# Global and Situational Relationship Satisfaction Moderate the Effect of Threat on Pain in Couples

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**Abstract**

**Objective.** The aim of this study was to test the hypothesis that greater global and situational relationship satisfaction would reduce the negative impact of threatening information on acute pain. **Design.** An experimental design was used to manipulate threat and elicit acute pain via a cold pressor task. **Setting.** The study was completed in a research laboratory at a large urban university in the Midwestern USA. **Subjects.** Participants were 134 couples, in which at least one individual was an undergraduate student. **Methods.** After administration of a global relationship satisfaction measure, couples were randomly assigned to either receive high or low threatening information about the painful task. Following the threat manipulation, couples discussed the upcoming task and rated their satisfaction with the interaction (i.e., situational relationship satisfaction). The designated pain participant then completed the painful task alone. **Results.** The threat manipulation altered couples' perceived threat of pain. Situational relationship satisfaction moderated the effect of threat on pain trajectories such that situational relationship satisfaction predicted less pain intensity at an earlier point in the task for the low threat condition than the high threat condition. Greater global relationship satisfaction predicted greater likelihood of task completion among those in the low threat condition, whereas it was unrelated to task completion in the high threat condition. Greater global relationship satisfaction also predicted lower pain intensity throughout the task. **Conclusions.** These findings demonstrate that the interpersonal context is independently related to acute pain and may also alter the effect of threatening information on acute pain.

**Key Words:** acute pain; threat; couples; relationship satisfaction; cold pressor; social modulation of pain

## Introduction

The Fear Avoidance Model asserts that threatening information about pain can lead to the avoidance of behaviors that might cause pain, functional disability, and greater pain over time (1,2). Research has supported this model by showing that pain-related fear is associated with concurrently measured disability and avoidance behavior in patients with chronic back pain (3), and more importantly, pain-related fear predicts future disability (4-6). Threatening information, anxiety, and expectations about pain can also exacerbate acute pain, including post-operative pain in the context of a medical procedure (7-10). An oft-overlooked influence in fear avoidance models is the role of social relationships, which have been shown to have an important effect on pain (11-15). By their very nature, romantic relationships, which involve more frequent and intimate contact than other types of social relationships, may play an important role in mitigating fear and threat about pain. A satisfying romantic relationship (i.e., global relationship satisfaction) or a specific, satisfying interaction with one's partner (i.e., situational relationship satisfaction) may signal that support and comfort are available, serving to regulate fearful responses to pain and lessen the impact of threatening information about pain (e.g., less pain during an acute pain task). In other words, people who receive threatening information about a task but are in satisfying relationships or have helpful conversations with their romantic partners may report less pain. However, this hypothesis has not yet been tested in the literature. Furthermore, a recent systematic review of the literature has concluded that there is a dearth of experimental research exploring the social modulation of pain (15). To these ends, an aim of the current study is to determine the extent to which models of fear and pain should accommodate the influence of relationship satisfaction on the effect of pain threat during an experimental task.

The central hypothesis is that both global and situational relationship satisfaction will independently relate to pain as well as mitigate the effect of threatening information about a painful task (i.e., the cold pressor task) on pain intensity and pain tolerance.

The vast majority of studies associating relationship satisfaction with health and pain have focused on general or global relationship satisfaction (i.e., a rating of overall satisfaction that often is rated at a baseline assessment). Global relationship satisfaction represents how generally satisfied an individual is in the relationship, and is the result of cumulative relationship experiences, contextual factors (e.g. socio-cultural factors), and individual traits (16). While studying global relationship satisfaction can be informative, close relationships researchers have argued that specific interactions must also be studied as distinct phenomena to inform theory and clinical practice (17-19). Likewise, Krahé et al. identify both global or historical and situational aspects of relationships that may modulate pain (15). In contrast to global satisfaction, situational satisfaction captures the degree to which one is satisfied with a specific relationship event or interaction with one's partner. Situational satisfaction is likely the product of a number of aspects of the interaction including the degree of agreement between partners, expressed affection, and fulfillment of expectations about the interaction. Although global and situational satisfaction may seem similar, the two are thought to function independently; for example, a dissatisfying discussion with a partner can occur in a generally satisfying relationship and vice versa, a satisfying interaction with a partner can occur in a globally dissatisfying relationship. When both global and situational satisfaction are assessed, as in the current study, the possibility that they function independently can be tested.

Both global and situational relationship satisfaction have not, to our knowledge, been examined as they relate to pain fear and threat. Studies on relationship satisfaction and pain severity may offer clues as to how satisfaction may be related to pain threat. For example, global relationship satisfaction is associated with less need for analgesics following myocardial infarction (20). In this study, being in a relationship that one considers satisfying is expected to buffer the effect of threatening information about pain so that one is able to experience less pain and greater pain tolerance. With respect to situational relationship satisfaction, it is hypothesized that a satisfying interaction about a painful task would provide an indicator to individuals that their partner cares for them and will be concerned about their well-being during the task. Although no studies have examined how situational relationship satisfaction affects pain threat, there is evidence that positive social support during painful tasks reduces perceived pain (15,21). Thus, situational satisfaction may change the way in which one interprets the threatening information or may strengthen one's resolve so that less pain is experienced during the task.

In the present study, both *global* and *situational* (i.e., pertaining to a specific interaction with one's partner about the painful task) relationship satisfaction were assessed as independent predictors and potential moderators of pain threat. Both are expected to be related to less pain over the course of the cold pressor task and greater pain tolerance. In addition, both are expected to reduce the impact of threatening information on pain and pain tolerance. This study appears to be the first to examine the association between relationship satisfaction and experimentally manipulated pain threat. Krahé et al. asserts that experimental pain studies are essential complements to clinical studies because the controlled manipulation of variables is crucial to determine causal influencing factors (15). In the present study, pain, threat, and discussion time

with one's partner are tightly controlled. The study also contributes to the literature by addressing the fact that researchers rarely investigate both global and situational satisfaction despite the fact that both types of relationship satisfaction provide information that can provide insights into clinical intervention design. For instance, results showing that global satisfaction buffers the effect of threat would suggest that future research should test interventions that incorporate activities to bolster general feelings of satisfaction. In contrast, if satisfaction with an interaction about pain buffered the effect of threat, then perhaps building interaction skills surrounding threatening information about pain should be targeted. If both global and situational satisfaction act on threatening pain, then strengthening relationship satisfaction in general and enhancing specific interactions may both be useful components to investigate further. In sum, the distinction between global and situational relationship satisfaction may improve specificity of models and offer new directions for pain intervention development.

# Method

## Participants

Subjects were 134 undergraduate students and their romantic partners. Detailed demographic information about participants and their partners (e.g., gender, age, race, ethnicity, education level) and about the couples (e.g. relationship duration) is displayed in Table 1. All subjects were recruited from an online research participation system, SONA, at Wayne State University in Detroit, Michigan. Couples were eligible for the study if at least one individual in the couple was a psychology student. Subjects were excluded from the study if they had medical conditions that might involve blood circulation problems (e.g., Reynaud's disease or Diabetes). From this point forward, individuals who were randomly selected to undergo the cold pressor task are referred to as 'participants' to distinguish them from their partners. There was not an exclusion criterion in regards to relationship length.

## Procedure and Measures

Study approval was obtained from Wayne State University's Institutional Review Board and study procedures were in accordance with the ethical standards of the IRB and the Helsinki Declaration (1964). Potential subjects responded to an advertisement posted on SONA. Interested couples signed up for scheduled times and were randomized to a threat condition. Prior to the laboratory tasks, informed consent was obtained from all individuals. Both participants and their partners were asked to complete several self-report measures individually

in separate rooms, including questions about demographic information and global relationship satisfaction. Participants and partners were asked to keep their answers private until the completion of the study. Table 2 displays the means, standard deviations, and ranges for the following variables.

**Baseline measures**

*Global relationship satisfaction.* The Couples' Satisfaction Index, which includes 32 items, was used to assess global relationship satisfaction (22). This scale yields a summed score that can range from 0 to 161. Higher scores indicate greater relationship satisfaction. In this sample, participants and partners were modestly satisfied (participants: M = 125.17, SD = 26.57; partners: M = 124.83, SD = 25.96), which is similar to the characteristics of the scale development sample (M = 121, SD = 32) (22). This scale demonstrated excellent internal consistency in this sample (Cronbach's alpha = .97).

After completing baseline measures, the couple was informed about which partner was randomly assigned to complete the cold pressor task.

**Threat manipulation**

*Perceived threat.* Participants and partners responded to four questions that were specific to the pain task and designed to capture the extent to which participants and partners felt threatened and anxious about the task. The questions for participants were as follows: "*How anxious or tense*

*are you about the cold water task?*"; "*Right now, how hesitant are you about doing the cold water task?*"; "*Right now, how reluctant are you about doing the cold water task?*"; "*How threatening do you expect the cold water task to be*?". For partners, each item was modified slightly to highlight that they should respond about their own feelings by emphasizing the word 'YOU'. For example, *"How anxious or tense are YOU about your partner doing the cold water task?"* The response scale for both participant and partner items was an 11-point Likert-type scale (0 = "Not at all", 10 = "Very much"). The four items were summed to create a composite score of perceived threat of pain. In this sample, the composite score demonstrated excellent internal consistency (Cronbach's alpha = .88 for participants, Cronbach's alpha = .83 for partners).

After the completion of baseline surveys, each couple was randomly assigned to a threat manipulation delivered via video to both partners conjointly. Both videos contained silent footage of participants in a previous study (23) who consented to the use of their video in future research. These videos were previously used in studies by Helsen et al. to manipulate threat in participants (24,25) but never in a dyadic design. The high threat video showed footage of people expressing strong painful facial expressions while completing the cold pressor task (e.g., grimacing, eyes tightening), whereas footage in the low threat video portrayed people displaying no or minimal pain in their facial expressions. Both videos featured a sequence of 8 individuals (4 females, 4 males, with gender alternating), with each individual displayed for 35 seconds. In total, each video's duration was 6 minutes and 40 seconds. Individuals were not shown withdrawing their hand from the cold water bin at any point in the video.

**Post-manipulation measures**

*Perceived threat.* Following the threat manipulation, participants and partners were asked to again report perceived threat (see description above). The participants' threat scale showed good internal consistency (alpha = .89), as did the measure of partner's perceived threat (alpha = .87).

**Couple interaction**

Couples were then asked to engage in a discussion about what they expected in the cold pressor task, and any thoughts, feelings, concerns or fears about performing the task. The research assistant left the room and the couple engaged in a two-minute discussion. Couples were unaware prior and during the couple discussion that the participant about to undergo the cold pressor task would be asked to fill out a self-report measure following the discussion, described below.

**Post-interaction measures**

*Situational relationship satisfaction.* Following the couple interaction, participants and partners separately rated their satisfaction with the interaction: "*To what extent are you satisfied with the interaction you just had with your partner?*" on a Likert-type scale from 0 (not satisfied at all) to 10 (extremely satisfied). For both global relationship satisfaction described earlier, and situational relationship satisfaction, only participants' ratings were used in analyses because it is thought to be most relevant to other aspects of the participants' pain experience.

**Cold pressor task**

Following the completion of these questionnaires and after thorough instruction, the participant completed the cold pressor task alone, while being observed by their partner from a separate room via a mounted video camera and a television that displayed the live video to the observers. Participants were aware that their partner would be watching them from another room. Participants were given instructions to rate their pain when a tone alerted them to do so and were informed that they could remove their hand from the cold water at any time. To ensure all participants began the task at a standard hand temperature, participants first dipped their non-dominant hand in a bucket of room temperature water for 1 minute. Participants were additionally asked to keep their head up and look at cross-hairs on a piece of paper affixed to the wall. Prior to beginning, the research assistant asked participants if there were any questions about the cold pressor task procedure and also asked the participant to describe the procedure themselves before proceeding to ensure participant's understanding of the directions. The maximum duration of immersion was set at 2 minutes although participants were not informed of this limit. The cold pressor apparatus consists of a stainless steel bath, Techne© brand Flow Dip Cooler (model RU-200), and a Thermoregulator (model TE-10D). The flow dip cooler extracts heat from the water while the thermoregulator circulates the water. The thermoregulator, which safely maintains the temperature of the water, was set to 6°C (43°F). Research utilizing the cold pressor task exhibits variation in temperatures ranging from 0°C to 7°C, with no standard temperature used across studies (26). However, recent research shows that pain tolerance measured by the cold pressor task set to 6°C demonstrates excellent 2-week test-retest stability

(27).

**Pain measures**

*Task Completion.* The experimenter used a digital stopwatch to record the time in seconds that the participant held their hand in the cold water basin, which will be referred to as cold pressor task duration. Many cold pressor task studies conceptualize cold pressor task duration as a measure of pain tolerance (28,29). The negatively skewed, J-shaped distribution of these data suggested that this variable should be transformed into a dichotomous variable representing task completion or non-completion. Evidence supporting the decision to dichotomize this variable will be presented in the results section.

*Pain intensity.* Participants reported pain intensity on an 11-point pain rating scale, ranging from 0 (no pain) to 10 (extreme pain). Tones alerted participants to record their current pain level every 10 seconds for the first 40 seconds and then every 20 seconds thereafter. In this sample, pain ratings ranged from 0 to 10 across all time points. Internal consistency of pain ratings across time points in this sample was excellent (Cronbach's alpha = .95).

After completion of the cold pressor task, the couple was reunited and debriefed about the purpose of the study, given the opportunity to ask questions, and administered any applicable compensation. In each couple, at least one subject was a student who received extra credit toward a psychology class.

**Data Analysis Plan**

First, data were screened for accuracy of input, outliers, and missing data. There were no univariate or multivariate outliers. A small amount of data (less than 2%) were found to be missing, and the data appeared to be missing at random (30). In regards to perceived threat and situational relationship satisfaction measures, if any participant was missing any number of items in that scale, his or her data were not used for that scale, given the few numbers of items in these measures. If a participant did not respond to some of the items in a self-report measure but those items made up less than 10% of the scale, the missing values were replaced with the series mean. This procedure for dealing with missing data is considered acceptable (31).

Preliminary data screening revealed that 64% of participants completed the cold pressor task, which resulted in an extreme J-shaped, negatively skewed distribution. The skewness of this distribution remained significant despite the application of multiple data transformations, including square root, logarithm, and inverse transformations (31). In addition, individuals who did not complete the task had a mean duration of 46.28 seconds (SD = 25.42) compared to those who completed the task (duration of 120 seconds), $t(47) = -20.09$, $p = .00$ (note: equal variances were *not* assumed). Thus, cold pressor duration (i.e., pain tolerance) data were dichotomized to reflect the data distribution and conceptual distinction between individuals who completed the cold pressor task (i.e., duration of 120 seconds) and those who did not (i.e., duration of less than 120 seconds).

Next, a series of ANCOVAs were conducted to determine whether the threat manipulation

affected participants' and partners' perceived threat of the task, as a manipulation check. Given that cold pressor task duration (i.e., task completion) was severely skewed, two different analyses were conducted to examine whether threatening information affected participants' pain. First, a Mann-Whitney U test, which does not assume a normal distribution of continuous data, was used to examine whether cold pressor task duration in seconds varied by threat condition. Second, chi-square analyses were conducted to test whether participants in the two conditions differed on task completion by transforming cold pressor task duration into a binary variable.

Multilevel modeling was used to examine group differences in pain intensity trajectories over time. This analysis models trajectories using all available data from participants regardless of how long they endured in the task. The multilevel analyses included a main effect for threat condition and time as well as a quadratic effect for time. The quadratic effect for time was included because prior research has shown curvilinear patterns of pain ratings during the cold pressor task, with pain increasing in the beginning and then plateauing or decreasing slightly (29,32,33). In addition, interactions for threat condition by time and threat condition by quadratic time were included.

Next, global relationship satisfaction and situational relationship satisfaction were investigated as moderators of threat on pain. Two sets of analyses were conducted: logistic regressions for task completion and multilevel modeling for pain intensity. Each analysis included the main effects of global relationship satisfaction, situational relationship satisfaction, threat condition, and all higher-order interactions. Multilevel modeling analyses also included main and interaction effects for time to account for the expected curvilinear pattern of pain intensity over time. For all

analyses, the highest order interaction that was significant is reported. For multilevel modeling analyses, statistical significance was determined using multiple single-df likelihood ratio tests, in which the p-value represents whether the addition of the predictor explains additional significant variance (34,35).

The sample size needed to have sufficient power to detect effects was derived from power analyses as well as existing literature on experimental pain. Power analyses were conducted for the ordinary least squared analyses (i.e., ANCOVAs, chi-square analyses, logistic regressions) with medium effect sizes and a power of .80. For these analyses, sample sizes ranging from 34 to 128 were required. In regards to the multilevel modeling analyses predicting pain trajectories, the calculation of power is more difficult; there is considerable debate as to how to estimate power in multilevel models (36). Therefore, a conservative estimate of the sample size needed to test these analyses was based on the extant literature involving cold pressor tasks comparing two or more experimental groups (e.g., sample sizes ranging from 60 to 100 (25,28,37).

# Results

## Participant Characteristics

Table 1 displays detailed demographic information of participants and their partners. Couples in the high and low threat conditions did not differ on any of these demographics. Ranges, means, and standard deviations of variables of interest are shown in Table 2. Participants' and partners' reports of global and situational satisfaction were significantly correlated; however, the correlation between participants' and partners' situational relationship satisfaction, $r$ (130) = .34, $p < .001$, was somewhat weaker than the correlation between participants' and partners' global relationship satisfaction, $r$ (130) = .57, $p < .001$. For the following analyses, participants' relationship satisfaction is used, as it is expected to be most relevant to other aspects of the participants' pain experience.

## Preliminary Analyses and Manipulation Checks

The two threat conditions did not differ on levels of perceived threat prior to the experimental manipulation, participants: $t(132) = 0.63$, $p = .53$, partners: $t(128) = -0.70$, $p = .49$. A series of ANCOVAs was used to test whether the threat manipulation affected perceived threat. Each ANCOVA compared high and low threat conditions on perceived threat and controlled for participants' baseline perceptions of threat (i.e., perceived threat prior to the threat manipulation, but after receiving assignment to the pain task or observer/partner role). Results showed that following the threat manipulation, participants and partners in the high threat condition reported

higher levels of perceived threat than participants and partners in the low threat condition, $F(1, 130) = 5.94$, $p = .02$, $\eta^2 = .044$ and $F(1, 127) = 12.73$, $p = .001$, $\eta^2 = .091$, respectively. Effect sizes for the threat manipulation are small. Group differences persisted following the couple interaction for partners, $F(1, 126) = 5.98$, $p = .02$, but not for participants, $F(1, 130) = 2.45$, $p = .12$, although the group difference was in the expected direction.

**The Effect of Threatening Information on Pain**

To examine the effect of threatening information on pain tolerance (i.e., cold pressor task duration and task completion), both Mann Whitney-U and chi-square analyses were conducted and produced similar results. Participants in the high threat condition persisted in the task for a longer duration compared to those in the low threat condition, Mann-Whitney U (133) = 2,688.50, $p = .012$. In addition, participants in the high threat condition were *more* likely to complete the cold pressor task compared to those in the low threat condition, $X^2(1, N = 134) = 5.90$, $p = .02$, $\varphi = .21$, $V = .21$ (small effect size). Specifically, 73.8% of the high threat participants completed the task, compared to 53.6% of the low threat participants. As described below, this effect was moderated by global relationship satisfaction.

The only significant term in the multilevel modeling analyses of threat condition predicting pain intensity was the effect of quadratic time ($b = -0.0006$, $SE = 0.00003$, $t = -19.40$, $p < .001$). Participant's pain ratings followed a curvilinear pattern over time; however, the pattern did not differ by threat condition. This finding confirms early work on the curvilinear nature of cold pressor pain (29,32,33). This effect was moderated by situational relationship satisfaction, as

described below.

**The Effect of Global and Situational Relationship Satisfaction on Threat and Pain**

Global relationship satisfaction and situational satisfaction were weakly correlated, $r = .17$, $p = .056$, suggesting that these variables are distinct facets of relationship satisfaction.

Regarding task completion, a significant interaction between threat condition and global relationship satisfaction emerged, $b = -0.04$, Wald $X^2(1) = 5.43$, $p = .02$. As shown in Figure 1, participants in the low threat condition were more likely to complete the cold pressor task if they reported higher global relationship satisfaction. In contrast, those in the high threat condition had a similar likelihood of completing the cold pressor task regardless of their global satisfaction scores. When predicting task completion, there were no significant effects for any of the other interaction terms including the interaction between global and situational relationship satisfaction.

In predicting pain intensity, global relationship satisfaction interacted with the quadratic time effect ($b = 0.000003$, $SE = 0.000001$, $t = 2.54$, $p = .011$). Greater relationship satisfaction resulted in slower increases in pain ratings during the task and lower pain ratings over the course of the task (see Figure 2).

The interaction term composed of threat condition, situational relationship satisfaction, and the quadratic time effect was found to significantly predict pain intensity ($b = -0.00007$, $SE =$

0.00003, $t$ = -2.61, $p$ = .009). As shown in Figure 3, participants in both groups appear to benefit from a satisfying interaction, as indicated by lower pain intensity ratings than participants reporting less satisfying interactions; however, participants in the low threat condition who reported greater situational relationship satisfaction tended to have slower increases in pain ratings and lower pain ratings for almost the entire task. For the high threat condition, differences in pain rating trajectories between those with low and high situational relationship satisfaction did not emerge until about halfway into the task but persisted to the end of the task. None of the other interactions between group, time, global satisfaction, and situational satisfaction reached statistical significance.

## Discussion

The purpose of this study was to examine the extent to which global and situational relationship satisfaction correlated with pain and mitigated the effects of threatening information on experimentally induced pain. Existing research primarily focuses on either global or situational variables but not both within the same couple. In this study, a novel threat manipulation was associated with changes in perceived threat. According to the Social Communication Model of Pain, pain expression may aid cognitive processing of pain (38). The current findings suggest that an interaction about pain may also aid in cognitive processing of pain threat even before the pain is experienced. The results also demonstrated partial support for the hypotheses regarding relationship satisfaction, threat, and pain. As predicted, situational satisfaction moderated the effects of threat on pain intensity over time. In other words, a mere 2-minute interaction with one's partner, provided it is satisfying, appeared to mitigate one's experience of pain, although it had slightly different effects depending on the intensity of the threatening information.

Additionally, greater global relationship satisfaction was independently related to lower pain intensity during the task regardless of threat group. Global relationship satisfaction also predicted task completion, although unexpectedly, this effect only occurred in the low threat condition. The results presented here contribute to a growing number of studies that examine the effect of relational variables on pain, including the social modulation of pain (15).

As hypothesized, situational satisfaction buffered the effect of threat on pain intensity. Situational satisfaction appears to have tempered the pain ratings for both groups. This effect occurred earlier for the low threat group than for the high threat group but persisted to the end of the task for the high threat group. It is possible that the impact of highly threatening information may initially supersede situational satisfaction effects; yet, as one adjusts to the cold pressor task, situational satisfaction may become cognitively available and thus serve to buffer the effects of threatening information on pain intensity. These results are consistent with existing research on the social modulation of pain. For instance, viewing a photograph of one's romantic partner is associated with pain relief, suggesting that activation of a mental representation of one's romantic partner can temper pain (39-42). Additional research is needed to determine whether participants who reported greater situational satisfaction recalled their satisfying interaction during the painful task, and if so, at what point recall occurred. It is also possible that participants reporting satisfying interactions believed that their partners were experiencing empathy for them given their satisfying interaction about the task, an effect that has been shown to relate to less pain in a study in which partners were together during the cold pressor task (29). However, other research has shown that perceptions of empathy during the cold pressor task, but without an interaction between partners, may increase pain (43). Participants reporting satisfying

interactions also might have engaged in more emotional disclosure, such as disclosing fears about the upcoming task, which then might have been validated by their partners. Emotional disclosure and validation appear to provide a number of health and relationship benefits, including a modest effect on chronic pain (44-50). The role of mood should also be investigated given that negative mood states are strongly related to pain (51). It is possible that pre-existing depressed mood may have contributed to participant performance throughout the task. Overall, there are a number of potential mechanisms that may independently or concomitantly explain the effects of a satisfying interaction on threatening pain. Clearly, more research is needed to investigate the situational social modulation of pain using different experimental paradigms.

Greater global relationship satisfaction was also associated with less pain intensity throughout the task. This effect held regardless of threat exposure and because this effect did not statistically interact with situational satisfaction, it can be interpreted along with the situational satisfaction effect described above. The main effect of global relationship satisfaction supports literature suggesting that marital quality is associated with better physical health, lower risk of mortality, and structural markers of cardiovascular disease (52), perhaps through cognitive and affective pathways, such as improved cognitive processing and emotion regulation (44). However, in chronic pain samples, marital quality and pain severity are not typically associated (53), an effect that may have been found because many of these studies rely on global reports of pain rather than performance in specific painful tasks.

Only when pain is less threatening does global relationship satisfaction emerge as a predictor of task completion. For participants in the low threat condition, withdrawing from the task may be a

way to avoid displaying pain in facial expressions and "save face" in the presence of one's partner, particularly for participants in relationships characterized by less satisfaction. Individuals in satisfying relationships may have continued the task because they felt confident that they would receive support regardless of how they behaved during the task. Another interpretation is that couples who received less threatening information may have been surprised by the pain of the task and were more susceptible to the influence of their cumulative relationship histories, good or bad. This explanation is consistent with Krahé et al.'s review showing that cumulative relationship history is related to experimental pain and suggests further investigation into the social modulation of pain willingness (15). Further research is also needed to study the effects of global relationship satisfaction on pain, including potential embarrassment, shame, or perceived vulnerability about expressing pain in the presence of a partner with whom one has an dissatisfactory or unstable relationship.

Taken together, these results partially support the initial hypotheses that both global and situational relationship satisfaction would predict higher rates of task completion and lower pain intensity ratings, particularly for individuals receiving highly threatening information about pain. Pain intensity and task completion tended to be predicted by different facets of relationship satisfaction. These findings might be explained by the possibility that pain intensity and task completion are tapping into different pain processes. Alternatively, pain intensity and task completion may be impacted by different types of relationship processes. While both verbal pain intensity ratings and task completion in the cold pressor task could arguably be considered pain communications, withdrawing one's hand from the cold pressor task may also be prompted by an unwillingness to experience social judgment from one's partner about one's pain expressions.

Thus, participants may rely more on their overall relationship satisfaction to predict their partner's judgment or support towards them in regards to the painful task, rather than their partner's behavior in the most recent interaction. On the other hand, pain intensity ratings might be more influenced by current aspects of the situation, such as one's current feelings towards their partner, anxiety, and/or attention to the task. Regardless of the explanation for the distinct findings between global and specific relationship satisfaction, this study provides novel evidence that each type of relationship satisfaction contributes to the effects of threat on pain. This study is the first to our knowledge to examine the association between global and situational relationship satisfaction as it pertains to a discussion about an upcoming threatening pain task. The weak correlation between situational and global relationship satisfaction may be due to the fact that one measure assesses a particular event and the other relies on memories of multiple events. Thus, situation satisfaction is expected to be more variable, and even volatile, than global satisfaction. These findings echo the call of relationships and pain researchers who advocate for the study of both global and situational relationship factors to improve the specificity of models and enhance interventions (15,17,18).

The current findings should be understood in light of study limitations. First, these findings may not generalize beyond this particular cold water temperature (6°C) or maximum cold pressor task duration (2 minutes). Observational data were not available to examine couples' interaction behaviors and thus findings are limited to perceptions of the interaction. However, research has demonstrated that couples' perceptions of interactions, assessed in a similar manner as is in this study, are more predictive of outcomes than objective ratings of interactions (29,54-56). In addition, this study was conducted with healthy, undergraduate couples mostly in dating

relationships. Research is needed to determine whether these results are replicable in similar and clinical populations of interest including people undergoing clinical acute pain (e.g., pain induced by medical procedures, injury) or chronic pain as well as couples in long-term and/or more serious romantic relationships. Further, threatening information may be provided in the presence of a variety of different types of relations, such as friends, family, romantic partners, and health care providers. It is possible that the effects found here are generalizable to social support from any person, or alternatively, these effects may be exclusive to romantic relationships. This study also lacked an assessment of pain history prior to the experimental pain manipulation. Although randomization likely negated any differences in pain histories between threat conditions, a prior pain assessment would have allowed for direct tests of the role of pain history on pain, threat, and relationship satisfaction. Despite these limitations, this study also demonstrated several strengths. Notably, the standardized pain stimulus, random assignment, duration of couple interaction, and experimental manipulation of threat contribute to a high degree of internal validity. Additionally, the study exhibited strength in its measurement. Multiple types of relationship satisfaction were assessed and repeated assessment of pain allowed for the analysis of pain over time.

The current findings suggest that models of pain threat, such as the Fear Avoidance Model (1), should incorporate relationship satisfaction in predicting how threatening information affects the experience of pain. While the beneficial effects of global relationship satisfaction was expected given the large body of literature suggesting that global marital quality is associated with better health (52,57), little research had been conducted on situational satisfaction, and none had tested whether both types of relationship satisfaction buffered the effects of threat on pain. Other

researchers have found that hand-holding (a state-like, situational variable) attenuates neural response to threat (measured with functional magnetic resonance imaging [fMRI]), and greater marital quality (a global variable) predicts greater attenuation of that neural response (58). As imaging research continues to accommodate more complex research designs and participant activities, it will be interesting to determine whether global and situational relationship satisfaction predict both endurance in a painful task and pain intensity through these same neural pathways.

In conclusion, it must be acknowledged that potentially threatening information is rarely given to patients in isolation. For instance, loved ones often attend health care appointments and are exposed to information about diagnoses, prognoses, and treatment options. Fear avoidance models should be expanded to accommodate the social context by including close others and even health care workers in the model and developing pathways that account for the global quality of one's relationships as well as specific interactions that may mitigate fear and pain. Intervention development may be needed to identify relationship-enhancing methods that could be used when health care workers must deliver potentially threatening information about painful procedures. For example, it may be useful to encourage participants to reflect on times when their partner has been supportive to garner the benefits of a generally satisfying relationship. In addition, it may be helpful to provide coaching to loved ones to enhance the interaction quality when discussing a pending procedure. Continued research in this area can determine whether this work can be applied to clinical situations.

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## Tables

Table 1

*Participant and Partner Demographics*

| | Participants | | | Partners | | |
|---|---|---|---|---|---|---|
| Demographic | Total Sample | High Threat | Low Threat | Total Sample | High Threat | Low Threat |
| Gender | | | | | | |
| *n* | 134 | 65 | 69 | 134 | 65 | 69 |
| Male | 47.8% | 49.2% | 46.4% | 54.5% | 50.8% | 58.0% |
| Female | 52.2% | 50.8% | 53.6% | 45.5% | 49.2% | 42.0% |
| Age | | | | | | |
| *n* | 133 | 65 | 68 | 134 | 65 | 69 |
| M | 22.89 | 23.02 | 22.78 | 22.73 | 22.55 | 22.90 |
| Race | | | | | | |
| *n* | 132 | 65 | 67 | 130 | 63 | 67 |
| Caucasian | 50.7% | 56.9% | 44.9% | 47.8% | 50.8% | 44.9% |
| African American | 28.4% | 30.8% | 26.1% | 28.4% | 27.7% | 29.0% |
| Asian American | 18.7% | 12.3% | 24.6% | 18.7% | 15.4% | 21.7% |
| Other | 0.7% | 0% | 1.4% | 1.5% | 3.0% | 1.4% |
| Ethnicity | | | | | | |
| *n* | 133 | 65 | 68 | 132 | 64 | 68 |
| Arabic | 7.5% | 21.5% | 13.0% | 14.2% | 18.5% | 10.1% |
| Hispanic | 17.2% | 3.1% | 11.6% | 7.5% | 6.2% | 8.7% |
| Neither | 74.6% | 75.4% | 73.9% | 76.9% | 73.8% | 79.7% |
| Highest Level of Education | | | | | | |
| *n* | 131 | 64 | 67 | 134 | 65 | 69 |
| High School | 15.7% | 12.3% | 18.8% | 14.9% | 15.4% | 14.5% |
| College | 79.9% | 84.6% | 75.4% | 80.6% | 84.6% | 76.8% |
| Graduate School | 2.2% | 1.5% | 2.9% | 4.5% | 0% | 8.7% |
| | | Couples | | | | |
| Couple Composition | | | | | | |
| *n* | 134 | 65 | 69 | | | |
| % Opposite-Sex | 94.8% | 96.9% | 92.8% | | | |
| % Same-Sex | 5.2% | 3.1% | 7.2% | | | |
| Relationship Duration | | | | | | |
| *n* | 132 | 64 | 68 | | | |
| M (in months) | 26.94 | 25.28 | 28.50 | | | |
| SD (in months) | (25.78) | (25.16) | (26.44) | | | |
| Range (in months) | 1 - 132 | 1 - 132 | 3 - 128 | | | |

*Note*. Some ns are lower than expected due to some individuals omitting responses.

Table 2

*Descriptive Statistics of Relevant Threat and Relationship Variables*

| Measure | Range | Participant Mean (SD) | Partner Mean (SD) |
|---|---|---|---|
| Global Relationship Satisfaction | 51 – 151 | 125.17 (26.57) | 124.83 (25.96) |
| Pre-Manipulation Perceived Threat | 0 – 38 | 13.15 (9.78) | 13.57 (9.32) |
| Post-Manipulation Perceived Threat | 0 – 38 | 13.29 (9.90) | 12.18 (9.71) |
| Situational Relationship Satisfaction | 1 – 10 | 8.08 (1.92) | 8.07 (1.92) |
| Post-Interaction Perceived Threat | 0 – 40 | 11.18 (9.34) | 11.77 (9.14) |
| Cold Pressor Task Duration (in seconds) | 11 – 120 | 93.39 (38.64) | -- -- |

## Figures

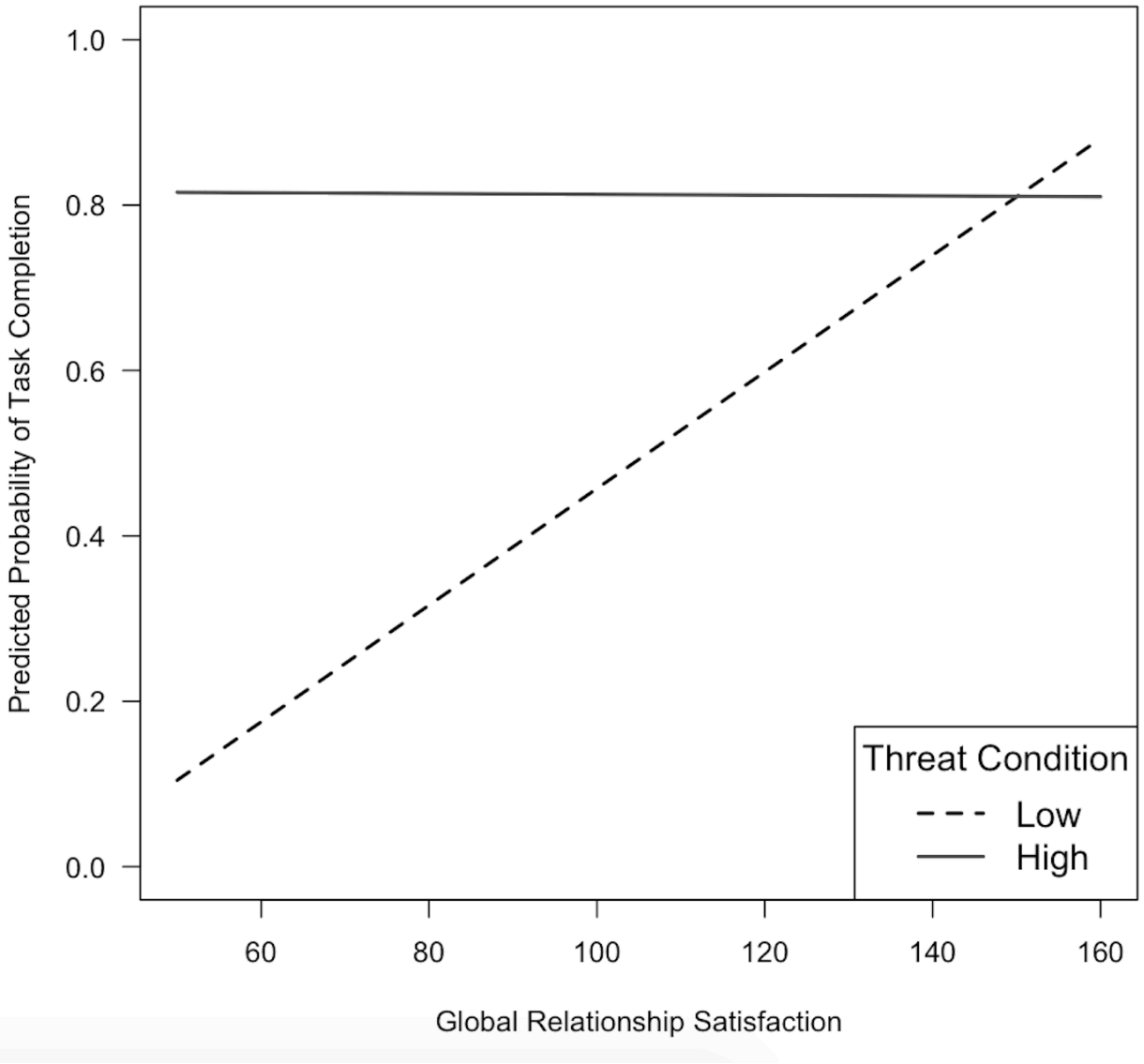


*Figure 1*. Predicted probability of task completion by threat condition and global relationship satisfaction. In the high threat group, participants' likelihood of task completion is relatively high across levels of global relationship satisfaction. In the low threat group, individuals with greater global relationship satisfaction demonstrate greater likelihood of task completion.

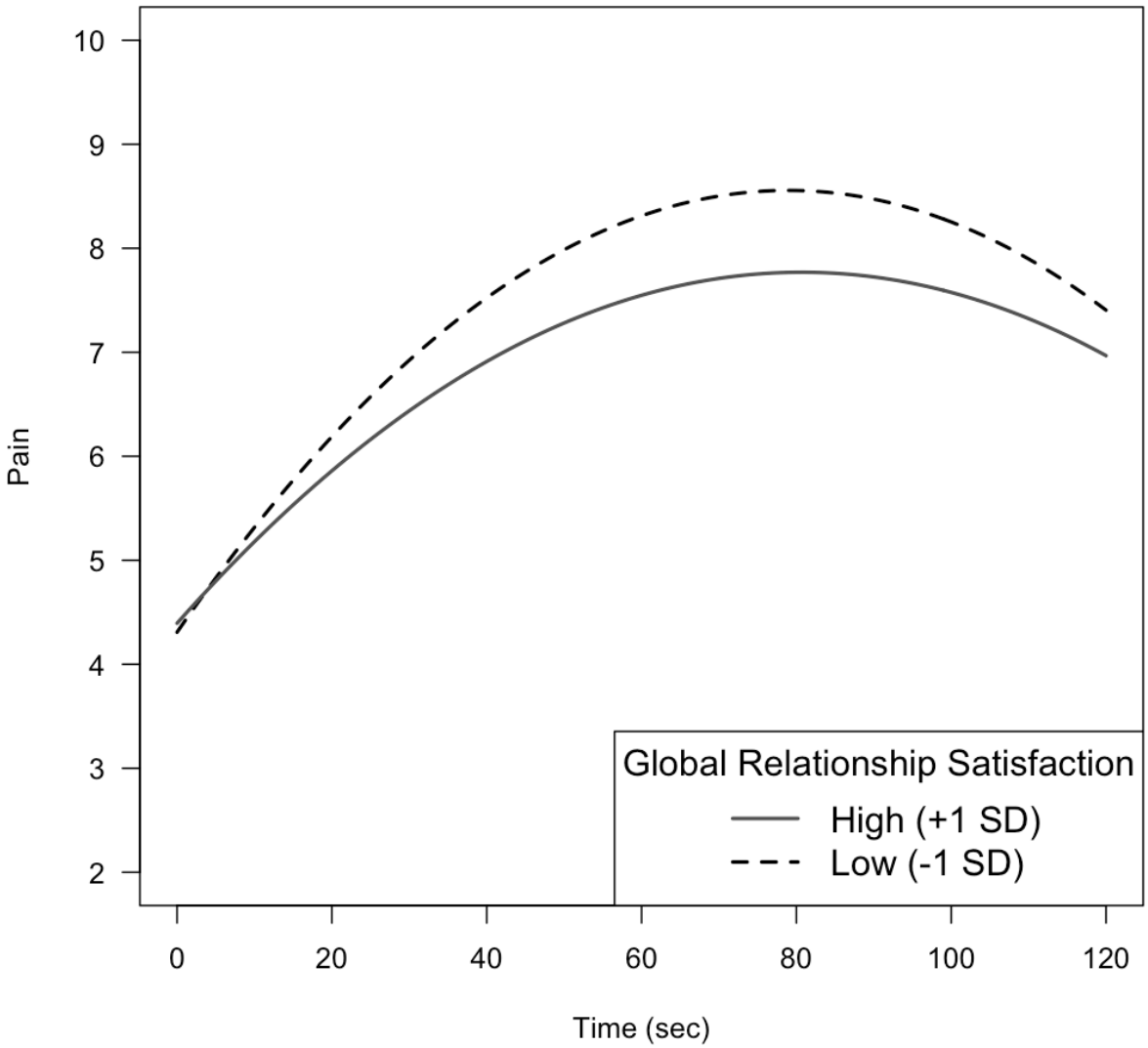


*Figure 2*. Pain ratings over time by global relationship satisfaction. Participants' pain ratings throughout the cold pressor task are displayed. Participants with greater global relationship satisfaction have slower increases in pain ratings and continue to have lower pain ratings throughout the task.

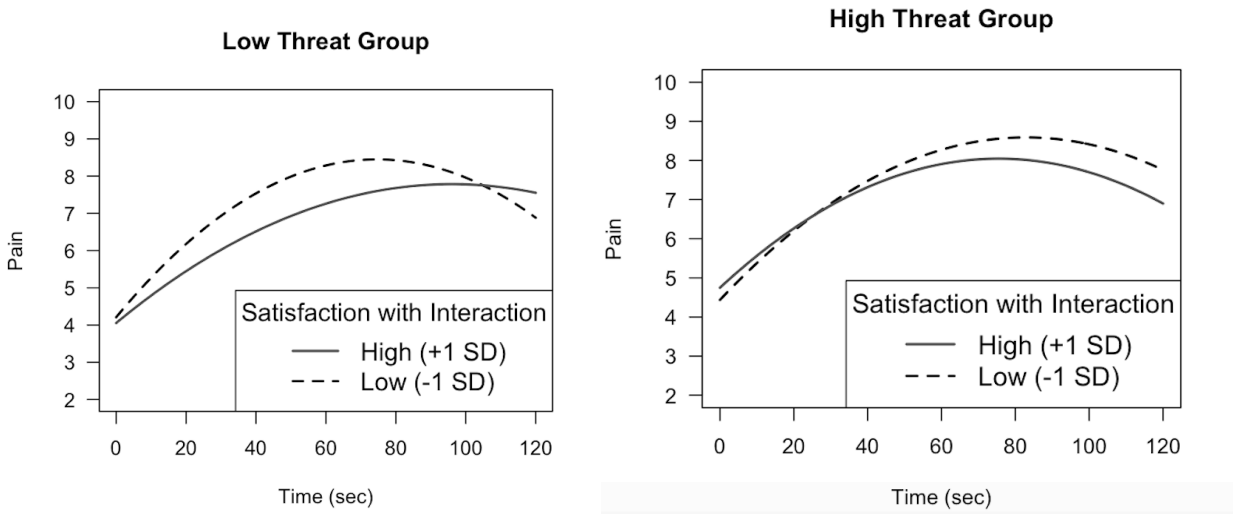


*Figure 3*. Pain ratings over time by threat condition and situational relationship satisfaction. Participants' pain ratings throughout the cold pressor task are shown. In the low threat group, individuals who had low situational satisfaction (i.e., satisfaction with the interaction) tended to have greater pain over time. In the high threat condition, it is not until later in the task that differences emerge, with participants with low satisfaction reporting greater pain.