigue, and desire to pursue more information: *I felt curious about what was happening; I was feeling puzzled; My curiosity was aroused; I felt like searching for answers; I felt absorbed in what I was doing; and My interest was captured.* These items revealed satisfactory internal consistency, $\alpha = .79$.

Positive Affect. At the end of the study, participants completed the state positive affect subscale of the *Positive and Negative Affect Schedule* (PANAS; Watson et al., 1988) consisting of emotion adjectives rated on a 5-point Likert scale, such as “interested,” “excited,” and “enthusiastic.” The positive affect subscale demonstrated good reliability ($\alpha = .97$).

Social Approach Motivation. Participants were asked to rate the following items on a scale from 1-9: *I am eager to learn more about another participant, I am excited to interact with someone, and I am looking forward to sharing more about myself, and I would prefer **not** to further interact with anyone* (reverse-coded). This measure demonstrated good reliability ($\alpha = .93$).

Social Reward and Threat Scales

Social reward and threat scales were devised to capture the degree to which participants anticipated the social media activity would be socially rewarding and threatening (social reward

SOCIAL ANXIETY AND SOCIAL PAIN

and threat *anticipation*) and, after the task, to capture the degree to which participants perceived the social media activity as having been socially rewarding and threatening (social reward and threat *perception*). See Appendix A of Supplementary Materials for details about the development of reward and threat scales and the psychometric analyses used to support their discriminant validity.

Social Reward Anticipation (Pre-Social Media Task). Participants were asked to rate the following items on a scale from 1-9: *Others will enjoy reading my profile; I will feel good sharing information about myself with others; I will discover that I share common interests with other participants; based on my profile, other participants will think positively about me; participants on the social media platform will accept me; and I will enjoy connecting with others through this online activity.* This measure demonstrated good reliability ($\alpha = .92$).

Social Reward Perception (Post-Social Media Task). Participants were asked to rate the following items on a scale from 1-9: *Others enjoyed reading my profile; I felt good sharing information about myself with others; I discovered that I shared common interests with other participants; based on my profile other participants probably thought positively of me; participants on the social media platform appear to have accepted me; and I enjoyed connecting with others through this online activity.* This measure demonstrated good reliability ($\alpha = .89$).

Social Threat Anticipation (Pre-Social Media Task). Participants were asked to rate the following items on a scale from 1-9: *Other participants will dislike my profile; Sharing information about myself will make me feel inferior to others; I will feel like an outsider during this task; Based on my profile, other participants will think poorly of me; Other participants will ignore my profile; and Participants on the social media platform won't be interested in connecting with me.* This measure demonstrated good reliability ($\alpha = .89$).

SOCIAL ANXIETY AND SOCIAL PAIN

Social Threat Perception (Post-Social Media Task). Participants were asked to rate the following items on a scale from 1-9: *Other participants disliked my profile; Sharing information about myself made me feel inferior to others; I felt like an outsider during this task; Based on my profile, other participants probably thought poorly of me; Other participants ignored my profile; and Participants on the social media platform probably won't be interested in connecting with me in the next activity.* This measure demonstrated good reliability ($\alpha = .85$).

Data Analytic Plan for Primary Hypothesis

Data were analyzed with the Hayes PROCESS macro developed for SPSS (Hayes, 2017). Hayes PROCESS examines both the direct effects and R^2 change values for interaction effects, in addition to providing bias corrected bootstrap confidence intervals based on 5000 bootstrap samples. We sought to follow-up on any significant interaction effects by probing for simple effects at 1 *SD* at, above, and below the mean of the moderator variable.

Using Hayes PROCESS model 91, we tested the preregistered moderated consecutive mediator model by entering condition (exclusion vs. inclusion) as the predictor variable (X), social pain (M1) and approach motivation (M2) as the consecutive mediators, and positive affect (Y) as the outcome variable. Trait social anxiety was entered as a moderator between social pain (M1) and social approach (M2). The model was run with and without depression entered as a covariate in the model.

Data Analytic Plan for Exploratory Hypotheses

With Hayes PROCESS model 84, we tested the first exploratory model, which also consisted of a moderated consecutive mediator model. Social pain was entered as the predictor variable (X), curiosity (M1) and reward perception (M2) as the consecutive mediators, and approach motivation (Y) as the outcome variable. Trait social anxiety was entered as a moderator

SOCIAL ANXIETY AND SOCIAL PAIN

between social pain (X) and curiosity (M1), as well as between social pain (X) and reward perception (M2). This model was also run with and without depression entered as a covariate in the model.

Finally, with Hayes PROCESS model 4, we used a simultaneous mediation model by entering social anxiety as the predictor variable (X), and reward anticipation (M1), reward perception (M2), threat anticipation (M3), and threat perception (M4) as the simultaneous mediators, with approach motivation (Y) as the outcome variable. Once again, this model was run with and without depression entered as a covariate in the model.

Results

Means, standard deviations and bivariate correlations between variables—both within and collapsed across conditions—are provided in the Supplementary Materials in Tables S5-S7.

Missing Data and Outlier Analyses

Most measures had no missing data, and those that did had very little missing data, with a maximum of 0.7% missing data per item. Missing data across measures were considered MCAR based on non-significant Little's MCAR tests. Missing data were imputed using the expectation-maximization approach whenever the majority of items were completed for a particular scale. Data points were deleted listwise from analyses in instances when the majority of items for a particular scale were missing. Data were visually scanned for outliers using boxplots and descriptive analyses, and no data points were excluded as outliers. All measures were normally distributed, with skewness and kurtosis less than 3 and greater than -3 for each measure.

Manipulation Checks

Compared to participants in the inclusion condition, those assigned to the exclusion condition were more likely to respond that they received the ball less frequently relative to the other players, $t(450) = 20.307, p < .001$, CI of M difference [2.09, 2.54], and less likely to respond that they received the ball an equal number of times relative to the other players $t(450) = -22.186, p < .001$, CI [-2.58, -2.16]. Moreover, those in the exclusion condition reported higher ratings on the Needs-Threat Scale, $t(450) = 16.026, p < .001$, CI of M difference [23.42, 29.96].

Trait Social Anxiety Measure

Participants represented a normally distributed range of social anxiety symptoms ($M = 26.44, SD = 15.01$). As shown in Table S5, scores were similar across conditions.

Depression Covariate

SOCIAL ANXIETY AND SOCIAL PAIN

Findings from each of the three models did not change meaningfully when depression was entered as a covariate, suggesting that the observed relationships between trait SA and other factors were not due to the comorbid low mood symptoms frequently observed in those with SAD. As such, results reflect iterations of each model where depression was not included as a covariate.

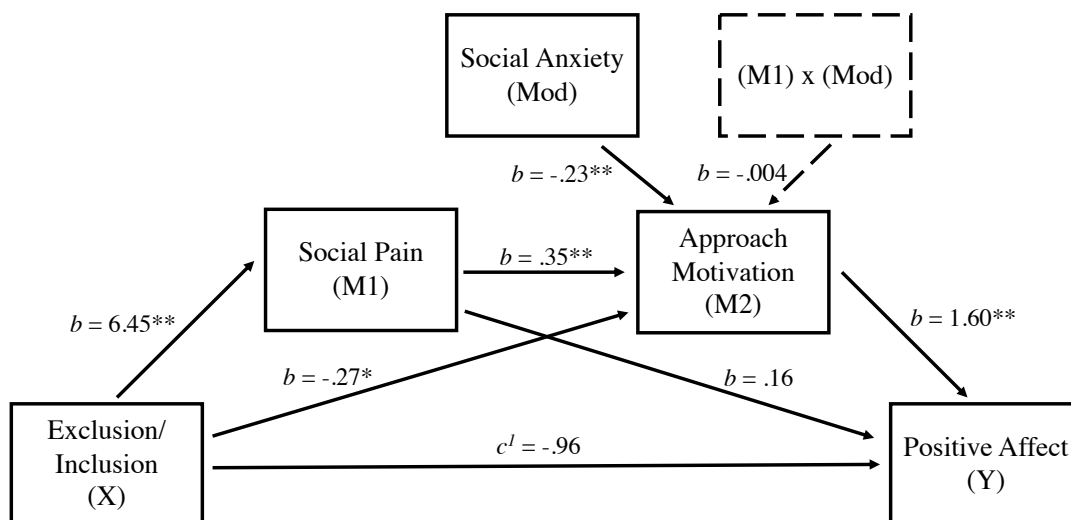
Primary Analysis: Does the Pain of Social Exclusion Promote Heightened Social Approach Motivation and Positive Affect, but Only at Low Levels of SA?

Results demonstrated that the proposed conditional indirect effect was non-significant, $index = .04$, $SE = .04$, $CI [-.11, .04]$. However, the consecutive mediation effect was significant. In other words, the relationship between condition (X) and positive affect (Y) was mediated by social pain (M1) and approach motivation (M2), but this consecutive indirect effect was not moderated by trait SA. The indirect effect was significant at all levels of SA: low, $b = 4.18$, $SE = 1.26$, $CI [1.83, 6.68]$, average $b = 3.61$, $SE = .83$, $CI [2.08, 5.36]$ and high, $b = 3.01$, $SE = .77$, $CI [1.60, 4.56]$. The findings for each step of the model are reported below and in Figure 5.

SOCIAL ANXIETY AND SOCIAL PAIN

Figure 5.

Direct Effects in the Primary Analysis



Note. Box with dotted lines represents the interaction term (social anxiety x. social pain).

In the first step of the model, condition predicted significant variability in social pain, $R^2 = .16$, $F(1, 449) = 82.512$, $p < .001$, such that those who were excluded felt more social pain.

In the second step, condition, social pain, social anxiety and the interaction between social pain and social anxiety collectively predicted significant variability in approach motivation, $R^2 = .12$, $F(4, 446) = 15.020$, $p < .001$. Of these, condition, social pain and social anxiety each predicted unique variability in approach motivation. Those who were included reported higher approach motivation, $b = -2.70$, $SE = 1.0$, $p = .007$, $CI [-4.66, -.73]$, as did those who reported higher levels of social pain, $b = .35$, $SE = .07$, $p < .001$, $CI [.21, .49]$, whereas high trait SA predicted lower approach motivation, $b = -.23$, $SE = .03$, $p < .001$, $CI [-.30, -.17]$. The

SOCIAL ANXIETY AND SOCIAL PAIN

interaction between social pain and social anxiety was non-significant, $b = -.004$, $SE = .004$, $p = .320$, $CI [-.01, .003]$.

Finally, in the third step, condition, social pain, and approach motivation collectively predicted significant variability in positive affect, $R^2 = .48$, $F(3, 447) = 134.806$, $p < .001$. Of these, only approach motivation exhibited a direct relationship with positive affect, $b = 1.60$, $SE = .08$, $p < .001$, $CI [1.44, 1.76]$, while the direct effects of condition, $b = -.96$, $SE = 1.76$, $p = .589$, $CI [-4.42, 2.51]$ and social pain, $b = .16$, $SE = .11$, $p = .145$, $CI [-.05, .37]$, did not.

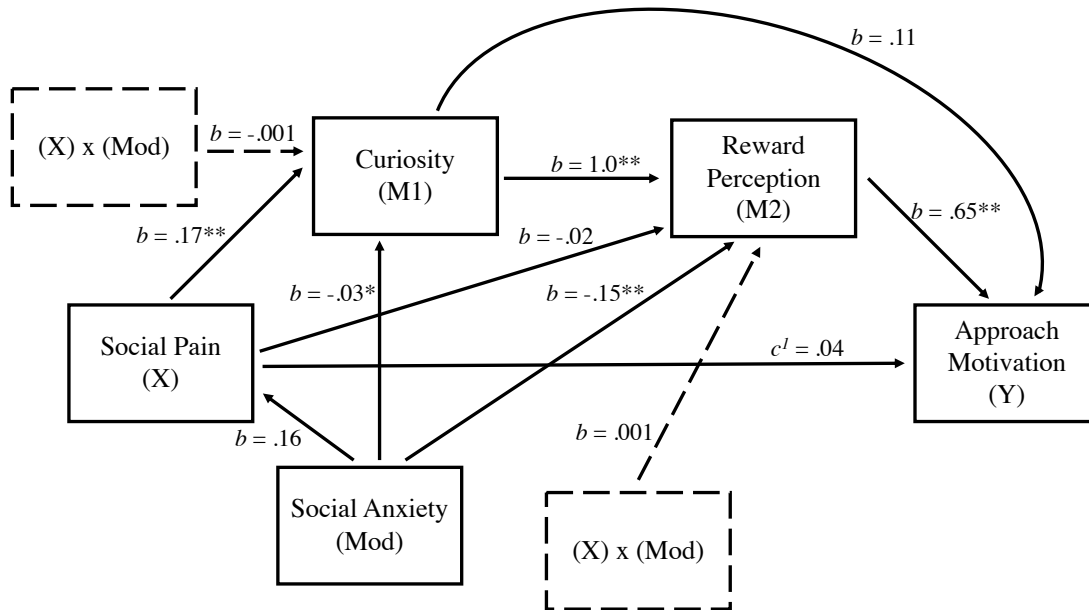
Exploratory Analysis 1: Does Social Pain Promote Curiosity, Leading to Heightened Social Reward Perception and Social Approach Motivation, but Only at Low Levels of SA?

Results demonstrated that the proposed conditional indirect effect was non-significant, $index = -.001$, $SE = .001$, $CI [-.003, .001]$. However, the consecutive mediation effect was significant. In other words, the relationship between social pain (X) and approach motivation (Y) was mediated by curiosity (M1) and reward perception (M2), but this indirect effect was not moderated by trait SA. The indirect effect was significant at all levels of SA: low, $b = .13$, $SE = .03$, $CI [.07, .19]$, average, $b = .11$, $SE = .02$, $CI [.07, .15]$ and high, $b = .09$, $SE = .02$, $CI [.06, .13]$. The findings for each step of the model are reported below and presented in Figure 6.

SOCIAL ANXIETY AND SOCIAL PAIN

Figure 6.

Direct Effects in Exploratory Model 1



Note. Boxes with dotted lines represent the interaction term (social anxiety x. social pain).

In the first step of the model, social pain, social anxiety and their interaction term collectively predicted significant variability in curiosity, $R^2 = .10$, $F(3, 447) = 16.793$, $p < .001$. Those who experienced higher social pain reported greater curiosity, $b = .17$, $SE = .03$, $p < .001$, $CI [.12, .22]$, while individuals with higher trait SA reported lower overall curiosity, $b = -.03$, $SE = .01$, $p = .022$, $CI [-.05, -.004]$. However, the interaction between social pain and social anxiety did not predict significant variability in curiosity, $b = -.001$, $SE = .001$, $p = .278$, $CI [-.004, .001]$.

In the second step, social pain, curiosity, social anxiety and the interaction between social pain and social anxiety collectively predicted significant variability in reward perception, $R^2 = .20$, $F(4, 446) = 27.836$, $p < .001$. Of these, only curiosity and social anxiety demonstrated

SOCIAL ANXIETY AND SOCIAL PAIN

significant direct relationships with approach motivation: those who were more curious perceived more social rewards, $b = 1.0$, $SE = .12$, $p < .001$, $CI [.77, 1.24]$, while those with higher trait SA perceived fewer social rewards, $b = -.15$, $SE = .03$, $p < .001$, $CI [-.21, -.10]$. The direct relationship between social pain and reward perception was non-significant, $b = .02$, $SE = .07$, $p = .683$, $CI [-.10, .16]$, as was the interaction effect between social pain and social anxiety on reward perception, $b = .001$, $SE = .003$, $p = .856$, $CI [-.01, .01]$.

Finally, in the third step, social pain, curiosity and reward perception collectively predicted significant variability in approach motivation, $R^2 = .45$, $F(3, 447) = 121.814$, $p < .001$. Higher reward perception predicted greater approach motivation, $b = .65$, $SE = .04$, $p < .001$, $CI [.58, .73]$. However, the direct effects of both social pain, $b = .04$, $SE = .05$, $p = .322$, $CI [-.04, .13]$, and curiosity, $b = .11$, $SE = .11$, $p = .299$, $CI [-.10, .32]$, were non-significant.

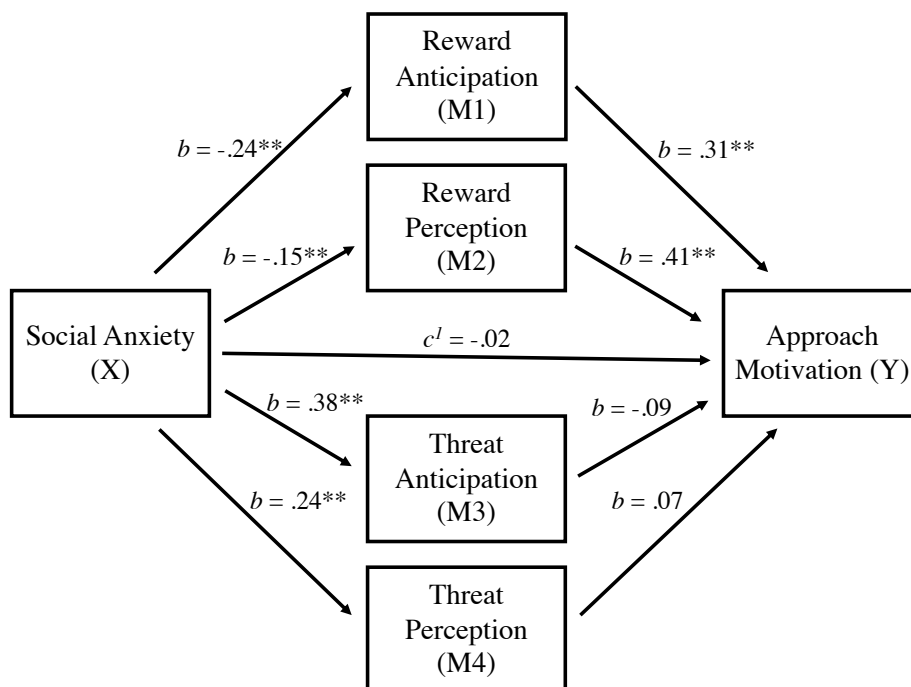
Exploratory Analysis 2: Do Anticipated and Perceived Social Reward and Threat Explain the Relationship Between Social Anxiety and Social Approach Motivation?

Results showed that anticipated and perceived social rewards significantly mediated the relationship between SA and approach motivation, $b = -.08$, $SE = .02$, $CI [-.11, -.05]$, and $b = -.06$, $SE = .02$, $CI [-.09, -.03]$, respectively, but anticipated and perceived social threat did not predict additional, significant variability beyond what was accounted for by the reward measures, $b = -.03$, $SE = .02$, $CI [-.07, .003]$, and $b = .02$, $SE = .01$, $CI [-.01, .05]$, respectively. The findings for each step of the model are reported below and presented in Figure 7.

SOCIAL ANXIETY AND SOCIAL PAIN

Figure 7.

Direct Effects in Exploratory Model 2



SA predicted significant variability in each of the mediator variables, including reward anticipation, $R^2 = .11$, $F(1, 449) = 58.115$, $p < .001$, reward perception, $R^2 = .05$, $F(4, 449) = 23.101$, $p < .001$, threat anticipation, $R^2 = .27$, $F(4, 449) = 166.791$, $p < .001$, and threat perception, $R^2 = .17$, $F(4, 449) = 94.624$, $p < .001$.

With all mediators in the model concurrently, only anticipated and perceived rewards were significantly related to approach motivation, $b = .31$, $SE = .05$, $p < .001$, $CI [.21, .40]$ and $b = .41$, $SE = .05$, $p < .001$, $CI [.31, .51]$, whereas anticipated and perceived threat were only marginally and non-significantly related to approach motivation, respectively: $b = -.09$, $SE = .04$, $p = .054$, $CI [-.17, .002]$ and $b = .07$, $SE = .05$, $p = .180$, $CI [-.03, .17]$.

SOCIAL ANXIETY AND SOCIAL PAIN

Finally, with the effects of reward and threat mediators accounted for, SA was no longer directly associated with approach motivation, $b = -.02$, $SE = .03$, $p = .374$, $CI [-.08, .03]$.

Discussion

The current study sought to investigate the mechanisms that promote heightened affiliation in the face of painful exclusion, and to examine how the social repair process may be disrupted for those with higher levels of trait SA. Within an online context, participants were first made to feel rejected or included, and then provided with an opportunity to engage with others. We tested one primary mediation model and two exploratory mediation models in a well-powered sample of community participants. These models were derived from hypotheses originally proposed in Hudd and Moscovitch (2020), which specified how social pain and social approach processes may work together to facilitate social and emotional repair in the face of social pain, and how these processes may be impacted by trait SA.

Results of the Primary Model

We predicted that following social exclusion, heightened feelings of social pain would enhance the desire to reconnect with others and, in turn, would elevate feelings of positive affect. We also expected that individuals with higher levels of SA would respond to their social pain with attenuated desire to approach, thus inhibiting the social repair process. Results supported the proposed consecutive mediation effect at all levels of SA, suggesting that heightened desire to approach in the face of painful exclusion was associated with downstream positive affect. The simple interaction between SA and social pain for predicting social approach motivation was non-significant. Including current depressive symptoms as a covariate had no meaningful impact on results.

Results of the Exploratory Models

Next, we tested two exploratory models that were designed to improve our understanding of the cognitive mechanisms that might link heightened social pain with an increased desire to

SOCIAL ANXIETY AND SOCIAL PAIN

reconnect with others. In the first model, we expected greater social pain to predict heightened curiosity, leading to greater perception of social rewards and, in turn, an increased desire to engage in a subsequent social task. Again, we explored whether this effect would be moderated by trait SA in one of two ways, such that only those at lower levels of SA would respond to their social pain with either heightened curiosity and/or enhanced reward perception. Results supported the proposed consecutive mediation effect at all levels of SA, suggesting curiosity in the face of social pain was associated with heightened reward perception and greater downstream approach motivation. As in the primary analysis, the simple interaction effects revealed that SA did not moderate the effect of social pain on curiosity, nor did it moderate the effect of social pain on reward perception.

Since diminished approach motivation has long been conceptualized as a critical problem for individuals with SAD that may account for deficits in positive interpersonal and emotional experiences (e.g., Kashdan, 2007; Richey et al., 2014), our second exploratory model was designed to investigate potential mediators of the relationship between SA and approach motivation. Specifically, we tested whether heightened social threat appraisals and/or diminished social reward appraisals may link higher trait SA with lower approach motivations when individuals are faced with opportunities to engage socially with others. Findings revealed that reward anticipation and perception mediated the relationship between SA and approach motivation, over and above the effects of threat anticipation and perception. In other words, threat anticipation and perception had no significant predictive value beyond the effects of reward anticipation and perception.

SOCIAL ANXIETY AND SOCIAL PAIN

Impact of Trait SA on Social Repair Processes

For those with lower levels of SA, the consecutive mediation effects in the primary analysis and first exploratory model revealed social repair processes that appeared to reflect a state of goal pursuit, which conferred short-term social and mood benefits. For low SA participants, higher social pain was associated with greater curiosity, which in turn predicted greater recognition of socially rewarding information. In contrast, findings from all three models suggested that high SA participants exhibited low desire to pursue social connections, perhaps due to dampened social reward expectations and perceptions. The simple interaction effects between social pain and social anxiety on social approach motivation and reward perception were sufficiently powered and found to be non-significant with effect sizes that were quite small, suggesting that challenges in initiating social repair processes for those with high SA may be unrelated to the strength of the pain signal, or may occur further downstream in the repair process. Indeed, individuals with high SA may have entered the study expecting that affiliative contexts are unlikely to be rewarding or enjoyable, thereby dampening their desire to connect with others irrespective of how painful their experience during Cyberball may have felt. Given their pessimistic expectations, higher SA individuals may never have experienced the kind of prediction error that is hypothesized to generate affiliative goal pursuit in the aftermath of social pain. In contrast, if low SA participants entered the Cyberball context expecting to be included, attending with curiosity to socially positive and rewarding information in the face of social pain may have been the most efficient route for resolving the initial prediction error.

The association between high SA and dampened social reward responsivity is consistent with evidence that suggests individuals with high SA have difficulty recognizing, appreciating, and retaining socially rewarding information. Prior research has found that people with high SA

SOCIAL ANXIETY AND SOCIAL PAIN

tend to discount positive social information, even if positive social feedback is explicit and unambiguous (Koban et al., 2017; Vassilopoulos & Banerjee, 2010). In fact, people with high SA tend to fear positive social feedback (Weeks & Howell, 2012). Even in contexts in which socially rewarding information is initially recognized, the perceived positivity of such information tends to degrade uniquely over time in the memories of high SA individuals specifically (Glazier & Alden, 2019; Romano, Tran, et al., 2020).

Study Limitations

The current study was limited by a number of factors. First, while the model pathways in the current study specified a forward causal direction, it is likely that some of these relationships were in fact bidirectional. Indeed, indicators of appetitive goal pursuit are interrelated and can build off one another. For example, activation of goal pursuit draws one's expectations and attention toward appetitive stimuli (Kim, 2013) which, in turn, can lead to positive affect. The reverse can also take place, wherein positive affect becomes a source of informational feedback that promotes further goal pursuit (Orehek et al., 2011).

Additionally, although the sequence of variables presented in each of the mediation models was consistent with the order in which they were measured, this does not guarantee that changes in certain variables took place at the exact time of measurement. For instance, we measured approach motivation and positive affect at the end of the study (i.e., following the social media activity) but did not track changes across these, or the other outcome measures, across multiple time points. Thus, we cannot be certain precisely when changes in these measures took place: it is possible that positive affect became elevated as soon as the social media activity began, and our measure of positive affect represented this early elevation and not one that specifically followed an activated desire to affiliate. A similar concern is that the state

SOCIAL ANXIETY AND SOCIAL PAIN

curiosity measure was collected immediately following the social pain measure, which did not afford a meaningful separation between these time points, thereby limiting our ability to claim that changes in social pain truly occurred before curiosity, as outlined in exploratory model 1.

As well, although our study relied primarily on well-validated measures, some of our measures were unvalidated. For example, by only using a select few items from the State-Trait Curiosity Inventory (Naylor, 1981) to limit participants' response fatigue, we sacrificed our ability to rely on the validity data presented in Naylor (1981) that—with the full scale—would support our claim that this was indeed a valid measure of state curiosity. Moreover, we used unvalidated measures of reward and threat anticipation; however, their psychometric properties and discriminant validity were strong, as outlined in the Supplementary Materials.

The validity of our social pain measure is also an issue worth highlighting. Researchers have conceptualized social pain as a diffuse, negative emotion state involving a combination of anger, fear, sadness, and general upset that arises from an appraisal of having been rejected or hurt by others (Leary et al., 1998). This approach informed how we conceptualized and measured social pain in the present study. Following prior research (Auyeung & Alden, 2016), we measured social pain with the PANAS negative affect subscale in addition to two items assessing rejection and exclusion. Although there is no clear consensus based on psychometric data of the gold standard measurement of social pain, we opted for the approach used in the current study for three reasons: First, the PANAS-N includes items that capture diffuse, negative emotion states that have been suggested to be characteristic of social pain (as per Leary et al., 1998), such as “I feel upset” and “I feel distressed”). Second, the additional two items that measured perceived feelings of having been rejected and excluded directly connect the source of emotional distress to the relational event (Cyberball exclusion). Third, we replicated the

SOCIAL ANXIETY AND SOCIAL PAIN

measurement of social pain utilized by Hudd and Moscovitch (2020), which enables us to follow-up directly on hypotheses preliminarily outlined in that earlier paper.

There were also limitations related to the external validity of this study. First, the nature and degree of social pain generated by the online Cyberball task may not have resembled the pain that individuals tend to experience when their feelings are hurt within their close relationships. Although Cyberball has been shown across multiple previous studies to be a reliable method for eliciting the pain of exclusion and amplifying perceptions of relational devaluation (e.g., Hartgerink, 2015; Hudd & Moscovitch, 2020; Zadro et al., 2006), researchers have suggested that relational devaluation is often even more painful in close relationship contexts or in contexts where the perceived reason for being rejected could hold personally relevant implications (Hudd & Moscovitch, 2021; Leary et al., 1998; Romero-Canyas et al., 2010). Thus, the social pain literature could benefit from future studies that directly capture an individual's in-situ responses to painful interpersonal events and how they might vary as a function relational closeness (e.g., Laws et al., 2017).

The external validity of our study was also limited because participating in the social media game was not optional; therefore, we cannot know for certain whether our findings would generalize to real life social contexts in which people must exert greater personal effort to connect with others. At the same time, we face many social contexts incidentally in our daily lives, without having to make concerted efforts to find and approach others. Indeed, many situations offer social opportunities in which individuals can choose to what extent they will make efforts to affiliate (e.g., checking in for an appointment and choosing to make small-talk with a front-desk employee versus immediately taking a seat in the waiting room). To some extent, this experience is comparable to what participants experienced during the current study.

SOCIAL ANXIETY AND SOCIAL PAIN

Within the social media activity, participants did not have to make a concerted effort to approach the activity because it was non-optional, but they could choose what they wished to write in their social media profile. Future studies of SA may wish to examine how avoidance versus approach goals operate within the range of possibilities for social engagement in any given situation. It is possible, for instance, that reward responsiveness and resulting positive affective experiences may be a stronger predictor of social approach initiation or of the desire to take advantage of new social opportunities that arise (Gable, 2006), whereas threat responsiveness may be a stronger predictor of ‘holding back’ and using subtle avoidance strategies within already-occurring social exchanges (Gray et al., 2019).

It is also essential to note that data from the current study were collected during the global COVID-19 pandemic. During this time, Canadian and American participants would have either recently experienced or were currently experiencing a period of social distancing, which may have affected their desire or motivation to affiliate socially with others.

Future Research and Conclusions

Despite these limitations, results of the present study help to advance our understanding of the mechanisms involved in facilitating social reconnection following exclusion and the factors that may inhibit social repair for individuals with higher levels of trait SA, suggesting fruitful avenues for future research. While the current study focused on social-term outcomes for high SA individuals within the context of a 30-minute experiment, findings suggest the potential importance of future research designed to observe longer-term effects over more prolonged time periods and across various types of socially painful situations. In the long-term, a diminished ability to perceive social rewards and derive positive affect from social situations may produce culminated, downstream losses. These losses could occur at multiple stages, beginning with the

SOCIAL ANXIETY AND SOCIAL PAIN

process of memory encoding. Positive affect has been associated with our ability to more effectively integrate old and new information, which may prompt someone who was recently excluded to contextualize the unpleasant event instead of isolating its meaning as a negative focal point (Zbozinek & Craske, 2017). Beyond encoding, memory retrieval could be impacted as well, as a rewarding interaction following a socially painful event could become an emotionally salient source of retrieval competition against socially painful memories (Brewin, 2006). In other words, anticipating or perceiving pleasurable social rewards soon after a socially painful event may serve to recontextualize or compete with the meaning of the painful event. Because those with high SA display signs of diminished social reward responsivity and positive affect, their socially painful encounters may sustain a more prominent negative impact over time.

In support of this interpretation, some studies have shown that individuals with high SA may carry with them the sustained negative impact of their past socially painful experiences. For example, those with high SA tend to recover their needs more slowly following socially painful events (Zadro et al., 2006) and they tend to draw more self-referential information from socially painful memories and re-experience them in greater detail and with more accompanied distress (Morgan, 2010; Moscovitch et al., 2011, 2018). Some authors have theorized that evidence of high SA individuals' lower baseline reward perception and responsivity may begin with early and repetitive socially painful events (Richey et al., 2019); indeed, animal-based social defeat models indicate that early or persistent social exclusions or "defeats" cause decreases in reward-based neural activation over time (Carlton et al., 2020). Notably, within the SAD literature there is evidence that suggests that memories of early social "defeats" (e.g., bullying, rejection, etc.) are common among those with high SA and can negatively impact current views of self

SOCIAL ANXIETY AND SOCIAL PAIN

(Hackmann et al., 2000; Merrifield, Balk, & Moscovitch, 2013; Park et al., 2017; Pontillo et al., 2019).

It is noteworthy that being assigned to the inclusion condition *and* experiencing higher social pain both predicted higher approach motivation for participants in the present study. At first glance, these findings may seem contradictory since included participants also experienced less social pain overall at the group level. However, we believe these results may point to the mediating roles of negative and positive affect in promoting social approach following exclusion or inclusion, respectively. Specifically, both the pain of exclusion *and* the thrill of inclusion may be involved in promoting social approach motivation in social situations, depending on the nature of the context. Future studies should test the hypothesis that individuals who are less reactive emotionally to either exclusion or inclusion (i.e., those who report lower NA/social pain in response to exclusion or lower PA in response to inclusion) may be less likely to desire further social engagement.

Finally, while some researchers have proposed that social threat blocks socially anxious individuals' ability to recognize rewards and shift into an approach-oriented mindset (Becker et al., 2017; Maner et al., 2012), others have suggested that high SA is associated with dampened social reward responsivity, irrespective of levels of perceived threat. In accordance with the latter perspective, we found that high SA participants experienced dampened social reward responsivity and positive affect, irrespective of their levels of social pain. Therefore, findings support the importance of clinical interventions for SAD that target social anhedonia directly rather than presuming that interventions that succeed at alleviating threat hyperresponsivity will automatically enable socially anxious individuals to have more rewarding social experiences. To this end, clinicians may guide patients to challenge their assumptions and beliefs pertaining to

SOCIAL ANXIETY AND SOCIAL PAIN

low reward drive. Current conceptualizations of SAD emphasize the centrality of negative core beliefs and schemas, such as those that characterize the self as being fundamentally deficient (e.g., unintelligent, incompetent, unattractive) and others as being judgmental and likely to respond harshly if these flaws are exposed for scrutiny (see Moscovitch, 2009). Based on the current findings, it is possible that individuals with SAD also hold assumptions and beliefs that more directly pertain to low reward drive, such as “this social event will be a chore, I will not enjoy talking to anyone.” Although clinicians may typically be drawn to guiding their socially anxious patients to challenge threat-based thought content because anxiety reduction is often the implied target therapy outcome, recent studies have shown that targeting and increasing positive affect experiences directly can promote responsiveness to SAD treatments, improve feelings of social connectedness, and reduce anxiety, stress, low mood and suicidal ideation more effectively than treatments which seek to reduce negative affect alone (Taylor et al., 2017, 2020).

General Discussion

Using experimental methods, these studies extended our knowledge of how social anxiety and social pain, threat sensitivity, and reward sensitivity promote or undermine adaptive coping responses and emotional outcomes when facing threats to social belongingness.

Summary of Findings

Study 1 built upon our understanding of the contexts that can elicit social pain, and the relationship between SA and social pain sensitivity. University of Waterloo undergraduate research participants were recruited ($N = 739$) and randomly assigned to 1 of 9 possible conditions in which they experienced social inclusion or a personal adverse event with or without explicit relational devaluation by recalling a past memory, playing an online game, or imagining a future scenario. Data revealed that social pain indicators were elevated in response to adverse events with or without explicit relational devaluation. Moreover, positive relationships emerged between SA and social pain across all contexts and tasks, including standardized experiences of social exclusion or personal failure (i.e., Cyberball and the anagram failure task).

Study 2 sought to examine whether HSAs' social pain sensitivity would affect how they engage in and benefit from affiliative repair processes. University of Waterloo undergraduate research participants were recruited ($N = 69$) and randomly assigned to be included or excluded during an online game of Cyberball. Participants subsequently engaged in another online social activity with avatars they believed were other participants. Findings revealed that individuals with low SA were significantly more motivated than those with high SA to engage in affiliative repair processes following the pain of exclusion, and that those who responded to the pain of exclusion with greater social approach motivation experienced heightened positive affect. SA did not moderate the relationship between social pain and increased pro-social behaviours ("liking"

SOCIAL ANXIETY AND SOCIAL PAIN

participants in the social media task). As well, while greater engagement in pro-social behaviours was associated with higher levels of approach motivation about a subsequent social interaction, only social approach motivation (but not pro-social behaviours) predicted higher levels of subsequent PA.

Study 3 followed-up on Study 2 by examining whether goal and reward pursuit play a role in promoting affiliative repair, and whether HSAs' dampened reward sensitivity inhibits their engagement or benefit from affiliative repair processes. Study 3 used the same procedures as Study 2 while addressing key limitations: Hypotheses from Study 2 were re-examined in Study 3 using a larger sample size ($N = 452$) and Hayes PROCESS models that were powered to capture proposed moderated mediation effects. As well, participants were drawn from a community sample (Prolific) with greater age, gender, educational, and regional diversity. Data analyses replicated and extended past findings, revealing, first, that participants responded to the pain of exclusion with heightened desire to affiliate and greater downstream positive affect and, second, that this process appears to be driven by increased curiosity and attention to social rewards. While this consecutive mediation effect did not vary across different levels of SA, those with high SA reported lower overall curiosity, reward sensitivity, desire for affiliation, and positive affect, irrespective of their social pain. Furthermore, diminished reward sensitivity accounted for HSAs' low desire for affiliation, whereas heightened threat sensitivity did not.

The Role of *Perceived Threats to Belongingness* in Evoking Social Pain

Results of Studies 1-3 revealed consistently that threats to belongingness reliably cause psychological and emotional distress (MacDonald & Leary, 2005). Relative to being included, social exclusion provoked increased negative affect, threatened needs, and hurt feelings across

SOCIAL ANXIETY AND SOCIAL PAIN

multiple exclusion paradigms, such as recalling or projecting a relational devaluation or being excluded during an online game of catch.

Data from Study 1 also indicated that social pain may become signalled in broader contexts, beyond those that involve explicit forms of relational devaluation. Even when the adverse events did not involve relational devaluation, participants may have imagined potential downstream social consequences. Although Study 1 did not test this hypothesis directly, coded qualitative data revealed that several participants described imagined consequences for their relationships even when they were asked to imagine adverse events that did not involve direct relational devaluation or social losses, such as imagining or experiencing a private failure. Mental time travel is a powerful tool that allows humans to anticipate and act upon future problems (Berntsen & Bohn, 2010); thus, social pain may become signalled in response to projected relational devaluation or loneliness that may result from current private failings even if there was no explicit rupture or one's current state of belongingness. To this end, the "Future Alone" paradigm—a task specifically developed to elicit social pain—provides feedback to participants which suggests they will struggle to connect with others *in the future*, based on results of a false-feedback personality test (Twenge et al., 2001). This task reliably provokes social pain even though participants have not faced any immediate or actual threats to belongingness (Maner et al., 2007; Mead et al., 2011). Indeed, Study 1 participants who imagined future negative relational events experienced elevated social pain levels that were similar to those who recalled or faced actual exclusion.

Social Pain and Goal Pursuit in Affiliative Repair Processes

Collectively, findings from Studies 1-3 underscore the degree to which humans are primed to attend to their current and future states of social belongingness (Baumeister & Leary,

SOCIAL ANXIETY AND SOCIAL PAIN

1995). Theorists suggest relational ruptures are signalled promptly so threatened fundamental needs can be restored (Ferris et al., 2019). In support of this notion, Studies 2 and 3 showed that social pain enhanced participants' pro-social orientation and increased their motivation to seek out social interaction, suggesting that the social pain signal serves an adaptive function for mending threats to belongingness.

Although these findings align with numerous studies that found rejected or excluded participants were more likely to experience increased affiliative motivation and behaviours, relative to those who were socially included (Chester et al., 2016; DeWall et al., 2009; Romero-Canyas et al., 2010), it remains unclear why a recent and painful threat does not instead motivate a desire to retreat and protect oneself from further harm (Kawamoto et al., 2013; Ren et al., 2021). Thus, Studies 2 and 3 examined what leads certain individuals to overcome the desire to withdraw and instead pursue reconnection. Study 2 provided preliminary evidence that affiliative desire in response to social pain may be driven—in part—by reward pursuit, as social approach motivation was associated with downstream heightened PA. Moreover, Study 3 replicated these findings and determined that heightened curiosity and increased social reward perception led to greater desire for affiliation, highlighting the importance of goal pursuit and reward drive in maintaining people's social networks. During social interactions, curiosity promotes affiliative motivations and behaviours (Barber et al., 2021), and this may be especially true following relational devaluation in so far as social exclusion violates expectations of being included. When expectancy violation occurs in this manner, the social pain experience appears to signal and stimulate a need to seek information and resolve the discrepancy between expectations and reality (Wesselmann et al., 2017). According to the PACE framework, curiosity and goal-directed exploration are typically elevated under circumstances in which the prediction error is

SOCIAL ANXIETY AND SOCIAL PAIN

appraised as being sufficiently non-threatening to enable individuals to gain understanding, control, or resolution within the situation (Gruber & Ranganath, 2019). This may explain why increased approach-oriented affiliative behaviours are observed when opportunities for reconnection are perceived to be available and feasible (DeWall & Richman, 2011; Maner et al., 2007), or when individuals are primed to feel powerful and in-control (Narayanan et al., 2013).

How does SA Inhibit Affiliative Repair Processes?

Although Studies 2 and 3 created environments conducive to affiliative repair by providing clear follow-up opportunities to socially reconnect (DeWall & Richman, 2011), trait SA was expected to moderate affiliative repair, such that only those with LSA would respond to the pain of exclusion with heightened social approach motivation. Consistent with this hypothesis, Study 2 demonstrated that at higher levels of social pain, those with low but not high SA experienced heightened social approach motivation.

How might we interpret this interaction effect between SA and social pain in Study 2? One possible interpretation is that HSAs' hyper-sensitivity to social threat cues, and especially to signs of rejection (e.g., Harb et al., 2002; Zimmer-Gembeck et al., 2021), led them to predict they would be excluded in subsequent social interactions. Indeed, across Studies 1-3, HSAs displayed a pattern of heightened social threat sensitivity: They reported higher levels of social pain in response to relational devaluation in Studies 1 and 3¹², and heightened levels of anticipated and perceived social threats during the social media activity in Study 3. However, it is worth noting that the simple effects from the interaction between SA and social pain on social approach motivation in Study 2 revealed that HSAs did not experience a significant *decrease* in

¹² One exception to this pattern emerged, wherein SA did not predict higher social pain in response to Cyberball-induced social exclusion in Study 2. This finding should be interpreted with caution as this correlation was observed within a relatively small sample size of $n = 36$.

SOCIAL ANXIETY AND SOCIAL PAIN

their affiliative desire in response to social pain, which would more clearly indicate threat-withdrawal or avoidance—rather, their affiliative desire remain unchanged, while those with LSA displayed an increase in desire. Additionally, Study 3 revealed a negative relationship between SA and affiliative desire, but higher levels of social pain did not attenuate this relationship. Thus, threat-aversion or heightened threat sensitivity alone may not accurately explain why HSAs exhibited reduced affiliative desire in Studies 2 and 3.

An alternate perspective highlights the role of dampened social reward sensitivity. Study 3 revealed negative relationships between SA, curiosity, and social reward anticipation and perception, and the reward sensitivity variables mediated the relationship between HSA and low social approach motivation (whereas threat anticipation and perception did not). Taken together, Studies 2 and 3 suggest curiosity and reward pursuit play a key role in promoting affiliative drive in the face of threatened belongingness, and HSAs' dampened reward sensitivity may have played a central role in inhibiting their social approach motivation. This interpretation is consistent with results reported by [Maner et al. \(2012\)](#), who found that those with HSA were less likely to become approach-oriented relative to their LSA counterparts after being placed in a position of social power, and this effect was driven by diminished perception of social rewards.

There is continued debate in the SAD literature about whether HSAs' dampened reward sensitivity is merely a by-product of their threat hypersensitivity. In support of this possibility, [Becker, Simon, Miltner, and Straube \(2017\)](#) discovered that those with SAD revealed more inhibited reward processing while under scrutiny, suggesting the looming threat of social evaluation disrupted their ability to feel rewarded when receiving positive feedback. Moreover, [Taylor et al. \(2020\)](#) discovered that experiencing greater levels of PA downregulated HSAs' anticipatory anxiety prior to facing a socially stressful situation. In both studies, threat and

SOCIAL ANXIETY AND SOCIAL PAIN

reward sensitivity interacted to predict SA symptom-related distress and interference.

Conversely, other studies have reported evidence to suggest threat and reward sensitivity are distinctive predictors of SA symptomology. For example, Manning et al. (2015) found widespread functional connectivity deficits in HSA individuals' neural reward centres during resting state, indicating signs of dampened reward sensitivity exist even while threat arousal is low. Moreover, Blay et al.'s (2021) findings suggested low social desire was uniquely related to HSA and not accounted for by the relationship between HSA and elevated avoidance motivations or depressive symptoms. Findings from the current program of research are consistent with the latter pattern of results, suggesting there are circumstances in which hyper-sensitivity to threat and hypo-sensitivity to reward and approach motivation can play distinctive roles in predicting social behaviours and maladaptive outcomes for those with HSA.

Notably, HSA predicted lower affiliative *motivation* in Studies 2 and 3 but did not predict lower affiliative *behaviour* when it was measured in Study 2 (i.e., number of “likes” given during the social media activity). Furthermore, social approach motivation was associated with PA whereas pro-social behaviour was not. These findings may suggest pro-social efforts do not necessarily capture the same underlying motivational processes and emotional outcomes. For instance, participants—especially those with HSA—may have been motivated to conform to the standard of “profile-liking” behaviours displayed by others within the task (Feng et al., 2018; Wasylyshyn et al., 2018), whereas desire to engage in a subsequent one-on-one conversation may have been driven by goal and reward pursuit.

Emotional Benefits of Affiliative Repair and Negative Implications for HSAs

As observed in Studies 2 and 3, affiliative desire in response to heightened social pain led to heightened downstream PA, but those with high trait SA were less likely to access positive

SOCIAL ANXIETY AND SOCIAL PAIN

affective benefits during this affiliative repair process. While these studies focused on immediate, short-term outcomes of affiliative repair, it is likely that diminished access to PA may culminate in long-term consequences for individuals with HSA. First, PA promotes greater desire for social interaction, which, in turn, produces more rewarding experiences and positive emotion (Fredrickson, 1998; Keltner & Haidt, 1999; Whelan & Zelenski, 2012). When HSAs fail to engage in these mood repair and social networking experiences, they also squander opportunities for encoding positive autobiographical memories that enable access to more positive or adaptive self-representations. Strengthening such self-representations may later help to make them more accessible, enabling them to win the retrieval competition against the ubiquitous negative self-representations that are encapsulated within their socially painful autobiographical memories (Brewin, 2006; Moscovitch et al., 2018; Stopa & Jenkins, 2007). Furthermore, PA stimulates cognitive processes that involve higher-level abstraction, cognitive flexibility, and the integration of old and new information (Zbozinek & Craske, 2017). In this vein, those who experience heightened PA in the aftermath of social exclusion by engaging in social interaction with others may ultimately come to appraise themselves more broadly, in a way that takes into consideration both the prior exclusion event and the subsequent positive interaction that serves a mood-balancing reparative function. Conversely, in the absence of a PA-generating reparative experience following a relational devaluation experience, those with HSA may ultimately derive their self-appraisals exclusively from the perceived meaning and consequences of the single, socially painful event in which they were excluded, which may then be encoded as a highly accessible negative event memory.

Further research is needed to examine how dampened PA functions to maintain or worsen SA symptomology, but researchers have made significant progress in developing

SOCIAL ANXIETY AND SOCIAL PAIN

etiologiical frameworks to help us understand why and under which conditions those with HSA may experience social anhedonia in the first place. Richey et al.'s Sensitivity Shift Theory (2019) characterizes social anhedonia as arising from a reinforcement learning process. This theory suggests that early dispositional threat sensitivity (i.e., childhood behavioural inhibition) causes social pain sensitivity and resulting coping strategies that serve to protect these individuals from pain but, over time, dampen low reward drive and approach motivation (Richey et al., 2019). Indeed, those with HSA often report memories of acutely, socially painful events (e.g., bullying, rejection, etc.) (Hackmann et al., 2000; McCabe et al., 2010; Park et al., 2017; Pontillo et al., 2019) that longitudinal studies have connected to the development of future SA symptoms (Zimmer-Gembeck et al., 2021). For HSAs, highly accessible memories of these events carry information about perceived core flaws that inform formation and persistence of negative self-schemas (Conway & Pleydell-Pearce, 2000; Moscovitch, 2009; O'Toole et al., 2016). Moreover, social pain memories are more easily reactivated with accompanied emotion (Chen et al., 2008; Chen & Williams, 2012). Thus, memories of past painful events could motivate HSAs to avoid facing similar pain in the future by using behaviours that keep this pain at a distance, such as impression-management and self-concealment strategies. Unfortunately, these strategies have the unintended outcome of limiting of enjoyment and fulfillment from the encounter (Kashdan, 2007), leading to fewer encoded memories of positive social encounters to inform optimistic expectations for what can be gained from future social encounters (Brewin, 2006; Kashdan et al., 2011). Consequently, activities that initially held high pain expectations also hold low reward expectations; in this way, low reward sensitivity begins to exert a distinctive impact on social approach drive, as observed in the present study.

SOCIAL ANXIETY AND SOCIAL PAIN

Notably, Sensitivity Shift Theory (Richey et al., 2019) theorizes that behaviourally inhibited adolescents will become specifically attuned to social information and social threats. Yet, Study 1 revealed that SA did not uniquely associate with social pain sensitivity within explicitly social, or socially threatening contexts. Instead, higher SA was associated with broader pain sensitivity in response to personal adversity with or without explicit relational devaluation, as well as elevated social pain even in response to social inclusion. HSAs' elevated pain following social inclusion is consistent with Sensitivity Shift Theory (Richey et al., 2019) and past research that has shown HSAs have a tendency to interpret ambiguous or even positive social feedback as threatening (Budnick et al., 2015; Park et al., 2017; Weeks & Howell, 2012). However, Study 1 data produced novel findings that revealed HSAs experience heightened pain within adverse contexts (e.g., solitary task failure) that did not involve explicit primes or exposure to social cues and social relationships. One interpretation of these findings is that individuals with HSA are prone to neuroticism and trait perfectionism, and these underlying or higher-order traits cause broad levels of distress and negative affect, even outside purely social contexts (Newby et al., 2017). In this vein, according to Clark and Watson's (1991) tripartite model, pervasive patterns of heightened negative affect, dampened PA, and amplified physiological hyperarousal can account for symptom interference associated with various mental health disorders, including both SAD and depression (Brown et al., 1998). Thus, HSAs' widespread pain sensitivity may reflect an underlying feature of the tripartite model—such as heightened negative affect or dampened PA—that we would similarly observe in related mental health disorders like depression (Hughes et al., 2006).

Alternately, we may view these findings through a different lens that is consistent with Richey et al.'s (2019) hypothesis that individuals with HSA are especially attuned to social

SOCIAL ANXIETY AND SOCIAL PAIN

information. Those with HSA have a stronger tendency to view themselves as a social object within a social hierarchy (Berger et al., 2017; Weisman et al., 2011), which could lead them to more readily view their personal successes and failures as lost or gained social currency that will determine the status of their relationships (Gilboa-Schechtman et al., 2017). Thus, HSAs may be more likely to attend to social threats (as per Sensitivity Shift Theory; Richey et al., 2019) by imagining downstream consequences for their social relationships even in the aftermath of a private failure when an explicitly relational rupture has not occurred. Moreover, during the process of engaging in future projection (e.g., of social consequences), HSAs may be highly susceptible to negative, personal biases. Schema and attentional biases can impact the ways we encode and recall autobiographical memories, but our perception of past events is still somewhat anchored to external, perceptual stimuli that were present at a specific time and place. A future projection is less anchored to these external features, and may therefore rely on pre-existing schema to imagine events that have yet to take place (Berntsen & Bohn, 2010). HSAs have a tendency to hold generalized, negative self-schemas (Moscovitch, 2009) and thus, they may find personal adversity or failures to be especially painful and catastrophic if they imagine social consequences on behalf of their “flawed” self that is on the precipice of ostracism, unable to withstand any social losses (Aderka et al., 2009).

Future research should investigate why those with HSA experience heightened pain within explicitly social vs. non-social contexts. Furthermore, it would be worthwhile to determine whether maladaptive pain-protection mechanisms HSAs use within social situations occur more pervasively within less explicitly social contexts as well. For example, HSAs’ might exhibit social pain-avoidance behaviours when faced with opportunities to pursue or advance

SOCIAL ANXIETY AND SOCIAL PAIN

their hobbies, interests, or career goals because the imagined potential for failure or ineptitude during learning growth stages results in expectations of pain or low reward potential.

Limitations

Findings from the current program of research must be taken within the context of key limitations across Studies 1-3. To begin, data from Studies 1 and 3 were collected during the global COVID-19 pandemic when participants would have either recently experienced or were currently experiencing a period of social distancing and increased social engagement through technology and online interactions. In a similar vein, Studies 1-3 were conducted within an online setting. This approach was necessary as the University of Waterloo implemented safety protocol during the COVID-19 pandemic that disallowed in-person data collection. While online data collection afforded opportunities to collect larger data samples to power mediation analyses in Study 3, and several between-condition comparisons in Study 1, the online format also imposed constraints on the external validity of studies within this program of research.

To begin, the online paradigms used to elicit social pain across Studies 1-3—including Cyberball and autobiographical writing and future projection imaginal exercises—are well-established and reliable means of provoking social pain and affiliative motivations and behaviours (DeWall, 2006; Hartgerink et al., 2015; Zadro et al., 2006). Yet, the social pain generated within online settings and between strangers may not mimic the nature or degree of hurt experienced in relationships where there may be greater perceived consequences for relational ruptures. Indeed, affiliative repair processes are more likely to occur in contexts where relational devaluation is perceived to hold greater personal implications (for example, by threatening a self-defining feature of the rejected person) (Romero-Canyas et al., 2010). However, the pattern of findings observed in Studies 2 and 3 (e.g., the association between the

SOCIAL ANXIETY AND SOCIAL PAIN

pain of exclusion and heightened affiliative drive) aligns with similar findings reported by studies that adopted in-person, peer-to-peer methods of relational devaluation, such as partner preference paradigms whereby the participant is rejected vs. chosen as a partner for an upcoming task (e.g., Maner et al., 2007; Narayanan et al., 2013). Even so, the mechanisms within the current program of research should continue to be closely studied within intimate relationships and how coping responses might vary as a function of relational closeness. Furthermore, online interactions may be less anxiety-provoking for those with high SA (Yen et al., 2012). Indeed, Studies 1-3 may have protected participants from exposing some of the self-perceived deficits that fuel their SA symptoms, such as negative beliefs about their physical appearance (Moscovitch, 2009). Yet, other procedures that asked participants to engage in self-disclosure (e.g., during Cyberball and the social media profile sharing activity) may have elicited fears related to exposing insufficient social competence or likeability (Moscovitch, 2009). Overall, HSAs displayed characteristic signs of their symptom features across Studies 1-3, including heightened social pain and threat sensitivity, but it is possible that these responses were different or at least weaker than those we might observe within in-person contexts with actual face-to-face interaction partners.

The standardized and controlled nature of experimental paradigms across Studies 1-3 may have also constrained the external validity of participants' behavioural responses to social engagement opportunities following exclusion. For instance, study tasks and procedures were non-optional and opportunities for reconnection required minimal activation energy. It is possible that desire for continued social engagement would deteriorate in contexts that require more personal effort on behalf of the individual. Studies 1-3 created circumstances where social opportunities were readily available but, in their absence (i.e., when such opportunities required

SOCIAL ANXIETY AND SOCIAL PAIN

greater efforts), an excluded individual may consider withdrawal and intrapersonal emotion regulation to be a more efficient and attractive coping response (Ren et al., 2021), especially for those with HSA. Future studies may wish to examine how SA moderates a range of coping responses (aggressive, affiliative, withdrawal) when they are perceived to be equally available.

Another limitation worth noting for Studies 2 and 3 is that while the regression model pathways implied or specified forward causal links (e.g., social pain → approach motivation → PA), some relationships may have been bidirectional. In particular, reward and goal pursuit may build off each other in an iterative, cyclical process. For instance, approach-orientation promotes goal pursuit and reward sensitivity (Maner et al., 2012; Min & Kim, 2013) which, in turn, can lead to positive affect that promotes further encouragement toward goal pursuit (Orehek et al., 2011). Moreover, model pathways in Study 3 represented the order in which each included factor was measured, but without repeated measures to track changes over time, we have limited certainty that changes in these factors took place at the time of measurement.

It is also essential to revisit the validity of social pain measures used across Studies 1-3, and how social pain is defined and captured in the broader literature. In accordance with the extant literature, we conceptualized social pain as a combination of emotional distress and cognitive appraisals about one's compromised state of social belongingness (Eisenberger, 2012; Leary et al., 1998; Riva et al., 2011). However, social pain is a construct that is not yet fully understood. In its early stages, researchers conceptualized social pain as a response to social rejection, criticism, or imagined loss of social relationships. Yet, emerging data support the notion that affective and neurological response patterns once defined as a social pain response are activated more broadly, in response to threatened self-esteem and not just threatened

SOCIAL ANXIETY AND SOCIAL PAIN

belongingness and relational devaluation. For instance, Perini et al. (2018) demonstrated that the same neurological pathways that are stimulated when individuals are rejected or excluded also become activated when people receive any sort of feedback about themselves (regardless of valence). Therefore, the social pain literature could benefit from studies that continue to investigate the nature and boundaries of social pain and the social and or self-esteem threatening contexts in which it is elicited. One approach may involve building on methods and procedures used in Study 1, by comparing changes in neurological response patterns across situations that vary the salience and immediacy of perceived belongingness threats (e.g., comparing private task failures to explicit, peer-to-peer rejections) and assessing associated self-report measures of threat appraisals and affect.

Finally, while this program of research studied the role of trait SA for predicting factors involved in social pain and affiliative repair processes, this does not presume SA plays a more significant role in these processes than other personal characteristics or trait-like features. Focusing on the moderating effects of SA allowed me to examine how and why this group of individuals struggle to maintain or benefit from their social networks so I could build upon known SAD symptom mechanisms and associated treatment approaches. However, mechanisms observed in the current program of research could be used to predict outcomes for other known dispositional traits that display aberrant levels of social pain, threat, or reward sensitivity. For instance, dispositional qualities that promote indifference or security in one's social network have been found to inhibit social pain (Hermann et al., 2014; Wirth et al., 2010), which may predict lower engagement with and benefit from affiliative repair processes.

Clinical Implications

Consistent with evidence that HSA individuals struggle with both amplified social avoidance and dampened social approach motivations (Blay et al., 2021), findings from the current program of research suggest that threat and reward sensitivity can each impact repair mechanisms that may inhibit belongingness and well-being for those with HSA, and that each should be targeted in treatments for SAD.

Those with HSA often set social and interpersonal goals that are oriented toward preventing negative outcomes in social situations (e.g., conceal flaws, avoid negative relational outcomes, and downregulate negative affect) as opposed to promoting rewarding social experiences such as connection and bonding (Aderka et al., 2009; Weisman et al., 2011). Chronically setting one's goals toward threat-prevention may limit positive affect experiences that align with reward pursuit or promotion-focused goals (Klenk et al., 2011). Therapists may inadvertently maintain HSAs' prevention and threat-focus during cognitive behavioural therapy (CBT) skills training for SAD. For instance, it is often recommended that therapists challenge threat perceptions during cognitive restructuring (Koerner et al., 2013) and ask clients to identify their negatively-biased predictions before engaging in a behavioural experiment to assess whether the outcome was less catastrophic and intolerable than expected (Bennett-Levy, 2004; Hofmann & Scepkowski, 2006). These goals reflect a prevention-focused lens (Higgins, 1998), wherein those with SAD are guided to attend to internal and external threat cues to challenge their presence and impact. While this approach can promote new learning and symptom reduction, it does not teach HSAs how to develop promotion goals and monitor social reward cues that can facilitate connection and increase positive emotions (Barber et al., 2021).

SOCIAL ANXIETY AND SOCIAL PAIN

CBT that is delivered from a promotion-focused lens might ask clients to devise behavioural experiments that seek to maximize opportunities for social and emotional rewards, including humour, fun, and building social relationships with others, while challenging their biased predictions about the low likelihood of attaining such outcomes. A promotion-focused process could explicitly draw clients' attention to reward cues by increasing reward anticipation in ways that HSAs may struggle to achieve on their own. Without explicit training, memories of positive social feedback tend to become impoverished and less accessible for those with HSA over time (Glazier & Alden, 2019; Romano, Tran, et al., 2020). Thus, without guidance, individuals with HSA may find it difficult to retrieve positive social memories and visualize socially rewarding mental imagery when anticipating future social encounters, reducing the likelihood that they will subsequently search for and recognize external reward cues. Moreover, HSAs may benefit from guidance to help them savour and internalize social rewards once they have been recognized. For instance, in Alden et al. (2004), HSAs reported higher levels of anticipatory anxiety when they were told they achieved positive outcomes on a social performance task (relative to feedback that they avoided negative outcomes). Positive feedback is often misaligned with HSAs' sense of self and this can be threatening for them, as the misalignment may be interpreted as a sign that they are being lied to, placated with false feedback, or that the feedback was based on an exceptional performance they will be unable to replicate, leading to future disappointment (Budnick et al., 2015; Koban et al., 2017). To this end, HSAs may benefit from novel treatment approaches that seek to conjure positive memories and then connect the meaning and outcome of these events to positive, enduring features of the self (Young et al., 2017).

SOCIAL ANXIETY AND SOCIAL PAIN

Indeed, recently published intervention studies that used treatment protocol seeking to directly enhance positive affect and approach motivation were effective at alleviating social anxiety symptoms. In [Taylor et al., \(2020\)](#), participants with clinically impairing anxiety and depression who engaged in Amplification of Positivity (AMP) protocol experienced greater social connectedness, positive affect, and reduced negative affect at post-treatment and 6-month follow-up, relative to waitlist controls. The AMP protocol included several PA enhancement strategies that are not delivered within traditional CBT protocols, such as gratitude exercises, performing acts of kindness, and engaging in a process of recognizing and savouring positive events. Additionally, [Alden et al., \(2018\)](#) found that participants with SAD who were assigned to focus on interpersonal processes and eliminating interpersonal safety behaviours experienced greater post-treatment relationship satisfaction relative to those who were assigned to a gradual exposure and anxiety-monitoring protocol. There may be additional ways to further refine these PA and social approach-enhancing treatment approaches. For instance, psychoeducation about what it looks and feels like to engage in goal-setting within a loss vs. gain-oriented mindset may help HSA clients to build an improved awareness of their motivations.

The current program of research also highlights the utility of emotion-focused treatment for SAD. The social pain literature describes social pain coping responses as implicit and automatic (Eisenberger, 2012; MacDonald & Leary, 2005). However, psychoeducation about the role and function of emotions such as social pain could allow individuals to recognize and respond more deliberately to their emotions in a manner that services their needs more effectively (Haberman et al., 2019). This could be especially impactful for HSAs who often try to avoid or suppress their emotions (Kashdan et al., 2014), or hold negative beliefs about the presence and function of fear, anxiety, and other distress-related emotions that are common in

SOCIAL ANXIETY AND SOCIAL PAIN

SAD (Levin et al., 2017). Indeed, Emotion-Focused Therapy (EFT) can effectively reduce SA symptoms by evoking and transforming shame into other emotions, such as anger, sadness, or compassion (Shahar, 2013, 2020). Shame may follow or coincide with social pain if an individual attributes a relational rupture and/or loss of relational value to fundamental flaws that exist within themselves, especially flaws that deviate from what is morally valued and upheld in one's sociocultural context (see Moscovitch, 2009). Thus, EFT or other therapies which activate memories imbued with shame—especially those that involve relational ruptures—may help HSA individuals to recognize their shame-avoidant responses to social pain and instead shift toward compassionate or assertive responses that may better serve their compromised need to feel seen and valued (Romano, Hudd, et al., 2020; Shahar, 2020).

Conclusion

The quality of one's social networks significantly impacts their mental and physical health (Beller & Wagner, 2018; Lim et al., 2016). As such, it is important to find effective ways to restore the need for social belongingness when it becomes compromised through experiences of rejection, exclusion, criticism, or personal failure. Theoretical models of SAD suggest symptoms worsen over time as individuals excessively focus on avoiding negative social outcomes and decrease their efforts to maximize positive social connections (Richey et al., 2019), resulting in biases within threat and reward motivational systems. The current program of research investigated how biases within each of these motivational systems separately and synergistically impact the extent to which HSA individuals will engage with and benefit from affiliative coping mechanisms and repair efforts that hold the potential to restore belongingness. While HSAs displayed a consistent pattern of social pain and threat sensitivity across tasks that evoked relational devaluation as well as personal non-relational failures, their dampened reward

SOCIAL ANXIETY AND SOCIAL PAIN

sensitivity played a distinct role in limiting their desire for social reconnection and downstream experiences of reparative positive affect. These data support a variety of clinical interventions that use a multi-pronged approach to address maladaptive patterns within the threat-avoidance and reward-approach motivational systems to ameliorate threat- and reward-based symptoms of social anxiety.

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SOCIAL ANXIETY AND SOCIAL PAIN

Appendices

Table S1. <i>Bivariate Correlations Between Outcome Variables for Each Condition Separately During Past Memory Recall Task</i>	179
Table S2. <i>Bivariate Correlations Between Outcome Variables for Each Condition Separately During Online Games Task</i>	180
Table S3. <i>Bivariate Correlations Between Outcome Variables for Each Condition Separately During Future Projection Task</i>	181
Table S4. <i>Bivariate Correlations Between Study Variables</i>	182
Table S5. <i>Descriptive Statistics [M (SD)] for Measures Within and Between Conditions</i>	183
Table S6. <i>Correlations Between Study Measures Averaged Across Conditions</i>	184
Table S7. <i>Correlations Between Study Measures Within Each Condition</i>	185
Appendix A. <i>Development and Discriminant Validity of Social Reward and Threat Scales</i>	186

SOCIAL ANXIETY AND SOCIAL PAIN

Table S1.

Bivariate Correlations Between Outcome Variables for Each Condition Separately During Past Memory Recall Task

Past Memory Recall						
Explicit Relational Devaluation						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.82**	1	-	-	-	-
3	.32**	.35**	1	-	-	-
4	.44**	.44**	.32**	1	-	-
5	.51**	.47**	.63**	.54**	1	-
6	.45**	.37**	.63**	.46**	.80**	1
Without Explicit Relational Devaluation						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.82**	1	-	-	-	-
3	.69**	.71**	1	-	-	-
4	.55**	.67**	.48**	1	-	-
5	.58**	.64**	.66**	.62**	1	-
6	.61**	.62**	.67**	.60**	.69**	1
Social Inclusion						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.69**	1	-	-	-	-
3	.16	.23*	1	-	-	-
4	.40**	.53**	.52**	1	-	-
5	.58**	.64**	.45**	.65**	1	-
6	.62**	.59**	.59**	.68**	.80**	1

Note. ** $p < .001$, * $p < .05$. SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

SOCIAL ANXIETY AND SOCIAL PAIN

Table S2.

Bivariate Correlations Between Outcome Variables for Each Condition Separately During Online Games Task.

Online Games						
Explicit Relational Devaluation						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.71**	1	-	-	-	-
3	.41**	.40**	1	-	-	-
4	.61**	.48**	.41**	1	-	-
5	.51**	.59**	.36**	.44**	1	-
6	.34**	.37**	.37**	.45**	.71**	1
Without Explicit Relational Devaluation						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.62**	1	-	-	-	-
3	.10	.03	1	-	-	-
4	.54**	.43**	.21	1	-	-
5	.47**	.37**	.25*	.54**	1	-
6	.38**	.31**	.53**	.42**	.67**	1
Social Inclusion						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.65**	1	-	-	-	-
3	.24*	.26*	1	-	-	-
4	.53**	.31**	.24*	1	-	-
5	.59**	.66**	.54**	.46**	1	-
6	.41**	.36**	.46**	.40**	.72**	1

Note. ** $p < .001$, * $p < .05$. SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

SOCIAL ANXIETY AND SOCIAL PAIN

Table S3.

Bivariate Correlations Between Outcome Variables for Each Condition Separately During Future Projection Task.

Future Projection						
Explicit Relational Devaluation						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.70**	1	-	-	-	-
3	.30*	.23	1	-	-	-
4	.62**	.59**	.29*	1	-	-
5	.58**	.64**	.46**	.50**	1	-
6	.43**	.53**	.60**	.51**	.79**	1
Without Explicit Relational Devaluation						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.55**	1	-	-	-	-
3	.50**	.19	1	-	-	-
4	.46**	.23	.32*	1	-	-
5	.51**	.34**	.76**	.45**	1	-
6	.51**	.33**	.69**	.42**	.74**	1
Social Inclusion						
	1. Rejection-exclusion	2. Hurt feelings	3. SF-MPQ	4. NTS	5. PANAS-N	6. STICSA-S
1	1	-	-	-	-	-
2	.88**	1	-	-	-	-
3	.62**	.73**	1	-	-	-
4	.74**	.59**	.50**	1	-	-
5	.70**	.72**	.62**	.60**	1	-
6	.72**	.68**	.69**	.66**	.77**	1

Note. ** $p < .001$, * $p < .05$. SF-MPQ: Short-Form McGill Pain Questionnaire; NTS: Needs-Threat Scale; PANAS-N: Positive and Negative Affect Schedule; STICSA-S: State-Trait Inventory of Cognitive and Somatic Anxiety.

SOCIAL ANXIETY AND SOCIAL PAIN

Table S4.

Bivariate Correlations Between Study Variables

Across Conditions					
	1	2	3	4	5
1. Trait SA					
2. Approach Motivation	-.22				
3. Approach Behaviour	-.16	.35**			
4. Social Pain	.12	.14	.21		
5. Positive Affect	.05	.42**	.19	.38**	
6. Condition	.11	-.04	-.28*	-.45**	-.17
Within Control Condition (n = 33)					
1. Trait SA					
2. Approach Motivation	-.18				
3. Approach Behaviour	-.31	.44**			
4. Social Pain	.51**	-.28	-.01		
5. Positive Affect	.17	.40*	-.01	-.03	
Within Exclusion Condition (n = 36)					
1. Trait SA					
2. Approach Motivation	-.11				
3. Approach Behaviour	-.11	.30			
4. Social Pain	.00	.37*	.15		
5. Positive Affect	-.01	.44**	.23	.50**	

Note. The exclusion condition was coded as 0 and the control condition as 1. Approach and affect variables were measured in the following sequence: 1) Social pain (post-Cyberball task); 2) approach behaviour and motivation (post-social media task); and 3) positive affect at the end of the study.

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

SOCIAL ANXIETY AND SOCIAL PAIN

Table S5.

Descriptive Statistics [M (SD)] for Measures Within and Between Conditions

	Inclusion M (SD)	Exclusion M (SD)	Total M (SD)
Trait Measures			
Social Anxiety	26.21 (14.77) ^a	26.70 (15.30) ^a	26.44 (15.01)
Depression	17.17 (6.82) ^a	17.27 (6.57) ^a	17.22 (6.69)
Outcome Measures			
Social Pain	19.42 (6.53) ^a	25.89 (8.48) ^b	22.51 (8.18)
Curiosity	14.39 (3.70) ^a	14.88 (3.89) ^a	14.63 (3.80)
Ant. Reward	29.44 (10.63) ^a	27.71 (11.03) ^a	28.61 (10.85)
Perc. Reward	33.90 (9.99) ^a	32.75 (10.09) ^a	33.35 (10.04)
Ant. Threat	19.78 (11.08) ^a	22.30 (10.64) ^b	20.98 (10.93)
Perc. Threat	14.62 (8.51) ^a	15.49 (8.90) ^a	15.04 (8.70)
Approach Mot.	19.09 (10.13) ^a	18.48 (10.03) ^a	18.80 (10.08)
Pos. Affect	63.30 (22.93) ^a	62.38 (24.31) ^a	62.86 (23.58)

Note. Within-condition values with different superscripts differ significantly from one another.

SOCIAL ANXIETY AND SOCIAL PAIN

Table S6.

Correlations Between Study Measures Averaged Across Conditions

	1	2	3	4	5	6	7	8	9	10
1. Condition	-	-	-	-	-	-	-	-	-	-
2. Social Anxiety	.02	-	-	-	-	-	-	-	-	-
3. Depression	.01	.56**	-	-	-	-	-	-	-	-
4. Social Pain	.40**	.34**	.29**	-	-	-	-	-	-	-
5. Curiosity	.07	.00	-.03	.30**	-	-	-	-	-	-
6. Ant. Rewards	-.08	-.34**	-.31**	.01	.35**	-	-	-	-	-
7. Perc. Rewards	-.06	-.22**	-.22**	.06	.39**	.72**	-	-	-	-
8. Ant. Threats	.12*	.52**	.39**	.40**	.02	-.42**	-.30**	-	-	-
9. Perc. Threats	.05	.42**	.36**	.42**	.05	-.18**	-.29**	.63**	-	-
10. Approach Mot.	-.03	-.26**	-.17**	.09	.30**	.67**	.67**	-.34**	-.19**	-
11. Pos. Affect	-.02	-.30**	-.30**	.11*	.33**	.61**	.58**	-.30**	-.14**	.69**

Note. ** $p < .001$, * $p < .05$.

SOCIAL ANXIETY AND SOCIAL PAIN

Table S7.

Correlations Between Study Measures Within Each Condition

Exclusion Condition	1	2	3	4	5	6	7	8	9
1. Social Anxiety	-	-	-	-	-	-	-	-	-
2. Depression	.53**	-	-	-	-	-	-	-	-
3. Social Pain	.34**	.34**	-	-	-	-	-	-	-
4. Curiosity	.01	-.07	.23**	-	-	-	-	-	-
5. Ant. Rewards	-.31**	-.35**	.02	.31**	-	-	-	-	-
6. Perc. Rewards	-.15*	-.26**	.11	.37**	.69**	-	-	-	-
7. Ant. Threats	.48**	.37**	.35**	.01	-.43**	-.31**	-	-	-
8. Perc. Threats	.37**	.34**	.43**	.01	-.21**	-.33**	.66**	-	-
9. Approach Mot.	-.24**	-.19**	.20**	.31**	.64**	.65**	-.29**	-.18**	-
10. Pos. Affect	-.27**	-.31**	.17**	.33**	.55**	.55**	-.22**	-.13	.69**
Inclusion Condition	1	2	3	4	5	6	7	8	9
1. Social Anxiety	-	-	-	-	-	-	-	-	-
2. Depression	.59**	-	-	-	-	-	-	-	-
3. Social Pain	.38**	.30**	-	-	-	-	-	-	-
4. Curiosity	-.01	.01	.35**	-	-	-	-	-	-
5. Ant. Rewards	-.37**	-.27**	.06	.40**	-	-	-	-	-
6. Perc. Rewards	-.29**	-.18**	.08	.42**	.75**	-	-	-	-
7. Ant. Threats	.56**	.42**	.44**	.01	-.39**	-.29**	-	-	-
8. Perc. Threats	.46**	.38**	.45**	.08	-.15*	-.24**	.60**	-	-
9. Approach Mot.	-.28**	-.15*	.04	.30**	.70**	.69**	-.38**	-.20**	-
10. Pos. Affect	-.33**	-.30**	.09	.32**	.66**	.61**	-.38**	-.16*	.69**

Note. ** $p < .001$, * $p < .05$.

Appendix A.

Development and Discriminant Validity of Social Reward and Threat Scales

Social reward items were created to reflect the degree to which participants felt they would or did share common social goals with others in the social media activity, and the degree to which they enjoyed interacting with them (McCollum, 2005). Social rewards have been conceptualized as rewards that can be attained across a broad set of social goals, such as achieving dominance or leadership, being perceived as sexually attractive, or even manipulating or coercing others (Foulkes et al., 2014). However, items in the scales devised for the current study largely reflected a subset of goals that were most relevant to the study aims, which were to examine how people respond within a context that threatens their sense of belongingness. Thus, the reward items were based on goals related to affiliation, acceptance, belongingness, popularity, and having fun with others (Foulkes et al., 2014). For instance, items included statements such as *“I felt good sharing information about myself with others,” “I discovered that I shared common interests with other participants,” “Based on my profile, other participants probably thought positively of me.”* Alternately, social threat items captured the degree to which the social environment was expected or perceived to be hostile and unaccepting, or signifying that the respondent was devalued or treated like an “outsider,” or like they did not belong. For instance, items included statements such as *“Sharing information about myself made me feel inferior to others,” “I felt like an outsider during this task,” “Based on my profile, other participants probably thought poorly of me.”*

We had reason to believe evaluations of social reward and threat would present as related but distinct constructs. Reinforcement Sensitivity Theory (RST) describes reward and threat

SOCIAL ANXIETY AND SOCIAL PAIN

responsivity as a result of interactive but ultimately orthogonal systems (Corr, 2002), a conceptualization which has been supported with experimental data (Berkman et al., 2009).

In the present study, we examined the discriminant validity of our reward and threat scales by conducting two exploratory factor analyses (EFAs) – one on the anticipated reward and threat items, and one on the perceived reward and threat items – and by comparing the strength of alpha coefficients when reward items were left separate vs. combined with threat items. To ensure reliability estimates were not due to response demands from the timing and visual presentation of items, we presented reward and threat items to participants simultaneously (i.e., on the same web page) and amalgamated with each other in random order.

The EFAs and reliability data suggested that the reward and threat anticipation and perception measures should be treated as separate constructs. We used Principal Axis Factoring and a promax rotation for each EFA. Items in both analyses tended to cluster such that reward items were more closely related to each other than threat items, and vice versa. Visual examination of the scree plot and eigenvalues suggested a two-factor solution for both the *anticipated* and *perceived* measures. We followed up on the visual data by performing a minimum average partial (MAP) test to determine the most appropriate estimate of the number of observable factors (O'Connor, 2000). The MAP test results suggested a 2-factor solution for both the anticipated and perceived measures. A composite measure combining the reward and threat anticipation items together yielded a reliability of $\alpha = .63$. Similarly, the composite measure combining the reward and threat perception items yielded a reliability of $\alpha = .67$. In contrast, when the reward and threat items were arranged into separate measures, internal reliability noticeably increased, ranging from .85 to .92 across all four measures. Finally, correlations between anticipated and perceived reward measures with anticipated and perceived

SOCIAL ANXIETY AND SOCIAL PAIN

threat measures were significant but not strong enough (ranging from $r = -.18$ to $-.42$) to suggest the reward and threat variables represented overlapping constructs.