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The relationship between fear of social and physical threat and its effect on social distress and physical pain perception

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ABSTRACT

Past research has found that measuring individuals' fear of pain predicts their physical pain perceptions: those reporting higher levels of fear of pain report higher levels of pain. We investigated links between fear of social threat and fear of physical pain, testing whether these fears predict responses to social distress and physical pain. In 3 studies, we found that fear of social and physical threat were related yet distinct psychological constructs (study 1), that fear of social (but not physical) threat predicted the perception of social distress (study 2), and that fear of physical (but not social) pain predicted the perception of physical pain (study 3). Thus, we found that, similar to the influence of fear of physical pain on physical pain perception, fear of social threat moderated the perception of social distress. However, we also found that these effects were specific, such that each type of fear uniquely predicted the experience of the same type of distress. We argue that timely identification of high levels of social threat-related fear is critical for identifying individuals who will benefit most from preventative interventions aimed to limit negative cycles of high avoidance and increased social threat perception. Furthermore, our work sets a boundary condition to pain overlap theory by showing that high levels of fear of one type of pain (e.g., social) are specifically linked to increased perception of that particular type of pain (e.g., social) but not the other (e.g., physical).

1. Introduction

The observation that social distress activates some of the brain regions known to be associated with the experience of physical pain gave rise to pain overlap theory [11–13,26], according to which a system that uses similar signals for social separation and physical damage may have been evolutionarily advantageous [26]. Although the need for a more cautious interpretation was recently advised [21], data that show activation in the so-called pain matrix in response to social distress nevertheless suggests new testable hypotheses about potential relationships between physical pain and social distress. For instance, research showed that physical pain and social distress can cause similar psychological consequences [36].

Here, we turn our attention to the possible overlapping factors that might explain interindividual variability of both social distress and physical pain. We argue that the key role of cognitive and emotional processes related to the subjective experience of physical pain may be important for the perception of social distress as well. In particular, fear of threat may be a common factor explaining interindividual differences in the experience of physical pain and social distress. In the context of physical pain, despite the key role of fear of pain in promoting the individual's safety and survival, theorists suggested that high levels of fear of pain can be detrimental [2]. Accordingly, several experiments found that physical pain-related fear (assessed by the Fear of Pain Questionnaire [29]) was a consistently stronger predictor of pain perception compared to other predictors [16,19].

However, a generic fear of pain may not necessarily account for the specific reactions to the 2 experiences. In keeping with this reasoning, hierarchical structural models of fears [42,43] posit there is a hierarchy of general and specific mechanisms that affect one's tendency to develop fears. General factors, such as neuroticism, relate to the acquisition of most fears, whereas specific factors are particular to a given type of stimulus (e.g., spiders). Therefore, fear of specific kind of threat (e.g., social) should be distinct (albeit associated) from other threat-related fears (e.g., fear of physical pain).

Our aim was to investigate the relationship between fear of social and physical threat and to test whether fear of social threat influences the reactions to social distress in a similar way in which fear of physical pain influences the reactions to physical pain.

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Specifically, the current set of studies was designed to test the following predictions. As hypothesis 1, we hypothesized that fear of social threat is related to, yet distinct from, fear of physical pain. That is, individuals with high fear of social threat should also exhibit high fear of physical pain, but these 2 constructs should be empirically distinguishable (study 1). As hypothesis 2, we hypothesized that, similar to the influence of fear of physical pain on the perception of physical pain, fears of social threat should exacerbate perception of social distress (study 2). Finally, as hypothesis 3, we hypothesized that individuals high in fear of one type of threat would report increased distress perception from being subjected to that type of distress than the other type (studies 2 and 3).

2. Study 1

In study 1, we examined the degree of overlap between fear of social and physical threat. We predicted that fear of social threat and fear of physical pain would factor separately, and these factors would be positively correlated (hypothesis 1). We also examined the degree to which fear of social threat might overlap with other constructs that would be expected to be conceptually associated with it. More specifically, we examined the relationship of fear of social threat and fear of physical pain as they overlapped with rejection sensitivity (e.g., the tendency to anxiously expect, readily perceive, and overreact to social rejection [10]), pain catastrophizing (e.g., cognitions of ruminating on negative outcomes resulting from the experienced pain, thinking pain is unbearable, and the inability to tolerate painful situations [16,19,40]), anxiety [32], depression [38], loneliness [29], and items related with past experiences of social distress and physical pain. The latter were included to investigate links between past experiences of social distress and physical pain and current levels of fears [3,9,22,24].

2.1. Methods

2.1.1. Participants

Four independent samples were recruited for study 1. This methodological choice was adopted because our focus was on the relationships between the fear of social and physical threat and each of the considered concurrent constructs, rather than on the full matrix of relationships among all the measures. In this way, we avoided overloading the participants with a large number of items and avoided possible distortions in the correlation coefficients resulting from specific characteristics of a single sample.

Our samples comprised 272 participants (135 female subjects; mean age 19.48 years, standard deviation [SD] 2.92) for sample 1, 111 participants (38 female subjects; mean age 19.56 years, SD 1.53) for sample 2; 113 participants (42 female subjects; mean age 19.48 years, SD 1.55) for sample 3, and 146 participants (90 female subjects; mean age 19.36 years, SD 3.76) for sample 4. All participants were students at Purdue University who participated in this study as part of a course requirement.

2.1.2. Procedures and materials

Each participant in every sample completed a written informed consent form, a brief demographic questionnaire, and the Fear of Social Threat Scale and the Fear of Pain Questionnaire, along with a number of additional measures.

Fear of Social Threat Scale. Given that no fear of social threat assessment currently exists, we drew on the item structure of the Fear of (physical) Pain Questionnaire [30] and constructed a 15-item self-report scale that incorporated a variety of instances of social threatening events. These instances included feeling socially excluded [1], ostracized [45,46], humiliated [17,33], betrayed [15], interpersonally devalued [23], and verbally abused (i.e., being harmed by others with words [7]). For item reduction, a pilot study was conducted to identify a set of items from the 25 items initially generated. Forty-five students (21 women; 19.76 years, SD 2.34) at Purdue University took part in a preliminary study to exchange course credits. Ten items were dropped from the original set of 25 items. Specifically, 3 items were removed because they demonstrated a ceiling effect, and the remaining 7 items were dropped because of conceptual overlap and varying degrees of redundancy with the content in other items. The final Fear of Social Threat Scale consisted of 15 items, with 4 items related to relational devaluation (e.g., "your partner forgetting your birthday"), 3 items related to ostracism (e.g., "feeling ignored by someone who is important to you"), 2 items related to rejection (e.g., "being left out of a group"), 2 items related to betrayal (e.g., "being betrayed by someone who is important to you"), 2 items related to humiliation (e.g., "being embarrassed in front of your classmates by your professor"), and 2 items related to verbal abuse (e.g., "being verbally abused by your boss"). Our primary aim was to build a short scale that could provide a valid and reliable index of fear of social threat and be comparable to the overall score of the Fear of Pain Questionnaire.

Fear of Pain Questionnaire. The FPQ-III is a 30-item self-report instrument measuring fear of a variety of physical pain-related stimuli [30]. For the purposes of the present study, we used a shorter version of the Fear of Pain Questionnaire. We selected 9 items, retaining the 3 items that in the original validation study [30] showed the highest factor loadings on each of the 3 domains of the Fear of Pain Questionnaire (the same procedure for item selection has been previously adopted; e.g., [6]). Considering the aims of the present investigation, we focused more on obtaining a brief measure of the construct of fear of physical pain in order to compare it with fear of social threat rather than on distinguishing its specific subdimensions (e.g., severe pain, minor pain, medical pain).

For sample 1, participants completed a questionnaire that included a set of items developed to assess fear of social threat (α = .943) and a subset of items taken from the Fear of Pain Questionnaire (α = .833) [30]. The items used for both scales can be seen in the Supplementary Appendix. For sample 2, the questionnaire package included the 15-item Fear of Social Threat Scale (α = .940), the 9-item subset of the Fear of Physical Pain Scale [30] (α = .850), and the Rejection Sensitivity Questionnaire [10] (α = .827). Sample 3 completed the 15-item Fear of Social Threat Scale (α = .921), the 9-item subset of the Fear of Physical Pain Scale (α = .848), and the Pain Catastrophizing Scale [39] (α = .916). Finally, participants in sample 4 were asked to complete the 15-item Fear of Social Threat Scale (α = .946), the 9-item subset of the Fear of Physical Pain Scale (α = .846), the Beck Anxiety Inventory [4] (α = .916), the Beck Depression Inventory [5] (α = .874), the 3-item Scale for Measuring Loneliness [20] (α = .832), and 2 sets of ad-hoc composed indexes regarding past experience of social (α = .747) and physical (α = .878) pain. The 3 items for the Past Experience of Social Distress Index were: "In the past, people have not been there to give me warmth, comfort, and affection"; "In the past, I often felt excluded and ignored"; and "In the past, I haven't felt that I am special to someone." The 3 items for the Past Experience of Physical Pain Index were: "In the past, I have suffered a lot from illness and injury"; "In the past, I have suffered much physical pain"; and "In the past, I often had pain in my body." Responses to all these items were recorded on a 1 ("Completely untrue of me") to 7 ("It describes me perfectly") scale and were averaged together to create the 2 overall indexes. For each sample, the order of the presentation of scales and items in each scale was randomized.

2.2. Results

2.2.1. Data management

The means, standard deviations, and corrected item total correlations of the items are presented in Table 1. The 2 subscales also

were tested for normality. The Fear of Social Threat Scale had a skewness of −.437 (*SE* = .148) and a kurtosis of −.288 (*SE* = .294). The Kolmogorov-Smirnov test was nearly significant, $D(272) = .51$, $P = .082$, suggesting a tendency of a deviation from normality. However, the Fear of Physical Pain Scale had a skewness of .365 (*SE* = .148) and a kurtosis of −.218 (*SE* = .294), and the Kolmogorov-Smirnov test was significant, $D(272) = .58$, $P < .026$, indicating an even more extreme deviation from normality. Therefore, our subsequent analyses were conducted with both the original data and with log-transformed data that normalized the distribution of scores [41]. The results were equivalent in both cases; we thus report only the results on the original, nontransformed data.

2.2.2. Factor analysis

To investigate the dimensionality of the 2 subscales, a principal axis factor analysis was performed on the scores of the 24 items (15 items related to fear of social threat and 9 items related to fear of physical pain). Two indices suggested that the overall set of items from this sample were appropriate for principal axis factor analysis [41]: Kaiser's measure of sampling adequacy was 0.897, and Bartlett's test of sphericity was significant, $\chi^2(276) = 4846.73$, $P < .001$. Principal axis factor analysis was chosen on the basis of early guidelines on exploratory factor analytic techniques [8,14], which recommend this extraction technique when data are not normally distributed. Two factors were extracted and subjected to an *oblimin* rotation [41]. These methodological choices (ie, principal axis factoring with oblimin rotation) were highly consistent with those adopted in the validation process of the Fear of (physical) Pain Questionnaire [34].

The requested 2-factor solution accounted for 51.8% of the variance. As shown in Table 2, the 2-factor solution can be interpreted as comprising factors related to fear of social threat (factor 1) and fear of physical pain (factor 2). The structure was simple, with no cross-loading items. Indeed, all items had a factor loading greater than .50 on one factor and less than .20 on the other factor.

Table 1
Means, SDs, and corrected item total correlations of the 15 items of the Fear of Social Threat Scale (items 1 to 15) and of the 9 items of the Fear of Physical Pain (items 16 to 24; study 1).[a]

Item	Mean	SD	Corrected item, total correlation
1	3.94	1.762	.680
2	3.62	1.771	.716
3	3.54	1.723	.712
4	3.54	1.699	.717
5	5.61	1.673	.658
6	5.01	1.691	.786
7	4.96	1.905	.749
8	4.02	1.898	.686
9	4.15	2.050	.619
10	4.23	2.092	.711
11	4.15	2.076	.694
12	5.45	1.900	.721
13	4.02	1.864	.703
14	4.36	2.052	.693
15	3.98	1.941	.747
16	3.75	1.967	.805
17	3.93	1.980	.807
18	5.14	2.012	.824
19	2.14	1.483	.819
20	2.04	1.495	.819
21	2.38	1.584	.818
22	3.03	2.086	.820
23	2.72	1.968	.812
24	2.99	1.917	.820

SD, standard deviation.
[a] Fear of Social Threat Scale overall scores: mean = 4.30, SD = 1.39. Fear of Physical Pain Scale overall scores: mean = 3.12, SD = 1.21); *N* = 272.

2.2.3. Correlation between fear of social threat and fear of physical pain

As predicted, the 2 scales correlated with each other, $r = .436$, $P < .001$ (2-tailed—sample 1). Furthermore, in all our next 3 additional samples, we found that fear of social threat was moderately correlated with fear of physical pain ($r = .498$; $P < .001$ in sample 2; $r = .467$; $P < .001$ in sample 3; $r = .427$; $P < .001$ in sample 4). Thus, fear of social threat seems to be positively related to fear of physical pain, but the correlation is not so high as to render the newly generated fear of social threat set of items redundant with those related to fear of physical pain.

2.2.4. Correlation among fear of social threat and fear of physical pain and their potentially related constructs

In terms of relationships among fear of social threat, fear of physical pain, and their related constructs, we found that fear of social threat was significantly correlated with rejection sensitivity ($r = .363$, $P < .001$). Also, fear of physical pain was significantly correlated with rejection sensitivity ($r = .322$, $P < .001$) (Table 3). Fear of social threat was significantly correlated with physical pain measures, such as pain catastrophizing ($r = .306$, $P < .001$). In line with past research [19], fear of physical pain and pain catastrophizing were positively associated ($r = .472$, $P < .001$).

Next, we found that scores on the Beck Anxiety Inventory were significantly correlated with those on the Fear of Social Threat Scale ($r = .208$, $P < .05$) and those on the Fear of Physical Pain Scale ($r = .282$, $P < .001$). Similarly, it emerged that scores on the Beck Depression Inventory were positively related with those on the Fear of Social Threat Scale ($r = .306$, $P < .001$) and Fear of Physical Pain Scale ($r = .223$, $P < .001$). The same pattern of results was true for experiences of loneliness: the Short Scale for Measuring Loneliness correlated with fear of both social ($r = .281$, $P < .001$) and physical ($r = .181$, $P < .05$) pain. Finally, fear of social (but not physical) pain was positively associated with past experiences of social threat ($r = .246$, $P < .001$). In a parallel way, fear of physical (but not social) pain positively correlated with past experiences of physical pain ($r = .174$, $P < .05$). We also ran a partial correlation analysis considering fear of social threat and fear of physical pain and controlling for scores on anxiety and depression in order to get a better estimate of the unique overlap between the 2 types of fear. This analysis showed that the relationship between fear of social threat and fear of physical pain remained significant ($r = .386$, $P < .001$) after controlling for anxiety (i.e., scores on Beck Anxiety Inventory) and depression (scores of Beck Depression Inventory), indicating that the correlation between the 2 dimensions of fear was not—at least in its largest part—due to the intervening variance of anxiety or depression.

2.3. Discussion

We tested whether fear of social threat and fear of physical pain were related to each other. To do so, we emulated the Fear of (physical) Pain Questionnaire, maintaining its instructions, syntax, grammar, and presentation and changing only the types of pain to include social threat (e.g., feeling interpersonally devalued, ostracized, socially excluded, humiliated, betrayed, and verbally abused). Scores obtained for those items support cross-situational consistency of fear-related reactions to a variety of situations involving a social threat. The same analysis on the short version of the Fear of Physical Pain Scale indicated good internal validity. Furthermore, principal axis factor analysis (PAF) of the responses indicated that the items related to fear of social threat and those related to fear of physical pain yielded 2 distinct yet correlated dimensions. Crucially, the association between scores on the Fear of Social Threat Scale and scores on the Fear of Physical Pain Questionnaire provided support for hypothesis 1: individuals' fears of

Table 2
Factor loads obtained from principal axis factor of the 24 fear of social and physical threat items (study 1).

Item no.	Item description	Factor 1	Factor 2
1	Being left out of a group	.774	−.105
2	Being ignored during a party	.843	−.173
3	Being ignored during a conversation	.842	−.167
4	Being excluded from a conversation	.837	−.147
5	Being betrayed by someone who is important to you	.655	.031
6	Feeling ignored by someone who is important to you	.801	.004
7	Someone who is important to you stops talking to you	.736	.061
8	Not being invited to a party organized by your friends	.665	.095
9	Being verbally abused by a family member	.552	.160
10	Your partner forgetting your birthday.	.671	.111
11	Your spouse/partner forgetting your anniversary	.667	.068
12	Being betrayed by your partner	.690	.101
13	Being embarrassed in front of your classmates by your professor	.657	.122
14	Your professor telling at you that you are an incompetent student	.629	.156
15	Being verbally abused by your boss	.707	.111
16	Breaking your arm	.013	.724
17	Breaking your leg	.065	.683
18	Breaking your neck	.133	.503
19	Hitting a sensitive bone in your elbow—your funny bone	−.005	.603
20	Getting a paper cut on your finger	−.066	.614
21	Getting strong soap in both eyes while bathing or showering	.063	.575
22	Having a blood sample drawn with a hypodermic needle	−.006	.508
23	Receiving an injection in your arm	−.015	.556
24	Receiving an injection in your hip/buttocks	.006	.476

Table 3
Means, SDs, and zero-order correlations for Fear of Social Threat, Fear of Physical Pain, and related constructs (study 1).

Item no.	Scale	Mean	SD	Fear of Social Threat Scale	Fear of Physical Pain Scale
1	Fear of Social Threat Scale	4.26	1.30	. . .	
2	Fear of Physical Pain Scale	3.41	1.29	.498**	. . .
3	Rejection Sensitivity Questionnaire	8.94	3.17	.363**	.322**
4	Pain Catastrophizing Scale	1.59	.79	.306**	.472**
3	Beck Anxiety Inventory	10.80	10.02	.208*	.282**
4	Beck Depression Inventory	10.78	8.35	.306**	.223**
5	Short Scale for Measuring Loneliness	2.94	1.36	.281**	.181*
6	Past Experience of Social Distress Index	2.16	1.10	.246**	.151
7	Past Experience of Physical Pain Index	1.89	1.15	.147	.174*

SD, standard deviation.
Significance levels of correlations of $^{**}P < .01$ (2-tailed) and $^{*}P < .05$ (2-tailed).

one type of pain were related to fears of the other type of pain. Nonetheless, the results indicated that the 2 measures were factorially distinct from each other, consistent with hierarchical conceptualizations of different types of fears [42,43].

We then found initial evidence for discriminant validity of the Fear of Social Threat Scale to other theoretically relevant constructs. Although scores on the Fear of Social Threat Scale were positively correlated with scores on the Rejection Sensitivity Questionnaire, the Short Scale for Measuring Loneliness, the Beck Anxiety Inventory, and the Beck Depression Inventory, the strength of coefficients between variables ranged from low to moderate (Table 3), suggesting that the Fear of Social Threat Scale, rather than measuring a redundant construct with already existing ones, taps into a distinct psychological dimension.

Moreover, the correlation matrix reveals a significant degree of overlap between fear of social threat, fear of physical pain, and other specific types of social (e.g., rejection sensitivity, loneliness, depression) and physical (ie, pain catastrophizing) pain-related constructs. For example, the tendency toward pain catastrophizing, a construct traditionally associated with fear of physical pain [19], was also related to fear of social threat. Namely, individuals with high levels of fear toward socially painful situations reported high levels of pain catastrophizing. Likewise, rejection sensitivity, a construct arguably related to fear of social threat, was also related to fear of physical pain. A similar pattern was found for depression and loneliness: high levels of fear of physical pain were associated with higher scores on depression and loneliness.

In addition to overlaps among measures potentially related to both fear of social and fear of physical pain, we found unique associations between past experiences of each type of distress and fears for each type of threat. Indeed, high scores of past experiences of social threat were related to high fear of social, but not physical, threat. By contrast, high levels of past experiences of physical pain were associated with high levels of fear of physical, but not social, threat. This pattern of findings is in line with previous research [3,24] and suggested the possibility that the relationship between fear of threat and distress perception might be type specific, such that each type of fear of threat might be uniquely associated with the perception of the same type of threat (hypothesis 3).

3. Study 2

Study 2 tested the hypothesis that, similar to what happens with the perception of physical pain [16], high levels of fear of social threat would predict greater perception of social threat (hypothesis 2). Moreover, in study 2, we investigated whether factors (e.g., fear of physical pain) known to regulate the perception of one type of distress (e.g., physical pain) also regulate the perception of the other type (e.g., social distress) [11]. Thus, study 2 tested the specificity of the effect of fear of social threat on social distress by comparing its

predictive ability to that of 2 other related constructs: fear of physical pain and rejection sensitivity (hypothesis 3).

3.1. Methods

3.1.1. Participants

One hundred thirty-six students in an introductory psychology course at Purdue University (58 female subjects, mean age 19.16 years, SD 1.39) volunteered to take part in the study in exchange for course credit.

3.1.2. Procedures and materials

Participants were tested in individual cubicles in sessions lasting approximately 45 min. They were told that the study was investigating the effects of mental visualization [47]. Then they were informed that they would be asked to fill out some personality measures, take part in a mental visualization exercise, and then evaluate their mental visualization experience.

Participants were asked to complete their demographic information and a package of questionnaires, which included the 15-item set of the Fear of Social Threat Scale ($\alpha = .923$), the 9-item subset related to the Fear of Physical Pain Scale [30] ($\alpha = .859$), and the Rejection Sensitivity Questionnaire [10] ($\alpha = .841$). The order of the presentation of scales and items in each scale was randomized.

During an ostensibly separate study, participants completed a standard manipulation of social distress (ie, Cyberball [47]). More specifically, the Cyberball paradigm has been created to induce ostracism (ie, being excluded and ignored; [45,46]). This paradigm is designed to resemble an online game that users access through a network connection. Participants are told that they will engage in a ball-throwing game with 2 players, ostensibly real participants, for the purposes of exercising their mental visualization abilities. They are told that what matters is that they visualize all aspects of the game, the players, and the location—that who gets or throws the ball is of no importance to the purpose of the game. In actuality, the 2 computer characters that appear on the screen are computer players programmed to either include or exclude the real participant from the game. In the ostracism condition, after a few throws, the 2 computer players stop throwing the ball to the actual participant for the remainder of the game. In the inclusion condition, the computer players throw the ball to the actual participant for approximately one-third of the total tosses [47].

After performing Cyberball, participants were asked to fill in an NRS-11 [18], an 11-point numerical rating scale on which participants were asked to rate the unpleasantness (0 = *not unpleasant,* 10 = *most unpleasant experience imaginable*) and the intensity (0 = *not at all intense,* 10 = *most intense imaginable*) of the social distress they felt during Cyberball. The 2 items were combined in an overall index of social distress. Cronbach's alpha was .911.

After completing the experiment, participants were thoroughly debriefed and thanked.

3.2. Results

The influence of fear of social threat and the social distress manipulation (social inclusion vs ostracism) on reported pain was explored with a series of moderated multiple regressions. As revealed by the analyses, both social distress manipulation and fear of social threat proved to be (on average) predictors of the participants' reported pain (Table 4): induction of social distress resulted in higher levels of self-reported distress compared to the control condition. However, these results were qualified by a significant interaction between social distress manipulation and fear of social threat. Simple slopes show that in the social distress condition, fear of social threat was significantly related to the reported pain ($B = .433$, $t(132) = 4.12$, $P < .001$), whereas in the social inclusion condition, it was not ($B = .035$, $t(132) = .336$, $P = .737$) (Fig. 1).

Finally, we controlled for the specificity of this effect (ie, fear of social threat predicts the experience of social distress) by estimating the same regression model with possible confounding variables (and their interaction with the manipulation) as covariates. When fear of physical pain was added to the analysis, the effect of social distress manipulation, fear of social threat, and their interaction remained significant; the effects of fear of physical pain did not (Table 5). The same pattern occurred when scores on the Rejection Sensitivity Questionnaire were included in the analysis (Table 5).

3.3. Discussion

In the current experiment, we randomly assigned participants to be ostracized or included. Consistent with the main hypothesis of this set of studies (hypothesis 2), people with higher levels of fear of social threat were more likely to report greater social distress when ostracized. Supporting hypothesis 3, we found that this effect was specific to fear of social threat: when concurrent predictors, such as fear of physical pain or rejection sensitivity, were entered into the regression analyses, they were not significant predictors of the perception of social distress (e.g., ostracism).

4. Study 3

Study 3 was designed to test the hypothesis that assessing fear of physical pain would predict perception of physical pain better than would assessing fear of social threat or rejection sensitivity. In doing so, we further investigated the hypothesis that high levels of fear of one type of pain (in this case, physical) is linked to increased perception of the same type of unpleasant experience (hypothesis 3).

4.1. Methods

4.1.1. Participants

Sixty-three students in an introductory psychology course at Purdue University (30 female subjects; mean age 18.87 years, SD

Table 4
Fear of social threat predicting the experience of social distress (dependent variable: NRS-11; study 2).

Predictor	*B*	*t*	*P*
Social Distress Manipulation (Cyberball)	.950	6.72	<.001
Fear of Social Threat	.258	3.61	<.001
Social Distress Manipulation × Fear of Social Threat	.350	2.46	.015
	$R^2 = .349$, $F(3, 132) = 23.60$, $P < .001$		
Simple slope coefficients of Fear of Social Threat at:			
Cyberball = inclusion	.035	.336	.737
Cyberball = ostracism	.433	4.120	<.001

NRS-11, numerical rating scale.

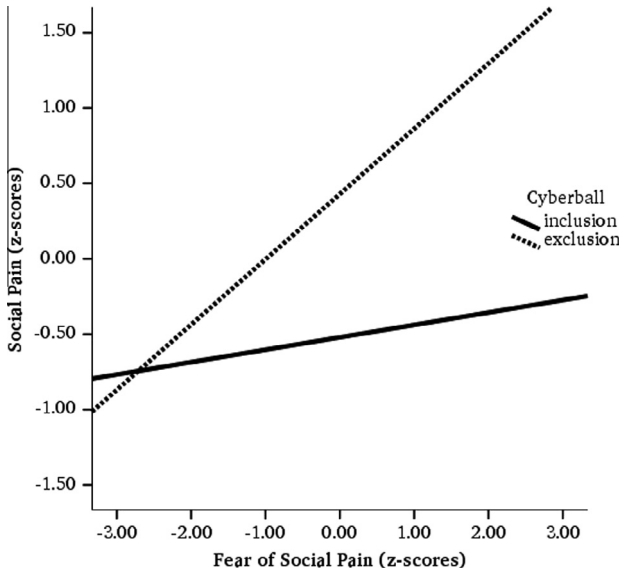

Fig. 1. Effect of fear of social threat on the perception of social distress (e.g., ostracism): Participants high in fear of social threat perceived higher levels of pain intensity and unpleasantness when ostracism was induced. When social inclusion was induced, fear of social threat did not affect perception of social distress.

Table 5
Series of multiple regressions testing fear of social threat predicting the experience of social distress with the effects of fear of physical pain and rejection sensitivity covarying (dependent variable: NRS-11; study 2).

Predictor	*B*	*t*	*P*
Social Distress Manipulation (Cyberball)	.946	6.64	<.001
Fear of Social Threat	.243	3.11	.002
Social Distress Manipulation × Fear of Social Threat	.318	2.04	.043
Social Distress Manipulation × Fear of Physical Pain	.090	.583	.561
Social Distress Manipulation (Cyberball)	.962	6.83	<.001
Fear of Social Threat	.216	2.91	.004
Social Distress Manipulation × Fear of Social Threat	.229	2.02	.045
Social Distress Manipulation × Rejection Sensitivity	.097	.662	.509

NRS-11, numerical rating scale.

1.14) took part in physical pain manipulation. Participants volunteered to take part in the experimental procedures in exchange for course credit.

4.1.2. Procedures and materials

Participants were tested individually. Similar to study 2, participants were told that the study was investigating the effects of mental visualization.

The same premanipulation measures used in study 2 were adopted in the present study. Participants completed the 15-item subset of the Fear of Social Threat Scale ($\alpha = .923$), the 9-item subset of the Fear of Physical Pain Scale [30] ($\alpha = .871$), and the Rejection Sensitivity Questionnaire [10] ($\alpha = .786$).

Then participants completed a standard physical pain induction manipulation (ie, Cold Pressor Task; [31]). Participants were told that the task was aimed at practice their mental visualization abilities. Participants were randomly assigned to place the nondominant hand up to their wrist into a bucket of water maintained either at a cold temperature (41°F to 42°F [5 °C to 6 °C]; the physical pain induction) or to room temperature (75°F to 80°F [24 °C to 27 °C]; the physical pain control). They were told they could remove the hand at any time if the distress of the experience became too intense. The duration of exposure to the water was recorded (video surveillance allowed the experimenter, without being in the same room, to register the amount of time participants kept their hand in the water). However, in order to standardize the amount of physical stimulation, participants were asked to try to keep their hand inside the cold water for 1 min, an amount of time usually well tolerated by subjects [44].

Similar to study 2, after performing the pain manipulation, participants completed the NRS-11 [18] ($\alpha = .986$), which assessed the unpleasantness and the intensity of the pain they felt during the physical pain induction manipulation.

4.2. Results

The influence of the physical pain manipulation (warm water vs cold water) and of fear of physical pain on reported pain was explored with a series of moderated multiple regressions. The effects of the physical pain manipulation, fear of physical pain, and their interaction were estimated after all continuous variables were standardized and the manipulation variable was centered to zero. Table 6 summarizes the results of the regression analysis for the dependent variable NRS-11. Both physical pain manipulation and fear of physical pain proved to be predictors of the participants' pain report, thus confirming that our manipulation of physical pain by its induction resulted in high levels of self-reported pain compared to the control condition. However, the analyses revealed a significant interaction of physical pain manipulation × fear of physical pain. Simple slopes showed that in the cold-water condition, the fear of physical pain was significantly related to the reported pain ($B = .338$, $t(57) = 4.25$, $P < .001$), whereas in the control condition (ie, warm water) it was not ($B = .027$, $t(57) = .288$ $P = .774$) (Fig. 2).

We then controlled for the specificity of the effect (ie, fear of physical pain in predicting the experience of physical pain) by estimating the same model with additional predictor and their interaction with the manipulation as covariates. When fear of social threat or rejection sensitivity were included in the analyses, physical pain manipulation, fear of physical pain, and their interaction remained significant in predicting participants' pain report, while neither fear of social threat or rejection sensitivity showed a significant main effect or an interaction (Table 7).

4.3. Discussion

In the present experiment, we randomly assigned participants to submerge their hand in either cold water or room-temperature water. Otherwise, participants followed the same procedure of study 2. We found that higher levels of fear of physical pain predicted higher levels of self-reported pain during the procedure. However, supporting hypothesis 3, this effect was specific to fear of physical pain. When concurrent predictors, such as fear of social threat or rejection sensitivity, were entered into the regression

Table 6
Fear of Physical Pain predicting the experience of physical pain (dependent variable: NRS-11; study 3).

Predictor	*B*	*t*	*P*
Physical Pain Manipulation	1.66	13.74	<.001
Fear of Physical Pain	.182	2.96	.004
Physical Pain Manipulation × Fear of Physical Pain	.311	2.52	.014
	$R^2 = .784$, $F(3,59) = 71.18$, $P < .001$		
Simple slope coefficients of Fear of Physical Pain at:			
Manipulation = warm water	.027	.288	.774
Manipulation = cold water	.338	4.25	<.001

NRS-11, numerical rating scale.

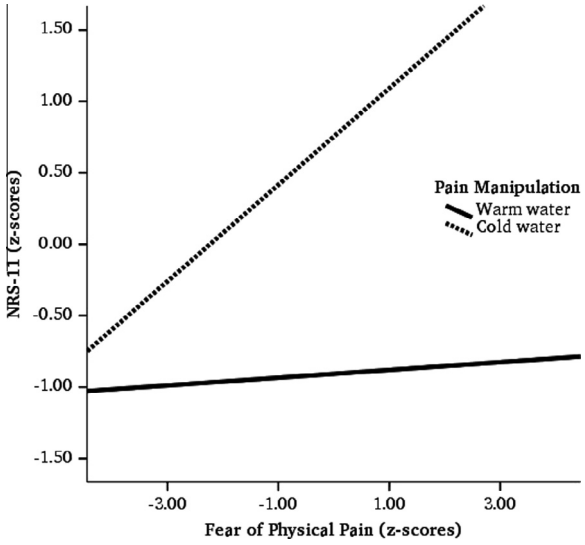

Fig. 2. Effect of fear of physical pain on the perception of physical pain. Participants high in fear of physical pain perceived high levels of pain intensity and unpleasantness when physical pain was inducted. When physical pain was absent, fear of physical pain did not affect the perception of pain.

Table 7
Series of multiple regressions testing fear of Physical Pain predicting the experience of physical pain with the effects of fear of social threat and rejection sensitivity covarying (dependent variable: NRS-11; study 3).

Predictor	*B*	*t*	*P*
Physical Pain Manipulation	1.66	13.50	<.001
Fear of Physical Pain	.178	2.68	.010
Physical Pain Manipulation × Fear of Physical Pain	.309	2.33	.023
Physical Pain Manipulation × Fear of Social Threat	−.012	−.091	.928
Physical Pain Manipulation	1.64	13.19	<.001
Fear of Physical Pain	.167	2.65	.010
Physical Pain Manipulation × Fear of Physical Pain	.286	2.26	.027
Physical Pain Manipulation × Rejection Sensitivity	.141	.943	.350

NRS-11, numerical rating scale.

analyses, they did not show a significant effect on physical pain perception. Our data thus suggest that high levels of fear of one type of threat (e.g., physical) is linked to increased perception of its associated type of distress (e.g., physical) but not to the other (e.g., social).

5. Discussion

As a German proverb states, "Fear makes the wolf bigger than he is." The current investigation supported this observation. Our study was inspired by medical research documenting that fear of pain is one of the most important predictors of the experience of physical pain [16,19,25]. In light of the recently proposed theoretical framework provided by the pain overlap theory [11], we extended these findings by testing a common effect underlying reactions to both social distress and physical pain.

First, we found that fear of social threat and fear of physical pain yielded 2 distinct yet correlated constructs (hypothesis 1). This finding is compatible with hierarchic structural models of fears [42,43] and empirical studies on fear of physical pain, which found that fears of physical pain were associated with social anxiety and social phobia [2]. Moreover, when we extended our analysis, we found that constructs such as depression, anxiety, loneliness, and pain catastrophizing showed a low to moderate correlation with fear of social and physical threat. Thus, both fear of social and physical threat related to other conceptually similar constructs, yet they were not empirically redundant with them.

Second, similar to the effect of fear of physical pain on the perception of physical pain [16,19], we found that fear of social threat increased the perception of social distress (hypothesis 2). This effect provides evidence for the common role of fear of threat in explaining between-person differences in the perception of social distress and physical pain.

Third, the present results suggest the specificity of the effect in that each fear was able to predict the increased perception of its associated type of distress (ie, fear of social threat predicted socially painful experiences; fear of physical pain predicted physically painful experiences), but not the other (hypothesis 3). By showing the specificity of the link between the fear of one type of threat and the selectively increased perception of its associated type of distress, we provided further support for hierarchical conceptualizations of fears suggesting that different fears are structurally related yet distinct from each other [42,43]. More specifically, we argue that, within a hierarchical conceptualizations of fears [42,43], fear of social threat and fear of physical pain are parallel in structure; they operate at the same level of specificity within the hierarchical structure, both under higher-order factors (e.g., neuroticism) and both above factors that are stimulus specific (e.g., fear of needles, fear of betrayal). However, the specificity effect indicates that the increased perception of a particular type of threat may not be due only to a general fear or to a general sensitivity trait, but additionally to a specific component. In this regard, we also note that this finding might provide a boundary condition to pain overlap theory. Indeed, pain overlap theory posits that traits related to a heightened sensitivity to one type of pain (e.g., physical) should also relate to a heightened sensitivity to the other type of pain (e.g., social) [11]. This statement should lead to the expectation that a trait known to be related to heightened sensitivity to physical pain, such as fear of physical pain [16,19], should be related to sensitivity to social threat as well. This is not what our data showed. Indeed, we found that high levels of fear of one type of pain (e.g., social) are specifically linked to increased perception of that particular type of distress (e.g., social), but not the other (e.g., physical). The pattern of these results is compatible with the notion that intense and repeated past experiences of one type of distress might selectively sensitize the individual toward that specific type of distress [37] and that the personal pain history of the individual could affect his or her perception of pain [3,24].

In terms of social threat understanding and management, the present findings provide insights as to at least one reason why individuals differ in their experiences of social distress (including reactions to ostracism, exclusion, and rejection): their fears of social threat differ. People who fear humiliation are more likely to experience higher levels of social threat when they are humiliated. These results might also inform our understanding of how individual differences in fear of social threat moderates the relationship between experiences of social distress (e.g., social separation) and individuals' reactions to them. The current study is consistent with previous research that showed that social anxiety moderated responses to social exclusion, such that participants high in social anxiety exhibited more evidence of maladaptive social responses [27]. Indeed, fear and anxiety can increase the perception of social threat, thus promoting avoidance and withdrawal rather than motivation to connect with others.

Moreover, by showing the overlap of the effect of the same underlying factor (ie, fear of threat on increased distress perception) on both social distress and physical pain, our findings suggest that the same effect might account for the onset of the perception of persistent social distress and physical pain. In the context of physical pain, fear avoidance models [2] predict that the onset of

a vicious cycle of high physical pain-related fears, increased physical pain perception, and avoidance tendencies are likely to lead to chronic physical pain. In the context of social threat, the same cycle of high fear→increased distress perception→avoidance tendencies might be involved in the long-term experiences of ostracism and social exclusion. Indeed, individuals with high levels of fear of social threat might be more prone to avoid, rather than seek, social connections [28]. Accordingly, we argue that timely identification of high levels of (social or physical) threat-related fear is critical for identifying individuals who will benefit most from preventative interventions aimed to limit negative cycles of high avoidance and increased distress perception. Considering the common brain responses for social distress and physical pain [13], an interesting question concerns the potential common antecedent of chronic social distress and physical pain. Future research is needed to address this issue.

5.1. Limitations

This study has several limitations. First, in the present research, we incorporated only self-report measures of fear of physical pain, fear of social threat, and the experience of social distress and physical pain. Therefore, future studies should adopt implicit and/or physiological measures of fear of threat (e.g., skin conductance) and use different strategy to assess social distress and pain perception (e.g., fMRI). However, previous research has shown that neural activation correlates strongly with self-report scores of fear of pain and with pain ratings [13]. Second, although we have shown initial evidence for convergent (study 1), predictive (study 2), and divergent (study 3) validity of our newly developed scale, more research is needed to further evaluate other psychometric properties of the Fear of Social Threat Scale. Third, our sample population consisted of university students (pain-free individuals) who received extra credit for their participations. Thus, replicating the pattern of our results with a community sample would be necessary before attempting generalizations and norms. Furthermore, as we have already pointed out, future studies should investigate the role of fear of social threat in the experience of long-term episodes of social threat and its overlap with the experience of chronic physical pain. In this sense, the questions raised here are the beginning of a program of research investigating fear of social threat and its impact on perception of social distress. So as many questions as we hoped to answer, there are many more that we could ask. For instance, which factors determine one's tendency to become fearful of pain (fear-proneness)? How does threat-related fear increase the perception of social distress (ie, via which neural processes [35])? How does this mechanism serve to maintain social distress? Is this the path to the development of chronic feelings of ostracism and social exclusion? How can we best treat individuals with high fear of social threat? Future research should start to address some of these important questions.

5.2. Conclusion

Decades of research on physical pain perception have shown that the simple proportionality that was initially presumed to occur between the strength of a stimulus and the degree of perceived pain lacks empirical support. Several factors intervene in modulating pain perception, among which fear seems to be one of the most key predictor of the perception of physical pain. On the basis of pain overlap theory [11], we tested whether fear of social threat could modulate the perception of social distress. We found that, similar to the influence of fear of physical pain on physical pain perception, fear of social threat moderated the perception of social distress (e.g., ostracism). Yet we also found a specific type-related effect, such that the specific type of threat one fears (e.g., social) predicts the perception of its associated type of distress (e.g., social), but not the other (e.g., physical). Thus, we provided evidence for a general effect (e.g., the role of fear in increasing the perception of distress) but also evidence that high levels of fear of one type of threat is selectively linked to increased perception of that particular type of distress.

Conflict of interest

The authors report no conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.pain.2013.11.006.

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