Lovers in a dangerous time: Ecologically motivated relationship safety regulation

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A B S T R A C T

The proposed model of ecologically motivated relationship safety regulation posits that close relationships offer symbolic safety when natural ecologically-based threats activate the need for self-preservation. The model makes the twin assumptions that (1) natural ecological threats motivate people in unreliable relationships to perceive their relationships as bastions of safety, but (2) that their personal capacities for resilience in the face of threat constrain such motivated perceptions. Two internal meta-analyses of 4 correlational/cross-sectional and 5 experimental studies (N_{total}=5,030) using different methods and conceptualizations of natural ecological threats (acute and chronic pain; pathogenic transmission) supported the hypotheses. People in less satisfying relationships symbolically defended against natural ecological threats by affirming the available safety in their close relationships when they were high in self-esteem (i.e., high in personal resiliency), but not when they were low in self-esteem. However, people in highly satisfying relationships did not defend against natural ecological threats, likely because they already felt safe in their relationships.

1. Introduction

"These pains you feel are messengers. Listen to them." – Jalaluddin Rumi

Self-preservation is an innate motivational force for all living organisms. When living in a world that seems potentially dangerous, people could easily become overwhelmed by anxiety and worry if they lack adequate psychological defenses against ongoing reminders of existential risk (Jonas et al., 2014). For instance, simply contemplating one's mortality enlists a host of psychological defenses that alleviate anxiety (e.g., Terror Management Theory; Greenberg et al., 1997). One such psychological defense system lies in people's ability to affirm safety in their close relationships (e.g., Florian et al., 2002; Mikulincer et al., 2004). This psychological adaptation is likely not accidental. Humans have evolved to rely heavily on their social networks throughout the lifespan (Roberts, 2005; Trivers, 1971) and high-quality relationships can offer a safe haven against harm and vulnerability (Feeney and Collins, 2004, 2015).

Considerable research suggests that people often turn to close relationships for comfort or safety from abstract or generalized reminders of their existential vulnerability (e.g., generalized mortality salience; Florian et al., 2002; Mikulincer et al., 2004). However, most of the daily reminders people have of their own physical and existential vulnerability are neither abstract nor generalized, and importantly, responses to abstract/generalized threats differ from responses to concrete, personal threats (Cozzolino, 2006; Cozzolino et al., 2014). For example, when people are abstractly reminded of death they seek support from abstract defenses (e.g., cultural worldviews), whereas when they are concretely confronted by their mortality (e.g., diagnosed with a severe illness) they seek support from their personal defenses (e.g., their self-concept, their relationships with others; Cozzolino, 2006). While usually not as extreme as a brush with death, concrete, real-time experiences with cues that signal the presence of ecological threats, like pain and pathogens, permeate everyday existence. Indeed, the most fundamental branch of the human motivational system for self-preservation manages such ecological threats (Pyszczynski et al., 1997). Nevertheless, little research has examined how such concrete ecological threats shape the human desire to see close relationships as a source of comfort or safety. The current paper addresses this gap. It presents a new model of ecologically motivated relationship safety regulation. This model assumes that concrete ecological threats like physical pain and pathogens can motivate people to seek safety in their close relationships, and consequently, concrete everyday experiences with pain and pathogens can motivate people to see even troubled family relationships as offering safe respite.

1.1. Alarms in the bell tower: natural ecological threats to self-preservation

Human beings are programmed to respond to vulnerability or uncertainty over their safety with anxiety or stress (Brosschot et al., 2016). Physical pain and pathogens are fundamental warning signs of such vulnerability (Hadjistavropoulos and Craig, 2004; Melzack, 1973). Failure to act on these warning cues can be harmful, if not outright deadly. Consequently, nearly all organisms–including humans–are equipped with safety-monitoring systems dedicated to stopping or circumventing such ecological threats (Gray, 1972, 1981; Loewenstein, 1996). These systems constantly monitor internal or visceral sensations for signs of harm, while simultaneously scanning the surrounding environment for signs of potential or anticipated future harm so it can be eliminated or avoided (Fowles, 1988; Gray, 1987). In particular, being exposed to either pain or pathogens sensitizes people to their physical vulnerability and motivates them to take action to reduce it (Orbell and Henderson, 2016; Schaller and Park, 2011). For instance, a raging headache the morning after one too many pints is not only a visceral warning of much needed rehydration, but memories of this headache also serve as a reminder to avoid disrupting the body's normal, homeostatic functioning again next weekend. Similarly, a colleague's flu-like symptoms may not only motivate people to wash their hands, but it may also serve as a cautionary reminder of one's own last bout with a cold and motivate healthier future eating to increase physical immunity.

The defenses people might enact against concrete pain or pathogen threats differ in the extent to which they concretely or symbolically cope with the threat of physical harm (see Fig. 1). Proximal defenses involve concrete actions that directly remove the concrete threat of harm from the environment, including behavioral inhibition, stimuli avoidance, and increased vigilance for new threats (Corr et al., 2013; Gray and McNaughton, 2000; Jonas et al., 2014). For example, removing a hand from a hot pan or using hand sanitizer after interacting with a sick colleague eliminates the physical threat itself, conferring actual physical safety from harm. In contrast, distal defenses involve symbolic subterfuge or mental slights of hand that reduce anxiety about the physical threat, without actually eliminating the source of harm (Greenberg et al., 1994; Jonas et al., 2014; Pyszczynski et al., 2000). For instance, someone may focus on the accolades and self-enhancing affirmations they will receive from their family for a delicious dinner, as way of coping with the visceral discomfort of carrying a hot casserole from the oven to the ta-

ble. Likewise, someone undergoing painful renal dialysis may take solace in the knowledge that their partner will be their steadfast ally as they battle this disease. In neither example is the risk of harm eliminated—accolades will not make the casserole any less hot, and even the most supportive partner cannot cure renal failure. Rather, the distal defenses make threats more manageable by reducing the distress they invoke.

To best minimize the experience of vulnerability, the defenses people deploy against physical threats should be calibrated to the nature of the threat they face. The effectiveness of proximal defenses depend in part on the threat being escapable. Therefore, proximal defenses are likely best suited to eliminate physical threats that are acute or fleeting in nature. For instance, removing one's hand from a hot stove effectively averts the possibility of a painful burn and closing a door to a coughing colleague effectively averts the possibility of getting sick oneself. However, physical threats are often difficult to escape because they are hard to localize (e.g., cryptic pain or a pandemic virus), enduring in nature (e.g., chronic pain or illness) or implicate other pressing goal pursuits, such as providing care for a sick child or engaging in athletic training regimens despite injury.

Unlike the limitations inherent to proximal defenses, distal defenses are extraordinarily flexible, limited only by the scope of someone's (motivated) imagination. Moreover, being able to deploy distal defenses in the face of even manageable biological threats may yield certain advantages over relying on proximal defenses alone. For instance, fixating on threats that are either minor in scope (e.g., a sore neck from a poor night's sleep; a stuffy nose caused by hay fever) or that are not easily eliminated (e.g., persistent arthritic pain; a global pandemic) could block or obstruct goals unrelated to threat management (Kruglanski et al., 2013). By actively engaging available symbolic defenses to help quell the anxiety associated with these threats, people can instead power through these experiences when necessary. Thus, distal, symbolic defenses help people to meet their defensive needs and move past obstacles that could otherwise lead to impairment (Boudreaux and Ozer, 2013; Pyszczynski et al., 1999, 2000).

1.2. Safer together: relationships and felt security

Fig. 2 presents a new model of ecologically motivated relationship safety regulation. This model posits that awareness of one's own vulnerability to ecological threats motivates people to feel psychologically *invulnerable* and safe in their close relationships. This model builds on past research on attachment and life history theory that suggests early developmental experiences establish primitive scripts or relationship schemata linking physical safety with close others (Chisholm, 1993; Greenberg et al., 1986; Kenrick et al., 2013; Simpson, 2007; Simpson and Rholes, 2017). Given such representational overlay, the model assumes that acute experiences with vulnerability in the physical domain implicitly implicate the potential for safety/harm in the social/relationship domain (and vice versa). For instance, being rejected by close others can accentuate the threat implicit to physical pain (Eisenberger et al., 2006; Kross et al., 2011) and contagious diseases (Murray et al., 2022). In contrast, feeling connected to others can attenuate the threat implicit to both physical pain (Master et al., 2009; Eisenberger et al., 2011; Wilson and Simpson, 2016; Yanagisawa et al., 2011) and contagious diseases (Bressan, 2021; Tybur et al., 2020).

Of course, people are generally motivated to feel safe and invulnerable to harm, rather than at risk and vulnerable (Murray et al., 2006, 2020). Consequently, the model further assumes that the representational overlap between physical and relational experiences gives people license to deflect concerns about their own physical vulnerability through motivated, symbolic distortions of relationship safety. Consistent with this logic, growing evidence suggests that people distort their perceptions of their closest relationships to deflect the vulnerability they experience outside their relationships (Murray et al., 2017, 2018, 2020, 2021). For instance, people deflect daily anxiety about depending on fel-
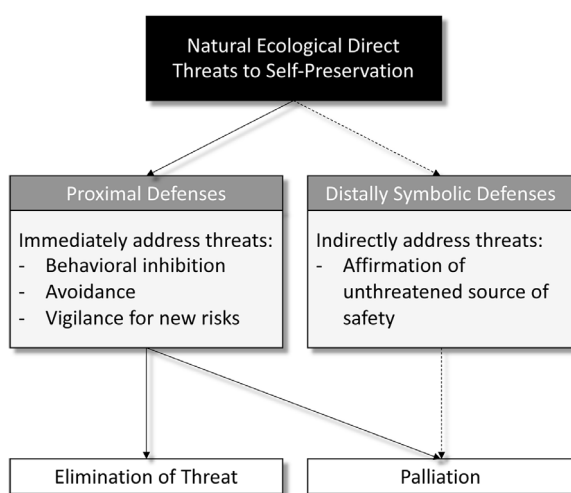

Fig. 1. Proximal versus distal symbolic defenses against natural ecological direct threats to self-preservation. People can cope with naturally-occurring direct ecological threats to self-preservation through proximal (immediate) defenses which eliminate the source of the threat and palliate the anxiety associated with the need for safety, or through distally symbolic (indirect) defenses which palliate anxiety without eliminating the threat itself.
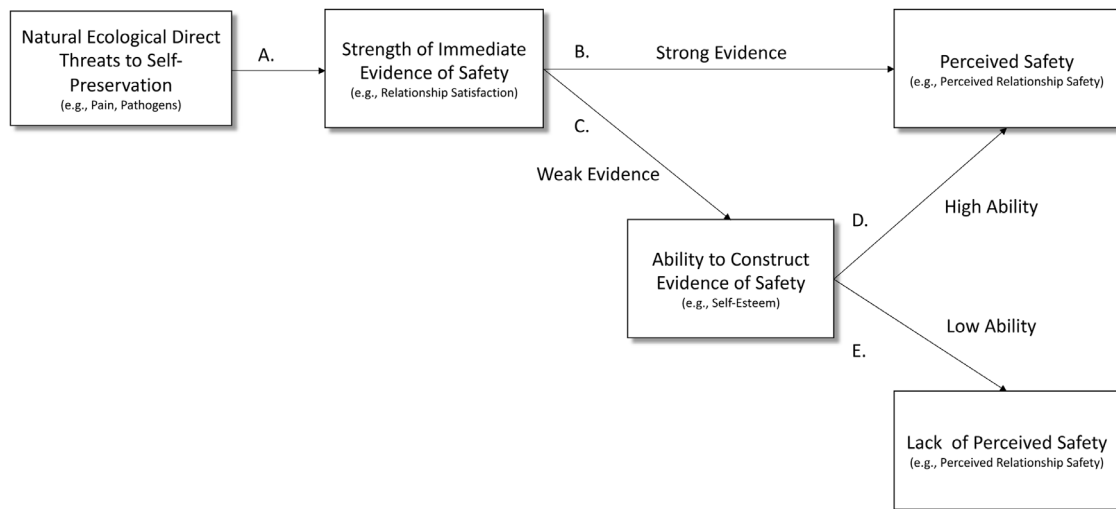
Fig. 2. The model of ecologically motivated relationship safety regulation. Direct naturally-occurring ecological threats to self-preservation (e.g., physical pain, pathogens) activate the need to seek out distally symbolic sources of safety in a new domain (e.g., close relationships). People can fluidly compensate for this need for safety by reaffirming their perceptions of security in their relationships. This process is expected to be moderated by individual differences in the strength of the evidence supporting relationships as offering safety from harm, and individual differences in the ability to construct evidence that relationships offer safety.

low community members who cannot be trusted to vote for the "right" candidates or behave responsibly during a pandemic by finding greater happiness in their families (Murray et al., 2021). They can also defend against reminders of death and the fragility of human existence by drawing closer and reaffirming their commitment to their relationships (Florian et al., 2002; Mikulincer et al., 2004; Plusnin et al., 2018).

1.3. Calling up the reserves: individual differences in seeing safety in relationships

Neurobiological models of stress argue that people need to have a reason to feel safe in order to inhibit the stress and anxiety activated in response to uncertainty about one's safety (e.g., the generalized unsafety theory of stress, Brosschot et al., 2016). For close relationships to provide an antidote to vulnerability-related anxiety and stress, people need to be able to believe their close others are invested in protecting and caring for them (Murray et al., 2006). In our model, the potential for people to respond to natural ecological threats with symbolic reassurances about the safety available in their relationships depends on two individual differences. First, individual differences in the ability to perceive safety as immediately available in the relationship. Second, individual differences in the ability to impose or construct evidence of such safety in the relationship when it is otherwise lacking (Kunda, 1990).

1.3.1. Gauging immediate safety through relationship satisfaction

An individual's overall sense of satisfaction in a given close relationship (or across such relationships) attests to the immediate safety to be found in such connections. Satisfaction captures the relative positive (vs. negative) feelings people have about a relationship based on its ability to meet their needs as expected in the past, present, and in the future (Rusbult et al., 1998). People experience relationships as *more* satisfying when they perceive their partner as meeting more of their needs, and anticipate that their partner will continue to behave this way in the future. In contrast, people experience relationships as *less* satisfying when they perceive their partner as meeting fewer of their needs, and anticipate more negative outcomes in the future (Miller and Rempel, 2004; Rusbult, 1980; Rusbult et al., 1998; Rusbult and Van Lange, 2003). Indeed, people who experience more responsiveness, and have their needs met more consistently by others, expect more positive outcomes in their relationships even when ongoing experience gives them reasons

to doubt their partner (Rusbult and Van Lange, 2003, 2008; Van Lange and Balliet, 2015).

Experiences that confirm that needs can be met as expected not only predict greater relationship satisfaction, but they also make people feel relatively safer in the relationship (Reis, 2012). Therefore, satisfaction provides people with an ongoing and dynamic barometer of the level of safety they might reasonably expect to find in their relationships. Specifically, the inhabitants of more satisfying relationships typically enjoy more positive interactions with the other party (or parties) in the relationship than those in less satisfying relationships. Therefore, people in more satisfying relationships have considerable reason to feel relatively safe and invulnerable to harm in their relationships because they perceive their significant others to be invested in caring for them in particular (Path B in Fig. 2). Therefore, consistent with perceptions of safety assuaging uncertainty (Brosschot et al., 2016) , when people in highly satisfying relationships are in pain or concerned about pathogens, they should *not need* to further convince themselves they are safe in their relationship. These beliefs are already in place. Consistent with this logic, trusting in a romantic partner's availability and caring protects people against their partner's transgressions, eliminating the psychological pressure to minimize them (Luchies et al., 2013; Simpson, 2007).

However, when people in less satisfying relationships are ecologically threatened—such as by pain or pathogens—they are not going to find immediate respite in their relationships. Instead, rather than deflecting anxiety, less satisfying relationships provide a constant reminder that the relationship is unable to meet one's needs (Murray et al., 2017). Therefore, for people in less satisfying relationships, natural ecological threats should accentuate their need to create or impose new evidence that they really are safe from being hurt in their relationships. That is, natural ecological threats should motivate people in more troubled, less satisfying relationships to want to prove to themselves that their familial ties really do treat them well and love and value them even if this necessitates distorting the available evidence.

1.3.2. Self-esteem and the ability to affirm safety in its immediate absence

Once the motivation to construct evidence of such safety is activated for people in less satisfying relationships, the model further assumes that individual differences in self-esteem then control one's *ability* to assem-

ble and/or distort the available evidence.[1] In other words, high self-esteem provides the license for people in less satisfying relationships to convince themselves that close others really are invested in caring for them when ecological threats motivate them to believe they are invulnerable and safe from harm in their closest relationships. Why would this be the case?

People with high self-esteem have more globally positive views about themselves, feel more capable of coping with challenges, and generally expect others to be accepting and valuing of them (Leary et al., 1995; Murray et al., 1998). Relative to people low in self-esteem, people high in self-esteem are thus better evidentially equipped to convince themselves of their safety from harm inside and outside of relationships (Greenberg et al., 1986, 1997). For instance, when presented with symbolic threats to their self-preservation motives (e.g., reminders of an unjust world, disrupted meaning and value), high self-esteem people experience less anxiety than low self-esteem people (Greenberg et al., 1992). Likewise, when threatened with rejection, high self-esteem people also better sustain their own sense of self-worth than low self-esteem people (Sommer and Baumeister, 2002). Furthermore, in times of interpersonal vulnerability or social ambiguity, high self-esteem people more readily discount negative information about close others (Lamarche and Murray, 2014; Murray et al., 1996a, 1996b) and anticipate future responsiveness despite present relational uncertainty (Murray et al., 2008). Therefore, when natural ecological threats motivate people to believe they are safe from harm in less-than-completely satisfying relationships, high self-esteem people should be able to convince themselves to believe they have the necessary (embellished) evidence that others care for them.

By contrast, low self-esteem further amplifies feelings of precarity and vulnerability. For example, people with low self-esteem feel the sting of social rejection more acutely than those with high self-esteem (Onoda et al., 2010) and project personal insecurities about their worth onto their relationship partners (Murray et al., 2006). Furthermore, despite wanting to be able to find safety and comfort in their relationships, people with low self-esteem prioritize their need for self-protection following acute threats by *minimizing the availability of safety and support* from their social bonds rather than affirming their function as a safe haven (Murray et al., 2008). Therefore, when natural ecological threats motivate people to believe they are safe in their vulnerability, people with low self-esteem should lack the ability to draw up evidence that others care for them.

In sum, when people in highly satisfying relationships are faced with the ecological threats posed by pain or pathogens, simply thinking of the relationship should provide immediate evidence of safety. Consequently, people in highly satisfying relationships should not need to exaggerate the safety afforded by their relationship in order to defend against ecological threats. In contrast, when people in less satisfying relationships are faced with pain or pathogens, simply thinking of the rela-

tionship should not provide enough immediate evidence of safety to inhibit their worries (Brosschot et al., 2016). Consequently, people in less satisfying relationships should need to exaggerate the safety afforded by their relationship in order to defend against ecological threats, but their capacity to satisfy this motivation will depend on their self-esteem. Specifically, people with high self-esteem in less satisfying relationships should be *more* likely to believe their vulnerable relationships actually offer safety from harm when they are faced with more (vs. less) serious natural ecological threats. In contrast, people with low self-esteem should feel *less* safe in their vulnerable relationships when faced with more serious natural ecological threats, given their general tendency to confuse one reason for vulnerability with another (Paths D & E in Fig. 2).

1.4. Theoretical contributions of model

The model advances prior research in three principal ways. First, prior research has shown that threats to self-preservation elicit proximal defensive reactions oriented toward eliminating or avoiding biological hazards. The current research instead aims to show such threats elicit distal defensive reactions (i.e., restoring perceived safety) that address the ecological threat symbolically rather than practically (Jonas et al., 2014). Second, prior research suggests that rewarding close relationships can function as symbolic defenses against some ecologically based threats (Eisenberger et al., 2011; Florian et al., 2002; Wilson and Simpson, 2016). For example, people report less pain when imagining a loving significant other (Eisenberger et al., 2011; Wilson and Simpson, 2016). The current research instead aims to show that ecologically based threats can motivate people to *construct* evidence of safety, rather than simply being protected by preexisting beliefs about their relationship. Third, in terror management research examining the links between mortality salience and asserting relational safety, attachment style is typically used as the individual difference associated with safety (e.g., (Mikulincer and Florian, 2000); Simpson and Rholes, 2017). For example, prior research has shown that people who are securely attached report feeling closer to loved ones, compared to those who are insecurely attached, following symbolic reminders of death and mortality (e.g., (Mikulincer and Florian, 2000) . However, it is unclear whether these relative differences between securely and insecurely attached people are being driven by securely attached people asserting their safety, or insecurely attached people expressing greater concerns with their relationships. This is potentially problematic because securely attached individuals possess both the evidence of safety _and_ the personal resiliency to impose safety on their social world. By contrast, those who are insecurely attached *lack* both the evidence of safety _and_ the personal resiliency to impose it. Our model addresses this gap by using relationship satisfaction and self-esteem as indices of safety and personal resources rather than attachment, which can conflate these two domains of safety and resiliency.

1.5. Overview and hypotheses

The proposed model of ecologically motivated relationship safety regulation examines how people impose safety onto relationships when confronted with their vulnerability to natural ecological threats. Each of the nine correlational and experimental studies captured natural ecological threats associated with physical pain or pathogens and included convergent measures that assessed perceptions of safety in close relationships. Four studies focused on the natural ecological threats posed by physical pain, utilizing both acute and chronic pain, as well as measured and manipulated pain. The other five studies focused on the natural ecological threats posed by pathogens, and included manipulated pathogenic primes and measured concern about a viral outbreak.

Across the nine studies, we utilized convergent conceptualizations of the perceived safety of a given relationship bond – tapping perceptions of close others' investment in caring through various measures of their availability and responsiveness in daily interactions. Following

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[1] There are several individual differences that tap into motivational processes associated with the ability to construct or distort the available evidence of interpersonal safety (e.g., self-esteem, attachment style, rejection sensitivity). The a priori decision to focus on self-esteem rather than attachment style as a moderator for the proposed model was both theoretically and practically informed. First, self-esteem is a multifaceted individual difference that captures both a global assessment of the self that includes social and non-social information, and has been shown to buffer against both existential threats as well as interpersonal threats (e.g., Greenberg et al., 1986; Murray et al., 2008). Second, while self-esteem is a global self-assessment, attachment style can vary depending on target (Hazan & Shaver, 1994), creating a variable source of resilience depending on the focal relationship in the outcome measures. Finally, not all of the studies reported in this paper included measures of attachment, including the large cross-sectional datasets (i.e., the MIDUS & MIDJA) which did include measures of self-esteem. Thus, we limit the focus to self-esteem in this paper with the note that future research should examine the possible implications of this model for attachment.

from attachment perspectives, felt security is predicated on the perception of a loved one's availability and responsiveness (Hazan and Shaver, 1994; Simpson and Rholes, 2017). In adult relationships, the availability of responsiveness—and therefore felt security—can be evidenced in many different, but convergent ways, such as through the perceptions of a partner's commitment to the relationship persisting or their perceived closeness, through the absence of conflict and interpersonal strain, and/or through rewarding day-to-day interactions with a loved one (Reis et al., 2004; Reis, 2012).

The model assumes that natural ecological threats generally motivate people to embrace relationships as a source of invulnerability and safety from harm, a kind of psychological band-aid. Because relationships vary in the objective safety they afford, and therefore the relationship's ability to inhibit the uncertainty of a perceived threat (Brosschot et al., 2016), the model further assumes that natural ecological threats motivate people in *less* satisfying relationships to try to convince themselves their intimates really do afford safety. But, whether people are able to make this case to themselves depends on self-esteem. Specifically, when natural ecological threats activate self-preservation motivations, high self-esteem people in less satisfying relationships should be better equipped than low self-esteem people to believe relationship partners are invested enough in caring for them to keep them safe from harm.

The nine studies presented provide convergent tests of the model hypotheses, while helping to rule out limitations associated with any one methodology. Indeed, complementing correlational with experimental studies helps rule out non-motivational explanations for the effects we anticipated. For instance, rather than being a motivated distortion, high self-esteem people in less satisfying relationships might perceive greater safety when they are faced with ecological threats because their relationship partners step up to provide support in crises. While the correlational studies cannot rule out this possibility, the experimental studies can. Indeed, the experiments can show that the psychological band-aid afforded by relationships can be constructed defensively in the moment, *without* requiring close others to actually provide the support.

2. Methods

Because the nine studies represent conceptual replications of the model using different manipulations and outcome measures (all capturing perceived social safety), we present the studies meta-analytically, as a collective. This follows recommendations to use internal meta-analyses to evaluate replicability (Braver et al., 2014; Chan and Arvey, 2012; Goh et al., 2016; Fabrigar and Wegener, 2016; Stroebe, 2016). We describe the basic design of each study next, followed by a discussion of the meta-analytic results (N_{total}=5030). Table 1 provides an overview of

Table 1
Overview of Measures and Manipulations Across Studies.

Construct	Measure	Study 1 MIDUS	Study 2 MIDJA	Study 3 COVID Concern 1	Study 4 COVID Concern 2	Study 5 Cold Pressor 1	Study 6 Cold Pressor 2	Study 7 Pathogen Prime 1	Study 8 Pathogen Prime 2	Study 9 Pathogen Prime 3
Model Predictors										
Relationship Satisfaction	Single-item measure			X	X	X	X	X	X	X
	Multi-item measure	X[1]	X[1]							
Self-Esteem	Rosenberg Self-Esteem Scale (Rosenberg, 1965)	X	X[2]	X	X	X	X	X	X	X
Physical Pain	Chronic Pain Interference	X								
	Pain Frequency		X							
	Cold Pressor Task					X	X			
Pathogens	COVID-19 Concerns			X	X					
	Winter Flu News Article							X		
	Images of Pathogens								X	X
Dependent Variables[5]										
Perceived Safety	Affectual solidarity with Spouse and Family	X	X							
	Perceived Partner Closeness			X	X		X	X	X	X
	Perceived Partner Commitment			X	X		X[3]	X	X	X
	Confidence in Partner's Regard					X[4]	X			
	Social Support					X				
	Partner Support						X	X		
	Partner Qualities						X			
	Willingness to Risk Interdependence						X			
	Social Benevolence					X				
	Social Adversity					X				

Notes	
	1. Studies 3–9 used a single item measure of relationship satisfaction. Studies 1–2 used a multi-item average of two single-item measures of satisfaction with partners and family.
	2. All 9 studies used the Rosenberg Self-Esteem Scale (Rosenberg, 1965); however, in Study 2, the responses were summed across the scale items rather than averaged as in the other studies.
	3. Studies 3–4 and 6–9 included a measure of perceived partner commitment in the perceptions of safety composite. In Study 6, this measure was made up of two items; in the other studies, this measure was made up of three items which fully mirrored the "own" subscale items of the full measure.
	4. Studies 5 & 6 included the same measure of confidence in the partner's regard; however, in Study 5, this measure was modified such that a best friend was the target relationship.
	5. Scale responses were averaged across items and then z-transformed. The z-transformed scales were then averaged to create composite measures of perceived partner safety in each study.

Table 2
Sample Details Across Studies.

Study	Sample Size	Nationality of Sample	Recruitment	Relationship Types
Study 1	1332	USA	Midlife in the US Sample (MIDUS)	Partners & Children
Study 2	550	Japan	Midlife in Japan Sample (MIJDA)	Partners & Children
Study 3	601	USA & UK	Prolific Academic Sample	Partners
Study 4	607	USA	Prolific Academic Sample	Partners
Study 5	96	USA	Student Sample	Others
Study 6	242	USA	Student Sample	Partners
Study 7	330	USA	ResearchMatch Sample	Partners
Study 8	775	USA	ResearchMatch Sample	Partners
Study 9	497	USA	ResearchMatch Sample	Partners

the measures and manipulations used across the nine studies reported in the internal meta-analysis, and Table 2 provides an overview of each study's sample, followed by brief overview of the individual studies. The online supplemental materials (OSM) describe study procedures and measures in full detail, as well as present model tests for each study individually. None of the studies in this manuscript were preregistered. Survey materials, aggregate data and analysis codebooks are available on the project's online repository: https://osf.io/cv9qf/.

2.1. Correlational & cross-sectional studies

Four of the nine studies presented in this paper used correlational and/or cross-sectional designs to test the proposed model, with Studies 1–2 using physical pain as the operationalization of natural ecological threats, and Studies 3–4 using pathogenic concern. In **Study 1**, we examined the effect of ***chronic pain*** on perceptions of safety within romantic and parent-child relationships using a subset ($n = 1332$) of chronic pain sufferers from a national sample of American adults (the MIDUS 2 dataset; Ryff et al., 2004–2006). In addition to a measure of chronic pain interference, the MIDUS dataset includes measures self-esteem, satisfaction with relationships with children and with spouses, as well as measures of affectual solidarity (i.e., perceptions of strain and support) within spousal and family relationships, which we used to index perceptions of safety. In **Study 2** ($n = 550$), we examined the effect of ***pain frequency*** over a 30-day period in a sample of Japanese adults (the MIJDA 2 dataset), which also included corresponding measures of affectual solidarity within spousal and family relationships as the index of perceived safety, and measures of satisfaction and self-esteem. **Study 3** ($n = 601$) and **Study 4** ($n = 607$) provided conceptual replications of the model using individual differences in ***concerns about the COVID-19 outbreak*** in early 2020 (February-March). Both studies used identical measures and procedures, which in addition to COVID-19 concerns included measures of relationship satisfaction and self-esteem analogous to the other studies, and perceived partner safety indexed through a composite measure of perceived partner closeness and commitment.

2.2. Experimental studies

The experimental paradigms used in Studies 5–9 gave us the control to both manipulate the threat more consistently across participants (e.g., same pain stimulus, same information about pathogenic risks) and to capture motivational shifts in the perceptions of relationship safety that could not conceivably be attributed to an (absent) loved one's actual provision of support. Studies 5 and 6 used a pain-induction task to manipulate natural ecological threats, and Studies 7–9 used pathogen primes to manipulate natural ecological threats. In **Study 5** ($n = 96$) and **Study 6** ($n = 242$), participants completed measures of relationship satisfaction and self-esteem, followed by a ***cold pressor task*** in which participants were asked to submerge their hands in an uncirculated vat of ice water (pain condition; average temp. 1.06 °C) or room-temperature water (control condition; average temp. 21.46 °C) for 30 s(Seery et al., 2013). Following the pain manipulation, participants in Study 5 completed the measure of perceived social safety indexed through a composite measure

of perceived social benevolence, confidence in their friend's regard, social support, and social adversity (reversed). In Study 6, the measure of perceived social safety was indexed through a composite measure of perceived partner closeness and commitment, confidence in their partner's regard, partner support, positive partner qualities, and willingness to risk interdependence in the relationship. In **Study 7** ($n = 330$), following the measures of satisfaction and self-esteem, participants were randomly assigned to a ***pathogen news article*** that described an anticipated flu outbreak (threat condition; Miller and Maner, 2011) or a control news article about anticipated increases in deadly winter road accidents, under the guise that they would be tested for recall later in the study. Following the manipulation, participants completed the measures of perceived safety indexed by a composite of the partner closeness, commitment and support measures from Study 6. Finally, in Study 8 ($n = 775$) and Study 9 ($n = 497$), following the measures of satisfaction and self-esteem, participants were randomly assigned to a ***pathogen prime*** consisting of a series of 10 images depicting pathogens (e.g., person coughing, images of bacteria; ecological threat condition), or a control condition of 10 images of buildings (Ackerman et al., 2009; Study 8) or 10 images of people yawning (Jimenez, 2016; Study 9), again under the guise that they would be tested for recall later in the study. Following the manipulation, participants in both studies completed the measures of perceived safety indexed in the same way as in Studies 3 and 4.

3. Results

We hypothesized a 3-way interaction between satisfaction, self-esteem, and natural ecological threats predicting the perceived safety of close relationships across studies. First, people in highly satisfying relationships have a pre-existing reason to feel safe, which should inhibit stress responses to situational vulnerability (Brosschot et al., 2016). Therefore, in the face of ecological threats, we expected people in *less* satisfying relationships to be more motivated to construct evidence of their relationship's safety than people in highly satisfying relationships. That is, the threat by self-esteem interaction should be stronger (i.e., more positive) for people in less satisfying relationships than people in more satisfying relationships. Second, when people in *less* satisfying relationships are faced with ecological threats, people *high* in self-esteem should be more likely to perceive their relationships as affording *greater* safety than people *low* in self-esteem. That is, the simple effect of self-esteem predicting perceptions of safety should be stronger (i.e., more positive) when less satisfied people are *highly* ecologically threatened than when less satisfied people are *not* ecologically threatened. Third, when *high* self-esteem people are involved in *less* satisfying relationships, should be especially likely perceive their relationships as affording greater safety when they are *more* ecologically threatened and thus vulnerable than when they are not. That is, the simple effect of threat predicting perceptions of safety should be stronger (i.e., more positive) for *high* than *low* self-esteem people in *less* satisfying relationships.

In order to examine the consistency of the effects across the studies, we completed two internal meta-analysis—one of our correlational/cross-sectional studies and one of our experimental
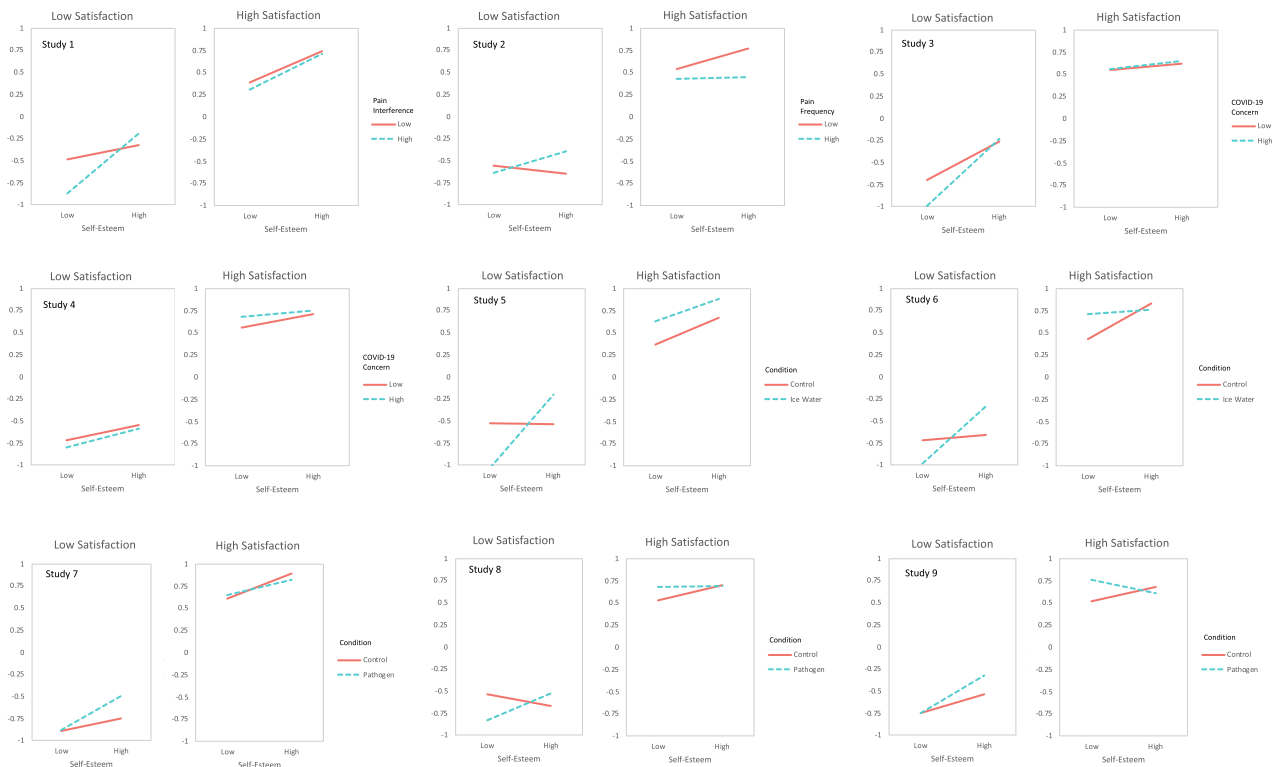
Fig. 3. The natural ecological threat by self-esteem interaction for people high & low in relationship satisfaction Studies 1–9. Self-esteem and relationship satisfaction are plotted at +/−1SD from the mean. Higher scores on the y-axes reflect greater perceived safety in close relationships in each sample. Dashed lines represent the pain/pathogenic threat in each study.

data—following recommendations from Goh et al. (2016). We also report the results of the omnibus meta-analysis of all nine studies in the OSM for further comparison.[2] Small meta-analyses are a useful way of embracing inconsistencies across studies (Maner, 2014) while homing in on the reliability of effects (Goh et al., 2016) and avoiding publication biases that can result from excluding individual studies that provide mixed-support for hypotheses (Lakens and Etz, 2017). The current meta-analytic results supported the model predictions. The main text therefore limits its discussion to the meta-analytic results, rather than study-level results, of the model in order to focus on the robustness of the effects overall. The OSM present the model results for each study individually. Fig. 3 presents the predicted scores for each study (after standardizing all variables before analyses) and Table 3 presents the three-way interactions from each study. Fig. 4 presents the forest plot of the fisher's z-transformed correlation coefficients used in the meta-analysis.

3.1. Meta-analysis of correlational/cross-sectional studies

As hypothesized, the 3-way natural ecological threat by self-esteem by relationship satisfaction interaction predicting perceptions of safety in relationships was significant, $z=−3.72$, $p<.001$, $r=−0.07$. Suggesting that natural ecological threats motivate people in risky, unreliable relationships to perceive their relationships as bastions of safety, the 2-way natural ecological threat by self-esteem interaction was significant for people low in relationship satisfaction, $z = 4.58$, $p<.001$, $r = 0.08$, but not for those high in relationship satisfaction, $z=−1.45$, $p=.15$, $r=−0.02$.

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[2] The omnibus meta-analysis was also significant across the nine studies, $z=−5.77$, $p<.001$, $r=−.08$.

Table 3
Model coefficients for the three-way interactions predicting perceptions of safety in close relationships across studies.

Study *(3-way interaction)*	b	t-test	$\eta^2_{partial}$
Study 1 *(Chronic Pain x Satisfaction x Self-Esteem)*	−0.01	−3.11**	.01
Study 2 *(Pain Frequency x Satisfaction x Self-Esteem)*	−0.003	−1.87	.01
Study 3 *(Pathogen Concern x Satisfaction x Self-Esteem)*	−0.02	−1.30	.003
Study 4 *(Pathogen Concern x Satisfaction x Self-Esteem)*	−0.01	−0.68	.001
Study 5 *(Pain Condition x Satisfaction x Self-Esteem)*	−0.06	−1.49	.02
Study 6 *(Pain Condition x Satisfaction x Self-Esteem)*	−0.08	−2.40*	.02
Study 7 *(Pathogen Prime x Satisfaction x Self-Esteem)*	−0.03	−1.39	.006
Study 8 *(Pathogen Prime x Satisfaction x Self-Esteem)*	−0.05	−2.97**	.011
Study 9 *(Pathogen Prime x Satisfaction x Self-Esteem)*	−0.05	−1.89†	.01

Note. †$p<.10$ *$p < .05$ **$p < .01$ ***$p < .001$. Tables including the other factors included in each model for each study are available in the supplemental materials.

3.1.1. Simple slopes of self-esteem and ecological threat for people low in relationship satisfaction

The meta-analytic simple effects of self-esteem further suggest that personal capacity for resilience constrains motivated perceptions of safety. When people were ecologically threatened (i.e., high pain/pathogen), less satisfied people who were high in self-esteem perceived significantly greater safety in their relationships than those who were low in self-esteem, $z = 9.38$, $p<.001$, $r = 0.17$. This self-esteem effect was considerably weaker when less satisfied people were not naturalistically exposed to ecological threat, though it was still significant, $z = 3.77$, $p<.001$, $r = 0.07$. However, the simple effects of natural ecological threat were mixed. Directionally consistent with model predictions, less satisfied high self-esteem people perceived *greater* safety in their relationships when they were experiencing high than low ecological threat, but this expected simple effect was not significant, $z = 1.38$, $p=.17$, $r = 0.02$. However, less satisfied low self-esteem people perceived
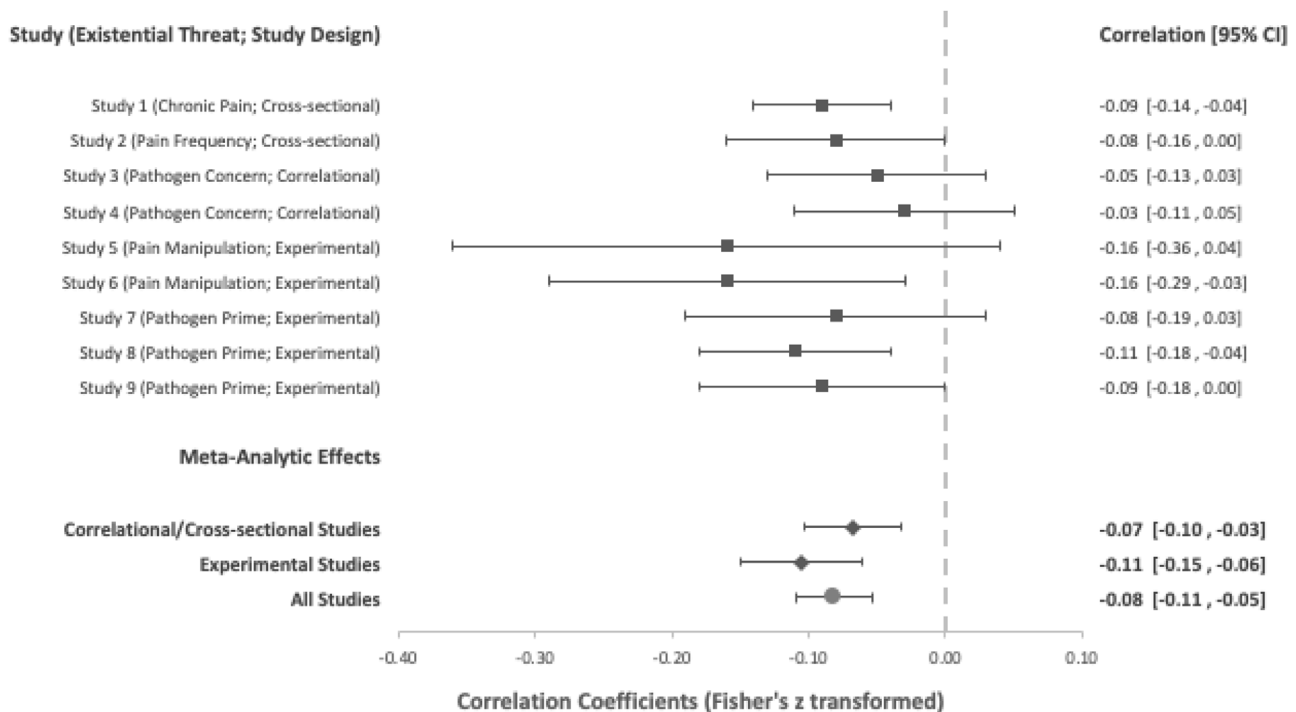
Fig. 4. Forest plot of correlation coefficients for the 3-way interactions and meta-analytic effects across studies.

significantly *less* safety in their relationships when they were experiencing high than low ecological threat, $z=-5.66$, $p<.001$, $r=-0.10$. Thus, whereas people with high self-esteem in less satisfying relationships seemed generally more equipped to cope with the chronic lack of safety in their relationship even in the face of ecological threats, those with low self-esteem appeared to be particularly vulnerable, as we reasoned they might be.

3.1.2. Simple slopes of self-esteem and ecological threat for people high in relationship satisfaction

The meta-analytic simple effects of self-esteem for people high in relationship satisfaction was significant for people who had been ecologically threatened, $z = 3.90$, $p<.001$, $r = 0.07$, and for people who had not been threatened, $z = 4.21$, $p<.001$, $r = 0.08$. Thus, regardless of ecological threat, people with high self-esteem perceived greater safety in their relationships than those with low self-esteem, although this difference was somewhat abated when threatened (unlike those with low relationship satisfaction). The simple slope of ecological threat was neither significant for highly satisfied people with high self-esteem, $z=-0.94$, $p=.35$, $r=-0.02$, nor for those with low self-esteem, $z=-0.53$, $p=.60$, $r=-0.01$. However, these simple slopes should be interpreted with extreme caution as the higher order two-way interaction was not significant.

3.2. Meta-analysis of experimental studies

Mirroring the internal meta-analysis of our correlational and cross-sectional studies, the 3-way natural ecological threat by self-esteem by relationship satisfaction interaction predicting perceptions of safety in relationships was significant across experimental studies, $z=-4.60$, $p<.001$, $r=-0.105$.[3] Furthermore, replicating the patterns of the cross-sectional studies, the 2-way natural ecological threat by self-esteem

interaction was significant for people low in relationship satisfaction, $z = 4.14$, $p<.001$, $r = 0.09$. However, unlike with the cross-sectional studies, the 2-way interaction was just significant for those high in relationship satisfaction, $z=-2.19$, $p=.03$, $r=-0.05$. Once again, the meta-analytic simple effects of self-esteem for the experimental studies further suggest that personal capacity for resilience constrains motivated perceptions of safety.

3.2.1. Simple slopes of self-esteem and ecological threat for people with low relationship satisfaction

The simple effects of self-esteem were consistent with model predictions. When less satisfied people were experimentally exposed to ecological threat (i.e., high pain/pathogen), those who were high in self-esteem perceived significantly greater safety in their relationships than those who were low in self-esteem, $z = 6.38$, $p<.001$, $r = 0.14$. However, this self-esteem simple effect was not significant when less satisfied people were not exposed to ecological threat (i.e., low pain/pathogens), $z = 0.63$ $p=.53$, $r = 0.01$. The simple effects of natural ecological threat (i.e., pain/pathogen) were also consistent with model predictions. Less satisfied high self-esteem people perceived significantly *greater* safety in their relationships when they were ecologically threatened (i.e., high pain/pathogen exposure) than when they were not ecologically threatened (i.e., low pain/pathogen exposure), $z = 2.79$, $p=.005$, $r = 0.06$. Furthermore, less satisfied low self-esteem people perceived significantly

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[3] An additional study was conducted with the aim of experimentally manipulating a pathogenic ecological threat. However, the control condition used a (non-pathogenic) illness (seasonal affective disorder). Upon further reflection, this was not an appropriate control as it may also be linked to natural ecological

concerns. While seasonal affective disorder is not an illness triggered by ecological threats, many people do not differentiate between physical and psychological illnesses, with some people going so far as to (incorrectly) believe that mental illnesses are contagious (e.g., Lund & Boggero, 2014). Furthermore, seasonal affective disorder was described as a "debilitating illness" with symptoms that typically mirror other pathogenically transmitted illnesses (e.g., fatigue, difficulty concentrating). Given that illness schemas can activate the same motivational systems as acute physical symptoms (Orbell & Henderson, 2016), seasonal affective disorder is no longer an appropriate control as a non-natural ecological threat. For these reasons, the study was removed from analyses. However, the meta-analysis remains significant when this study is included ($z=-2.61$, $p=.01$, $r=-.05$).

less safety in their relationships when they were exposed to ecological threat than when they were not exposed to ecological threat, $z=-3.02$, $p=.002$, $r=-0.07$.

3.2.2. Simple slopes of self-esteem and ecological threat for people with high relationship satisfaction

The simple effects of self-esteem were consistent with model predictions. When more satisfied people were experimentally exposed to ecological threat (i.e., high pain/pathogen), those with high in self-esteem did not significantly differ in their perceptions of safety in their relationships from those with low in self-esteem, $z = 0.24$, $p=.81$, $r = 0.01$. However, consistent with past work demonstrating differences between those high and low in self-esteem, when more satisfied people were *not* exposed to ecological threat, people with high self-esteem perceived significantly more safety in their relationships than those low in self-esteem, $z = 3.54$, $p<.001$, $r = 0.08$. This effect mirrors the finding from the meta-analysis of the correlational studies and the omnibus meta-analysis of all 9 studies (see OSM).

The simple effects of natural ecological threat followed a partially similar pattern. More satisfied people with high self-esteem did not significantly differ in their perceptions of safety when they were experimentally exposed to ecological threat versus not, $z=-0.59$, $p=.58$, $r=-0.01$. However, unexpectedly, more satisfied people with low self-esteem perceived *greater* perceived safety when they were exposed to ecological threat versus not, $z = 2.43$, $p=.02$, $r = 0.06$. This simple effect was not anticipated and it was not significant in the meta-analysis across all 9 combined correlational and experimental studies.

4. General discussion

The tenuousness of existence permeates all aspects of human psychology (e.g., Greenberg et al., 1997; Jonas et al., 2014; Leary et al., 1995). In this paper, we proposed the model of ecologically motivated relationship safety regulation to explain how people can be motivated to convince themselves of the availability of safety within close relationships in response to natural ecologically based threats to the self-preservation motivational system. We tested our model across nine studies with diverse methods (experimental; cross-sectional), different conceptualizations of natural ecological threats (physical pain; pathogens) and participants from different demographics (U.S. college students; U.S. and Japanese middle-aged adults). Consistent with model hypotheses, people in risky, vulnerable relationships (i.e., low relationship satisfaction) who had the personal resources to make the case for themselves that they can rely on others (i.e., high self-esteem) were motivated to use their less-than-perfect relationships with their romantic partner and children as a psychological band-aid to symbolically defend against natural ecological threats.

By contrast, those who were more latently skeptical of close others' ability to meet their needs (i.e., low self-esteem) perceived those close to them to offer even less safety when they were ecologically threatened than not. This latter effect echoes prior research on risk-regulation processes that has revealed low self-esteem people often find a sense of safety by diminishing their sense of connection to others (Murray et al., 2006). For people in less vulnerable relationships (i.e., high relationship satisfaction), the pattern differed somewhat. Those with satisfying relationships *and* high self-esteem (i.e., high evidence of safety relationally and personal resources to cope with uncertainty) showed no evidence of responses to ecological threats. However, in the experimental studies, people with low self-esteem in *satisfying* relationships appeared to respond to acute ecological threats by perceiving greater safety (note that this effect was not robust across the omnibus meta-analysis of all of the experimental and correlational studies [see OSM], so it bears further replication).

Overall, our findings complement existing research highlighting how uncertainty over safety can be inhibited in situations where people have another reason to believe they are safe (Brosschot et al., 2016). The model of ecologically motivated relationship safety regulation evidences that people respond to ecological threats with symbolic reassurances about their safety in their close relationships, provided they have the personal resources available to do so. These resources include (1) individual differences in the immediate availability of safety in the relationship (i.e., relationship satisfaction), and (2) individual differences in the ability to impose evidence of safety when such safety in the relationship is not immediately evident (i.e., self-esteem). Relationship satisfaction provides a first-line of defense against ecological threats by offering a chronic source of relative safety, such that even those with low self-esteem—who are typically sensitized to concerns over safety—were somewhat capable of affirming the safety their relationship offered when threatened. By contrast, highly satisfied people with high self-esteem appeared to be relatively unaffected by the presence of an ecological threat. This may be due to a ceiling effect whereby highly satisfied people with high self-esteem already report so much chronic safety that methodologically it was not possible to capture a compensatory effect in the present studies. Alternatively, it may be that the combination of chronic evidence of safety (i.e., high satisfaction) and their confidence in others' ability to meet their needs (i.e., high self-esteem) provides a more immediate disarming of ecological threats given the abundance of safety they experience (Brosschot et al., 2016).

When chronic reminders of safety were lacking (i.e., when satisfaction is low), people relied on their personal resources to affirm safety. In the absence of chronic relationship safety, people with low self-esteem were not able to affirm safety when experiencing an ecological threat and instead perceived even greater risk. By contrast, when people with high self-esteem were in less satisfying relationships that did not provide chronic evidence of safety, they capitalized on their personal abilities to cope with uncertainty by affirming safety in their close others.

This work has important implications for terror management and attachment research examining the role of relationships in buffering symbolic existential threats, as well as direct ecological threats. First, prior research has shown that threats to self-preservation elicit proximal defensive reactions oriented toward eliminating or avoiding biological hazards. The current research demonstrates that such threats also elicit distal defensive reactions (i.e., restoring perceived safety) that address the ecological threat symbolically rather than practically (Jonas et al., 2014).

Second, our research suggests that ecological threats only elicit symbolic compensation in relationships when the relationships (or individuals) are capable of imposing safety in that context. In terror management research examining the links between relational safety and mortality salience, attachment style is typically used as the individual difference associated with restoring safety (e.g., Simpson and Rholes, 2017). Past research has reliably demonstrated that people who are securely attached are more likely to affirm the safety in their (already safe) relationships following reminders of death and mortality compared to those who were insecurely attached (e.g., Mikulincer and Florian, 2000). However, insecurely attached people *lack both* the evidence of safety in their relationships <u>and</u> the personal capacity for resilience to impose it. Our model suggests that when people lack chronic evidence of safety in their relationship (i.e., low satisfaction), they can still use their relationship to affirm safety in response to an ecological threat if they have the personal resources to convince themselves of safety (i.e., high self-esteem). Our model therefore addresses existing gaps in the literature by using relationship satisfaction and self-esteem as dual indices of safety and personal resources rather than attachment which can conflate these two domains of safety and resilience.

The present findings have both limitations and strengths. First, there were some inconsistencies in replicating the effects across individual studies, with some studies not reaching statistical significance. However, mixed support for hypotheses can be expected over repeated replications even in instances where there is strong support for the hypothesis overall (Lakens and Etz, 2017). Despite the variability across studies, the meta-analyses revealed robust, significant and opposite effects of natu-

ral ecological threats on high versus low self-esteem people in vulnerable relationships. Overall, natural ecological threats seemed to motivate people with high self-esteem in less satisfying relationships to feel safer, and people with low self-esteem to feel more at risk. Another limitation is that although ecological vulnerability motivated people with low self-esteem in satisfying relationships to perceive more safety in their relationships, this only occurred in the experimental studies. Because this effect was not robust across the omnibus meta-analysis (see OSM) of all the experimental and correlational studies, it bears further replication.

These limitations can hopefully be viewed in the context of the strengths of the present findings. Prior research has already demonstrated that close relationships can symbolically defend against threats from outside the relationship, such as reminders of human mortality (Plusnin et al., 2018), or violated expectations about world order (Murray et al., 2017). However, very few studies have demonstrated that close relationships can also serve as a symbolic defense against *direct, ecologically based threats* to self-preservation. In one line of work, IJzerman and colleagues (2015, 2017) examined how threats to thermoregulation (e.g., feeling cold) motivate people to seek out trustworthy others, and that perceiving safety and responsiveness helps us feel warm. Consistent with their work, we have found that feeling ecologically vulnerable motivates people to see their loved ones as safe and reliable, but only if they have the personal resources to flexibly impose these expectations on others. Furthermore, whereas studies have shown that stable relationships (e.g., secure attachment figures) can offer a sense of reassurance following some threats (e.g., Bastian et al., 2014; Florian et al., 2002; Mikulincer et al., 2004), the current model extends the theoretical utility of relationships as a safe haven by demonstrating that even those in *vulnerable* relationships can engage them as a psychological band-aid when they have the personal resources to do so. This model therefore provides a novel contribution towards understanding the full scope of the processes that influence personal and relational well-being.

4.1. Understanding the boundary conditions of our effects

The current research raises several questions regarding the boundary conditions for our model that should be explored in future work. The first is the fact that the effects did not replicate in the one study that examined effects in a collectivist culture (i.e., the sample of Japanese participants, see OSM for full details). Contrary to the general pattern of findings, the pain by self-esteem by satisfaction interaction failed to reach significance in this sample. Given that the effects in all the studies are relatively small, this may be partially due to the comparatively small size of this sample, which may have been underpowered to test the proposed model. However, it is also important to consider whether the proposed model may manifest differently in different cultural contexts. For instance, some cultures may advocate for affective suppression or prioritize the maintenance of traditional gender roles, which undermine perceptions of responsiveness and intimacy in close relationships (Marshall, 2008; Takahashi et al., 2002). Likewise, the emphasis of attending to communal/relational needs in collectivistic contexts (Markus and Kitayama, 1991) may serve as a more consistent reminder of the safety afforded by close relationships, whereas more individualistic contexts may require greater individuated reassurance that safety exists. Thus, while both Americans and Japanese value their close relationships (Takahashi et al., 2002), and variability exists both within and across cultures (Gjerde and Onishi, 2000; Vignoles et al., 2016), the motivated engagement of relationships as a defense against vulnerability may manifest differently across cultural contexts. The current findings highlight the importance of testing theoretical models in different cultural contexts (Baumard and Sperber, 2010; Henrich et al., 2010), even when the underlying theory is culturally agnostic.

Another boundary condition to consider is the question of whether the immediate danger posted by the natural ecological threat matters. Although our studies varied in terms of threat severity (e.g., priming

concern vs. physical experiences), ethical limitations prevented us from testing this model in a context where the natural ecological threats represented a severe and imminent existential danger.[4] It is therefore worth considering whether the association between threat severity and motivated engagement of symbolic defenses is always likely to be a linear one. On the one hand, the more severe the natural ecological threat, the clearer the signal that something is amiss and needs reconciling. However, it is also possible that a severe-enough threat could induce a myopia that motivates people to ignore anything not immediately and instrumentally helpful in eliminating the threat directly (Eccleston and Crombez, 1999; McCracken, 1997). The association between threat severity and engaging with symbolic defenses through the relationship may therefore be a curvilinear one, where relationships cannot provide as effective a band-aid for more acutely dangerous threats. Future research might examine these important boundary conditions of pain severity given their implications for understanding how physical pain may affect other relationship outcomes such as support seeking, as well as how these factors may contribute to mental health and well-being.

4.2. Future directions and implications

4.2.1. Interventions targeting the availability of safety

A key takeaway from our findings is the importance of having a reliable source of safety or the personal resources to engage with safety systems when vulnerable. Despite being in vulnerable, less satisfying relationships, people with high self-esteem were able to muster the motivation to affirm safety in their relationships. Furthermore, people with low self-esteem in our experimental studies who were already in consistently safe relationships (i.e., those high in satisfaction) also showed the capacity to motivationally shift perceptions of safety in their relationships (though no differences emerged when looking at the results across all studies). Thus, interventions that help people feel more psychologically safe—either by targeting self-esteem or relationship satisfaction—might help people build a psychological band-aid that can be applied even when the latent threat is naturally ecological in nature.

4.2.2. Security motivated risk taking

Future research should consider the implications of our findings for people with low self-esteem who are *satisfied* in their relationships and experiencing existential threats. In particular, research could consider whether there are behavioral consequences to suddenly perceiving a relationship as safe when individuals otherwise chronically doubt their relational security. For instance, relationship security is associated with approach motivations and risk-taking when people feel threatened (Cavallo et al., 2009). Ecological threats may therefore provide low self-esteem people who are satisfied with their relationship the motivational nudge to embrace more risks and challenges in their lives. This may be advantageous if it opens them up to positive opportunities they would otherwise miss (e.g., Cameron et al., 2010). However, it also raises the question as to whether those with low self-esteem have the personal resources to cope with these challenges (e.g., Orth et al., 2009) if they are only embracing them because of motivational nudges within their environment.

4.2.3. Close relationships as the source of harm

Another question raised by this work is what happens when the physical threat is directly associated with a partner or family member. De-

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[4] Although, Studies 3 and 4 tapped into concerns about the 2020 COVID-19 outbreak, the data were collected in western samples *prior* to cases being reported in those countries. While some participants were therefore likely to have perceived COVID-19 as an imminent ecological threat to their well-being, many others may have readily dismissed it as an imminent threat or interpreted it in a way similar to an anticipated flu outbreak (e.g., Studies 8 & 9). We therefore refrain from claiming that the studies which capitalized on the COVID-19 pandemic fully account for experiences with imminent, pressing existential dangers.

spite the proximal and distal defenses offered by close relationships, they also represent the greatest potential source of harm to individuals. People are more likely to be abused or murdered by a loved one than a stranger (Finkel, 2007; Hessick, 2007), and pathogenic transmission is more likely to occur through social networks (e.g., Cauchemez et al., 2011). A loved one that causes physical harm may seem like an obvious person to avoid. But reality is more complicated. Victims of relationship violence are trapped in situations where they have to balance the reality that the same person who is capable of caring for them is also capable of hurting them. It should then come as no surprise that denial and reinterpretation are common coping mechanisms (Carver et al., 1989; Tobin et al., 1989), especially when commitment to that relationship is high (Arriaga, 2002). Our findings suggest there may be another level to this complicated equation in which the physical pain from the abuse may motivate some people to find safety and certainty in what they have, especially if the perpetrator is contrite after their inexcusable behavior.

Our findings also have potential implications for caregiving contexts where people must overcome pathogenic concern – such as a caregiver looking to support a loved one who either poses a transmission risk or activates behaviorally linked illness schemas, or a care-recipient who must trust their loved one will be capable of offering them the safety they need. People need to feel safe relying on their close others for support; they also need to feel safe offering their help and support to others. For caregivers with low self-esteem in already vulnerable relationships, the natural ecological threat of an illness could lead them to underperceive gratitude and appreciation in the care recipient, which could undermine relationship maintenance and lead to caregiver distress over time (Algoe, 2012; Lau & Cheng, 2017, Nah et al., 2021). The findings also have implications for care recipients with low self-esteem in vulnerable relationships. When threatened interpersonally, people with low self-esteem are more likely to disengage from their close relationships in order to avoid further disappointment. In a care-seeking context, the compounded vulnerability from the natural ecological threat of an illness may lead those with low self-esteem to assume their close others will be unwilling or unable to provide them with the care and support they need, thereby creating a self-fulfilling prophecy of less effective support from loved ones who do not fully know what is needed from them (Marigold et al., 2014, 2020). Thus, our findings suggest that there may be important consequences for long-term well-being if the caregiving system is disrupted through the mechanisms evident in this research.

5. Conclusion

The need for self-preservation is an invisible hand that motivates people to avoid threats and seek shelter in safe havens. Consequently, humans have evolved to engage both proximal and distal defenses that help them cope with the perpetual vulnerability associated with mitigating existential risks. The model of ecologically motivated relationship safety regulation suggests that the confounding social and natural ecological vulnerability motivates people to impose a sense of safety in their close relationships, provided they have the personal resources to do so.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.cresp.2022.100061.

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